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The Development of A Systematic Discharge Planning Process For the Care of Copd Patients In A Small Urban Community Hospital

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THE DEVELOPMENT OF A SYSTEMATIC DISCHARGE PLANNING PROCESS FOR THE CARE OF COPD PATIENTS IN A SMALL URBAN COMMUNITY HOSPITAL

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DEDICATION

This dissertation is dedicated in loving memory of my Mother, Edna Mae Moon, born October 18, 1944 and passed away on April 22, 2021.

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THE DEVELOPMENT OF A SYSTEMATIC DISCHARGE PLANNING PROCESS FOR THE CARE OF COPD PATIENTS IN A SMALL URBAN COMMUNITY HOSPITAL

MICHELE A. BARTON-VERDI

ABSTRACT

Background: Several attempts have been made to examine factors that influence 30-day readmissions in a hospital setting to ensure that inpatient care is accompanied by an effective post-discharge plan that can decrease 30-day readmissions to guide hospitals to use practices that increase hospitals 'quality implications (Shah et al., 2015; Kripalani et al., 2007; Rinne et al., 2017, Jenks, Williams and Coleman, 2009, Shah, Press, Husingh-Scheetz & White, 2016; Sickler et al., 2015; Pruitt, 2018; Hansen et al., 2013; Simmering et al., 2016; Alper, O'Malley, & Greenwald, 2019). **Purpose:** To determine the role of post-discharge care in 30-day readmissions along with the typical clinical outcomes identified, we examined a small urban hospital population and the patient characteristics in each post-discharge care setting (HSC, HHC, LTAC, and SNF). **Patients and Methods:** A retrospective study was conducted in patients with COPD hospitalizations using the data from a small urban community hospital from 2014 to 2019, n = 1,008. **Results:** Home health care was identified as having the highest readmission rate in this small urban community hospital using a test of proportions. The weighted variables from a researcher-developed covariate scoring table were analyzed using a Chi-square analysis. The findings provided a reference framework for a systemized discharged planning process according to how the variables/groups were scored.

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LIST OF ABBREVIATIONS

Abbreviation	Description
AE-COPD	Acute Exacerbation of COPD
AMI	Acute Myocardial Infarction
ATS	American Thoracic Society
BMI	Body Mass Index
CAP	Community-Acquired Pneumonia
CDC	Centers of Disease Control
CHF	Congestive Heart Failure
CMS	Centers for Medicare and Medicaid Services
COPD	Chronic Obstructive Pulmonary Disease
DRG	Diagnosis Related Group
EMR	Electronic Medical Record System
FEV	Forced Expiratory Volume
FVC	Forced Vital Capacity
GOLD	Global Initiative for Chronic Obstructive Lung Disease
HHC	Home Health Care
ICD	International Classification of Disease
ICS	Inhaled Corticosteroids
IT	Information Technology
LOS	Length of Stay
LTAC	Long-Term Acute Care Hospitals
Med PAC	Medicare Payment Advisory Committee
NIH	National Institute of Health
NTM	Nontuberculous Mycobacterial
PR	Pulmonary Rehabilitation
SNF	Skilled Nursing Facility
SPSS	Statistical Package for the Social Sciences
SUCH	Small Urban Community Hospital

LIST OF DEFINITIONS

Ambulatory – individual is able to walk about and not be bedridden (Meriam Webster, 2019)

Comorbidity – existing simultaneously with and usually independently of another medical Condition (Meriam Webster, 2019)

Continuum of Care – "a concept involving a system that guides and tracks patients over time through a comprehensive array of health services spanning all levels and intensity of care. Covers the delivery of healthcare over a period and may refer to care provided from birth to end of life" (Centers for Medicare & Medicaid Services (CMS), 2019).

Discharge – to relieve of a charge, load, or burden (Meriam Webster, 2019)

Exacerbation – to make more violent, bitter, or severe (Meriam Webster, 2019)

Health literacy – "the ability to read, understand and act on health care information" (US Department of Health and Human Services, 2000).

Home Bound – "You need the help of another person or medical equipment such as crutches, a walker, or a wheelchair to leave your home, or your doctor believes that your health or illness could get worse if you leave your home, and it is difficult for you to leave your home and you typically cannot do so" (Centers for Medicare & Medicaid Services (CMS), 2019).

Hypercapnia/ Hypercarbia – having an abnormally high concentration of carbon dioxide in the blood (Meriam Webster, 2019)

Hypoxemia - having low oxygen content in the blood (Meriam Webster, 2019)

Hypoxia – having low oxygen supply in the bodily tissues (Meriam Webster, 2019)

Index Admission – "the admission with a principal diagnosis of a specified condition that meets the inclusion and exclusion criteria for the measure (Centers for Medicare & Medicaid Services" (CMS), 2019).

Multimorbidity – the presence of multiple chronic conditions (Zulman et al., 2013).

Overdiagnosis – the diagnosis of a condition or disease more often than it is present (Meriam Webster, 2019)

Post-Acute Care – "includes rehabilitation or palliative services that beneficiaries receive after, or some cases, instead of, a stay in an acute care hospital. Depending on the intensity of care the patient requires, treatment may include a stay in a facility, ongoing outpatient therapy, or care provided at home (Centers for Medicare & Medicaid Services" (CMS), 2019).

Post-discharge Care – care occurring after discharge from a hospital (Centers for Medicare & Medicaid Services, 2019).

Purulent – consisting of, containing, or discharging pus (Meriam Webster, 2019)

Readmission – a second or subsequent admission (Meriam Webster, 2019)

Underdiagnosis – to diagnose (a condition or disease) less often than it is present. (Meriam Webster, 2019

CHAPTER I

INTRODUCTION

Chronic obstructive pulmonary disease (COPD) is currently the fourth leading cause of death in the United States and is close to becoming the third leading cause of death (Centers for Disease Control and Prevention, 2018). Approximately seventy percent of the 24 million with a COPD diagnosis are under the age of 65. COPD resulted in almost $50 billion in indirect/direct costs in 2016 (Guarascio, Ray, Finch & Self, 2017). It is estimated that as much as 60% or more of patients with respiratory symptoms readmit within 30 days back to the hospital and were not initially diagnosed with COPD, especially with the mild to moderate classification (Diab et al., 2018). There is also a high occurrence of overdiagnosis because of patients diagnosed with COPD based on symptoms and rather than a measurement of how well their lungs work (Diab et al., 2018). Nationally, for those patients diagnosed with COPD, 22.8% are readmitted to the hospital within 30 days of their indexed admission and this is associated with significant health care expenditures (Shah et al., 2015). The literature identifies that 10 to 55% of readmissions for an acute exacerbation of COPD may be prevented (Centers for Disease Control and Prevention, 2021).

Post-acute care/post-discharge care providers (home health care agencies, skilled nursing facilities, long-term acute care hospitals, and pulmonary rehabilitation) provide the opportunity to recover and rehabilitate after an acute care hospital stay. Premature discharge or release to an environment that is not capable of meeting the patient's medical needs may result in hospital readmissions within 30-days (Alper, O'Malley & Greenwald, 2019).

Ensuring that an engaging post-discharge care plan accompanies inpatient care can decrease excess healthcare use and increase quality implications for hospitals. Table 1.1 defines the most frequently used care settings that patients may be referred to upon discharge. Based on the patient's needs, effective discharge planning provides the continuity of care between the healthcare facility and the community. It has been described as the critical link (Kangovi & Grande, 2014). The discharge plan's goal is to reduce hospital length of stay and unplanned readmission to the hospital and also to advance the coordination of services following discharge from a hospital (Naylor & Keating, 2008).

Table 1.1 Post-Acute/Post-Discharge Settings Variables Defined

Post-Acute Care/Post-Discharge Care	Definitions (Centers for Disease Control and Prevention, 2018)
Long-Term Acute Care Hospital (LTAC)	Those patients with a chronic illness that have metabolic, endocrine, physiologic, and immunologic problems that may have respiratory failure and need hospital-level care for an extended period time.
Skilled Nursing Facility (SNF)	Patients that need short-term skilled care nursing or rehabilitation service on an inpatient basis following a hospital stay.
Home Health Care (HHC)	Patients are confined to their homes and need skilled care (from a nurse, physical, occupational or speech therapist) on a part-time basis.
Home with Self-Care (HSC)	Patients are discharged to home without any organized care (To be included from data in home with self-care category: discharged to court, group home, or a halfway house.

Background

Managing COPD patients continues to challenge health care systems, and challenges directly impact the financial performance of hospitals because the Centers for Medicare and Medicaid impose penalties on hospitals with excessive COPD readmissions (CMS, 2019), evidenced-based interventions are needed.

The results of a COPD exacerbation include a discouraging impact on the quality of life, accelerated lung function decline, increased symptoms and impaired lung function, increased economic costs and, increased mortality. Care does not end when a patient ambulates or is wheeled out the door. The hospital's appropriate discharge care needs to be systematically identified to ensure the proper continuum of care.

Currently at the small urban community hospital (SUCH), patients are admitted mostly through the emergency department, some may be a direct admit from a

Physician's office at SUCH. Any patient who is admitted to the hospital in respiratory distress and/or has shortness of breath, cough and sputum is normally given the basic COPD management regimen and then reevaluated to determine if they will be discharged from the emergency room or admitted to the hospital. Upon admission to the internal medicine floor or the intensive care unit (ICU) the admitting physician has 24 hours to visit the patient and decide what medications need to be started and perform a medication reconciliation of the medications a patient is taking at home, and to determine if those medications need to continue or temporarily stopped. Upon discharge medications will be reconciled and it will then be determined which medications will be restarted or added to their home regimen (Wolfe, 2020).

The management of a patient with COPD depends on the background of the physician and their familiarity with the patient. Currently there are order sets at SUCH depending on how the patient's diagnosis is documented. The order sets are clinical decision support tools that help the physicians prescribe the appropriate treatment for COPD, including applicable medications and the recommended dosages from evidence-based guidelines for COPD. Currently, there is not a systematic process that would alert the case management team or discharge administrator to aid in the early preparation or care transition process that would notify healthcare workers that an individual could be at high risk for readmission with certain identifiable factors (Wolfe, 2020).

Discharge assistance for COPD patients is crucial to minimize the impact of future readmissions (Kripalani et al., 2007). Identifying the best alternatives in post-discharge care for patients based on severity of the disease can give a patient the option to go home and care for themselves, which is referred to home with self-care (HSC), or be

referred to a suggested post-discharge care (HHC, SNF, or LTAC). A patient may be provided the option of having home health care (HHC) receiving rehabilitation services (occupational/physical therapy and nursing care) in their home. Some patients with more severe COPD may be sent to a skilled nursing facility (SNF) or a long-term acute care facility (LTAC) (Foster et al., 2007). After patients are discharged from inpatient care (HHC, SNF or LTAC) they can be referred to a supervised exercise training program that includes health education, breathing techniques, and specific instructions for the patient's self-management to prevent future relapses (Johnston & Grimmer-Sommers, 2010).

Rationale and Significance

The issue that inspired this project was the high incidence of patients discharged from the hospital with a COPD diagnosis readmitted back to the hospital within 30 days more in different discharge care dispositions. Without the proper classification of the severity of COPD, assessment, and health status measurement, and facilitation of early mobilization of post-discharge care, hospitals may not use the best available options that are in the best interest of each individual COPD case, and patients may readmit back to the hospital within 30 days (Burge & Wedzicha, 2003).

With COPD approaching the third leading cause of death globally, the estimated cost for treatment is $7,100 per patient a year in the United States (Portillo et al., 2018). The cost of a readmission of COPD within 30-days is approximately can be significantly higher than the initial stay costing $9,000 to $12,000 on average (Press, Konetzka & White, 2018). The risk of readmission for COPD within 30 days is over 22%. There is a 55% mortality rate and 44% rehospitalization risk within 5 years of hospital discharge (McGhan et al., 2007). The risk of rehospitalization within 30-days of COPD patients

increases with the number of comorbidities, previous hospitalizations, ethnicity, diabetes and hypertension (McGhan et al., 2007).

The quality-of-care is lacking in many aspects of patient care of those with COPD. The Centers of Medicare and Medicaid instituted penalties for 30-day readmissions in October 2014 as part of the Hospital Readmission Reduction Program (HRRP) (Centers for Medicare & Medicaid Services (CMS), 2018). Some of the risk factors that are not adjusted for with the accountability of the CMS system include: race, socioeconomic status, health related quality of life, cognitive impairment, severity of illness, health literacy, caregiver support and access to care (Feemster & Au, 2014). There is not an adjustment in penalties for those hospitals caring for disadvantaged patients (Shah et al., 2015). For those institutions with fewer resources, they are not held to a different standard. Hospitals that care for the sickest and poorest patients are at the most risk for penalties. Teaching hospitals in urban areas that provide care to those with complex medical problems are most likely to have HRRP penalizations (Shah et al., 2015).

There have not been any published programs that are evidenced based to reduce 30-day hospital readmissions with COPD patients that have been proven to be effective (Rinne et al., 2017). The events and circumstances that could potentially predict 30-day readmissions take place outside the hospital environment especially with those that have severe illnesses and with the socioeconomically disadvantaged populations which lack social support or primary care (Joynt & Jha, 2013).

One factor mentioned with the concern for HRRP is that hospitals want to avoid penalties so they are shifting care to outside resource settings to discharge quicker rather

than providing high quality care (Shah et al., 2015). To avoid the ticking time clock patients are held in the emergency department or they are admitted for observation (less than 24 hours). There have been slight reductions in readmissions but less gains in quality of care (Shah et al., 2015).

Shah et al., 2016 identified the factors in patients that have an increased risk of 30-day readmissions. Patient and hospital-level factors were identified, these included; black race, comorbidities (congestive heart failure, frailty, chronic renal insufficiency, diabetes, depression, anxiety, psychosis, alcohol and drug use), discharge to post-acute care, dual eligibility for Medicare and Medicaid, elevated serum arterial blood carbon dioxide level, low BMI, longer length of stay and male sex. Shah et al, 2016 stated in his study that the use of post-discharge care and the quality of care that is given from these agencies needs further investigation. There are not any algorithms that currently integrate data into a predictive model that can stratify a patient for risk early enough in the care process to find the appropriate care post discharge (Shah et al, 2016).

Problem Investigated

The problem investigated for this study was the 30-day readmissions of COPD patients and what post-discharge care settings (HSC, HHC, SNF and LTAC) illustrating the common covariates of COPD patients that are readmitted at the Small Urban Community Hospital. Each post-discharge care pathway was evaluated to determine if the selected care was associated with incidence of 30-day readmissions.

Improvement in the Management of COPD at SUCH

The overall aim of this project is to find out if there is a significant difference in 30-day readmission rates for the post-discharge care settings, and from this data suggest

how to make improvements in how COPD is managed at Small Urban Community Hospital.

Managing COPD aims to enhance the quality of life, and maintain or improve functional status through inpatient and outpatient rehabilitation services, addressing comorbidities, and minimizing or managing exacerbations and other characteristics of COPD (Foster et al.,2007). As of right now, there are different protocols for managing COPD at SUCH.

There were two primary objectives for this study. The first focused on the examination of each post-discharge care pathway chosen and which patients readmitted and its relationship to 30-day readmission frequency.

The second objective of this study focused on the characteristics of each patient that readmitted within 30-days individually and by discharge group. Each patient's medical chart was examined for demographics, respiratory symptoms, risk variables, comorbidities, diagnostic groups, hospital testing and medications and all physician documentation and patient history for the clinical practice management of each patient diagnosed with COPD. When reviewing the patient medical charts each patient was scored by variable according to severity by the listed numerical documentation. With an early identification of significant variables from this study a systems process can create an awareness with alerts to case management that patients with certain characteristics can be at risk of 30-day readmission at the Small Urban Community Hospital (SUCH) with COPD.

The identification of variables to predict readmission and the determined pathway of care will promote the adherence to a program to increase the most significant

improvement in the patient's COPD, improve quality and practice and decrease the financial expenditures for readmissions (Simons-Morton, McLeroy & Wendel, 2012).

Hypotheses/ Research Questions

RQ1: Is there a significant difference in 30-day readmission rates for the post-discharge care settings (discharge to home with self-care, home with home health care, skilled nursing facility, and long-term care facility) in patients with COPD?

H_{a1}: There will be significant differences in patients who get discharged to different post-discharge care settings (HSC, HHC, SNF and LTAC) who get readmitted within 30 days after index admission with COPD versus those who do not get readmitted back to the hospital within 30 days of their indexed admission with COPD.

RQ2: Is there a significant difference in patient characteristics (covariates) between those patients that get readmitted and those patients that do not get readmitted?

H_{a2}: There will be significant differences in the characteristics (covariates) of patients who get readmitted back to the hospital within 30 days of their indexed admission and those that do not get readmitted with COPD.

CHAPTER II

LITERATURE REVIEW

COPD is currently the fourth leading cause of death in the United States, as documented for the Center of Disease Control (Centers for Disease Control and Prevention, 2018). Even though COPD is a largely preventable, slightly reversible disease, COPD's global and national burden remains high (Pauwels et al. 2001). It is projected that COPD will exceed $49 billion in medical costs by the year 2020 (Global Initiative for Chronic Obstructive Lung Disease, 2019). Exacerbations of COPD account for up to 75% of the total disease cost. An estimated 29 million Americans aged 20 – 79 are living with COPD (National Institute of Health, 2018). COPD has led to more than 800,000 hospitalizations a year (Centers for Medicare and Medicaid Services, 2019). In the future, COPD is expected to increase globally because of the risk factors for COPD and the aging of the population (Mathers & Loncar, 2006). Hospital readmissions caused by an acute exacerbation of COPD is very common worldwide (U.S National Heart, Lung and Blood Institute [NHLBI], 2001; Mannino, 2003; Lau, Yam & Poon, 2001).

This chapter will be divided into many categorical areas to describe the small urban community hospital, the patient population, COPD as a disease and the components to manage COPD patients. Although exhaustive, the literature review was

deemed necessary to understand the disease in its entirety and to use the information to develop the covariate scoring chart which was used to help identify the biggest factors that influence 30-day readmissions within each post-discharge category. This study will be used to improve the discharge process and educate the healthcare system of the factors that may influence the risk of 30-day readmissions relative to the SUCH population.

Small Urban Community Hospital

It is important to describe the setting where this study took place. The small urban community hospital was founded in 1865 in Cleveland, Ohio. Small urban community hospital is Cleveland's oldest private hospital/medical center. SUCH has an available 205-bed capacity and has 6000 admissions per year. SUCH is considered a short-term acute care facility run as a nonprofit organization. The hospital has Joint Commission accreditation (Small Urban Community Hospital, 2019). The clinical services provided include cardiovascular, emergency, oncology, orthopedic, radiology, nuclear medicine and imaging, rehabilitation, special care, psychiatric, surgical, and wound care (Small Urban Community Hospital, 2019). The highest inpatient utilization categories are psychiatry, orthopedic surgery, internal medicine, cardiovascular services, and pulmonology. The highest categories for outpatient services include imaging, clinic visits and related services, ED visits, and nerve injections (Small Urban Community Hospital, 2019). The hospital has nearly 400 physicians on the Medical Staff. Most of the physicians are independent, and the medical group housed at SUCH employs 35 physicians. SUCH has a medical residency program which gives medical students a chance to work with an urban population. The residency program at SUCH consists of 57

residents from many different states and countries (Small Urban Community Hospital, 2019).

Patient Population Served

The hospital commits to the community it serves. The healthcare workers and staff have an understanding of the type of health needs and the social and environmental determinants of health in the community such as access to healthy food, safe and affordable housing, financial resources (Ohio Department of Health, 2018). These community resources are not evenly distributed throughout the city and can have a significant impact on health outcomes of the patient population (NACCHO, 2018). A Community Health Needs Assessment (CHNA) was completed in 2015 and 2018 to identify the most significant health needs within the community and the specific population's characteristics (Cuyahoga County Community Health Needs Assessment 2016) (Cuyahoga County Community Health Needs Assessment, 2019). The assessment recognizes that health is multi-factorial and those across the city especially with the people of color are excessively burdened with poor health and higher rates of chronic disease (Cuyahoga County Community Health Needs Assessment 2016) (Cuyahoga County Community Health Needs Assessment, 2019). The information helps to capture the patient population and their dwelling in which the study was conducted.

The hospital market area population is 852,600; 74.3% of the patient discharges are citizens of the primary market area (Cuyahoga County Board of Health, 2019). The primary market area, which is called the Central Neighborhood in the hospital's surrounding area, consists of 93.9% of the patients. In the primary market area, 69.7 % of patient discharges were Medicaid patients, and 4.5% were Medicare patients (Cuyahoga

County Board of Health, 2019). Twenty-one percent do not have insurance, and 4.3% have private insurance. Cuyahoga county is 63.9% white, and almost 30% African American. The population served by the hospital is nearly 96% African American. The area's median household income is $9,418, with the majority on public assistance income and food stamps (Cuyahoga County Board of Health, 2019). Poverty is a life-threatening issue that impacts the Central Neighborhood residents. The unemployment rate is above 12% in this area and many residents in the area surrounding the hospital may not have obtained a high school degree, especially with those 65 years of age and older, female and black (Cuyahoga County Board of Health, 2019). Ninety percent of the families have a female head of the household, no husband present with children under five years, and live under the poverty line. The population is primarily aged 25 to 34 and 55 to 64 (Ohio Department of Health, 2018).

A wide range of health conditions and challenges in access to care exists across the community. The issue of generational poverty has been experienced by many. There is a lack of available jobs, and many residents with past felony convictions cannot find employment, which creates barriers to the neighborhood's economic stability. There is a lack of stable, affordable housing that also impacts the residents' ability to have a stable home environment, leading to the development of chronic health conditions.

Several factors hinder the residents' ability to make healthy choices, including insufficient availability of low-cost healthy foods, lack of supermarkets, and a lack of awareness about what foods make up a healthy diet.

Many community residents suffer from chronic stress stemming from poverty, illegal activity in the neighborhood, and other stressors that impact many resident' lives in

the Central Neighborhood. It is understood that many of the patients cannot be compliant with treatment protocols given their life circumstances: alcohol and drug abuse run rampant in the neighborhood. A vast majority (68.2%) of the patients may have some chronic mental illness such as schizophrenia/affective disorder, depression/mood disorders, or bipolar disorders (Cuyahoga County Community Health Needs Assessment 2016) (Cuyahoga County Community Health Needs Assessment, 2019).

Because of the low level of health literacy within the patient population, education is rarely provided on managing the various chronic diseases that are diagnosed. Patients lack financial security, which creates a disincentive for residents in the community to seek appropriate healthcare services until they reach a crisis. They go to the emergency room instead of a primary care provider. The most common ambulatory care sensitive conditions (ACS) for Small Urban Community Hospital's discharged patients are congestive heart failure, cellulitis, chronic obstructive pulmonary disease (COPD), and diabetes. Almost 60% of discharged patients have hypertension (Small Urban Community Hospital, 2019).

Frameworks for the Study

The health belief model (HBM) was employed to create the theoretical basis for this research study. The HBM is a model frequently used in social psychology to evaluate health behavior and is commonly used in advocating behavioral change (Simons-Morton, McLeroy & Wendel, 2012). The HBM has been particularly useful in the management of various chronic conditions. The health belief model's premise is that beliefs about susceptibility and severity of a disease or health concern and the thoughts about the usefulness of preventative action or management of a disease or illness can

predict the likelihood of an action. Initially, the theory was used to identify screening determinants of chronic diseases and participation in programs to detect and prevent illness (Simons-Morton, McLeroy & Wendel, 2012).

The Andersen healthcare utilization model was used for the systematic identification of the covariates and the development of the covariate scoring sheet. The model was also used to evaluate patient characteristics and other predisposing or enabling factors (Andersen, 1995). The Donabedian model was also used to provide a context in which health care services could be evaluated focusing on structure, process, and outcomes (Donabedian, 1988).

Definitions/Classifications of Chronic Obstructive Pulmonary Disease

American Thoracic Society/European Respiratory Society (ATS/ERS) – "Chronic obstructive pulmonary disease (COPD) is a preventable and treatable disease state, characterized by airflow limitation that is not fully reversible. The airflow limitation is usually progressive and is associated with the abnormal inflammatory response of the lungs to noxious particles or gases, primarily by cigarette smoking. Although COPD affects the lungs, it also produces systemic consequences" (Burge & Wedzicha, 2003).

Canadian Thoracic Society – "Chronic obstructive pulmonary disease (COPD) is a respiratory disorder largely caused by smoking and is characterized by progressive, partially reversible airway obstruction and lung hyperinflation, systemic manifestations and increasing frequency and severity of exacerbations" (Burge & Wedzicha, 2003).

Global Initiative for Chronic Obstructive Lung Disease (GOLD) – "COPD is a preventable and treatable disease with some significant extra-pulmonary effects that may contribute to the severity in individual patients. Its pulmonary component is

characterized by airflow limitation that is not fully reversible. The airflow limitation is usually progressive and associated with abnormal inflammatory response of the lung to noxious particles or gases" (Burge & Wedzicha, 2003).

National Institute for Health and Clinical Excellence – "COPD is characterized by airflow obstruction. The airflow obstruction is usually progressive, not fully reversible, and does not change markedly over several months. The disease is predominantly caused by smoking" (Burge & Wedzicha, 2003).

World Health Organization (WHO) – "(COPD) is a lung disease characterized by chronic obstruction of lung airflow that interferes with normal breathing and is not fully reversible" (Burge & Wedzicha, 2003).

Although there are five definitions listed, all five have commonalities. Predominant symptoms include chronic cough, production of sputum, and shortness of breath with exertion. Patients can have reduced lung function, which in turn, reduces quality of life. With the decrease in lung function, exercise tolerance and their quality of life diminish. With the related symptoms, a downward spiral occurs, and the frequency of exacerbations increases along with hospitalizations and pharmacologic treatment (Fromer, 2011). Unfortunately, because of COPD being a prevalent condition, half of the 24 million adults in the United States who have COPD are misdiagnosed as asthma or emphysema or completely undiagnosed (Wise & Tashkin, 2007).

Introduction to COPD

COPD has been an umbrella term used for two different conditions: chronic bronchitis which is clinically diagnosed, and emphysema done radiographically or through pathologic diagnosis (Christie, 1944). With chronic bronchitis, airway resistance

is caused by inflammation and mucus production and does not affect airflow obstruction. With emphysema, there is damage to the alveolar septa, which reduces the gas exchange and reduces the elastic recoil after the lungs are inflated, which causes air trapping and hyperinflation. Because shortness of breath is the main characteristic of COPD (Christie, 1944), individuals may have anxiety and fear because of their perception of breathlessness. They may not know when to seek medical attention, abandon activity and go to the doctors. Some patients may have a cough and sputum productions, some coughs may produce mucous, and some may have a dry cough (Global Initiative for Chronic Obstructive Lung Disease, 2019).

With COPD, the limited airflow usually advances and is associated with the lungs' uncharacteristic inflammatory response to harmful particles or gases because of the airway and/or alveolar abnormalities (Overington et al.,2014). The most common respiratory symptoms include dyspnea (shortness of breath), cough and/or sputum (mucus) production, chest tightness and wheezing, and congestion of the bronchi (Overington et al., 2014).

COPD's main characteristic is a persistent inflammation of the lungs that disturbs the central airway, alveoli, lung parenchyma, and any pulmonary vasculature. The main mechanisms that promote these changes are the remodeling and narrowing of the airway (Global Initiative for Chronic Obstructive Lung Disease, 2019). The increase in the number of goblet cells and the swelling of mucus-secreting glands of the central airways can change the vascular bed, which leads to pulmonary hypertension. These are the pathologic changes that define the clinical presentation (Global Initiative for Chronic Obstructive Lung Disease, 2019).

Background/History of COPD

Some researchers describing conditions as we know as COPD today were Swiss Physician Theophile Bonet, 1679, who referred to a condition as "voluminous lungs", and the term "turgid" lungs was referred to by Italian anatomist Giovanni Morgagni in 1769 (Petty, 2006). In the year 1814, the British physician recognized chronic bronchitis as part of COPD. He used the term "catarrh" to explain constant cough symptoms and excessive amounts of mucus that COPD can produce (Petty, 2006). The clinician, pathologist, and inventor of the stethoscope Renee Laennec wrote the first descriptions of bronchiectasis, pleurisy, pneumonia, and other lung diseases in 1821. He especially recognized the lungs' hyperinflation that did not empty well and designated this condition as emphysema (Petty, 2006). In 1846, John Hutchinson invented the spirometer, which is used as an essential tool in diagnosing COPD. Today, the spirometer is not used to its maximum potential for diagnosis and management of COPD (Petty, 2006). Tiffeneau added the idea of using the timed vital capacity to measure airflow to become an instrument for diagnosis. Gaensler perfected the concept of using air velocity index for diagnosing COPD based on Tiffeneau's previous work. They both helped with the development of FEV_1 and FEV_1/FVC ratios, is currently used to determine the severity of disease (Petty, 2006).

Ronald Christie recommended that "the diagnosis of emphysema should be considered when there is dyspnea on exertion of cumulative onset not because of bronchospasm or left ventricular heart failure which can appear in a patient that has some physical signs of emphysema together with chronic bronchitis and asthma" (Christie,

1944). Christie identified COPD's components by relying on the history and physical examination for the diagnosis of each patient (Petty, 2006).

The CIBA Guest symposium in 1959 and The American Thoracic Society (ATS) Committee in 1962 defined the constituents of COPD. The ATS defined the differences in respiratory diseases; some did not use physiologic criteria (Ciba Guest Symposium, 1959). Chronic bronchitis is having a cough that lasts for a minimum of 3 months continuously over 2 years. Emphysema has been defined by anatomic terms with alveolar spaces that are enlarged with loss of alveolar walls. Asthma, on the other hand, was described as having hyperresponsiveness to a variety of stimuli (Ciba Guest Symposium, 1959). The literature recognized that bronchial hyperactivity and chest infections plus exposure to irritants could identify the pathogenesis of COPD (Petty, 2006).

In 1976, Charles Fletcher identified that smoking could accelerate the level of decline in the FEV_1 which caused disabling symptoms (Fletcher et al., 1976). It was determined that if an individual would quit smoking, this could slow the degree of FEV_1 decline. This information started developing smoking cessation at each stage of the disease (Fletcher et al. 1976).

By the time a patient presents clinical signs, they are frequently in a moderate to severe stage of COPD (Fletcher et al., 1976). It was also found that COPD often begins with overly complex small airway changes and cellular events surrounding the alveoli, leading to the decline in elastic recoil in which the lungs start to expand and the forced vital capacity increases (Petty, 2006).

COPD starts with the loss of elastic recoil, inflammation, increase in mucous production, bronchospasm, and the FEV_1 will decrease; this can also be the early stages of emphysema (Petty, 2006). Many advances have been made with COPD in the past; this summary of the history was meant to explain how COPD's identification got started with a brief overview of the tools to measure and identify the disease.

Overview of COPD

Prior to the 1960's, COPD was not a common disease because lifespan was shorter, and testing was not as prevalent. Six times as many men die versus women from COPD (Mannino, 2006). A person was more likely to be diagnosed with chronic bronchitis or emphysema than COPD. COPD was not used as a common diagnosis. The spirometer was only available in specialized settings to measure the volume and rate of flow of breath that is used to diagnose COPD today. In the past, smoking was not known as a risk factor for lung diseases or presented addictive properties (Mannino et al., 2003). There were not many therapies available to help individuals quit smoking. Doctors were very unsure of the treatments available as well as the efficacy to alleviate symptoms of COPD. Primarily, the research focused on proteases and the enzymes released by inflammation in the lungs that were suspicious in individuals that had emphysema and that cause the destruction of the lungs (National Institute of Health, 2018).

More than 16 million people today have COPD; it has become quite common. Approximately 120,000 people die from it each year. Additionally, more than 12 million people are thought to have COPD that has not been diagnosed (National Heart, Lung and Blood Institute, 2020). Deaths of women that have the disease are on the rise. Today, spirometry is widely available to doctors in both the office and hospital setting to confirm

the COPD diagnosis but is still underutilized (Kenealy et al.,2011). Today recognition of cigarette smoking and nicotine addiction allows doctors to provide referrals to smoking cessation programs and other counseling to overcome nicotine addiction (Pauwels et al.,2019). Treatments are now available to vaccinate against influenza and pneumonia, which can lead to COPD. Bronchodilator drugs, and glucocorticoids and/or antibiotics or both are used to treat an exacerbation of COPD (Silver et al., 2017). Other recommendations are made to participate in pulmonary rehabilitation, use oxygen therapy and investigate surgical interventions (Casey et al., 2013). Research has prevailed in nocturnal oxygen therapy and lung volume reduction surgery to improve the COPD patient's quality and longevity of life. Research continues on COPD and the inflammatory and immune components to COPD. The National Institute of Health (NIH) has partnered with advocacy groups to promote COPD education and awareness (National Institute of Health, 2018).

It has been documented that 10-20 % of patients who have COPD never smoked a cigarette, implying that both genetic and environmental factors can influence the development of COPD (National Institute of Health, 2018). A study is presently being conducted by the National Institute of Health is recruiting 10,000 smokers and non-smokers to identify the genetic factors that determine why some people develop COPD and others do not. Studies are currently being designed to use genomic information to analyze phenotypes and biomarkers to determine how COPD affects different subpopulations. Other studies will be done on therapeutic trials with the effectiveness of two different pneumococcal vaccines in those patients diagnosed with COPD. Azithromycin is being tested on COPD patients to evaluate whether it reduces the

number and severity of exacerbations. Lung tissue research will continue to explore the basis of COPD and other lung diseases. Continued investigation will improve the understanding of disease treatment and management through research and early interventions (National Institute of Health, 2018).

Development of New Issues

There is a significant need to develop improved treatments for COPD (Healthy People, 2020). Currently, there are no drug therapies that reduce the progression of the disease (Montuschi, 2006). There have been many developments in the advancement of asthma because of a better understanding of the underlying disease (Barnes, 2018). Liu et al., 2018 evaluated the use of inhaled steroids, increasing the prevalence of developing repetitive bacterial infections. It was found that inhaled steroids depress the immune system and increase the risk of developing respiratory infections, including nontuberculous mycobacterial (NTM) lung infections (Liu et al., 2018). NTM infections are exceedingly difficult to treat and can even cause death. The medical records of 549 patients were analyzed over ten years. It was found that the higher the inhaled steroid dose as well as how long the patient was on the steroid, the higher the chance was of developing NTM lung infections. As many as 75% of COPD patients may be taking an inhaled steroid. According to the authors, only a very modest number of patients benefit clinically from this treatment (Liu et al., 2018).

Pasquale et al. 2019, investigated the consequences of community-acquired pneumonia (CAP) in any patient that has COPD. The CAP Burden of Illness Questionnaire (CAP-BIQ) was distributed to 490 participants. A total of 481 completed the survey. More than 90% had symptoms for two weeks to a month following the

diagnosis. Symptoms included fatigue, headaches, trouble sleeping, and confusion. Patients were absent from work for an average of 21 days and could not perform usual activities of daily living. Information was collected directly from the patients. Self-reporting the prevalence of symptoms may not have been the most reliable method of collecting the information on these patients. Timing, recall, and description of symptoms may not have been accurate due to factors related to health literacy (Pasquale et al., 2019).

Mild and moderate small airway disease was investigated using novel multiresolution CT imaging on tissue samples of the whole lung or lobes of smokers with normal lung function (Hyun-Kyoung Koo et al., 2018). All 4 GOLD lung classification stages were used for the study. Out of the 34 patients, 10 were controls (smokers with normal lung function). The results indicated that "the number of terminal bronchioles decreased by 40% in GOLD 1 COPD and 43% in GOLD 2 COPD. The number of transitional bronchioles decreased by 56% in GOLD 1 and 59% in patients with GOLD 2. The alveolar surface area decreased by 33% in GOLD 1 and 45% in GOLD 2 patients" (Hyun-Kyoung Koo et al., 2018). These pathological changes correlated with decreased lung function. The study showed that in COPD patients with mild to moderate COPD can be a pathological feature. The need for stage classification is necessary for the early diagnosis of the disease because a patient may present with only intermittent symptoms. Early interventions may prevent rapid escalation to GOLD 3 or 4 (Hyun-Kyoung Koo et al., 2018).

Level of Evidence of COPD Cases

Lozano et al. 2012, did an analysis systematically on the burden of COPD in 2010. The study evaluated all available data in 187 countries and 235 causes of death from 1980 to 2010. Data were analyzed using extensive record review. The Cause of Death Ensemble model (CODEm) approach was used in every age and sex group. Some of the leading causes of death in 2010 were COPD, lower respiratory infections, lung cancer, ischemic heart disease, stroke, and HIV/AIDS. In 1990, the ascending order of rank of COPD was number 4 with the potential of COPD to move to number 3 by 2020, with Ischemic heart disease found as number 1 and stroke at number 2. Falling behind COPD was lower respiratory infections and lung cancer. With the identification of cause-specific mortality, the number of people who die according to what age and from what disease is essential in prioritizing research to develop policy, interventions, and new health technologies (Lozano et al., 2012).

Ford et al., 2013, completed the COPD surveillance report for the United States in 2011. The national data systems provided data on adults aged 25 years or greater. Almost 13.7 million had been documented as having a diagnosis of COPD. During the previous year, only 10.3 million were diagnosed in a physician's office, 1.5 million had visited the emergency department and, 700,000 were discharged with a diagnosis of COPD. It was noted that the trends of patients diagnosed were younger and that the death rates increased in adults from the age of 45 to 54 years and among American Indian and Alaskan natives. COPD declined in those aged 65 to 74 years of age and among Hispanics and Asian/Pacific Islanders. This study suggested that there has not been

progression in preventing COPD in the United States in specific populations (Ford et al., 2013).

Burden of COPD

The Global Burden of Disease Study reports having 251 million cases of COPD throughout the nation in 2016. More than 90% of COPD deaths occur in low-and middle-income countries (Lozano et al., 2012). According to the Centers for Disease Control (CDC), an estimated 15 million people in the United States have been told that they have COPD in 2015 (CDC, 2018). According to the Behavioral Risk Factor Surveillance System (BRFSS) survey completed in Ohio in 2011, 9.2% of the residents reported having the disease. The primary cause of COPD is being exposed to tobacco smoke either actively or through secondhand inhalation (CDC, 2018). Other determinants include being exposed to air pollution, either indoor or outdoor, and dust and fumes from occupational hazards. Some cases are due to long-term asthma. States with the highest COPD death rates come together along the Ohio and Mississippi Rivers. Other statistics reported from those having COPD were that they were on disability, did not graduate from high school, had an income with all household members less than $25,000, were divorced, widowed, or separated, were a smoker or had a history of asthma or other respiratory diseases (Ford, Croft, Mannino, Wheaton, & Giles, 2013).

Factors that Influence Disease Development and Progression

The most significant risk factor for COPD is for those who smoke tobacco (American Lung Association, 2020). Other environmental toxins such as biomass fuel exposure or air pollution can contribute to the disease (Fullerton, Bruce & Gordon (2008). Besides the previously mentioned factors, other factors may predispose an

individual to develop COPD. These include genetic defects, malformed lung development, and accelerated aging (Tsui et al, 2016). Other risk factors include previous hospital admissions, hypercapnia, and patients on oxygen long-term. Depression and anxiety have also been shown to be related to a higher risk of readmission (Bahadori & FitzGerald, 2007).

Other factors that influence disease development and progression are awareness and knowledge about COPD with primary care practitioners (PCP's) (Bhatia & Fromer, 2011). Health care providers may not clinically diagnose COPD or delay the diagnosis which, may only be recognized in its later stages, and the patient may have worsening symptoms and a poor quality of life with a rapidly declining condition. Guidelines have been developed to help clinicians recognize patients with symptoms and help in the early stages of COPD diagnosis. (Bhatia & Fromer, 2011).

Not using the proper diagnostic tools cause an underdiagnosis or misdiagnosis of COPD (Foster et al. 2007). Spirometry is an essential tool diagnosing COPD, and it is commonly not used even when available. A survey of 943 PCP's found that only 64% of established physician practices had access to spirometry, 34% of the physicians extensively used the instrument for COPD diagnosis (Foster et al., 2007). Diagnosis of COPD can also be confused by diagnostic criteria between COPD and asthma. When patients have a cough, dyspnea, and limited exercise tolerance, physicians have a partiality towards asthma especially in women (Chapman, Tashkin & Pye, 2001).

Tinkleman, Price, Nordyke, and Walsh, 2006 studied 597 patients and found the misdiagnosis of COPD and asthma quite common. Forty percent of those previously diagnosed with asthma had COPD. Factors that influence profitability may influence

asthma bias because of having the performance pay incentive (Tinkleman et al., 2006). There has not been an incentive to promote and improve COPD diagnosis and management. (Griffiths et al., 1999).

Symptoms of COPD

The most common symptoms of COPD are dyspnea (shortness of breath). Cough with sputum (mucus) production and presents in approximately 30% of all patients (Bhatia & Fromer, 2011). COPD symptoms may change each day and change with progression over time. The limited airflow diminishes over time. Those patients that present with the above-listed symptoms should be thoroughly examined for the potential cause of these symptoms. Physicians may base the diagnosis on the listed symptoms in Table 2.1 and on the functional status of the patient. Patients may go to the hospital or visit their physician because of long-term respiratory symptoms or because they have an exacerbation of respiratory symptoms (Global Initiative for Chronic Obstructive Lung Disease 2019).

Other causes of chronic cough [intrathoracic] include lung cancer, tuberculosis, asthma, interstitial lung disease, left heart failure, and cystic fibrosis. Additional causes of chronic cough [extra thoracic] include effects from medication including, ACE inhibitors, postnasal drip syndrome, chronic allergic rhinitis, upper airway cough syndrome, and gastroesophageal reflux (Global Initiative for Chronic Obstructive Lung Disease 2019).

Other symptoms include wheezing and chest tightness. A wheeze heard through a stethoscope may happen at the laryngeal level. Wheezes heard both inspiratory and expiratory may be heard on auscultation. Chest tightness presents itself with exertion or

exercise that may be muscular and will happen because of the intercostal muscles' contraction. If a patient does not have wheezing or chest tightness, this does not exclude COPD or asthma (Global Initiative for Chronic Obstructive Lung Disease 2019).

Other factors associated with COPD include fatigue and weight loss. Weight loss is common in patients with Level IV or very severe COPD (Hanania et al., 2011). Other diseases such as tuberculosis or lung cancer should be considered, and all symptoms should be investigated. Syncope during cough can occur because of the quick increase in intrathoracic pressure during long coughing attacks (Hanania et al., 2011). Coughing may cause rib fractures. Ankle swelling may be the only indication of cor pulmonale (enlargement of the heart's right side). Because of the reduced quality of life, patients may have the onset of depression or anxiety (Hanania et al., 2011).

Diagnosis and Assessment

A COPD diagnosis should be based on several factors including, dyspnea, cough or mucus production, a frequent history of lower respiratory tract infections and an awareness of exposure to risk factors such as tobacco, indoor/outdoor pollution, and occupational hazards (Global Initiative for Chronic Obstructive Lung Disease, 2019). The key indicators are listed in Table 2.1. The use of spirometry or a PFT is essential to making a clinical diagnosis. The existence of a post-bronchodilator Forced Expiratory Volume of Air in one second (FEV_1) < 0.70 can verify the presence of limited airflow along with the patient's identification of symptoms and noted exposure to harmful toxins of a COPD patient (Global Initiative for Chronic Obstructive Lung Disease, 2019).

Table 2.1 Indicators for considering a diagnosis of COPD

Symptom	Description
Dyspnea that is:	"Progressive over time Characteristically worse with exercise Persistent
Chronic Cough:	May be intermittent and may be unproductive Recurrent wheeze
Chronic Sputum Production:	Any pattern of chronic sputum production
Lower Respiratory Tract Infections	Recurrent
History of Risk Factors:	Host factors (such as genetic, congenital, developmental) Tobacco smoke (including popular local preparations) Smoke from home cooking and heating fuels Occupational dust, vapors, fumes, gases, and chemicals
Family History of COPD and Childhood factors	For example, low birth weight, childhood respiratory examples"

(Global Initiative for Chronic Obstructive Lung Disease, 2019)

"Spirometry is the most accurate and factual measurement of airflow limitation. Spirometry should measure the volume of air forcibly exhaled from the point of maximal inspiration (forced vital capacity, FVC), the volume of air exhaled in the first second of the test (forced expiratory volume in one second, FEV_1), and the ratio between the forced vital capacity and forced expiratory volume FEV_1/FVC ratio. The presence of a post-bronchodilator $FEV_1/FEV < 0.70$ confirms the presence of persistent airflow limitation and determines if a patient has COPD. Spirometry should always be compared to the reference values based on age, height, race, and sex" (Pellegrino et al., 2005). The GOLD Classification of Airflow Limitation Severity in COPD (based on post-bronchodilator FEV_1). GOLD 1: mild – $FEV_1 \geq 80\%$ predicted, GOLD 2: moderate – $50\% \leq FEV_1 < 80\%$ predicted, GOLD 3: Severe – $30\% FEV_1 < 50\%$ predicted, GOLD 4: Very Severe – $FEV_1 < 30\%$ predicted (GOLD, 2020).

A medical assessment of a new patient who may have symptoms or is suspected of having COPD should include patient exposure to risk factors such as smoking and any environmental exposures (Stephens & Yew, 2008). Identifying a patient's past medical history including, allergies, asthma, nasal polyps' sinusitis, any repetitive respiratory infections as a young child, and any other respiratory or non-respiratory diseases (Stephens & Yew, 2008). Family history of COPD or respiratory diseases can be important in the evaluation.

Evaluating the patient's symptom development, such as increased shortness of breath, more winter colds, and the number of years the patient did not seek out medical treatment and noting the history of hospitalizations for respiratory problems and worsening episodes not seeking medical help (Stephens & Yew, 2008). Evaluation of comorbidities including heart disease, musculoskeletal disorders, osteoporosis, and any malignancies that may cause a restriction of the airway and limited activity (Stephens & Yew, 2008). Other physiological factors that need evaluation to determine respiratory distress include oxygen saturation (SaO2), measurement of oxygen in the blood (PaO2) and the level of carbon dioxide in the bloodstream as COPD worsens and these results will determine the mechanisms involved with each patient (Global Initiative for Chronic Obstructive Lung Disease 2019; Cukic, 2014). Physicians will evaluate how the disease impacts a person's life such as avoiding activity, missing work, having an economic impact, performing activities of daily living, depression, and anxiety. Evaluating a patient's social support or living situation and how to reduce risk factors is also essential (Stephens & Yew, 2008).

Management of COPD

Treatment regimens are very individualized with a patient who has COPD (Montuschi, 2006). In previous years smoking cessation has been the most effective intervention for slowing COPD progression (Bantus, 2013). Global Initiative for Chronic Obstructive Lung Disease, 2019 stated that by initiating early pharmacological therapy at the early stages of COPD can reduce symptoms, reduce the number and severity of exacerbations, and improve the ability to exercise and complete activities of daily living. Inhalers remain the initial choice of optimal medical management. The choice of medications depends on the cost and availability and the insurance provider's coverage. Each treatment regimen is based on the severity of the patient's symptoms, airflow limitation, and exacerbation history (Global Initiative for Chronic Obstructive Lung Disease, 2019).

Spruit et al., 2013 reviewed pulmonary rehabilitation as a multidisciplinary intervention based on patient assessment followed by an individualized treatment plan that includes exercise training, education, medication management and self-management of symptoms aiming at behavior change designed to improve COPD's physical and psychological conditions. Pulmonary rehabilitation is the most effective strategy that improves shortness of breath, health status and exercise ability (Spruit et al., 2013). It was stated that symptom control and palliative care can help patients with symptoms as well as the management of the disease (Spruit et al., 2013).

COPD is highly unpredictable and has many elements that can affect a person, such as fatigue, dyspnea, insomnia, depression, and anxiety, requiring symptom-based palliative treatments (Seamark, Seamark & Halpin, 2007). The long-term administration

of oxygen therapy with chronic respiratory failure improves outcomes and management in patients with stable COPD (Kim, Benditt, Wise, & Sharafkhaneh, 2008; Stroller, Panos, Drachman, Doherty, & Make, 2010).

Guidelines have been developed by ATS/ERS, GOLD, NICE, and CTS to diagnose and treat COPD. The GOLD guidelines provide a simple classification for patients' education and treatment. These guidelines are very comprehensive and help to confirm an early diagnosis and improve the management of COPD (Global Initiative for Chronic Obstructive Lung Disease, 2019). It is recommended that patients over 40 years of age, that have activity limitations, shortness of breath, and a cough with a history of smoking should get a COPD evaluation, especially when they have a history of smoking or exposure to occupational or environmental hazards (Global Initiative for Chronic Obstructive Lung Disease, 2019). Additionally, patient spirometry should be an essential part of a respiratory practice or pulmonology as electrocardiography is to a cardiovascular investigation or cardiologist in determining appropriate diagnosis (Mannino, Ford & Redd, 2003).

Challenges with the Management of COPD

The literature identifies that 10 to 55% of readmissions for an acute exacerbation of COPD may be prevented (Benbassat & Taragin, 2000) Some factors identified may be discharging a patient prematurely because of the incorrect index admission, poor medication compliance, lack of patient and family education regarding COPD, and lack of follow-up with primary care physician and outpatient rehabilitation program referrals (Benbassat & Taragin, 2000).

There is low utilization of spirometry to confirm a COPD diagnosis (Spero et al., 2017). There is sometimes a lack of understanding with the definition of COPD and the fact that treatment may improve breathing, but it is not reversible when using a bronchodilator (Spero et al., 2017). Clinicians may have difficulty performing spirometry in a hospital setting and would rather see that patient be referred to an outpatient setting to have a pulmonary function test performed by a respiratory therapist (Griffiths et al., 1999). Patients who perform a spirometry test during their hospital stay can produce acceptable results (Spero et al., 2017). Other factors that determine whether a clinician will perform the spirometry test include the clinician belief that the patient must have had spirometry to confirm their diagnosis (Spero et al., 2017).

Of the patients admitted for a COPD exacerbation, 1 in 5 will be readmitted to the hospital for symptoms related to their disease within 30 days (Shah, Press, Husingh-Scheetz & White, 2016). Many hospitals in developed countries have implemented policies to enhance care quality and reduce costs related to COPD. COPD is part of Medicare's Hospital Readmission Reduction Program (HRRP) which was implemented in 2012 (Centers for Medicare & Medicaid Services, 2019. This program penalizes hospitals for 30-day readmissions for hospitalized patients for an acute exacerbation of COPD. At this point there are very few programs in hospitals to help in the reduction of readmissions with COPD patients (Centers for Medicare & Medicaid Services, 2019).

Morgan, Zakeri and Quint, 2017 defined the relationship between COPD and CVD. Cardiovascular diseases are the most important comorbidity when evaluating COPD. CVD is associated with longer lengths of stay in the hospital, increased risk for rehospitalization and for all-cause cardiovascular disease death (Morgan, Zakeri & Quint,

2017. There may be a lack of recognition and undertreatment of comorbid coronary artery disease in COPD patients depending on previous treatment or physicians' visits. Because of this, most patients with symptoms of sputum, cough, and dyspnea upon exertion are treated for COPD. There is an unmet need to review CAD, or any heart related diseases when it comes to COPD. Coronary artery disease (CAD) also called coronary heart disease (CHD) or ischemic heart disease (IHD), or just simply heart disease involves the reduction in blood flow to the heart because of atherosclerotic plaque that has built up in the arteries (Morgan, Zakeri & Quint, 2018).

Ford and Mannino (2004) used the findings from the National Health and Nutrition Examination Survey to determine incidence of diabetes in those that have impaired pulmonary function. Different forms of lung disease were studied. The findings indicated that in the early stage of diabetes there may be changes in lung function. This may be a biomarker for the potential diagnosis of diabetes. With more frequent doctors' visits a patient may have more opportunity to diagnose diabetes. COPD was associated with a moderate increase of the risk of diabetes (Ford & Mannino, 2004).

Smoking, physical inactivity, poor diet, and air pollution exposure are all risk factors for both COPD and CAD. Smoking increases an inflammatory response in the body which contributes to chronic inflammation which in turn can rupture atherosclerotic plaque. COPD is a consequence of the inflammatory response to inhaling noxious particles (smoking). This will lead to disruption in the lungs and repair mechanisms which becomes systemic and destroys the lung parenchyma. The systemic inflammatory response associated with COPD puts a patient at risk for CHD (Sin & Man, 2003).

It was mentioned in Braman, 2015 that there is no guarantee that reducing the 30-day readmission rates would benefit and not harm the overall patient's health and outcomes of the hospitals. CMS assumes that there is a high quality of care with treatment based on established guidelines, education for patients and family, and that there is coordination of care post-discharge (Centers for Disease Control and Prevention, 202). Some of the challenges include identifying the target population for COPD readmission specific to an urban hospital's characteristics while patients are hospitalized. The national average of patients readmitted for acute exacerbation of COPD within 30 days is 22% (Centers for Disease Control and Prevention, 2021). Another difference would include the use of the classification of the disease. Differences in the use of electronic health records and the use of International Classification of Diseases, Ninth Revision (ICD-9) or the use of the Tenth Revision (ICD-10), as well as differences in coding after discharge may be a challenge for the hospital (National Center for Health Statistics, 2019).

There will be differences between health care systems due to public vs. private, and inner-city vs. rural vs. suburban. SUCH is characterized as a private inner-city institution. The readmission policies are identified by the Centers of Medicare and Medicaid Services. The intervention for readmissions prevention is to utilize the patient navigator throughout the patient process (Centers for Disease Control and Prevention, 2021).

Shah, Press, Husingh-Scheetz & White, 2016 explained that Medicare has provided incentives to reduce 30-day readmission and instills a 3% penalty for an overabundance of readmissions. SUCH penalties may be disproportionately higher

because of the rate of those treated with limited resources. With the increase in hospital penalties, an acute exacerbation (AECOPD) may be coded as another condition, thus increasing the prevalence of health disparities due to changing the initial diagnosis and transferring or referring patients to another health care facility to prevent penalties and delay the patient from having further readmissions.

Does the delay of readmission improve patient health? Literature states that higher rates for readmission are associated with lower expiration rates with patients with COPD. Higher readmission rates can be a protective factor (Shah, Press, Husingh-Scheetz & White, 2016). Twenty-five percent of patients with an acute exacerbation of COPD do not recover lung function by day 30, leaving readmission as an appropriate remedy (Donaldson et al., 2015). With the lack of consistency in the definition of COPD and the change from ICD-9 codes to ICD-10 codes, the inconsistencies impair efforts in the development of guidelines and comparison of studies on COPD (National Center for Health Statistics, 2019). Some readmissions may be related to COPD, while others may be related to other respiratory causes. COPD may be well defined, but post-discharge and inpatient care may be lacking because of the improper diagnosis of symptoms and inaccurate classification (Shah, Press, Husingh-Scheetz & White, 2016).

Stein et al., 2012 evaluated the validity of ICD-9 codes and the clinical modification diagnosis codes for identifying COPD patients hospitalized for exacerbations. The assignment of primary and secondary ICD-9 discharge diagnosis codes is specifically done for reimbursement. It may be influenced by the clinical documentation in the medical record and by the relative rate of reimbursement by the insurance company. This raises concerns about the validity of this data for the

identification of patients with chronic conditions. The coding algorithm varies from hospital to hospital (Stein et al., 2012).

The COPD-ARTIFACT (Administrative Data to Identify COPD or Heart Failure) study was performed by Stein et al., 2012 to evaluate COPD's acute exacerbation (AE-COPD) and how it was medically coded. Hospitalizations were included with and without AE-COPD (Stein et al., 2012). There were two physician reviewers. Medical records were reviewed from two years prior. Patients were determined to have an acute exacerbation of COPD if the following criteria were presented; physician diagnosis of COPD, chronic bronchitis, or emphysema in the admission note have presence of cough for several days, dyspnea or sputum production, not dependent on color on presentation and hospitalization for one or more of any respiratory symptoms. Patients with COPD may have other pulmonary or cardiac conditions (pneumonia or heart failure). The validity of 4 different algorithms was tested. Of the 49,239 patients admitted during the study, 8,790 met the AE-COPD criteria, and only 20.8% had documented spirometry. The sensitivity and specificity of the algorithms evaluated were low, especially when related to a primary diagnosis of COPD. This indicates that hospitals are significantly underestimating the burden of hospitalizations for an acute exacerbation of COPD and that the incorrect coding will lead to an underestimated comparison of DRG's as well as lack of provision of quality of care and improvement for those with COPD. A limitation of the study was that there was no requirement or evidence of airflow obstruction based on spirometry to establish a clinical diagnosis (Stein et al., 2012). The study confirmed the use of ICD-9 codes to capture the picture of COPD patients who underestimate the

disease's burden and the importance of improved treatment and care initiatives to manage the continuum of care for COPD patients (Stein et al., 2012).

Misdiagnosis

Misdiagnosis of COPD is common. Those who are misdiagnosed usually have higher hospitalization rates than those clinically diagnosed using spirometry (Gershon et al., 2013). The diagnosis is usually based on history and a physical exam. The primary symptoms of cough, dyspnea and wheezing can contribute to a variety of diseases. Spirometry testing can be used to confirm the disease but is rarely used, leading to the numerous misdiagnoses of COPD (Spero et al., 2017).

In a study conducted by Spero et al., 2017, examined a total of 6,018 patients were admitted to the hospital and diagnosed as having COPD. Of the patients admitted, 504 had a spirometry test performed. Of the patients admitted, 104 patients were found to have restrictive lung disease, and 16 patients were considered normal. More than one-third of patients admitted to the hospital with respiratory symptoms and many times were diagnosed with COPD inaccurately. Other factors of presentation of COPD may be smoking history, BMI, and associated comorbidities. A history and physical examination cannot make an accurate clinical diagnosis of COPD. Spero et al., 2017 identified that spirometry was not used during hospital admission because the physician may want to wait until the patient is clinically stable and has some time to recover (Spero et al., 2017).

Kenealy et al., 2011 examined spirometry for patients in the hospital and one month after admission with COPD's acute exacerbation. The clinical diagnosis of COPD is based on a patient's clinical symptoms and spirometry results. Spirometry is required to assess the severity of COPD in a patient, and determines treatment recommendations

based on clinical guidelines. The Global Initiative for Chronic Obstructive Lung Disease (GOLD) guidelines state "when the patient is clinically stable and free from respiratory tract infection" a spirometry test should be performed (Global Initiative for Chronic Obstructive Lung Disease, 2019). The study also mentioned that the patient misdiagnosis was more likely to occur if non-smokers; had a high BMI, hypertension, coronary heart disease, congestive heart failure, or sleep apnea (Spero et al., 2017).

A study done by Kenealy et al., 2011 studied 101 with AE-COPD at a primary care center to compare spirometry measurements to that those performed during their hospital stay. Patients were identified as having mild to moderate COPD. It was found that patients that were tested post-discharge had little change in spirometry five days after post-discharge and again at one month. The pre-bronchodilator measurements were reported. There were no patients who moved more than one GOLD classification up or down (Kenealy et al., 2011).

Feinberg et al., 2017 found that patients are typically treated with inhaled corticosteroid (ICS) and a long-acting beta-agonist (LABA) especially, LABA/ICS combination. Patients are treated with LABA/ICS combinations without undergoing a pulmonary function test (PFT) or having an evaluation by a pulmonologist. General Practitioner's (GP's) may sometimes prescribe drugs based on a patients' symptoms, clinical examination, and smoking history (20 packs/year) (Feinberg et al., 2017). Spirometry may not be used to confirm the level of respiratory disease with a follow-up appointment to a respiratory therapist. Without clinically diagnosing COPD it may be difficult to align the appropriate treatment. The most popular LABA/ICS combinations will cover any COPD stage or any bronchial asthma (Bhatia & Fromer, 2011). It can be

difficult to manage the disease with a patients' lack of awareness of characteristics of COPD (Feinberg et al., 2017).

Underdiagnosis

COPD is often underdiagnosed leading to unnecessary sickness and death throughout the world. The underdiagnosis is attributed to the early stages of the disease and may not present with symptoms or with as much intensity as moderate to severe cases. Approximately 95% of stage 1 - mild COPD and 80% in stage 2 - moderate COPD remain undiagnosed (Sandelowsky et al., 2011). Many efforts to diagnose COPD including, screening and questionnaires that are not completed due to time consumption within the hospital/primary care practices/urgent care facilities. Methods and studies need to be performed regarding the early detection of COPD (Sandelowsky et al., 2011).

Sandelowsky et al., 2011 measured the occurrence and severity of underdiagnosed COPD patients in an urgent care setting with respiratory tract infections with smoking history and no prior pulmonary disease diagnosis. Patients were eligible if aged 40 – 75 who had recently visited a primary care doctor or urgent care facility. The patients had a spirometry test performed 4 to 5 weeks following an acute respiratory tract infection diagnosis. All patients showing airway limitation were given a $Beta_2$-agonist (formoterol) through an inhaler. The COPD diagnosis was made according to the GOLD standard. Of the 138, patients 38 patients were diagnosed with COPD. The study suggested that assessing three simple variables: age, smoking status, and smoking intensity with any patient with an acute respiratory tract infection could effectively determine who needs a spirometry test. The study concluded that patients aged 40 and over with a positive smoking history (over 20 packs/year) who develop any respiratory

infection might be at risk of having COPD (Sandelowsky et al., 2011). Other studies have shown that the underdiagnosis is because of a doctor's delay who does not suspect COPD because the patient may self-report that they are in good health (Hvidsten et al., 2008).

Hvidsten, Storesun, Wentzel-Larsen, Gulsvik, and Lehmann, 2008, wanted to determine the frequency and predictors of the undiagnosed chronic obstructive pulmonary disease in Norway. A total of 3,506 participants who had respiratory symptoms filled in questionnaires identifying their COPD symptoms, if they had a smoking history, socio-economic status, self-reported health, and cardiac conditions. A spirometry test was performed after inhaling 400 μg of salbutamol. It was determined that 66% were undiagnosed, and that every two out of three patients in Norway are undiagnosed with COPD. The results were not surprising as people with mild COPD have few non-intense airway symptoms and do not seek the physician's care. The three variables, anthropometric, socioeconomic status, and cardiac comorbidities were not associated with having COPD. The risk factors for not being diagnosed with COPD included having a moderate reduction in lung function, not having COPD symptoms, and reported being in good health (Hvidsten et al., 2008).

Readmissions

One in five people enrolled in Medicare will be readmitted to the hospital within 30 days, and it has been identified that up to 75% of these readmissions can be prevented. A study completed by Jenks, Williams and Coleman, 2009 reviewed records from 13,062,937 patients and 4,926 different hospitals. The top 10 reasons for hospitalization were reviewed, the readmission rate for COPD patients was 36% and all other reasons

was on average 25 %. Fifty percent of those readmitted after discharge from a medical condition do not follow-up with a medical doctor visit between discharge and readmittance. These unplanned preventable readmissions can cost the United States healthcare system approximately 17.4 billion in a year. This does not include readmissions to the emergency room, urgent care facilities, or going to a different hospital (Jencks, Williams, & Coleman, 2009).

It has been recognized that expenditures for preventable rehospitalizations may be higher than $12 billion a year (Med Pac, 2020). An important element of the Affordable Care Act was to reduce rehospitalizations. A proposal was developed to change the accountability of a hospital for metrics for patient outcomes after discharge. A Med Pac report was developed as a study in 2007. The three key questions were asked in dealing with readmissions: What is the frequency of unplanned hospitalizations within 30 days after discharge? How long does the elevated risk of rehospitalization last? What is the frequency of visits with a physician after a patient is discharged from the hospital (Jenks, Williams & Coleman, 2009)?

The Med Pac report statistics indicated that 19.6% of the 11,855,702 Medicare beneficiaries discharged from a hospital were readmitted back to the hospital within 30 days, 34% were readmitted back to the hospital within 90 days. Nearly fifty percent were discharged with zero follow-up care. The average stay of rehospitalization was almost a day longer than their initial visit. It was found that rehospitalizations among Medicare beneficiaries are very prevalent and are costly to the health care system. The ten most frequent reasons for each diagnosis-related group (DRG) were calculated. It was found that COPD was the third highest DRG behind heart failure and psychosis. Conditions

related to readmission in COPD patients included: respiratory or breathing problems, gastrointestinal problems, metabolic or nutritional issues, cardiac arrhythmias, and acute myocardial infarction. The DRG's were not evaluated on the severity of illness. Upon completing the report interventions could reduce readmission rates at the time of discharge. (Jenks, Williams & Coleman, 2009).

In efforts to support the results of this study with research factors will be identified that may contribute to the 30-day readmissions of those patients with COPD. Readmission in general, can be related to many factors that have been described in the literature review in diagnosis and assessment, management of COPD, challenges with the management of COPD, misdiagnosis, underdiagnosis, readmissions, hospital discharge and readmissions, post-discharge care, effective discharge planning/transitional care and prevention and maintenance.

The research on home health care agencies and 30-day readmissions began to be publicly reported in 2019 (Middleton, Downer, Haas, Knox, & Ottenbacher, 2019). Home health agencies provide services to patients discharged from the hospital and considered home bound and need skilled nursing therapy (Medicare Payment Policy, 2020). Medpac, 2020 cited that average about 29% of those discharged to home health care result in 30-day hospital readmissions. This measure was not risk-adjusted on severity. The results of this study indicate that 30-day readmissions of COPD at SUCH are below the national average, according to Medpac, 2020. Based on how the statistics are calculated results may vary. The agency for Healthcare Research and Quality calculated the rate of per 100 index stays. The 7-day readmission rate for COPD patients was 6.1%, and the 30-day readmission rate was 20.1% (Fingar, Barrett, & Jiang, 2017).

The readmission rate for those COPD patients that readmitted back to SUCH is higher by 2.17% (Fingar, Barrett & Jiang, 2017). Although the statistics vary, the intent of this study is to develop a discharge planning process that will benefit COPD patients and reduce 30-day readmissions.

Of the characteristics reported to predict readmissions, Wong & Wilkinson, 2020 studied the risk factors for readmissions, including comorbidities, physical activity and frailty, lung function, nutritional status and body mass index, social factors, hypercapnia, and biological mechanism and biomarkers, medications, treatment, interventions such as pulmonary rehabilitation, oxygen therapy, palliative care, self-management plans and home health care which is referred to hospital at home in this study. It was stated that the search needs to continue for interventions that are sustainable and can be applied to diverse populations (Wong & Wilkinson, 2020).

There was a lack of consensus in the multifaceted problem of identifying the factors that would prevent readmission and the system identification of post-discharge care. Because of the lack of agreement in the research and limited research on small urban community hospitals in the center of a major city, run as a non-profit, and a teaching hospital affiliated with universities but not connected to a hospital, it was important to evaluate the patients that readmitted at SUCH within 30-days characteristics using the covariate scoring chart in Table 3.1.

Additional patient factors for the readmission of COPD patients include patients that use oxygen at home, hypercapnia, comorbidities, systemic corticosteroid use, smoking, and drug use. Poor access to health care included not having a primary care provider, transportation issues, and language barriers. Efforts need to be made to analyze

and synthesize medical evidence, follow clinical guidelines, identify best practices of care delivery, and establish goals for improving the care process by assessing the quality of care and readmissions (Jenks, Williams & Coleman, 2009).

Rezaee et al., 2017, examined 30-day readmissions through an emergency department. A retrospective study was done on patients presenting with COPD over the age of 18 in a large health care system in Michigan. Predictors identified were demographics to include age, gender, race, insurance, marital status, and smoking status. Clinical data collected was arterial blood gas, BNP, height and weight, oxygen saturation, method of oxygen delivery if any, COPD medications, time in the emergency department, prior inpatient stays, and length of stay. A multivariate logistic regression model was used to evaluate the variables. It was found that those patients that presented with breathing difficulty that albuterol utilization, smoking, and an increased pulse rate were independent predictors of readmission (Rezaee et al., 2017).

Some of the factors associated with increased risk of readmission within 30 days include male gender, African American, low BMI, discharge to post-acute care, eligibility for Medicare/Medicaid, having an elevated serum arterial blood carbon dioxide (pCO2), alcohol and drug use. Some of the comorbidities include congestive heart failure (CHF), chronic renal insufficiency, diabetes, and psychiatric issues including depression; and anxiety (Shah, Press, Husingh-Scheetz & White, 2016).

Fingar, Barett & Jiang, 2017 did a comparison of all cause 7-day and 30-day readmissions. The Healthcare Cost and Utilization Project (HCUP) provided statistical data for the top 20 principal diagnoses with the highest 7-day and 30-day readmission rates. The highest principal diagnosis at the index stay was congestive heart failure

which was ranked #1 with a 30-day readmission rate of 23.2%. COPD was ranked #9 with a 30-day readmission rate of 20.1%. The data percentages in this study were based on per 100 index patient stays (Fingar et al., 2017).

Of the characteristics reported to predict readmissions Wong & Wilkinson, 2020 studied the risk factors for readmissions including: comorbidities, physical activity and frailty, lung function, nutritional status and body mass index, social factors, hypercapnia, and biological mechanism and biomarkers, medications, treatment, interventions such as pulmonary rehabilitation, oxygen therapy, palliative care, self-management plans and home health care which is referred to hospital at home in this study. The top ten reasons for readmission included: respiratory failure, pneumonia, congestive heart failure, asthma, septicemia, cardiac dysrhythmias, fluid and electrolyte disorders, intestinal infection and non-specific chest pain (Wong and Wilkinson, 2020).

Kong and Wilkinson (2019) investigated models predicting readmissions for exacerbations of COPD. Five different models were reviewed including: Age, dyspnea, airflow obstruction (ADO); body mass index, airflow obstruction, dyspnea, exacerbation (BODEX); dyspnea, obstruction, smoking, exacerbation (DOSE); length of hospital stay, acuity of admission, comorbidities, emergency department use (LACE); and previous admissions, extended Medical Research Council dyspnea score, age, right sided heart failure, left-sided heart failure (PEARL). Kong and Wilkinson (2019) wanted to understand the mechanisms that heighten the risk of having an exacerbation of COPD. These models helped stratify the highest risk groups for target treatment (Kong & Wilkinson, 2019).

Biomarkers are needed to detect disease activity and severity to guide clinical care and prognosis. The PEARL scoring index was proven to be easily applied and an effective diagnostic aid to stratify the risk for readmissions of COPD patients. The PEARL scoring index was superior to the ADO, BODEX, LACE, and DOSE (Kong & Wilkinson, 2019).

Sickler, Wang, Chawla, and Nigam, 2015 examined risk factors in predicting readmissions in COPD patients. The study was done to determine any clinical, socio-demographic factors and member character level factors associated with hospital readmissions in COPD patients. They also wanted to identify those patients at high risk for two or more hospital readmissions within six months after discharge. The study evaluated two years of patients with an index admission for a COPD-related condition in Southeastern Pennsylvania. COPD patients were identified using clinical diagnosis as defined by the Centers for Medicare and Medicaid Services. According to the Centers for Medicare and Medicaid Services, COPD is "an umbrella term used to describe progressive lung diseases including emphysema, chronic bronchitis, and non-reversible asthma. COPD is characterized by a chronic cough, increasing breathlessness, and wheezing. It is associated with increased morbidity and mortality" (Centers for Medicare & Medicaid Services, 2019). Readmission was defined as: "two or more all-cause hospital admissions within six months after the index admission" (Centers for Medicare & Medicaid Services, 2019). Of the 7,206 patients, 7.7% had two or more readmissions in 90 days and found that the following were predictors of readmission: home oxygen use, B-type natriuretic peptide test, quinolone antibiotic use, and patient education level. The highest predictive variables were emergency room (ER) visits, cellulitis, myocardial

infarction, renal disease, diabetes, and low education level. This study identified what factors improved their ability to identify COPD patients at the highest risk for readmissions. Outreach programs were developed to prevent future readmissions (Sickler et al., 2015).

Many factors have been shown to affect the 30-day COPD readmissions, and some hospitals have shown success in reducing their rates by applying these factors. Because of the penalties for excessive readmission, this can negatively impact the hospital's revenue if operating on a narrow profit margin. According to a comparison of the healthcare industry statistics, 2,573 hospitals in the fiscal year 2018 were penalized due to the Diagnostic Related Group (DRG) reimbursement system (Pruitt, 2018).

As mentioned previously, having different ICD codes using DRG code used for COPD is 088 and, in the ICD-9 codes, the codes used for COPD are 491, 492, and 494. "ICD-10 codes related to COPD include J40 (bronchitis not specified as acute or chronic), J41 (chronic bronchitis), J42 (Unspecified bronchitis), J43 (Emphysema), and J44 (Other chronic obstructive pulmonary disease)". There are charts that define the links between ICD-9 and ICD-10 codes. When a hospital has different codes associated with COPD, it can be difficult to interpret how different strategies can lead to improvement (Pruitt, 2018).

A comparison of the number of comorbidities and readmissions was completed. It was identified that comorbid conditions associated with readmissions were cardiovascular disease, lung cancer, metabolic syndrome, osteoporosis, skeletal muscle dysfunction, anxiety, and depression (Global Initiative for Chronic Obstructive Lung Disease, 2019). Risk factors identified for 30-day readmissions were heart disease, male

sex, depression, socioeconomic status, living in a nursing home, anemia, hyponatremia, elevated PCO_2, having a prior hospitalization, a longer length of stay (LOS), being on oxygen therapy long term, low serum magnesium, and elevated C-reactive protein (Global Initiative for Chronic Obstructive Lung Disease, 2019). New identifiable factors are sleep apnea, electrolyte imbalance, acid/base disorders, vertebral fractures, low health literacy, and substance abuse issues. Because there is no consistent set of guidelines that help with the diagnosis and treatment of COPD it is difficult to have consistent study results (Global Initiative for Chronic Obstructive Lung Disease, 2019).

There are an estimated 50 to 70 million Americans that have some sleep disturbance (CDC, 2020). Males have a prevalence of 10% to 17%, and women have a prevalence of 3% to 9% for obstructive sleep apnea (Global Initiative for Chronic Obstructive Lung Disease, 2019). Studies show that 82% to 93% of individuals with moderate to severe sleep apnea are not aware that they have the condition, and it remains heavily underdiagnosed (Foldvary-Schaefer, 2019). Patients may not be aware of their condition since they may have a controlled environment (Eagan, Knutson, Pereira &Von Schantz, 2016). Sardar, Sufyan & Javed, 2019, reflected on the fact that there is a high cost to the test, unavailability of appointments and lack of public awareness of the disease. Kapur et al., 2017 suggested the following guidelines to patient that have COPD with sleep disturbances; the recommendation is very strong to have a home sleep apnea test especially if a patient has cardiorespiratory disease, respiratory muscle weakness, hypoventilation, chronic opioid medication use, history of stroke or insomnia with patients that have COPD (Kapur et al., 2017).

Some programs were developed to reduce readmissions with COPD patients. Better Outcomes through Optimizing Safe Transitions (BOOST), Project Re-Engineering Discharge (Project RED), Care Transitions Intervention, and the Transitional Care Model (Hansen et al., 2013). These programs help promote adherence to practice guidelines, patient medication adherence, self-management practices for patients, phone calls within 24 hours to patient's post-discharge to assess how they are doing with their care plan and to check on symptoms and referrals to see if ambulatory programs have been completed. Unfortunately, the programs did not address issues with proper use of inhalers, supplemental oxygen, and pulmonary rehabilitation (Hansen et al., 2013).

Simmering et al. 2016, evaluated COPD patients with the highest risk of readmissions. Many hospitals use COPD hospitalizations as a performance measure of COPD care. The Healthcare Cost Utilization Project State Inpatient Database was used for the years 2005 to 2011 to examine the risk factors for readmissions without age or insurance restrictions. The data set included 17,918,374 patients from 480 hospitals accounting for 28,265,070 visits. The patients were identified as having a primary diagnosis of COPD aged $\geq$ 40 years of age and alive at discharge. The study findings indicated that younger patients aged 40 – 60 years old were more likely to be readmitted and when there was a winter spike in weather, especially in January (Simmering et al., 2016).

Home health care was the highest discharge status, and the highest comorbidities were congestive heart failure, hypertension, diabetes, electrolyte disorders, and anemia. It was also found that people with conventional insurance are less likely to be readmitted. Other factors were related to socioeconomic factors and comorbidities (Simmering et al.,

2016). Patients who were assigned home health care or that left against medical advice were more likely to be readmitted in 30 days than those discharged to home with self-care or a skilled nursing facility. It was also noted that they would be less likely to be readmitted for those discharged and provided home health services if they had a longer length of stay during their first admission. It was suggested that extra efforts should be made to refer patients to pulmonary rehabilitation for symptom improvement. Specific limitations to the study did not record the patient's current smoking status, access to specific laboratory results and imaging, and pulmonary function testing which would give COPD staging and medication use (Simmering et al., 2016).

Press, Konetzka and White, 2018 did a study on the economic impact of COPD readmissions and the implementation of the Hospital Readmission Reduction Program (HRRP). Press et al., 2018 identified that younger patients on public insurance are at a higher risk for readmissions and supported the results of Simmerling et al., 2016. This study identified factors that may place patients at a higher risk for readmissions and whether or not intervention costs are outweighed by the financial impact of HRRP. There have been variable findings on interventions and cost savings but cost analysis was not provided (Press et al., 2018).

Rinne et al., 2017, examined the association between COPD readmission rates, hospital characteristics and hospital quality. The study included 3,705 hospitals nationwide that had publicly reported data on COPD readmissions. COPD was compared with other conditions such as pneumonia, heart failure, myocardial infarction, stroke, CABG surgery, and hip/knee surgery. Data was also evaluated on the patient experience while in the hospital including factors of effective communication with doctors/nurses,

responsiveness to needs, pain management, communication about medication, hospital cleanliness, hospital quietness, provided discharge information, care transitions to home or a facility, the overall hospital rating and whether the patient would recommend the hospital to a friend or family member. Other factors evaluated were teaching status, ownership, and safety net status. The lowest readmission hospitals were compared with the highest readmission hospitals. It was found that the following variables were consistent in the highest readmission hospitals, which included they were teaching hospitals, private for-profit hospitals, and safety net hospitals (provide comprehensive services to medically and socially vulnerable populations). The highest readmission rate with patient experience was low scores on communication with nurses and doctors, responsiveness, and pain management. More than 70% of readmissions were found to be due to conditions other than COPD (Rinne et al., 2017).

According to the 2017 report on the Global Initiative for Obstructive Lung Disease (GOLD), the most common comorbid conditions include cardiovascular disease, skeletal muscle dysfunction, metabolic syndrome, osteoporosis, depression, anxiety, and lung cancer (Global Initiative for Chronic Obstructive Lung Disease, 2019). Categorically, COPD affects minorities and those with low socioeconomic status. The hospitals such as small urban community hospitals, primarily teaching hospitals that care for the underserved, will have higher readmission rates and more penalties through CMS (Brahman, 2015). The factors associated with Medicaid insurance include low income, lack of social support, unstable home environment, being unmarried, smoking, cocaine use, low health literacy, poor nutrition, lack of follow-up with a primary care doctor, and medication compliance (Calvillo-King et al., 2013).

Hospital Discharge and Readmission

Discharging patients from the hospital can be a complex process that presents many challenges. Unplanned readmissions cost hospitals 15 to 20 billion dollars annually (Alper, O'Malley, & Greenwald, 2019). Finding ways to improve the quality of life for patients and finding ways to improve the financial well-being of health care systems has become difficult. Various approaches have been researched to improve the discharge process, including pre-discharge interventions providing patient education, pre-discharge planning, medication reconciliation and education, the scheduling of follow-up appointments before leaving the hospital and completing post-discharge interventions (follow-up phone calls, communication with the care provider, and home visits), merging interventions with transition coaches, discharge specialists, and providing clinician continuity between the inpatient and outpatient settings (Alper, O'Malley, & Greenwald, 2019).

The continuation of hospitalization is determined by an acute health condition. The degree of severity that diagnostic testing, interventions, and monitoring have determined is necessary. Patients are sometimes kept in the hospital because of not having a suitable alternative setting to provide care. Some patients are discharged prematurely or to a living environment that is not appropriate for their needs, and hospital readmission recurs. An early patient discharge does not lead to cost savings for the hospital, especially when it results in hospital readmission (Kripalani, Theobald, Anctil & Vasilevskis, 2014).

When a patient has been recommended for discharge, the most appropriate setting that would benefit patient needs is determined. Some post-discharge care setting

determinants involve the medical, operational, and social aspects of the patient's illness. The patient's health history, the potential for rehabilitation, and the ability to make decisions must be determined. People involved in the decision include the patient, healthcare POA, the family, social worker, case manager, physician, physical and occupational therapist, and the insurance company. The following factors need to be considered: patient's cognitive status, activity level, and functional status, the patient's home, considering the presence of stairways and cleanliness, family support, ability to follow instructions with medications, transportation to and from follow-up visit and testing, and the availability of services in the local area to assist the patient with follow-up care (Kripalani et al., 2014).

Approximately 75% of patients hospitalized can return to their homes post-discharge. Patients and their family or caregivers should obtain and administer medications, perform self-care activities, eat a nutritional diet, and follow up with physicians. Suppose patients may need non-acute medical care to manage their home health need. In that case, a patient may be discharged to another care facility prior arrangement to an inpatient facility must be arranged for ongoing care through the facility and insurance company. Determining the most appropriate care setting requires matching the needs with the patient's diagnosis (Kripalani et al.,2014).

Medicare identifies three health facilities: acute care hospitals, long-term acute care hospitals (LTACs), and skilled nursing facilities (SNFs). For purposes of this study, LTAC and SNF will be described. Long-term acute care hospitals must maintain a length of stay of 25 days or greater. Patients must require daily monitoring and complex medical interventions such as complex wounds, chest tubes, ventilatory devices, and have

multi-organ failure. The number of LTAC facilities has more than doubled since the late '90s. A skilled nursing facility has more of a facility that is comparable to a hospital. Patients must have a qualifying event that includes a 3-night hospital stay and must require nursing or rehabilitation for one hour five days a week. In addition, home-based services or home health care is a highly variable service. Home-based services can be provided by Medicare-certified home health care agencies, private duty nursing services, infusion services, hospice, clinician home visit programs, and telemedicine (Kripalani et al., 2014).

The impact of discharge planning on outcomes is minimal. In 2010, Sheppard et al. did a review of patient satisfaction, length of stay, and readmission with different modes of discharge planning. It was observed that there was an increase in patient satisfaction while the length of stay and mortality rates were unchanged (Sheppard et al., 2010). Jha, Orav, & Epstein 2009, examined discharge planning for patients with heart failure measuring the chart documentation of discharge instructions and patient reports on discharge planning. There was no correlation found between readmission rates and the chart-based measure, and there was an extremely low correlation for lower readmission rates (Jha, Orav & Sheppard, 2009).

Post Discharge Care

In an ideal health care system, the patients that are discharged would get the needed appropriate care in their community. Readmissions can be avoidable after hospital discharge. With better clinical management, stabilizing the patient before discharge, having adequate outpatient care after discharge, appropriate discharge planning, education, and providing resources at home that meet the patients' needs can help with

management of their disease. The dietary and medication non-compliance of patients and the failure to seek prompt medical attention from their primary care physician when symptoms occur are all factors in being readmitted back to the hospital. It was addressed in Yam et al., 2010 that it is essential to have a consistent methodology/instrument with valid criteria that can be applied in context to determine the plan of care and how readmissions can be avoidable (Yam et al., 2010).

Yam et al. (2010) studied 603 patients performing an evaluation of patient characteristics, clinical data, physical and cognitive function, and discharge information. The average age was 74.8 years of age; 53.2% were male and spent an average of 9 days in the hospital during their index admission and seven drugs during discharge. Sixty-five percent were discharged home, and 69% had to follow up at clinics with a specialist, 8% at a general clinic, and 17.4% at sub-acute care clinics. A total of 38.6% walked independently, and 33% walked with support. A total of 56.8% were readmitted, the principal diagnosis at readmission included: ill-defined condition 15.4%, chronic obstructive pulmonary disease 12.3%, pneumonia 11.3%, heart failure 6.8%, ischemic heart disease 4.6%, cancer 3.2%, renal failure 3.0%, cardiovascular disease 2.0% and diabetes 1.5%. Thirty-two-point-eight percent had the same principal diagnosis in the previous discharge. The avoidable readmissions were 246/603. The factors identified in how it was considered due to clinician factor (42.3%), low threshold for admission (10.6%), premature discharge (9.3%), and medication-related event (7.7%), poor discharge planning (14.6%), and inadequate terminal care (4.1%). The study results gave insight into developing a discharge planning system (Yam et al., 2010).

The five main contributors identified in gaps in care transition include poor preparation for discharge, patients with low health literacy and comprehension, failure, or inability of patients to see physicians for follow-up after release, lack of hospital follow-up, and lack of communication between inpatient and outpatient providers. Preparation for patients to leave the hospital is inadequate. Many hospitals are characterized by fragmented, non-standardized, and haphazard care. Nurses and first-year residents are often placed in consideration of a patient discharge. Discharge is of low priority when many other duties may have importance, especially when staffing is inadequate due to hospitals controlling for cost. There are no clear lines of authority in the discharge process. This sets up the individual to fail and creates a dangerous situation for the patient (Naylor & Keating, 2008).

It has been said that nearly 90 million Americans have low functional health literacy. Patients have difficulty reading and understanding medical instructions, medical labels, appointment slips, and getting patients to understand what is required after discharge is difficult. Most patients do not understand their diagnosis, their treatment, home care instructions, or warning signs to call their physician or go to the hospital. At the time of discharge, residents or nurses may rush through education, and the patient may not ask questions. Most of the time, the caregiver needs to receive the instructions (Naylor & Keating, 2008).

Kripalani et al. (2007), describe the deficits in communication and information transfer between hospitals and primary care physicians for the continuity of care. Direct contact between the hospital and primary care physicians (PCP's) only happens in 20% of cases. Only 12-34% of PCP's receive a patient's hospital discharge summary.

Approximately 40% of patients have pending test results at the time of discharge, and 10% may require following up with a specialist according to the test results. When a patient hospital summary is not forwarded to the PCP, they may not know the hospital visit details and go by assumption because patients are often poor historians (Kripalani et al., 2007).

The fundamental changes mentioned in the literature are developing an assessment of the patient's post-discharge needs, including effective teaching and learning by patients and caregivers, improved communication with the PCP, and assurance of hospital follow-up. The Naylor Transitional Care Model suggests care coordination by a transitional care nurse, which reduced hospital costs by 39 percent and the number of readmissions by 36 percent (Kripalani et al., 2007).

Alper et al., 2021 completed a literature review on hospital discharge and readmissions. It was found that not all care alternatives can meet a patient's needs or insurance may deny the intended referral. For example, if a patient is referred to a SNF and their insurance company denies the claim, the patient would then be referred to HHC. Some factors that may influence readmissions while being discharged to home or while HHC is active is the inability of the patient to self-administer medications, not being able to complete activities of daily living, not having a nutritional diet, and lack of follow-up visits after a hospital stay (Alper et al., 2021).

Yam et al., 2010 found actors in those patients that readmit from HHC may include a decreased length of stay to avoid Medicare penalties. A patient that is discharged to home health care may have some advantages due to the fact that a nurse goes to their home to help the patient with their care and to help them get stronger (Jha,

Orav, & Epstein 2009). The downside is that patients are not able to get out of the house without significant difficulty, and patients are isolated (Kripalani, Theobald, Anctil & Vasilevskis, 2014).

The consequence of the patient not being able to follow their discharge plan such as receiving duplicate medications they have at home, having a different name, not filling their medications immediately following discharge, having tests pending at discharge that were never reviewed or documented in the discharge plan, poor information transfer from hospital providers to patient or caregiver, lack of follow-up care, some readmissions are obviously unavoidable due to underlying conditions exacerbating their COPD (Naylor & Keating, 2008).

Many patients that are admitted to SUCH may wait until the very last minute to go to the emergency room when having symptoms of cough, sputum, and tiredness upon exertion, so these patients tend to be sicker when evaluated versus going to their primary care physician when there is an initial onset of symptoms (Quach et al., 2012). In turn, these patients are entirely bedridden during their hospital stay and refuse physical therapy and getting out of bed when requested to, so patients become deconditioned quickly (Fried, Frangoso, & Rabow, 2012). Therefore, there may not be an appropriate full evaluation of the patient with the patient not receiving enough testing (Fried, Frangoso & Rabow, 2012). The nursing staff may determine that the patient needs continued inpatient services upon discharge to include physical/occupational therapy in the home (HHC) or to a skilled nursing facility (SNF)/long-term care facility (LTAC) (Kelley, Docherty & Brandon, 2013).

Yam et al. (2010) stated that better clinical management, stabilization before discharge, and adequate outpatient care as part of discharge planning could meet the patients' needs according to their evaluation. The use of guidelines and an assessment instrument may give insight to physicians and nurses regarding the total health of the patient and how that patient can communicate their condition(s) (Eikermann et al., 2014). Patients need to communicate to a healthcare worker effectively to increase the reliability and validity of the patient assessment (Eikermann et al., 2014). The physicians and nurses need to understand the patient complaints appropriately to decrease the risk of health issues reoccurring (Kelley, Docherty & Brandon, 2013).

While limited socioeconomic resources contribute to higher readmission rates in a hospital that primarily treats a vulnerable patient population, this study reveals that there may be some gaps in-hospital treatment, discharge, and a discharge care pathway (Hu, Gonsahn & Nerenz, 2014).

Effective Discharge Planning/Transitional Care

Transitional care refers to collecting services to provide optimal communication and coordination of services to provide a quality continuum of care for patients (Mularski et al., 2006). Accountability breakdowns occur when there is no coordination of the patient's care across various settings, mainly from hospital to home. With more complex patients, specialists may not communicate effectively with the patient and their caregivers. There is a need for care models in pre-discharge and post-discharge periods that increase the patients best care (Mularski et al., 2006).

Prieto-Centurion et al., 2014 completed five trials in six countries with a total of 1,393 participants. Readmissions were evaluated at 6 and 12 months. Each trial evaluated

up to 11 interventions used as a treatment bundle during the pre-discharge and post-discharge periods. Each of the five trials included patient education, which had instruction on the use of respiratory inhalers, the development of an action plan if symptoms worsen, and patients were given a number to call after discharge if symptoms persisted. Other interventions included discharge planning, patient education about COPD, health counseling, smoking cessation, assessments for comorbidities, referrals to pulmonary rehabilitation, and social services (Prieto-Centurion et al., 2014).

There was a significant drop in COPD readmissions at six months and more noticeably at 12 months. However, there was no statistical significance that supported a reduction in 30-day readmissions. The most effective interventions in the study were the follow-up telephone call and the patient hotline. There is a suggested need for an interprofessional care model to implement intervention bundles before and after discharge (Prieto-Centurion et al., 2014).

Initiatives that improve inpatient quality without making improvements in ambulatory care could unexpectantly increase hospital readmissions. Some factors are not modifiable with underserved patients, such as income, insurance, and coexisting conditions such as mental issues. The HRRP program penalizes the hospital for 30-day readmissions. In 2013, CMS developed a physician payment rule that incentivized ambulatory care providers to participate in transitional care management (TCM). For a physician to bill for these payments, they must provide three critical services, including contacting a patient within two days of hospital discharge, they must have a face-to-face visit with the patient from 7 to 14 days of discharge, and they must provide indicated care coordinated services during the 30 days after discharge. The TCM codes are not restricted

to any disease but used only for discharged patients to home. It was determined that the TCM codes could improve patient experience and improve health outcomes (Kangovi & Grande, 2014).

De Regge et al., 2003, completed a systematic literature review investigating how hospitals can bridge the care continuum. People today suffer from chronic diseases that can negatively impact their daily lives. The coordination of care requires long-term planning with many different healthcare professionals. The coordination is involved with the hospital, primary care provider, and community-based services. Hospitals need to work closely with community partners to avoid hospital readmissions. Hospitals need to shift from an acute care model to more of a chronic care model. Health policy has determined the reduction of length of care for a patient that has a long-term condition. Chronic illness management in an acute care environment is essential to managing COPD (De Regge et al., 2003).

Within the literature review, there was a comparison of outpatient care versus home-based care. De Regge et al., (2003), stated that caring for patients in their homes was more expensive and less effective. It was also found that the incidence of readmissions was higher when there is a shorter length of stay in COPD patients. This study supports case managers and patient care team's necessity in the intervention of those with chronic illness in an acute care facility (De Regge et al., 2003).

Prevention and Maintenance

Beyond the interventions mentioned throughout this study, some of the key issues in prevention are smoking cessation, annual influenza vaccination, and pneumococcal vaccination for all patients over the age of 65. Other management plans include proper

pharmacologic therapies with an emphasis on appropriate inhaler selection and inhaler technique. Rehab, education, and self-management are all essential to monitor the symptoms of patients and monitor airflow limitation. It is necessary to contact the patient to modify the care plan to uncover complications and other symptoms that may develop (Rinne et al., 2017).

Smoking Cessation

Smoking cessation is key to maintenance therapy when managing COPD. Pharmacotherapy and nicotine replacement increase the chances of successfully abstaining from the smoking habit. The effectiveness of e-cigarettes and using vape methods is unknown, along with the long-term effects of these modalities for quitting. Legislative smoking bans have effectively increased quit rates and reduced the harm to others with secondhand smoke. Nicotine replacement therapy (nicotine gum, inhaler, nasal spray, patch, tablets, or lozenge) increases long-term abstinence rates.

Counseling delivered by clinicians or healthcare professionals can significantly increase quit rates over self-directed strategies (United States Public Health Service, 2008).

Vaccinations

Having a patient get an influenza vaccination can reduce serious illnesses such as lower respiratory tract infections in COPD patients (Alfageme et al., 2006). Very few studies have evaluated the incidence of exacerbations after influenza vaccination as they have become beneficial for elderly patients. It has been demonstrated that the pneumococcal vaccine that was identified in 12 randomized studies provided significant

protection against community-acquired pneumonia. Vaccinations were found to significantly reduce the likelihood of a COPD exacerbation (Alfageme et al., 2006).

Pharmacologic Therapy

Pharmacologic therapy is used to reduce the symptoms of COPD patients, the frequency and severity of exacerbations, and they also improve health status and the ability to exercise. There are several classes of medications that are used to treat COPD. Choices are based on the availability and cost of the medication as well as clinical effects. Bronchodilators will increase the patient's FEV_1 and can change spirometry values. They alter the smooth muscle tone of the airway, also widening the airway. They tend to reduce dynamic hyperinflation and improve exercise performance. Long-acting bronchodilators given by a nebulizer appear to provide the most benefit in patients (Montuschi, 2006).

Beta2-agonists are prescribed. This will relax the smooth muscle in the airway by stimulating the beta2-adrenergic receptors. Short-acting (SABA) lasts 4-6 hours, and long-acting beta2-adrenergic (LABA) lasts up to 12 hours. Beta2-adrenergic can produce resting sinus tachycardia and cause cardiac rhythm disturbances. Hypokalemia can occur when treatment combines with thiazide diuretics (Montuschi, 2006).

Antimuscarinic drugs block the bronchoconstrictor effects of acetylcholine on the muscarinic receptors in the airways smooth muscle. It is found through a review of clinical trials that a short-acting muscarinic antagonist (SAMAs) such as Ipratropium provides substantial benefits in terms of lung function, health status, and the need for oral steroids. Long-acting muscarinic antagonists (LAMAs) work and SAMA's but have also been identified to reduce exacerbations and improve the effectiveness of pulmonary

rehabilitation. The SAMAs and LAMAs are considered anticholinergics. The main side effect is dry mouth. Combinations of Beta2-Agonists and SAMAs, and LAMAs are often prescribed (Montuschi, 2006).

Methylxanthines such as theophylline are used, which are metabolized by cytochrome mixed-function oxidases. This medication enhances inspiratory muscle function. Toxicity can be the most significant issue with methylxanthines because the effects are often established with higher doses. Atrial and ventricular arrhythmias have been noted as a problem with this medication. The most popular medicines distributed to patients during their hospital stay at SUCH are Ventolin (SABA), Symbicort (LABA), and Atrovent (SAMA). A combination of Albuterol Sulfate and Ipratropium Bromide may be used and the addition of Symbicort (Montuschi, 2006).

Inhaled corticosteroids (ICS) suggest that COPD-associated inflammation has a small response to corticosteroids. The safety of patients using ICS with COPD is unclear. With just the treatment of ICS, it does not modify the FEV_1 long term. In patients with severe COPD, an ICS with a LABA is the most effective in improving lung function, health status and reducing the number of exacerbations. When using an inhaler treatment, education and training in inhaler device technique are critical. Many studies have identified a significant relationship between low inhaler use and symptom control in patients with COPD (Montuschi, 2006).

Rehabilitation, Education, and Self-Management

Linking health care professionals such as exercise physiologists, respiratory therapists, nurses, dieticians, pharmacists, and physicians have demonstrated improved outcomes (Derdak, 2017). Other examples of self-management include Facetime, Skype,

tablet, or smartphone-based applications using digital diaries for symptom tracking, pulse oximetry, peak expiratory flow, and inspiratory capacity monitoring (Derdak, 2017).

Silver, 2017 investigated 428 subjects with a high risk of readmission to compare pre-discharge care versus comprehensive respiratory therapy disease management. The study was restricted to subjects $\geq$ 65 years old with prespecified risk factors for COPD readmissions: previous emergency department visits, hospitalizations, systemic corticosteroids within the last year, and supplemental home oxygen. The respiratory therapist incorporated pre-discharge subject education, including proper inhaler and medication use, patient follow-up clinic appointments, pulmonary rehabilitation, smoking cessation education, and structured phone calls from the respiratory therapist. The key findings indicated that those receiving comprehensive respiratory therapy disease management experienced significantly fewer readmissions, shorter hospital stays, and fewer ICU visits following discharge. This was a very low-cost program applied to a diverse population of subjects (Silver, 2017).

Critical non-pharmacologic approaches include case management, patient education with written action plans, smoking cessation, and pulmonary rehabilitation (PR). Pulmonary rehabilitation should ideally start within 30 days of discharge from the hospital. Despite the documented benefits of exercise and the reduction in shortness of breath, enhanced physical endurance, patients were not using pulmonary rehabilitation, which created a gap in their quality of health care. Most patients are not referred, yet it is proven to improve life, depression, self-efficacy, and exercise activity. Pulmonary rehabilitation reduces dyspnea, muscle fatigue, anxiety, and panic (Johnston & Grimmer-Sommers, 2010).

CHAPTER III

METHODS

Study Design

A retrospective descriptive research design was chosen for data collection at a small urban community hospital (SUCH) in Cleveland, Ohio. With this type of investigation, the phenomena existing in the present are linked to other events in the past before the study was initiated. The goal of this study is to determine the association between post-discharge care settings (home with self-care, home with home healthcare, skilled nursing facility, and long-term care hospital) and 30-day readmission rates of chronic obstructive pulmonary disease (COPD) patients and to identify the covariates (patient characteristics) that are shown by severity to have the most influence between those that readmit and those that do not readmit. If there is statistical significance between post-discharge care settings (HSC, HHC, LTAC & SNF) a further evaluation of variables will be performed. The independent variable is post-discharge care setting, and the dependent variable is 30-day readmission.

If differences in readmission rates are observed, patient characteristics (covariates will be evaluated in an attempt to discern unique patient characteristics with the patients that readmit the most at SUCH. Further this result will potentially provide the basis of

establishing a clinical care pathway to recommend the care settings to patients where they may have the greatest likelihood of avoiding 30-day readmissions.

Research Variables

Dependent Variable – Readmissions within 30 days of initial discharge.

Independent Variables – Post-discharge care settings (Discharge to home, home with home healthcare, skilled nursing facility, long term care hospitals, and covariates/groups of covariates.

Hypothesis/Research Questions:

RQ1: Is there a significant difference in 30-day readmission rates for the post-discharge care settings (discharge to home with self-care, home with home health care, skilled nursing facility, and long-term care facility) in patients with COPD?

H_{a1}: There will be significant differences in patients who get discharged to different post-discharge care settings (HSC, HHC, SNF and LTAC) who get readmitted within 30 days after index admission with COPD versus those who do not get readmitted back to the hospital within 30 days of their indexed admission with COPD.

RQ2: Is there a significant difference in patient characteristics (covariates) between those patients that get readmitted and those patients that do not get readmitted?

H_{a2}: There will be significant differences in the characteristics (covariates) of patients who get readmitted back to the hospital within 30 days of their indexed admission and those that do not get readmitted with COPD.

Participants

Participants were retrospectively recruited from SUCH, a 205-bed not-for-profit hospital in Cleveland, Ohio, by searching for patients with COPD as the primary diagnosis. The 30-day readmissions were also identified as having a diagnosis upon their return to SUCH for COPD within 30-days of discharge. A SUCH is a teaching hospital that is affiliated with but not attached with other medical schools and universities in and around Northeast Ohio. The participants in this study all had COPD listed as a primary diagnosis in their history and physical record documentation as identified by the clinical documentation improvement department (CDI) and through a processed insurance claim by Medicare, Medicaid, and conventional insurance. Data was only collected on subjects over 18 years of age with COPD as the primary diagnosis.

Inclusion/Exclusion Criteria

Inclusion: Adults aged 18 years or older with the primary diagnosis of COPD**.** Not limited to time, demographics, testing, symptoms, risk factors, comorbidities, diagnostic group, or post-discharge care setting

Exclusion: Any patient that does not have the primary diagnosis of COPD or that expired during the post-discharge time period.

Sample Selection

Figure 3.1 displays the process to identify the patient sample, which included the selection criteria by which each patient was initially identified, what constituted a readmission to be included in the evaluation of post-discharge care, and the readmission criteria. Patients were selected from medical records based on the primary diagnosis of COPD. CMS presented the COPD diagnosis's determination in May 2019 to include the

diagnoses under ICD-9 and ICD-10 codes specifically (Centers of Medicaid/Medicare Services, 2019). The count of COPD patients was identified by the following statement, "Count of acute care inpatients (elective or nonelective) with a principal diagnosis of chronic obstructive pulmonary disease, or principal diagnosis of respiratory failure and a secondary diagnosis of chronic obstructive pulmonary disease (index population)."

The number of patients in the sample size from SUCH from July 1, 2014, to July 1, 2019, with a confirmed diagnosis identified by a processed insurance claim of a primary COPD diagnosis (n = 1,016 patients). The total number of patients that were readmitted back to SUCH with any diagnosis n = 1,996. The total patients diagnosed with COPD that were readmitted within 30 days of the patients indexed admission n =155. This sample was verified by including the diagnoses provided by CMS guidelines, and then each patient was individually pulled from all readmit sample through excel filter options. The total number of patients expired within their indexed admission time frame, and 30 days totaled eight patients. Descriptive statistics are provided for the 30-day readmission sample. All patients included in the sample were admitted to SUCH and readmitted back to SUCH within 30-days of their indexed admission with a COPD diagnosis. Patients admitted to another hospital and readmitted back to SUCH within 30 days or admitted to a hospital other than SUCH and readmitted back to SUCH within 30 days of their index admission were not included in the sample. All patients included in the sample were older than 18 years of age. There was not an exclusion criterion given to the readmission admitting source. Patients may have been admitted within 30-days from home, another emergency department, SNF, healthcare facility, psych ED, physician's office, or an acute care hospital.

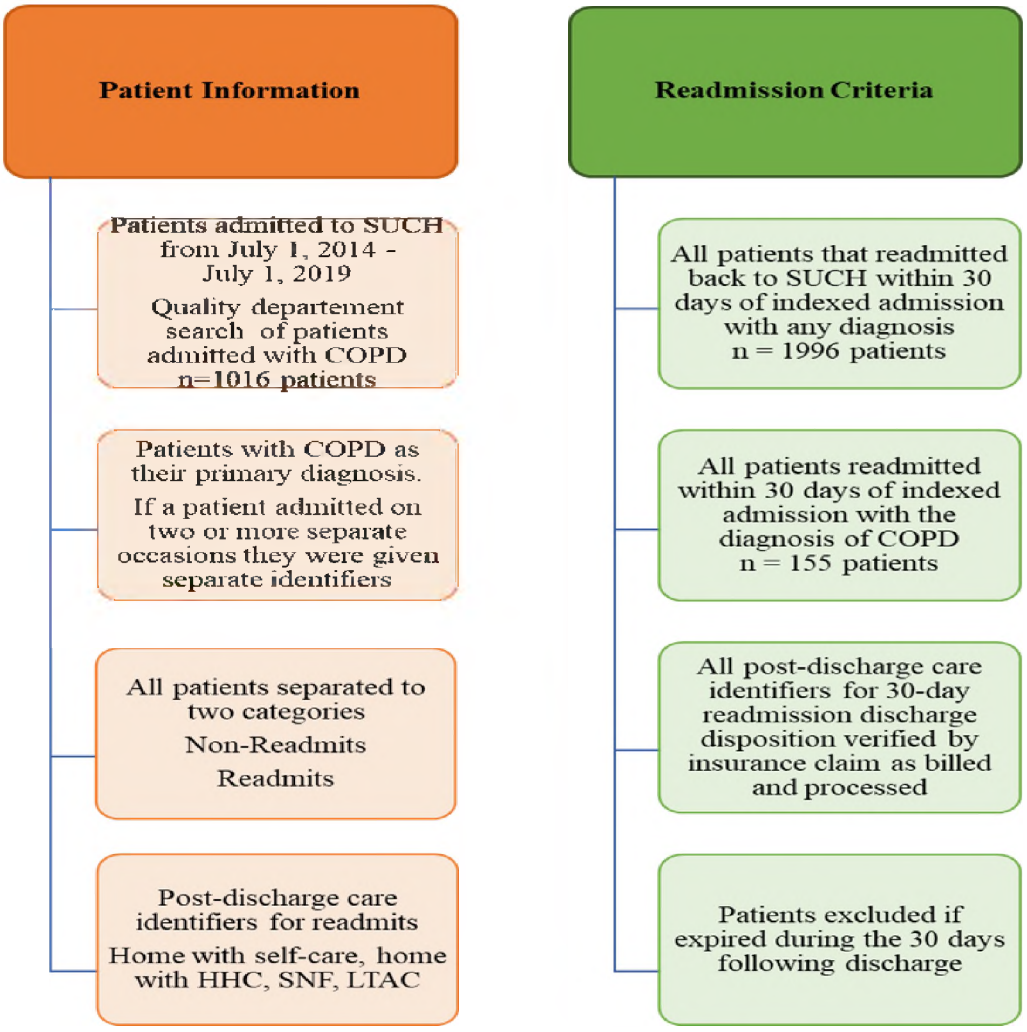

Figure 3.1 **Process to Identify Patients and Readmissions**

To represent the adult patient population of SUCH with a primary diagnosis of COPD, convenience sampling of patients was selected. Subjects for this study were extracted from patient data using the electronic medical record (EMR) system at the small urban community hospital. The sample size was determined after the search was performed using the primary diagnosis of COPD by the electronic medical records (EMR) between July 1, 2014, and July 1, 2019. Data were obtained from the SUCH EMR databases, and the patient lists were then forwarded from the CDI department for analysis. To determine the 30-day readmission group, the patients were identified as

having been readmitted to the hospital within 30 days with a readmission diagnosis of COPD. To verify the patient list was accurate, a request was made for all patients that were readmitted back to the hospital within 30-days of their indexed admission. From there, Excel was used to filter out the COPD categories, and the names were pulled and verified to the original list provided by the clinical documentation improvement department.

Three lists were created, all patients with COPD as their primary diagnosis, patients who readmitted back to the hospital within 30-days with a COPD diagnosis, and those who did not readmit back to the hospital within 30-days with a COPD diagnosis. From each list, all post-discharge settings were then put into separate categories to be analyzed by characteristics. The post-discharge categories were home with self-care, home with home health care, long-term care facilities, and skilled nursing facilities. A comparison chart was then made to evaluate the total sample of individuals with a COPD diagnosis, a total sample of individuals with COPD diagnosis that readmitted back to SUCH within 30-days, the total sample of individuals with a COPD diagnosis that did not readmit back to the hospital within 30 days and a chart for comparison of each post-discharge category that readmitted back to SUCH within 30-days of their indexed admission.

The purpose was to capture the process and identification of the patient/procedures related to the patient and how decisions were made according to the disease severity and the choice of post-discharge care and 30-day readmissions.

The patients' index admission diagnosis was again verified through a retrospective analysis of a secondary medical record utilizing Meditech (Meditech

Information Technology, Inc., 2019). Meditech is the hospital database used with all initial patient documentation with intake, admission, patient stay, and discharge.

Each patient history was reviewed for diagnoses, hospitalizations, symptoms, readmissions, tests, procedures performed, and emergency department visits. The specific characteristics of the patients were identified in the demographics data to include age, gender, race, living arrangements (marital status), insurance, number of diagnoses, and zip code from which the patient lives, length of stay, number of diagnoses, discharge location and physician specialty upon discharge. A chart for analysis of each category was then created.

Because the study is a retrospective analysis, participant consent was not obtained. A Small Urban Community Hospital Institutional Review Board Request for Waiver of Informed and Authorization for Research form filed with IRB. The data was for a retroactive study on discharged patients from SUCH. This research presented no greater than minimal risk for patients and their medical records. There were no incentives or compensation provided during this study.

An application requesting permission to conduct this study was submitted to a small urban community hospital Institutional Review Board and Cleveland State University Institutional Review Board. Permission to conduct this research was approved through the Institutional Review Board at the small urban community hospital and Cleveland State University. The memorandum for each has been enclosed as an Appendix B and D. An application requesting permission to conduct this study as part of the fulfillment of the doctoral requirement was submitted to Cleveland State University Institutional Review Board. Approval was granted on March 21, 2019 Appendix D.

An addendum was completed to add selection years, and another application was completed to extend the study deadline Appendix C.

Data Collection

The clinical record/chart review included the following data sources: case notes, inpatient case files, nursing records, pharmacy records, laboratory records, patient monitor records, clinical information, and demographic records. The independent variables/covariates were chosen based on literature reviews and the operationalization of those variables in a variety of studies.

The data collection used medical information without the written permission of the patient permission was granted by SUCH IRB. There was an adequate plan to protect identifiers for use and disclosure, and the data will not be re-used or disclosed for another purpose. The research for this study could not be possible without the use of the protected health information. The data collection sheet is provided as Appendix G for this study.

The data was to be collected through the development of a coding program through the IT department to extract the data. The data was individually collected based on the history and physical assessment performed in the hospital-based on a COPD diagnosis. An order was sent to the IT department, and it was decided that the data could not be collected to the specifics of each category. As a result, the CDI department was used to collect the data individually for each patient. At that point, the subjective, objective, assessment and plan were reviewed to capture the picture of the patient during admission, throughout their patient stay, and through discharge. A comparison was made with the clinical documentation improvement specialists/coders to provide insight into clinical findings and physician/resident behavior and validate the diagnosis.

An excel spreadsheet for the covariates was prepared to extract all variables determined. An excel sheet was used to populate the patient medical records after the data was processed. Understanding that not all variables would be found within the data compilation, some data will need to be abstracted by hand using computer records to record newly found data.

A logical data extraction form was provided for the covariates' rational organization, as shown in table 3.1. All co-investigators performing data collection were provided with training explanations on how the review was to be done and how the responses will be coded to error in variability. All co-investigators are medical doctors completing their residency at SUCH. Based on the data compilations, a decision tree was created for different coding situations that were foreseen. Standardization was crucial for ensuring that the study is of sound quality. Inter-rater reliability was determined by having different medial residents code the same set of variables. All data collectors were responsible for adhering to federal law concerning patient health information. The study was done on data that has already been recorded involved summarizing the data, subjecting it to the appropriate statistical analysis, drawing inferences based on severity levels, and recording that information appropriately.

The following was reviewed from the patient chart: history of present illness, family/social history, allergies/home medications review of symptoms, physical exam, and the assessment and plan of the patient. A well-designed coding plan was developed to extract the data from the case records. It has been agreed upon as to which variables/covariates are extracted and how the data is to be populated into excel

spreadsheets. A small subsample was to be reassessed to check agreement with the previously coded data to determine the pattern and extent of inaccuracies.

It was essential to recognize that the attempt for the data collection/analysis is to capture the image of what is going on in the hospital in terms of the patient being admitted to the floor, the initial assessment, the care of the patient, the medications administered, the plan of care followed for, the discharge information and the post-discharge care determination. It is also imperative that it was recognized that different individuals might operationalize signs and symptoms: intake specialists, nurse, physician, resident, etc., and documentation will reflect this evaluation according to how it is communicated by the patient and documented by the clinician. To increase the reliability and validity of the variables under investigation, Appendix F will be included for a glossary of definitions of the variables/covariates relevant to this study if needed.

Covariates

Table 3.1 represents the covariate chart risk scale to be used to determine risk with each covariate for each patient with COPD. The chart will be used to evaluate the characteristic, and are presented by a rating scale of 1 = mild, 2 = moderate and 3 = severe for analysis purposes. The covariates were chosen based on the identified characteristics of many research studies investigated and through clinical guidelines used for evaluation of a patient. The evaluation was done for all COPD 30-day readmissions and non-readmissions. The purpose of the covariate's evaluation was to determine whether each characteristic influenced the outcome measure of 30-day readmission. The significance was determined by each variable.

The significant variables were explained by analysis and analyzed according to research and recommendations to provide a guided choice/direction for the Physician's,

Residents, Nurses, and Social Services that could potentially be used to better identify a discharge care choice setting that could benefit the patient the most, and reduce 30-day readmissions. The study's goal was to structure a process for post-discharge care that generates a decision based on meaningful clinical data and research.

Table 3.1 Covariate Chart Risk Scale

Covariates to be investigated in COPD patients that readmitted within 30 days of indexed admission

Patient ID	Covariate	Description	Score 1	Description	Score 2	Description	Score 3
	Age	≤ 60		60 - 80		≥ 80	
	Living Arrangements	Married		Family Support		Lives alone	
	Length of Stay	4 Days or Less		5 Days		6 Days or More	
	Insurance	Private Insurance		Only Medicare		Medicaid	
	Comorbidities	< 3		3 or 4		> 5	
	Home O2	None		2L or 3L		4L or More	
	Previous CAD Disease	None		Stable		Symptomatic	
	Sleep Apnea	None		CPAP		BIPAP	
	Hypertension on Medication	No/Normal		120/80 - 140/90		Above 140/90	
	Diabetes on medication	None		1st FBG < 200 mg/dL		1st FBG > 200 mg/dL	
	Smoking History	None		Quit 5 years +		Current Smoker	
	Sputum	White		Yellow		Green	
	Cough	None		Increased		Severe/Vomit	
	Heart Failure sx on admission	None		On exertion		Orthopnea	
	LABA/ICS Drug combinations	None		PRN		Non-Compliant	
	SaO2 in 1st VS	94% to 100% RA		89% to 93% or Less than 3L		< 89% / > 4L O2 /CPAP	
	Weight Classificaton	Normal/Overweight		Obese		Morbid Obesity	
	Wheezing	None		Expiratory		Constant	
	Severity of Disease	Nasal Canula		4L O2 or CPAP		Requires Intubation	
	Hypoxia/hypoxemia PaO2	80-100 mm Hg		60-80 mm Hg		40-60 mm Hg or below	
	Hypercapnia/hypercarbia	None/Normal		PCO2 > 45		75 mmHg	
	Pulmonary Function Test	Yes		Within 2 years of visit		No	
	FEV 1	Mild - > 80%		Moderate - ≥ 50 - 79%		Severe - 49 or Less	
	Previous Echo	Yes		Within 2 years of visit		No	
	Systolic Heart Failure	Normal EF		≥ 40 - 50 EF		EF < 40	
	Right Ventricular Systolic Pressure	Mild 25 - 40		Moderate 41 - 55		Severe > 55	
	PT/OT During Hosp Stay	None		Active Services		Declined Therapy	
	Adaptive Equipment	None		Walker/Rollator		Wheelchair	
	Exacerbations in the last year	None		One		Several	

Procedure to Protect Privacy and Confidentiality

Initially, the patient data was to be run by the information technology (IT) department at SUCH using the search of COPD for the patients from July 2014-July 2019. It was found with data processing that there were very few pulmonary rehabilitation patients and that a pulmonary rehab patient could fit into more than one

category of post-discharge care, especially if the patient were discharged from another care facility early. This will be considered for a future study. An excel spreadsheet was initially prepared to extract all variables/covariates determined. An excel sheet was to be populated by patient medical records when the data was run. Because of the rating scale developed, the data had to be done by hand with each patient chart for evaluation purposes.

All patient records were viewed on a secure server at the SUCH only to complete all data for the project. Any information obtained during data extraction was only revealed to any researchers listed in this study. The individual patient was identified initially by medical record number and was secondarily identified using a different sequential number to identify the patient. The medical number was then be removed, making the patient de-identified. When the investigator and co-investigators filled in all variable blocks on the spreadsheet, the data was then analyzed. Any patient identification was removed for the analysis of data.

All individuals involved in the study had an active involvement in the analysis of the data information obtained during compilation, and this was done without identifying the medical record number. Data analysis was used for research purposes only. Any recorded variables were done within SUCH and on the campus of Cleveland State University as part of this research. Any data analyzed was done by the investigators listed on the study only. Each Investigator/Co-Investigator has completed Human Subject Protection Education (CITI/NIH/Other Ethics Training).

Upon completion of the study, data, medical, and research information was kept in a locked file drawer in the SUCH cardiac and pulmonary rehabilitation center. It will

be destroyed using appropriate methods which are secure and environmentally friendly after the 3 to 5-year expiration. Any publication of data will only use group data and not identify individuals that were part of the study data. There is no more than minimal risk to subjects whose information is used in this study. The medical records were only viewed by small urban community hospital employees and the researchers listed in this study.

Data Analysis

The data was entered into the Statistical Program for Social Sciences Version 25.0. Descriptive statistics were used to characterize all included outcome measures. Paired samples T-test and Crosstabulation Chi-Square test was used to evaluate patient demographics. An independent samples *t*-test was performed to determine if the number of readmissions differed by different post-discharge care settings. A Crosstabulation Chi-Square test was used to compare the post-discharge groups by 30-day readmission status.

The patient history was searched and coded for what discharge care setting the patient was sent to and did that patient readmit within 30-days of discharge. The four discharge care settings (HSC, HHC, LTAC and SNF) were evaluated to determine if there was a sufficient number of patients to be included in the model. A Crosstabulations dialog was utilized to identify potential independence between the care settings in terms of proportions of patients who readmitted within 30-days.

The association of post-discharge care setting, and 30-day readmissions was evaluated using Spearman's correlation to determine the strength of the relationship. Bivariate descriptive statistics identified any significant relationship between two variables utilizing cross-tabulation within a contingency table. A summary of the data is

provided for each research question. An explanation for each research question will be given, significance level is $p \leq 0.05$.

CHAPTER IV

RESULTS AND DISCUSSION

Results

The total number of patients admitted with COPD from July 1, 2014, until July 1, 2019, was N=1,016. The total sample used was n=1008 because of 8 patients that had expired. The demographics are provided in Table 4.1. The population is displayed as individuals who are readmitted and those who did not readmit. Values are also provided based on the post-discharge care setting and 30-day readmissions.

Table 4.1 shows on average, the age for all COPD patients had a mean age 64 (±12) years old. The age for those that readmitted was 68.3 (± 10.9) years old. For the total sample 59% were female and 41% were male. Those that readmitted were 54% female and 46% male. For the total sample, 77% were black, 22% were white, and 1% were categorized as "other". For those that readmitted 75% were black, 28% were white and 1 % were other. For the total sample and marital status, 548 were single, 287 were widowed, divorced or other, and 173 were married. Those that readmitted consisted of 85 single, 41 widowed, divorced or other, and 29 were married individuals. Among the total sample, 559 were on Medicare, 404 were on Medicaid, and 45 had conventional insurance. Those that readmitted included 82 using Medicare, 67 using Medicaid, and 6

using conventional insurance. The average length of stay for the total sample was 4.1 days, and the average length of stay for the readmits was 4 days.

Table 4.1 – Patient Demographics for Whole Sample and by Post-Discharge Care

Characteristics	Total Sample (n=1008)	Total Sample No Readmit (n=853)	Total Sample 30-Day Readmit (n=155)	HSC 30-Day Readmit (n=95)	HHC 30-Day Readmit (n=47)	LTAC 30-Day Readmit (n=7)	SNF 30 Day Readmit (n=6)
AGE (mean, ± SD)							
Age (mean, ± SD)	64 (± 12)	64 (± 11.36)	68 (± 10.9)	61 (± 10.9)	69 (± 10.1)	67 (± 11.2)	72 (± 10.8)
GENDER							
Male	420 - 42%	349 - 41%	71 - 46%	44 - 46%	20 - 43%	4 - 57%	3 - 50%
Female	588 - 58%	504 - 59%	84 - 54%	51 - 54%	27 - 57%	3 - 43%	3 - 50%
RACE							
White	221 - 22%	184 - 22%	37 - 24%	27 - 28%	7 - 14%	4 - 57%	0 - 0%
Black	773 - 77%	656 - 77%	117 - 75%	67 - 71%	40 - 86%	3 - 43%	6 - 100%
Other	14 - 1%	13 - 1%	1 - 1%	1 - 1%	0 - 0%	0 - 0%	0 - 0%
MARITAL STATUS							
Single	548	463	85	54	27	2	2
Married	173	144	29	16	9	2	2
Widowed/Divorced/Other	287	246	41	25	11	3	2
INSURANCE							
Medicaid	404	338	67	52	13	2	1
Medicare	559	476	82	40	32	5	5
Other	45	39	6	4	2	0	0
LENGTH OF STAY							
Average Length of Stay	4.1	4.1	4	3.22	4.04	7.3	10
NUMBER OF DIAGNOSES							
Average # of Dx's	13.9	14	14.2	13.3	15.2	14.5	20
CLEVELAND LOCATION							
Central Cleveland	418	344	74	47	14	7	6
Metro Cleveland	410	348	62	37	25	0	0
Suburban Cleveland	180	161	19	11	8	0	0
DISCHARGE LOCATION							
Internal Medicine	608	521	87	55	23	5	4
ernal Medicine, Card, Spine,Ger	220	183	37	24	12	0	1
CMU/ICU/CSU	180	149	31	16	12	2	1
DISHCHARGE PHYS SPECIALTY							
Cardiovascular Disease	132	112	20	12	7	1	0
Internal Medicine	820	688	132	81	39	6	6
Nephrology/Other	56	53	3	2	1	0	0

The average number of diagnoses for the whole sample was 13.9 and for the readmits was 14.2 diagnoses. For location and the total sample, 418 live in central

Cleveland, 410 live in Metro Cleveland and 180 live in suburban Cleveland, and among those that readmitted 74 live in Central Cleveland, 62 live in Metro Cleveland and 19 live in suburban Cleveland. The discharge location for the total sample was 608 from Internal Medicine, 220 from Cardiology, Spine or Geriatric, and 180 from CMU/ICU/CSU. Those that readmitted had the following discharge locations: 87 from Internal Medicine, 37 from Spine or Geriatric, and 31 from CMU/ICU/CSU. The discharge physician specialty for the total sample was Internal Medicine for 820 patients, Cardiovascular Services for 132 patients and Nephrology/other for 56 patients. For those who readmitted, the discharge physician specialty was Internal Medicine for 132 patients, Cardiovascular Services for 20 patients, and Nephrology/other for 3 patients.

Descriptive Statistics

Table 4.2 provides the discharge classifications and 30-day readmissions for the following categories: home with self-care, home health care, LTAC, and SNF. It also provides the breakdown of COPD patients as non-readmit and readmit along with the patient totals. The percentages are also given to demonstrate that those who went to a SNF had the lowest readmit percentage (10.17%) and those that went to home health care had the highest percentage at 22.17% of the readmissions.

Table 4.2 Patient Totals and Percentages with Discharge Dispositions

Facility DC Disposition	Non-Readmit	Readmit	Total Patients
Home with Self-Care	584	95	679
Home Health Care	165	47	212
LTAC	51	7	58
SNF	53	6	59
Grand Total	853	155	1008

Percentage DC Disposition	Non-Readmit	Readmit
Home with Self-Care	86.01	13.99
Home Health Care	77.83	22.17
LTAC	87.93	12.07
SNF	89.83	10.17

The facility discharge disposition was verified with each claim with the billing status to the insurance company. There were six instances in which HHC was reclassified to home with self-care. The patient changing their mind about receiving home health care deeming it unnecessary, or the home health care agent did not show up promptly, and the contract was terminated. A comparison was completed by analyzing the original patient discharge order and the final data statement processed by the insurance company. The data was adjusted accordingly. There were no other documented changes in patient records as investigated with each patient during the covariate extraction.

Table 4.3 Crosstabulation Facility Disposition and Readmission Status

	30day Readmit Status					
Facility DC Disposition	**No Readmission Count**	**No Readmission Expected Count**	**Readmit within 30 days Count**	**Readmit within 30 days Expected Count**	**Total Count**	**Total Expected Count**
Home Self Care	584a	574.6	95a	104.4	679	679.0
Home Health Care	165a	179.4	47b	32.6	212	212.0
LTAC	51a	49.1	7a	8.9	58	58.0
SNF	53a	49.9	6a	9.1	59	59.0
Total	853	853.0	155	155.0	1008	1008.0

Each subscript letter (a, b) denotes a subset of 30-day Readmit Status categories whose column proportions do not differ significantly from each other at the .05 level.

Chi-Square Tests	**Value**	**df**	*p*- value
Pearson Chi-Square	10.237a	3	0.017
Likelihood Ratio	9.694	3	0.021
Linear-by-Linear Association	0.019	1	0.89
N of Valid Cases	1008		

a. 0 cells (0.0%) have expected count < 5. The minimum expected count is 8.92

Hypothesis Testing and 30-Day Readmissions

Table 4.3 provides the results from the Chi-Square test of independence that calculated patients' frequency and facility discharge disposition with 30-day readmission status. The crosstabulation and Chi-square results revealed that there was significant difference in proportions between post-discharge care settings. A significant interaction was found between facility discharge disposition and by 30-day readmit status, (X^2 (3) = 10.237, p = 0.017). Patients discharged to home health care (22.17%) were more likely to readmit within 30-days more than those discharged to home with self-care (13.99%),

LTAC (12.07%), or SNF (10.17%). The expected cell count for this assumption was met with 8.92. Results of the chi-square test revealed that there was a significant difference in proportions between the care settings. Therefore, we reject the null hypothesis of: there will be no difference in 30-day readmission rates between post-discharge care settings.

A comparison of column proportions was performed to investigate the differences between care settings further. For these comparisons, the Bonferroni method was utilized to adjust the p-value based on making multiple comparisons. The column comparisons showed that the Home Health Care group had a higher proportion of 30-day readmissions compared to the other discharge settings. No differences were observed in readmission rates between home self-care, LTAC, and SNF. A post hoc t test was utilized to determine differences between column comparisons.

Table 4.4 Summary of Primary Hypothesis Statement

Hypothesis	Hypothesis Statement	Conclusion
H_{a1}	There will be significant differences in patients who get discharged to different post-discharge care settings (HSC, HHC, SNF, and LTAC) who get readmitted within 30 days after index admission with COPD versus those who do not get readmitted back to the hospital within 30 days of their indexed admission with COPD.	Accept
H_{a2}	There will be significant differences in the characteristics (covariates) in patients who get readmitted back to the hospital within 30 days of their indexed admission and those that do not with COPD.	Accept

Comparison of Covariates Between Readmits and Non-Readmits

Figures 4.4 represents the covariates that had the most difference according to those that were readmitted and those that were not readmitted as evaluated by a Chi-square test of analysis from the covariate chart evaluation. Table 4.4 showed that there were significant differences but not with every variable.

Table 4.5 COVARIATE ANALYSIS

Variable	Chi Square	Significance
Age	3.8	0.15
Living Arrangements	1.1	0.57
Length of Stay	13.5	0.001*
Insurance	8.8	0.01*
Comorbidities	0.8	0.67
Home O2	5.7	0.05*
Previous CAD Disease	30.0	<0.001*
Sleep Apnea	9.7	0.01*
Hypertension	0.5	0.80
Diabetes	19.2	<0.001*
Smoking History	0.5	0.80
Sputum	17.4	<0.001*
Cough	6.1	0.05*
Heart Failure Symptoms	4.9	0.09
LABA/ICS	0.6	0.75
SaO2	8.1	0.02*
Weight Classification	5.7	0.06
Wheezing	0.8	0.69
Severity of Disease	0.7	0.72
Hypoxia	8.3	0.02*
Hypercapnia	11.5	0.003*
PFT	9.8	0.01*
FEV_1	3.9	0.14
Previous Echo	5.6	0.06
Systolic Heart Failure	1.1	0.60
Right Vent Systolic	2.3	0.31
PT/OT	5.1	0.08
Adaptive Equipment	6.2	0.04*
Exacerbations	5.5	0.05*

*Significant Chi-Square Test ($p \leq .05$)

The significant variables are presented as proportions of those that readmitted withing 30-days and those who did not. The red bar graphs make up 100% of those that readmitted within 30-days and the blue bars represent 100% of those who did not readmit in a comparison of the scored variable from the covariate chart. The graphs are meant to compare a patient that readmitted versus the patient that did not.

SIGNIFICANT VARIABLES

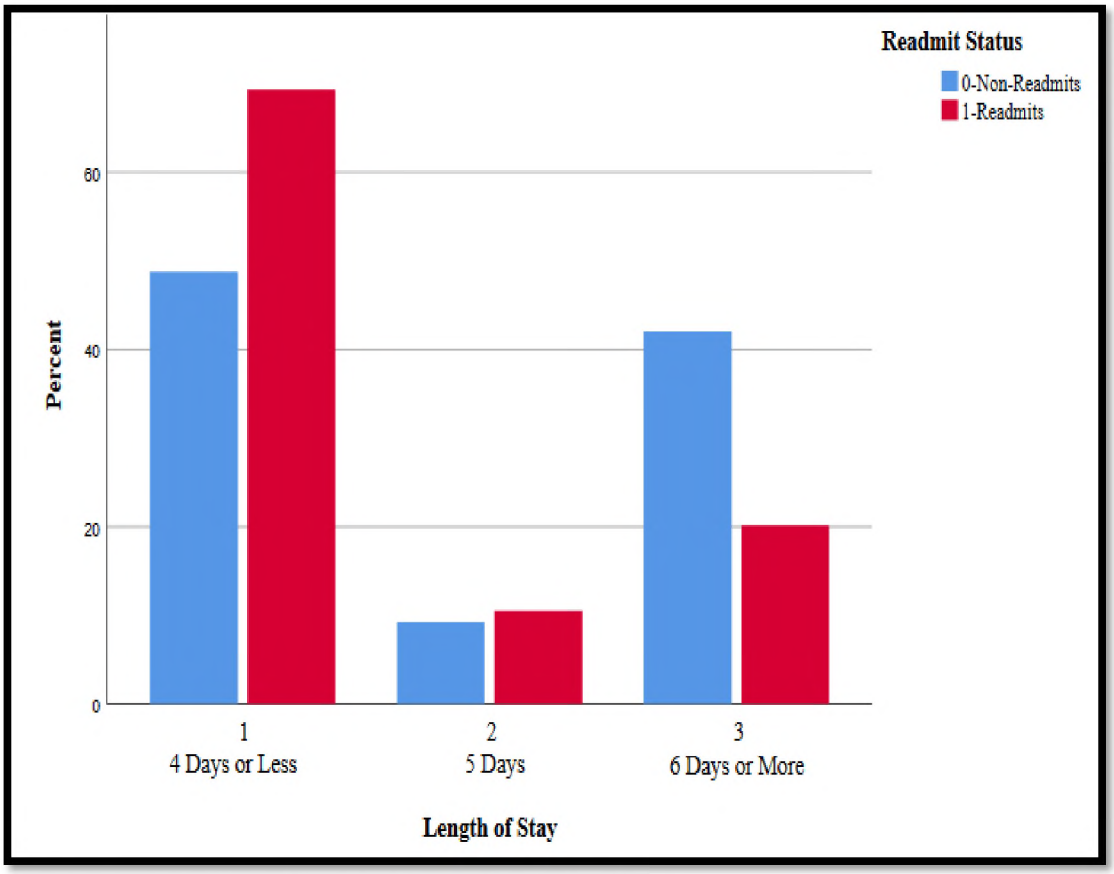

Figure 4.1 **Length of Stay by Readmission Status.**

Figure 4.1 represents the proportion of individuals spending 4 days or less who readmitted was significantly greater than the proportion that did not. The proportion that spent 6 days or more who readmitted was significantly less than those that did not readmit X^2 (2, N = 233) = 1.1, p = 0.001. The highest percentage of the readmits stayed four days or less in the hospital with 69.3% being readmitted. Twenty percent of the readmits stayed 6 days or more. The non-readmits stayed four days or less 48.7% of the time, and 42.0% of the non-readmits stayed 6 days or more.

The SUCH patients who had a longer length of stay tended to be older, more than likely to be unmarried, white, lived outside the Central Neighborhood in Metro

Cleveland, had more prior hospitalizations, and had a more significant number of comorbidities. Those patients discharged to a SNF had an average length of stay of 10 days and an average of 20 comorbidities. The readmission rate for these patients was exceedingly high considering that the average length of stay at SUCH is 4.1 days.

The research suggests that a longer length of stay was associated with an increased risk for readmissions on a patient-level (Rinne et al., 2017). Figure 4.1 displays that those patients that readmitted the most had a length of stay of 4 days or less. The SUCH results refute research results that the longer length of stay is associated with an increased risk for readmissions (Rinne et al., 2017). Because of the Hospital Readmission Reduction Program and penalties assessed to a hospital with excessive 30-day readmissions, the implications for many were that keeping a patient longer in the hospital would allow more time for the patient to become medically managed and reduce the risk for readmissions or discharging sooner to inpatient care (HHC, SNF, LTAC) (Benbassat & Taragin, 2000) (Shah et al., 2016).

Rinne et al., 2017, completed a study on the association between length of stay and readmission for patients with COPD. With many hospitals, there is a search for ways to reduce hospital costs. Rinne et al., 2017 indicated that it is unclear as to whether shortening the length of stay would reduce hospital costs and receive reimbursements or increasing the length of stay to reduce the chance of 30-day readmissions would reduce penalties for excessive 30-day readmissions. The confounding variable severity of illness was associated with a higher rate of readmission, and the results from previous studies indicate the opposite that those patients that were discharged earlier had a higher rate of 30-day readmissions. There was an unmeasured severity of illness in comparison with

the length of stay, so it would be difficult to adequately reflect on the results without bias. Rehospitalization can indicate that there are gaps in follow-up care or the appropriate discharge care was not selected (Jenks et al., (2009).

From a systems perspective, the patient's appropriateness for discharge should be initiated when a patient that is returning to home can fill and self-administer medications, perform activities of daily living, manage their nutritional needs, and follow-up with their primary care provided within 7-10 days of hospital discharge (Alper et al., 2019). Putting a discharge plan into action may increase the length of stay.

The recommendation for the hospital's appropriateness for discharge would be considered when there is a collaboration between the care team, the patient, and the aftercare provider prior to discharge (Mularski et al., 2006). COPD disease-specific education including, instructions for care and what to do, and who to call if symptoms worsen has been completed with patient understanding. If the patient lacks understanding, it should be documented. Medication reconciliation needs to be completed with all documented meds, and verification of new meds and compatibility of home medications (Prieto-Centurion et al., 2014). All hospital testing should be processed and applied to the discharge process. The discharge plan is complete and explained to the patient, and patient follow-up appointments are scheduled (De Regge et al., 2003). Any psychosocial barriers, needs for food, medical benefit issues, housing issues, ability to complete activities of daily living independently, and transportation issues should be documented, and appropriate referrals should be made with to a social worker (Alper et al., 2019).

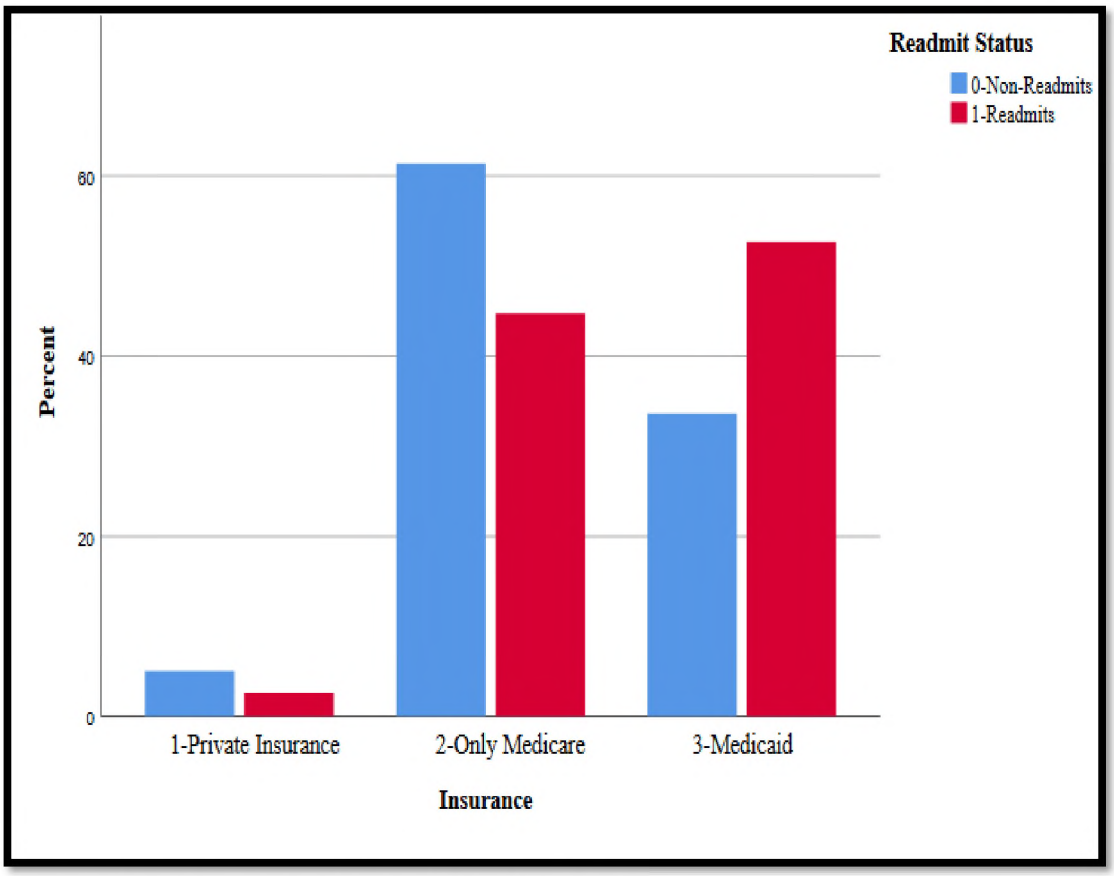

Figure 4.2 **Insurance by Readmission Status**.

Figure 4.2 represents the proportion of individuals that had Medicaid insurance who readmitted was significantly greater than the proportion that did not readmit X^2 (2, N = 233) = 8.8, p = 0. 01. The proportion of individuals that had Medicare insurance who readmitted was significantly less than the proportion that did not readmit. The highest percentage of the readmission group represents 52.6% of the group with Medicaid Insurance, the readmit group had 41.1% of the group with Medicare Insurance. The non-readmit group had 38% of Medicaid Insurance and had 61.3% with Medicare Insurance. There was a small total for both groups having private insurance.

It has been found that patients 40-64 years old with public insurance of either having Medicaid or Medicare have the highest readmission rates (Simmering et al.,

2016). Insurance status is identified as a proxy for socioeconomic status and an identifier of payer-specific reimbursement for chronic conditions (Press, Konetzka & White, 2018). Medicaid has a 16.7% rate of readmission, and Medicare has a 14.77% rate. Patients with private or conventional insurance were 8.25% which is the lowest readmission rate. The highest percentage readmit group at SUCH is those with Medicaid insurance, followed closely by Medicare. Simmering et al., 2016 determined the mean predicted probability of readmission group by Insurance and age group. Since the average age of a patient at SUCH is 64, the predicted probability of Medicare patients readmitting is 14.77%, Medicaid 16.27%, and private insurance is 8.25% for those under 65 years old. For those patients, 65 and older, the predicted probability of Medicare patients readmitting is 11.80%, Medicaid, 10.89% and Private insurance is 10.12%.

Since age was not adjusted in the model, data was used from Table 4.2. For those patients at such that readmitted within 30-days the average age was 68.3 years old. For the total sample at SUCH with 30-day readmissions, the results indicate that the Medicaid group had the highest number of readmissions which refutes Simmering et al., 2016 study results stating that those patients aged over 64 readmit the most with Medicare insurance. This could be an indication that a patient may be on Medicaid and is identified as having a disability due to the advanced stage of the disease and the variability and those that are eligible for Medicaid or Medicare. The non-readmit group of Medicare supports Simmering et al., 2016 research that those patients on Medicare insurance may have a higher level of access to care and have less probability to readmit (Simmering et al., 2016). It was suggested in the study that interventions should target patients with multi-comorbidity, those that leave the hospital against medical advice, and those discharged to

home health care (Simmering et al., 2016). The study at SUCH focused on the patient level factors that should be identified prior to discharge that could alert healthcare workers as to the type of care that is needed post-discharge.

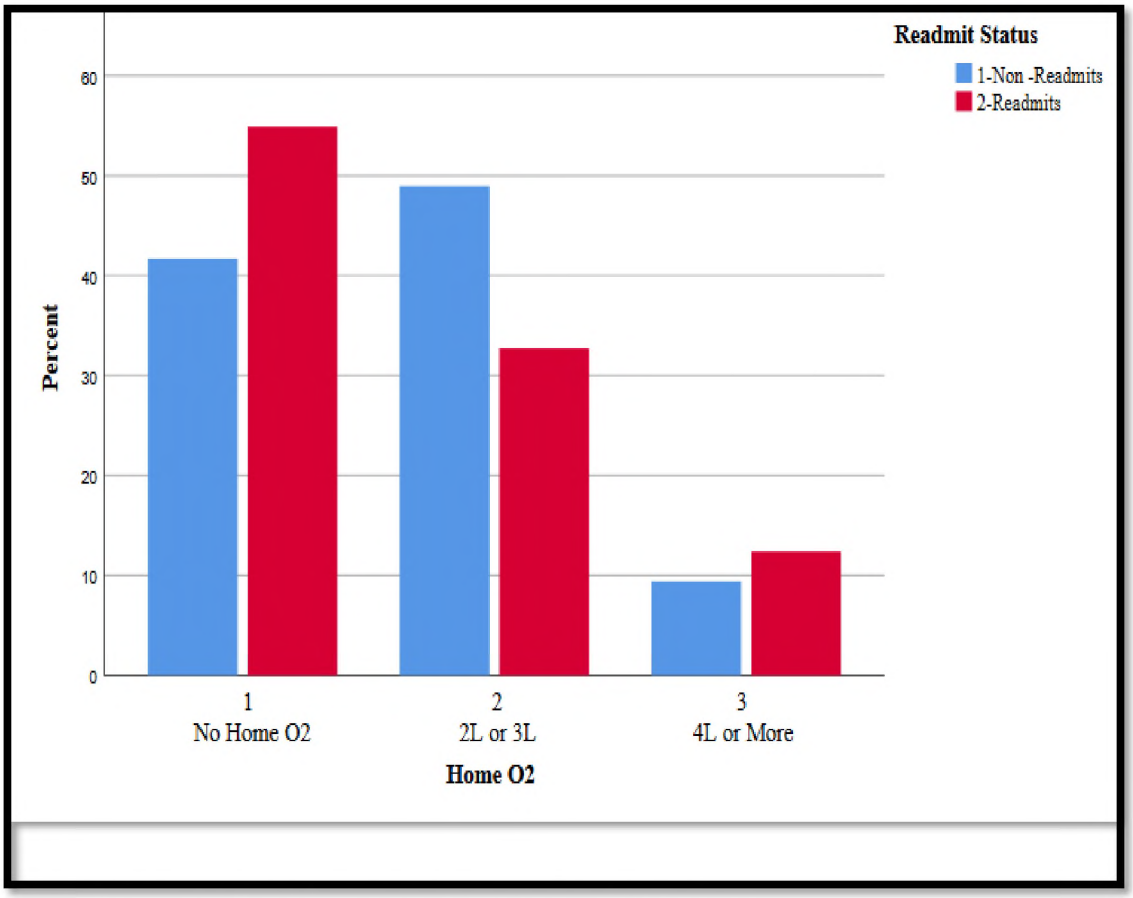

Figure 4.3 **Home Oxygen Use by Readmission Status.**

Figure 4.3 represents the proportion of individuals that used 2L or 3L of oxygen who readmitted was significantly less than the proportion that did not readmit X^2 (3, N = 233) = 5.7, p = 0.05. The highest percentage of readmits is having no home oxygen use with 54.9%, the non-readmit group had 41.7% with no home oxygen. The readmit group had 32.7 % of 2 or 3 liters of oxygen at home, and the non-readmit group was 49.0 %. Both the readmits and non-readmits had 11.0 % of the group using 4 liters or more oxygen at home.

There is evidence supporting the use of supplemental home oxygen in patients with COPD. Oxygen was the first treatment shown to prolong life in COPD (Stoller et al., 2009). Typically to qualify for home oxygen therapy, a patient must either have an arterial blood gas (PaO2) at or below 55 mmHg or an oxygen saturation at or below 88% taken at rest (Centers for Medicare and Medicaid Services, 2019). Some SUCH patients meet the recommendations by doing a 6-minute walk test and saturating less than 93% (Stoller et al., 2009).

Stroller et al., 2009 mentions that it is unclear that the use of 2 to 3 L of home oxygen with symptomatic COPD patients that have a mild level of hypoxemia and desaturation with exercise could be beneficial as the SUCH results show fewer readmissions with 2 to 3 L of home oxygen. Supplemental oxygen at night showed improvements in patients with COPD. Studies also showed that there are benefits of oxygen use with the duration of exercise, increased 6-minute walk test distance, reduced dyspnea, and improved health-related quality of life (Stroller et al., 2009).

Bahadorie and FitzGerald, 2007 indicated that the use of oxygen long-term might be a risk factor for 30-day readmissions with COPD. Jenks, Williams, and Coleman, 2009 identified oxygen use at home as a patient factor for the readmission of COPD patients. The Centers for Medicare and Medicaid Services, 2019 found that of 7,206 patients, 7.7% had of patients that had two or more readmissions in 90 days and found that home oxygen use as a predictor of readmission. Hansen et al., 2013 addressed the fact that some programs that were developed to reduce readmissions with COPD patients did not address the use of supplemental oxygen as a factor in readmissions. Silver et al.,

2017 prespecified risk factors for COPD readmissions and the use of supplemental home oxygen was presented.

When using supplemental durable medical equipment (DME), there may be barriers with the patients to receiving supplemental oxygen (Kim et al., 2008). As the results reflect that not using oxygen as a treatment for COPD had the highest readmissions at SUCH. Breakdowns in a hospital to home transition in obtaining oxygen can lead to poor outcomes and sometimes readmission (Thomas L. Petty, 2009). Petty 2009, recognized that it is not just long-term oxygen therapy that can help COPD patients, that it was also the need to develop an infrastructure within the hospital to promote collaboration among all stakeholders to translate the evidence into practice (Skulley et al., 2019). Skulley et al., 2019 recommended the chain of care to a patient that needs oxygen delivery should include patient identification, patient evaluation, documentation and prescription, patient education and discharge, home oxygen delivery and use, patient education at home, revised documentation and prescription, patient reevaluation (Skulley et al., 2019)

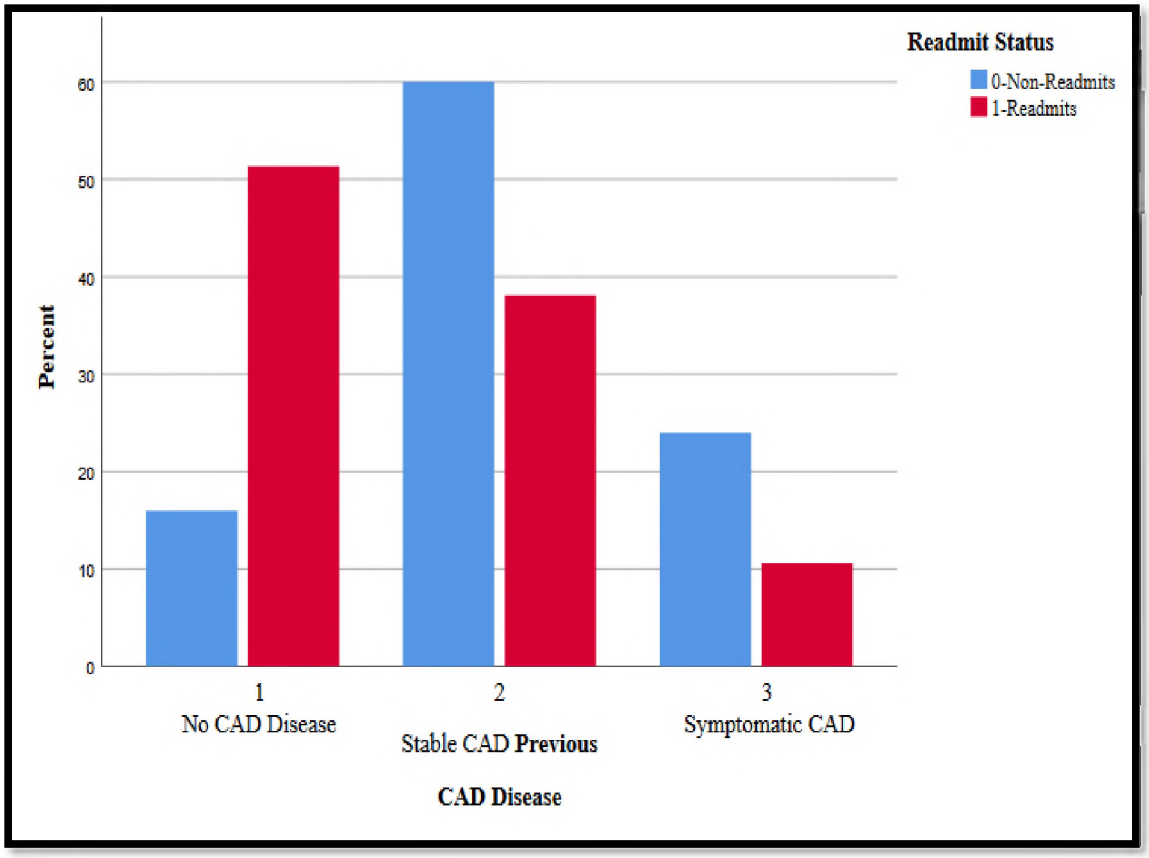

Figure 4.4 **Patients with Coronary Artery Disease by Readmission Status.**

Figure 4.4 represents the proportion of individuals that did not have CAD that readmitted was considerably greater than the proportion that did not readmit. The proportion of individuals with stable CAD who readmitted was notably less than the proportion that did not readmit. The proportion of individuals with symptomatic CAD who readmitted was significantly less than the proportion that did not readmit X^2 (3, N = 233) = 30.0, p = 0.001. The readmission group's highest readmits is group 1 (51.3 %), with not having any documented coronary artery disease. The readmission group with stable coronary artery disease was 38.1 %, and the symptomatic group had 10.6 % of the readmission group. Sixty percent of the non-readmit group consisted of those with stable

CAD, whereas 24% of the non-readmit group had symptomatic CAD. The remaining 16% of non-readmits were those without any known CAD.

There may be a lack of recognition and undertreatment of comorbid coronary artery disease in COPD patients (Morgan, Zakeri & Quint, 2018). This is demonstrated by the results of figure 4.4. Because of this, most patients with symptoms of sputum, cough, and dyspnea upon exertion are treated for COPD. A COPD patient is just as likely to die from a cardiovascular cause as they are from a disease related to the respiratory system (Morgan, Zakeri & Quint, 2018). Smoking is the shared risk factor in both cardiovascular disease and COPD (Sin & Man, 2003). The systemic inflammatory response associated with COPD puts a patient at risk for CAD.

COPD is described as "the component of the systematic endothelial disease," which can cause low-grade chronic systemic inflammation during physiological aging (Sin & Man, (2003). This systemic aging can simultaneously affect multiple organs, and it is exceedingly difficult to determine if COPD or CAD came first (Sin & Man, 2003). Both diseases reveal the same risk factors.

The COPD-related chronic inflammation can contribute to the development and progress of atherosclerotic plaque formation and progression, precipitated by respiratory infections and acute exacerbations of COPD, which can induce plaque rupture and cardiovascular events (Sin & Man, 2003). In this study, it is found that at least 80% of all patients diagnosed with COPD did not have at least a spirometry test. This is mentioned because there is considerable overlap between congestive heart failure and COPD in presenting symptoms (Morgan, Zakeri & Quint, 2018).

The recommendations for the identification of CVD in COPD patients would be to consider questioning a patient in assessment with shortness of breath at night, weight changes, exertional chest pain, and leg pain (Morgan, Zakeri & Quint, 2018). The physical exam would investigate irregular heartbeats, abnormal breath sounds, and differences in vascular pulses. The following tests should be performed; EKG, Chest X-ray, CT scan, echocardiogram, exercise stress test, or a nuclear test (Morgan, Zakeri & Quint, 2018). The following biomarkers should be evaluated as well to include Troponin and BNP (Sin & Man, 2003).

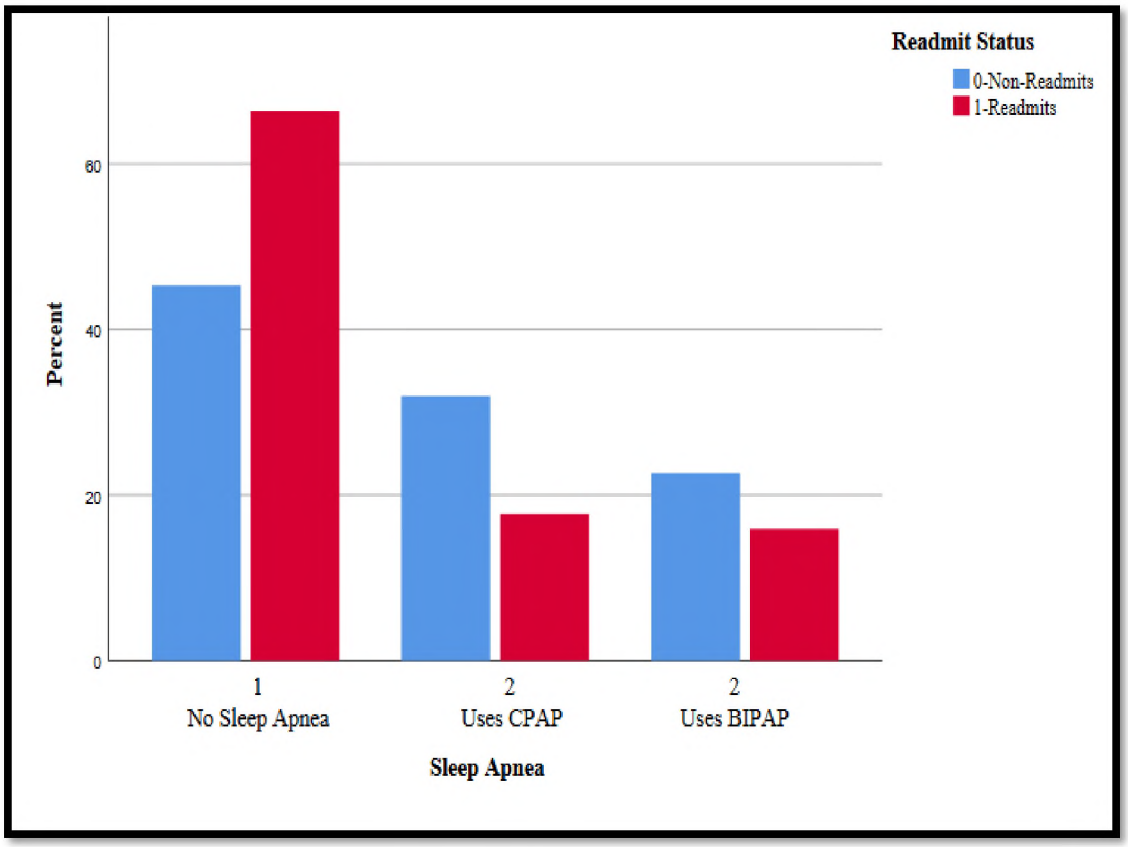

Figure 4.5 **Patients with Sleep Apnea by Readmission Status.**

Figure 4.5 represents the proportion of individuals at level 1 who readmitted was significantly greater than the proportion that did not readmit. The proportion of

individuals at level 2 who readmitted was significantly less than the proportion that did not readmit, X^2 (3, N = 233) = 9.7. More patients that did not have sleep apnea (66.4%) readmitted, those that used the BIPAP machine readmitted (15.9 %), those that used a CPAP readmitted 17%. Those that did not readmit with sleep apnea was 45.4% those that used CPAP did not readmit 32% and those that used a BIPAP 22.7% of the time.

There are an estimated 50 to 70 million Americans that have some sleep disturbance (CDC, 2020). Males have a prevalence of 10% to 17%, and women have a prevalence of 3% to 9% for obstructive sleep apnea (Global Initiative for Chronic Obstructive Lung Disease, 2019). Studies show that 82% to 93% of individuals with moderate to severe sleep apnea are not aware that they have the condition, and it remains heavily underdiagnosed (Foldvary-Schaefer, 2019). Patients may not be aware of their condition because they may not have a controlled environment (Eagan, Knutson, Pereira, Von Schantz, 2016).

Sardar, Sufyan & Javed, 2019 reflected on the fact that there is a high cost to the test, unavailability of appointments, and lack of public awareness of the disease. The graph in figure 4.5 is a clear representation of the readmitted group as almost 70% do not have sleep apnea. Patients may have sleep apnea but may not have had a sleep study to diagnose sleep apnea.

Kapur et al., 2017 suggested the following guidelines to a patient that has COPD with sleep disturbances; the recommendation is very strong to have a home sleep apnea test, especially if a patient has a cardiorespiratory disease, respiratory muscle weakness, hypoventilation, chronic opioid medication use, history of stroke or insomnia with patients that have COPD (Kapur et al., 2017).

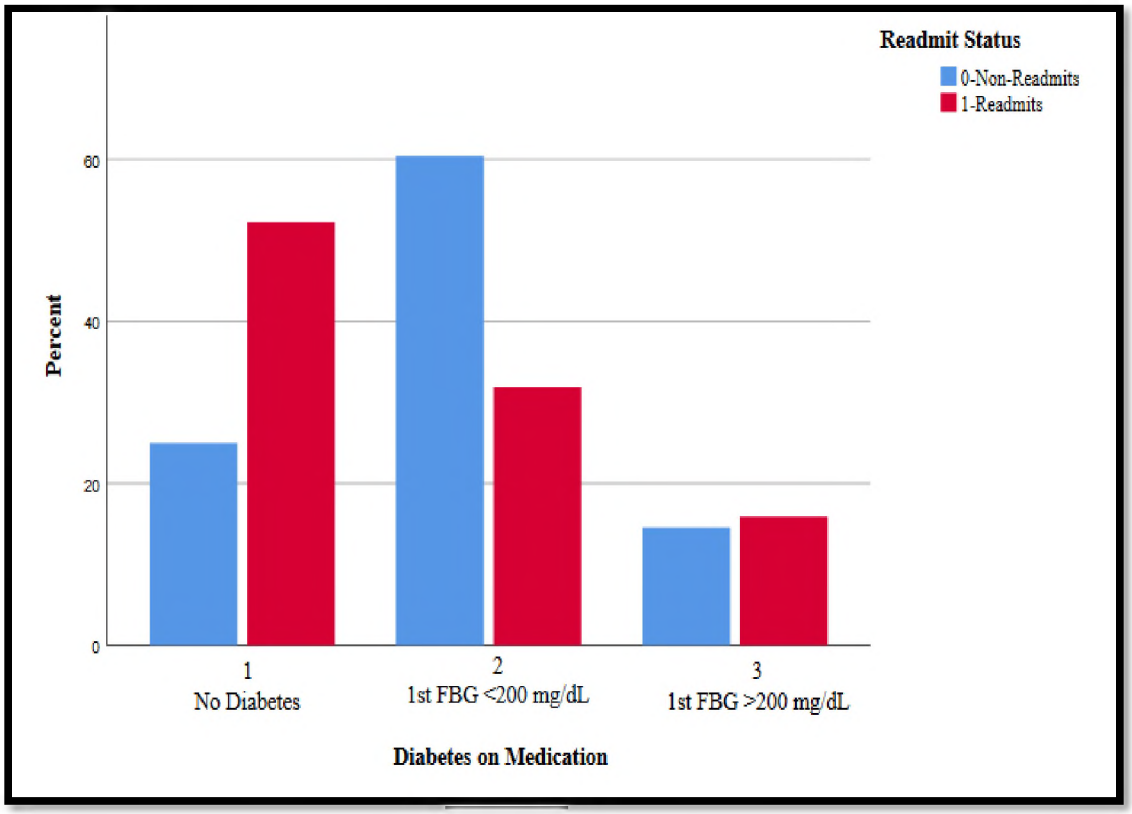

Figure 4.6 **Patients with Diabetes on Medication by Readmission Status.**

Figure 4.6 demonstrates that the proportion of individuals that did not have diabetes who readmitted was significantly greater than the proportion that did not readmit. Over 52.2 % of the readmission group did not have diabetes, whereas 61.7 % of the non-readmits reported having diabetes with a fasting blood glucose less than 200 mg/dL. Under 20% of both groups reported having diabetes and having their first fasting blood glucose over 200 mg/dL, X^2 (3, N = 233) = 19.2, p = 0.001. The readmission group had 52.2 % of patients without diabetes, and 25.0 % of the patients had a fasting blood glucose of less than 200 mg/dL. The readmission group had 31.9 % of the patients with a first fasting blood glucose greater than 200 mg/dL. The non-readmit group had their highest population in group 2, with their first fasting blood glucose of less than 200

mg/dL at 60.4 %. Twenty-five percent had no reported diabetes, and 14.6 % had their first fasting blood glucose above 200 mg/dL.

With the fact that there are glucose metabolism disturbances in COPD patients, the research may refute the highest category of readmissions is without diabetes (Mirrakhivmov, 2012). Centers for Medicare & Medicaid Services, 2019 indicated that the highest predictive variables for readmissions with COPD patients were emergency room (ER) visits, cellulitis, myocardial infarction, renal disease, diabetes, and low education level (CMS, 2019).

Chronic obstructive pulmonary disease is a risk factor for the onset of type 2 diabetes mellitus (Mirrakhivmov, 2012). Studies have suggested that the general inflammation that influences respiratory disease can be responsible for COPD development (Mirrakhivmov, 2012). There could be an association with obesity, the shortage of oxygen (hypoxia), and corticosteroids to reduce the inflammation. Hyperglycemia can influence the bacterial growth in the airways making a COPD patient worse (Yam et al., 2010).

Abnormal lung function is associated with an increased incidence of diabetes (Ford and Mannino, 2004). Depending, on the classification of COPD, patients may have a higher incidence of diabetes (Ford & Mannino, 2004). The findings from the National Health and Nutrition Examination study indicated that in the early stage of diabetes there might be changes in lung function (Ford & Mannino, 2004). Interpretation of the results of diabetes and readmissions may indicate that those that readmitted the most had a lower stage of COPD, and those that did not readmit had elevated blood glucose due to the use

of corticosteroids. Diabetes increases with a worsening GOLD classification score. COPD is associated with higher rates of diabetes (Glaser & El-Haddad, 2015).

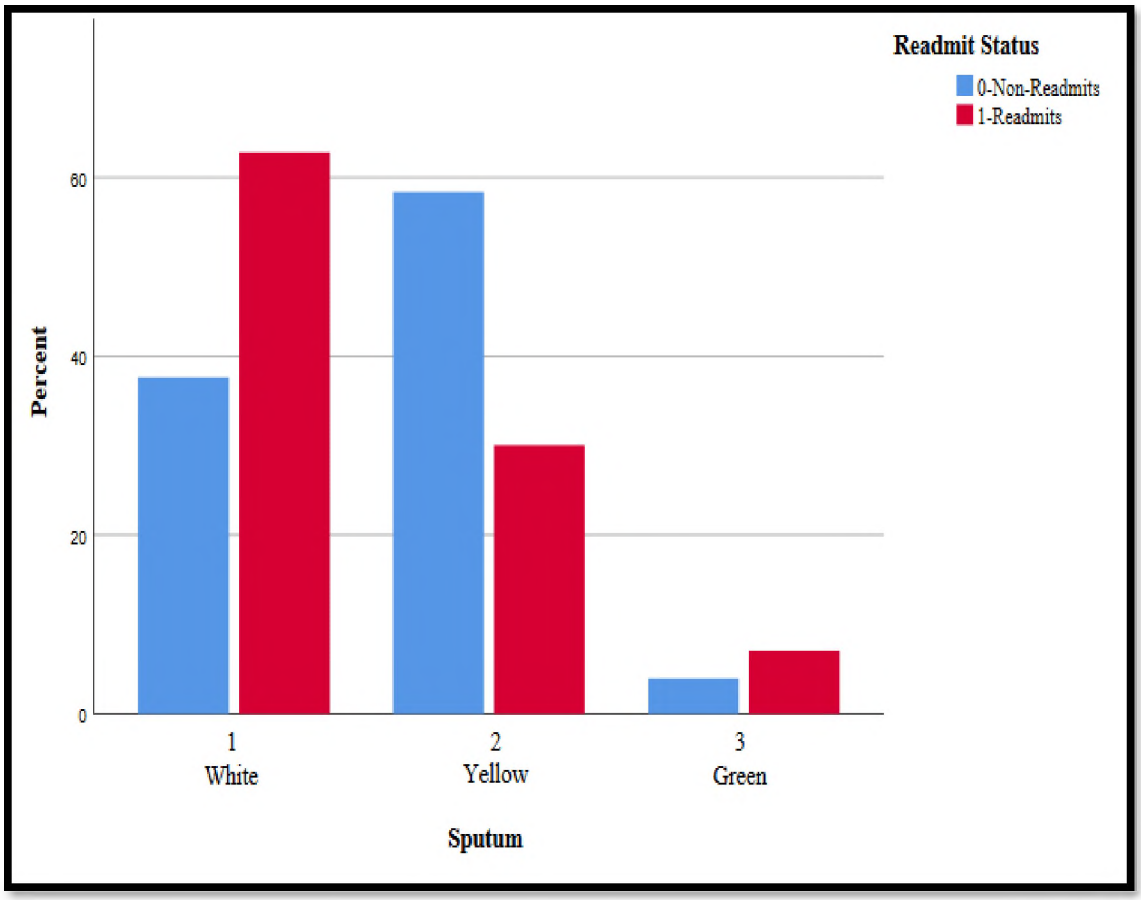

Figure 4.7 **Patients with Sputum by Readmission Status.**

Figure 4.7 shows that the proportion of individuals with white sputum who readmitted was significantly greater than the proportion that did not readmit. The proportion of individuals with yellow sputum who readmitted was significantly less than the proportion that did not readmit, X^2 (2, N = 233) = 1.1, p = 0.001. The figure represents sputum production which was descriptive by color. Over 62.8 % of the readmitted group reported having white sputum, 30% of the readmitted group reported yellow sputum, and less than 10% reported having green sputum. The non-readmit group

had almost 58.4 % of the patients with yellow sputum, 37.6 % reported having white sputum, and 7.1 % of those with green sputum.

Chronic cough and sputum production are associated with increased mortality and COPD exacerbation, especially in smokers (Miravitlles et al., 2000). COPD patients may not produce sputum with coughing. Patients may not expectorate sputum and may swallow it. Burgel and Martin, 2010 explained that sputum production might be intermittent and difficult to evaluate, especially when going from a flare up to remission. Sputum is also known as mucus hypersecretion (Burgel & Martin, 2010: Fletcher & Petro, 1976). Stein et al.2012 discussed how sputum production is not dependent on color on presentation and hospitalization for one or more of any respiratory symptoms. The results reflect the opposite of what one would expect. However, Melton, 2002 indicated that colored mucous might be an indicator that a patient is a smoker. An environmental stimulus such as drinking coffee or dark fluids or eating chocolate may affect the color. Tracking the events prior to color identification may change the perspective of color, and that color may not be an indicator of severity. Infection, yes but not the severity (Melton, 2002).

The body's defense against irritants or pathogens may produce more mucous in the respiratory tract and therefore have less color but more volume (National Heart, Lung and Blood Institute, 2020). With the results reflecting the highest readmission with patients having white sputum, it is safe to assume that there is hypersecretion of sputum (mucus) and the color is white (Global Initiative for Chronic Obstructive Lung Disease 2019). Those readmissions in the yellow and green may not have as much mucous production, and this may be because the patient is on corticosteroids to keep the disease

under control or that the patient has the presence of enzymes from white blood cells in their mucous, meaning they have an infection (Altiner et al., 2009). The high prevalence of those having yellow mucous and not readmitting could indicate that antibiotics were given to treat the condition and the patient did not readmit (Altiner et al., 2009).

Recommendations from Guerrero et al., 2016 would be to collect a microbiological sample from the patient on the first day of admission to the hospital. An adequate sample would contain a count of more than 25 leukocytes, and epithelial cells per field would be less than 10. If a sample could not be obtained, then a nebulizer device with hypertonic saline would induce sputum production (Guerrero et al., 2016).

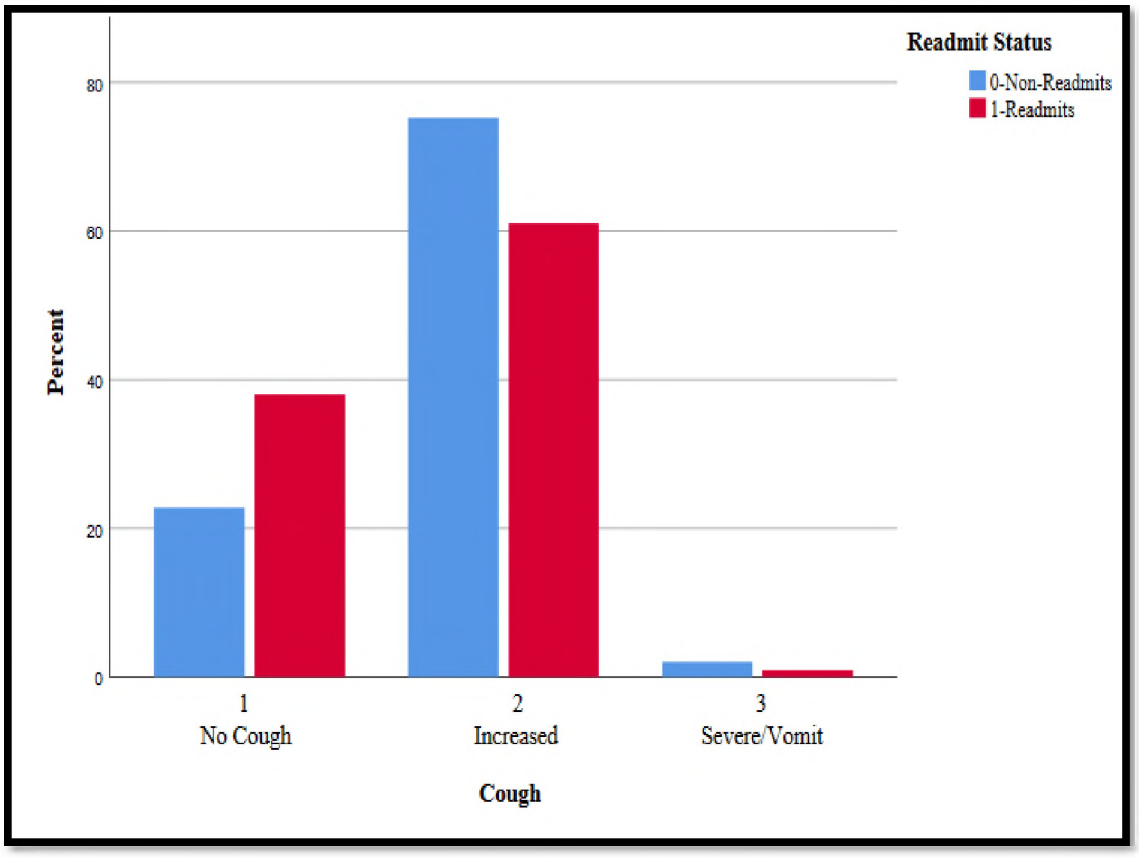

Figure 4.8 **Patients with Cough by Readmission Status.**

Figure 4.8 represents the proportion of those that readmitted was significantly greater than the proportion that did not readmit. The proportion of individuals with an increased cough who readmitted was significantly less than the proportion that did not readmit, X^2 (2, N = 233) = 6.1, p = 0.05. The figure represents the proportion of individuals with no documented cough who readmitted was 38.1 %, those that had a reported cough that readmitted 61.1 %. The non-readmits with no cough was 22.8 %. and with increased cough 75.2%. Those patients that reported a severe cough or vomiting that readmitted 0.9% and those that did not readmit 2.0 %.

The cough may be hard to differentiate according to its characteristics. Many patients would not count their coughs in an hour, explain the depth of their cough or how it makes the patient feel. It may be difficult to quantify a cough for a patient. Cough evaluation is subjective and not objective (Bhatia & Fromer, 2011). A patient may say, "it made me vomit" or "pee my pants" as a measure of severity. It was unclear how this would be documented in a medical record, especially when an intake person is unfamiliar with the patient. It was challenging to report the statistics since the cough was not measured.

The results of cough with the category increased cough had a little over 60% readmission. Several different questions would come into play, such as to what time of day the assessment was completed (day/night), was it document as coughs per second/hour/day? (Smith et al., 2003). Because cough is multifactorial and hard to explain, the increased coughs and the 60% readmission may be due to how the cough is evaluated in a patient or whether or not the condition developed pneumonia (Pasquale et al., 2019). The non-readmit group with almost 80% of not being readmitted may have

causes of increased cough [extra thoracic] due to include effects from medication including, ACE inhibitors, postnasal drip syndrome, chronic allergic rhinitis, upper airway cough syndrome, and gastroesophageal reflux (Global Initiative for Chronic Obstructive Lung Disease, 2019). Other causes of chronic cough [intrathoracic] include lung cancer, tuberculosis, asthma, interstitial lung disease, left heart failure, and cystic fibrosis (Global Initiative for Chronic Obstructive Lung Disease, 2019).

The recommendation for healthcare would be to use a validated questionnaire specifically for a chronic cough to have the patient complete with a clinician upon admittance. A suggested resource for the study of a cough is the Leicester Cough Questionnaire (LCQ); it is a valid and reliable measure of health status with those that have a chronic cough (French, Irwin, Fletcher and Adams, 2002). This questionnaire can detect changes in cough due to successful treatment (Coyle et al., 2005).

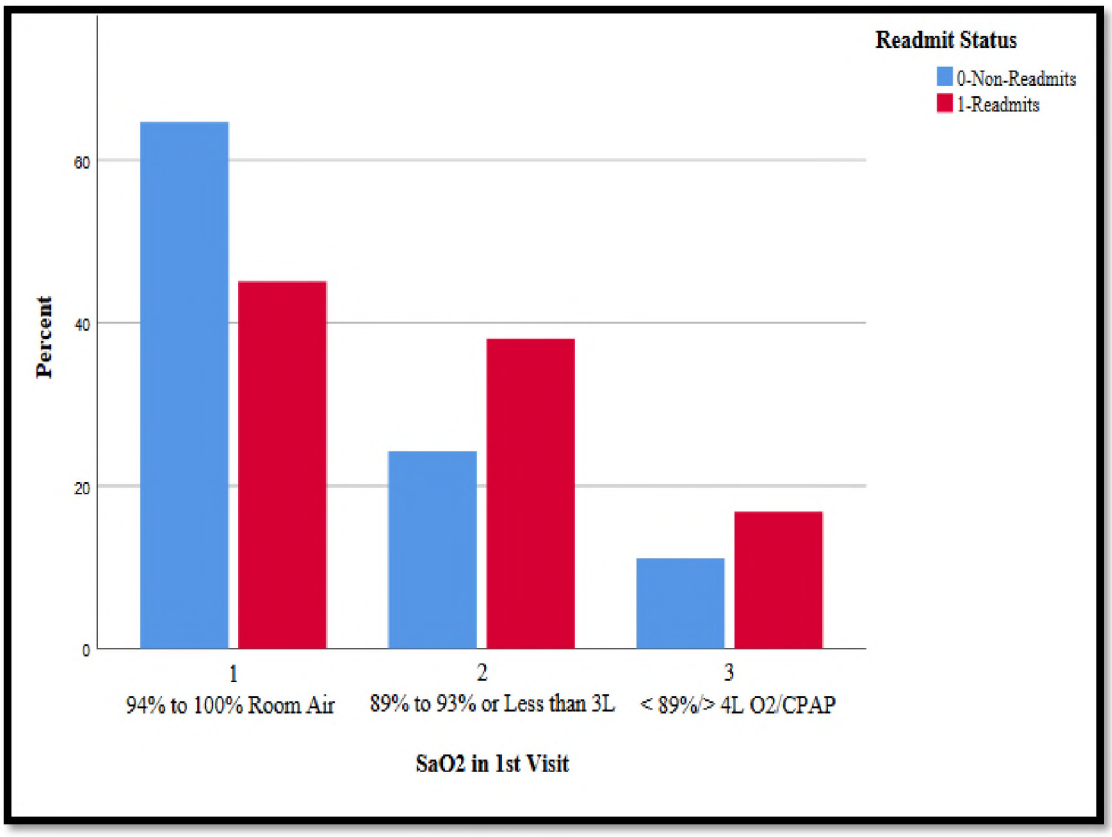

Figure 4.9 **SaO_2 During Hospital Admission by Readmission Status.**

Figure 4.9 shows that the proportion of individuals with 89% to 93% or less than 3L of oxygen who readmitted was significantly more than the proportion that did not readmit. The proportions demonstrate that with the progression of COPD or an exacerbation, oxygen levels become low and readmissions elevate as compared to non-readmits except for the COPD patients with normal SaO2, X^2 (2, N = 233) = 8.1, p = 0.02. Of those that readmitted, 45.1% had 94% to 100% oxygen saturation with room air, whereas 38% of the readmits had 89% to 93% or less than 3 liters of oxygen. Seventeen percent of the readmits had SaO2 of less than 89% with greater than 4 liters of oxygen or CPAP. For the non-readmit group, 64.6 % had 94% to 100% oxygen

saturation with room air, 24% had 89% to 93% or less than 3 liters of oxygen, and 11% had SaO2 of less than 89% with greater than 4 liters of oxygen or CPAP.

The normal SaO2 for adults at sea level is 94-98% (Brill & Wadzicha, 2014). The readmits and non-readmits at level 1 show that on room air the arterial blood is saturated with oxygen. With the readmits and SaO2, there may be an underdiagnosis of COPD which is attributed to the early stages of the disease and may not present with symptoms or with as much intensity as moderate to severe cases (Sandelowsky et al., 2011). Research has demonstrated that approximately 95% of stage 1 - mild COPD and 80% in stage 2 - moderate COPD remain undiagnosed (Sandelowsky et al., 2011).

The risk factors for being undiagnosed with COPD included having a moderate reduction in lung function, not having COPD symptoms, and reported being in good health (Hvidsten et al., 2008). More than one-third of patients admitted to the hospital with respiratory symptoms and many times are diagnosed with COPD inaccurately (Spero et al., 2017). Some factors identified in the literature may be discharging a patient prematurely because of the incorrect index admission, poor medication compliance, lack of patient and family education regarding COPD, and lack of follow-up with primary care physician and outpatient rehabilitation program referrals (Benbassat & Taragin, 2000) Factors that could influence those patients that had 94% to 100% room air oxygen saturation and readmitted was if a patient was admitted at night, their nocturnal SaO2 would be at the highest percent of a 24-hour period (Brill & Wadzicha, 2014).

The readmits at level 2 and 3 indicates that these patients have a more difficult time with oxygen getting into their bloodstream. This may be because there is a loss of lung tissue or airway obstruction (Fletcher & Petro, 1976). Dependent on the time of

day, SaO2 may fluctuate between day and night (Selfi & Moradi, 2018). If a patient had poor circulation, currently uses tobacco, wears fingernail polish, or had artificial nails, there may be an inaccurate result based on finger pulse oximeters (Lee, Hui, Tan & Lim, 1993). Older subjects may have lower levels of SaO2, have sleep disorder breathing, can have myocardial ischemia or measurement error (Lee, Hui, Tan & Lim, 1993).

The recommendation for healthcare workers is to review the GOLD guidelines that have been developed to help clinicians recognize patients with symptoms and help in the early stages of COPD diagnosis (Global Initiative for Chronic Obstructive Lung Disease, 2019). These guidelines are very comprehensive and help to confirm an early diagnosis and improve the management of COPD.

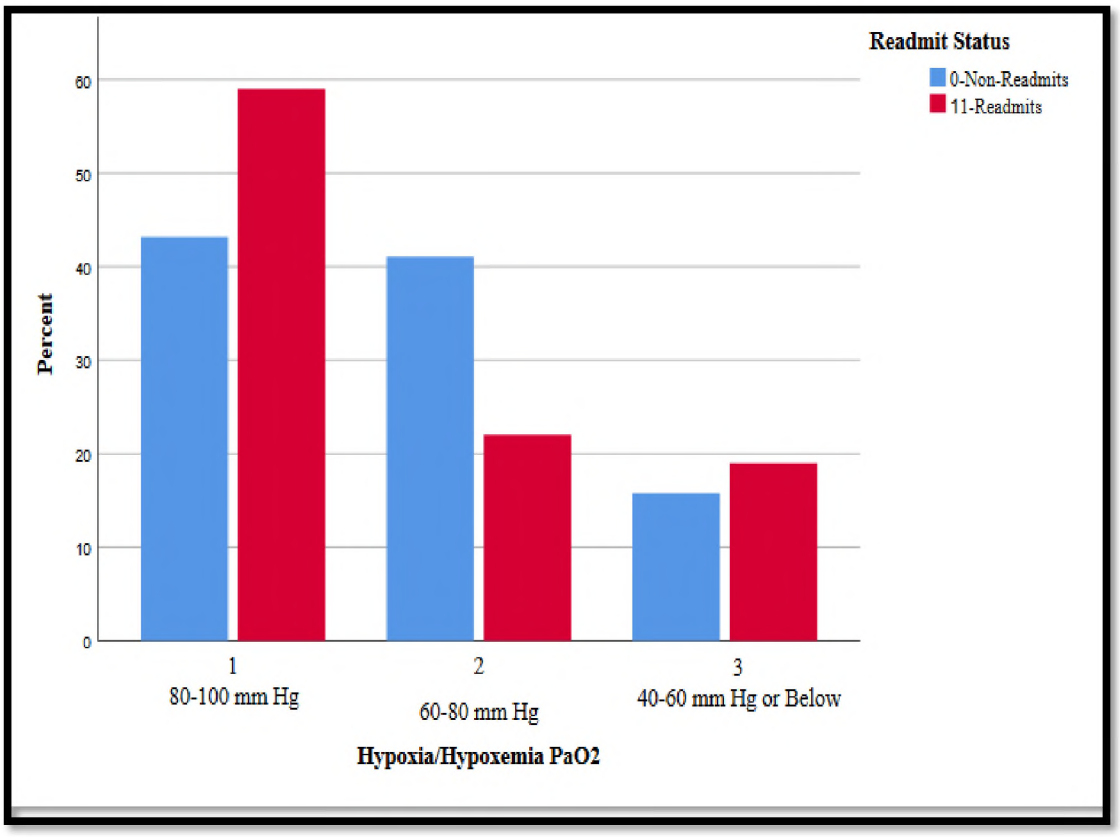

Figure 4.10 **Percent of Hypoxia/Hypoxemia PaO_2 by Readmission Status.**

Figure 4.10 demonstrates that the proportion of individuals at a normal partial pressure of oxygen in figure 4.10 at a level of 80 – 100 mmHg who readmitted was significantly greater than the proportion that did not readmit. The proportion of individuals at a moderate level of 60 – 80 mmHg who readmitted was significantly less than the proportion that did not readmit, X^2 (2, N = 233) = 8.3, p = 0.02.

The readmit group had 59.0 % at 80-100 mm Hg, 36.1% at 60-80 mm Hg, and 19% at 40-60 mm Hg or below. The non-readmit group was evenly distributed in both the 80-100 mm Hg and 60-80 mm Hg with 41.0% and 44.0%, respectively, with the additional 15.8% at 40-60 mm Hg. If there was not a score in the patient medical record, it was recorded as a normal result, and this may have affected the final result.

Whether there is low oxygen in the blood (hypoxemia) or low oxygen supply in the bodily tissues (hypoxia), hypoxemia can cause hypoxia (Porth & Matfin, 2009). Some of the indications of hypoxia can be physically identified by a physician by increased respiration, shortness of breath, respiratory distress using intercostal muscles to breathe, wheezing or crackles, oxygen saturation levels may range from 88 to 92% (Cukic, 2014). There may be a change in skin color being bluish or gray, and the patient would not be able to lay flat in bed, unable to speak full sentences, and experience changes in mental status (Cukic, 2014). When the blood oxygen levels fall below a certain level, a patient can experience shortness of breath, headaches, confusion, or restlessness and may indicate hypoxia/hypoxemia (Porth & Matfin, 2009).

The results in group 1 indicate that there are normal cellular metabolism and normal partial pressure of arterial oxygen. Those in group 2, such as the non-readmits, may be accustomed to living with a PaO2 less than 80 mm Hg if it is a gradual onset (O'Driscoll, Howard & Davidson, 2008). The readmits in the range of 60-80 mm Hg, which occurs suddenly, may be subjected to respiratory failure that may lead to organ failure (Kong & Wilkinson, 2019). Respiratory failure having PaO2 less than 60 mmHg can be divided into type I or II depending on PaCO2 (Cukic, 2014).

As Cukic 2014, concluded in her study of airflow limitation, the patients that received appropriate treatment such as bronchodilator medication and inhaled therapy along with symptom management being more medically mentioned and have fewer readmissions with the results of the patients in category 2. Those patients that did not administer bronchodilator medication and complete their inhaled therapy, manage their symptoms, and follow up with a physician would have a higher likelihood of

readmissions (Cukic, 2014). It was also mentioned that those that have had COPD longer might not respond as well to treatment which could be a cause for readmissions (Cukic, 2014). The number of exacerbations a patient has a year along with bronchial inflammation will also determine the prevalence of readmissions with COPD patients (Pauwels et al., 2001)

Those patients in group 3 could be in severe respiratory distress. There will be a ventilation/perfusion mismatch with this group. The damage of the bronchial mucosa can lead to the impairment in lung ventilation which can impair gas exchange causing hypoxemia/hypoxia (Cukic, 2014). Depending on the interventions of supplemental oxygen through a nasal cannula or through a BIPAP machine, steroids, inhaled bronchodilators, mucolytics, and respiratory therapy along with the post-discharge care chosen will determine the likelihood of readmissions (Piper, 2010)

Recommendations to healthcare workers would be to document any comorbid conditions. Perform a clinical assessment using pulse oximetry an arterial gas analysis which will quantify arterial partial pressures of oxygen and carbon dioxide and blood pH, which is the "gold standard" to assess oxygenation (O'Driscoll, Howard & Davidson, 2008). Document physical exam findings of wheezing, nasal flaring, assessor muscle use, etc. Testing maybe need to be done every 30-60 minutes to resume normal levels (Cukic, 2014).

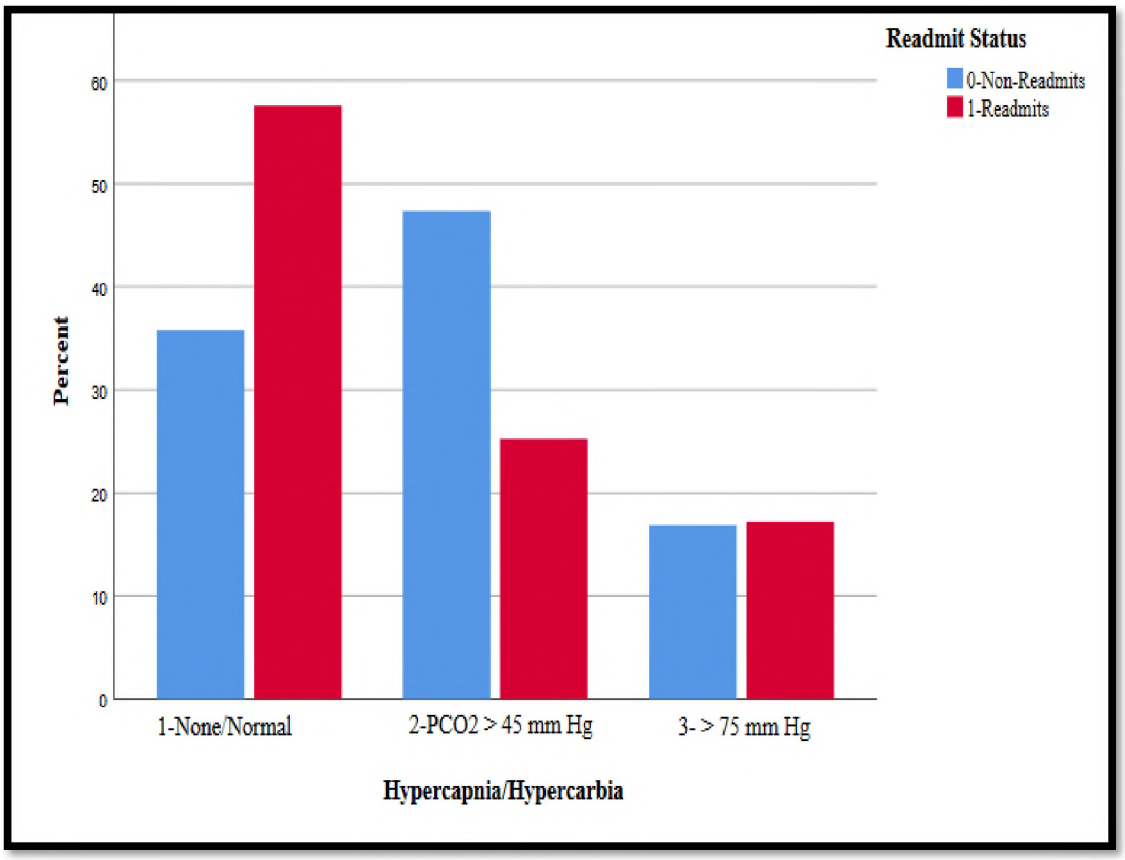

Figure 4.11 **Percent of Hypercapnia/Hypercarbia by PcO_2 by Readmission Status.**

Figure 4.11 shows that the proportion of individuals not having hypercapnia/hypercarbia who readmitted was significantly greater than the proportion that did not readmit X^2 (3, N = 233) = 11.5, p = 0.003. The readmit group was the highest in the none/normal category at 57.6 %, whereas those with a PcO2 of greater than 45 mm Hg was 25.3 %, and 17.2 % of patients readmitted had a PcO2 of 75 mm Hg or higher. The non-readmit group had 47.4 % with a PcO2 of greater than 45 mm Hg, 16.8 % with a PcO2 of 75 mm Hg or higher, and 35.8% with a normal PcO2. The patients at SUCH that readmitted with the highest frequency had normal PcO2 levels. This could indicate that the test was not completed and scored as having a normal level of CO2 (Cukic, 2014), or they had normal levels of CO2.

To diagnose hypercapnia or hypercarbia, a physician needs to order an arterial blood gas test and examine lung and breathing function. Kong and Wilkinson (2019) studied the predicted variables for hospital readmissions. It was determined that more than one comorbidity, previous hospital admission, frailty, and poor nutrition, and lower socioeconomic status were at the highest risk for readmissions. This could support the results for readmissions in the normal CO2 group, group 1 (Kong and Wilkinson, 2019). To identify the presence of an interaction between categorical variables in group 1, an analysis of variance would need to be tested for more definitive results. For the results in groups 2 and 3, Bahadori & FitzGerald, 2007, indicated that risk factors for readmissions include previous hospital admissions, hypercapnia, and patients on oxygen use long-term. Jenks, Williams, and Coleman, (2009) identified additional patient factors for the readmission of COPD patients include patients that use oxygen at home, hypercapnia, comorbidities, systemic corticosteroid use, smoking, and drug use (Jenks, Williams and Coleman, 2009).

At the moderate level, the proportion of individuals with a PCO2 level greater than 45 mmHg who readmitted was significantly less than the proportion that did not readmit. Not everyone with COPD will develop hypercapnia or hypercarbia. If a patient has more severe symptoms, testing may be performed on a patient, especially if the patient has bronchitis leading to inflammation and mucus in the airways (Kong & Wilkinson, 2019). The comorbidities of congestive heart failure, lung cancer, obesity, depression, diabetes, chronic kidney disease, hypertension, and sleep apnea were all related to higher rates of readmission (Kong & Wilkinson, 2019). The patient's objective biological state of their lungs is sometimes not accurate by the patient's beliefs, and this

communication of symptoms may influence how a hospital proceeds with testing (Kennedy et al., 2017).

Recommendations for patient management from Silver et al., 2017 with COPD should include respiratory therapy disease management to decrease hypercapnia include, a discharge program included the relatively low cost (respiratory therapist case-management, subject teaching, written action plan, telephone follow-up), minimal technology required (telephone), and applicability to a diverse population of subjects with COPD exacerbation (Silver et al., 2017).

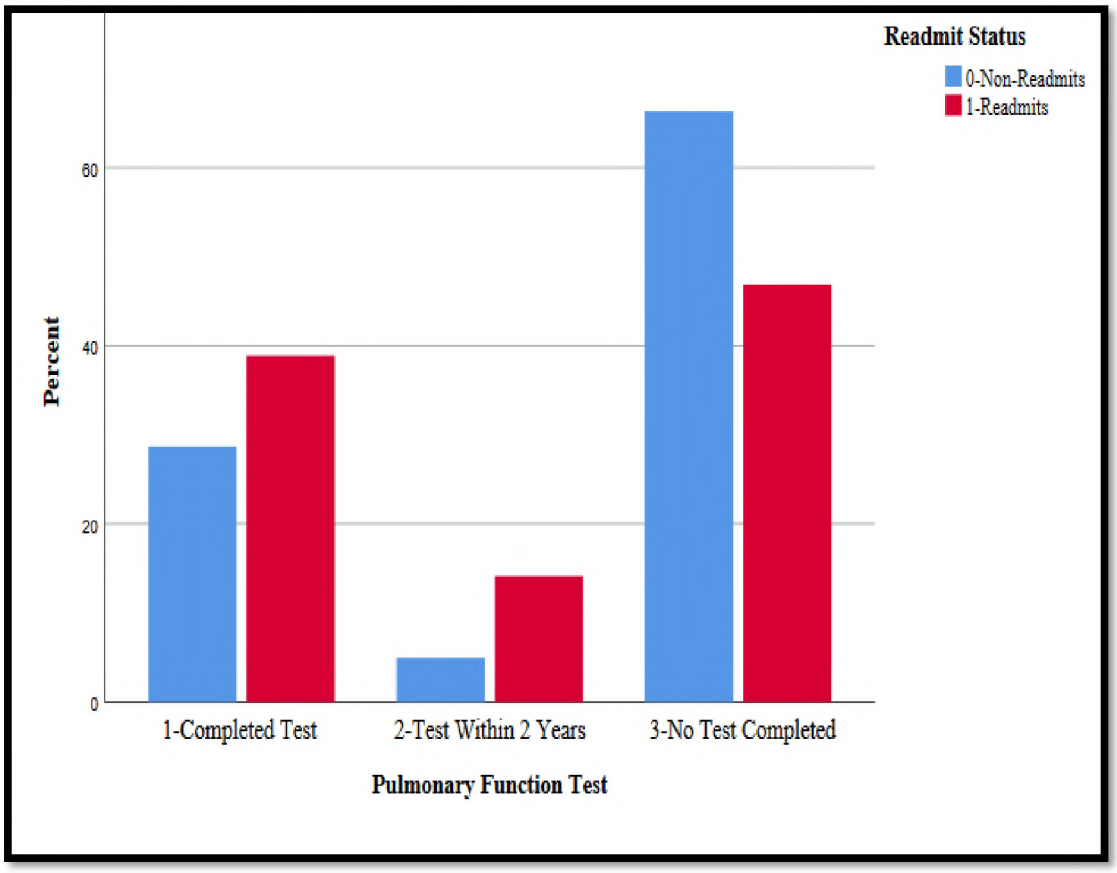

Figure 4.12 **Patients that Completed a Pulmonary Function Test by Readmission Status.**.

Figure 4.12 shows that the number of individuals that did not have a PFT who readmitted was significantly less than the proportion that did not readmit, X^2 (3, N = 233) = 9.8, p = 0.01. The readmit group was highest in the category of not having the test performed at 41.2%. The remainder of the readmitted group was almost 39.0 % having the pulmonary function test done, and 15.7 % had the test performed within two years of the visit. The non-readmit group scored the highest in the category of no test performed, with 64.2 % of the patients not getting a pulmonary function test. The remainder of the non-readmit group had 30.5 % that had received a pulmonary function test, and 5.3 % that had completed the test within two years of their visit to the hospital. The pulmonary function test (PFT) is only performed approximately 20% of the time at SUCH. It should be noted that when patient scoring was completed there may have been confusion with the category of completed test (test with completion and no documented date) versus those that had a test completed within two years (with a documented date).

The PFT declares the severity of disease by the forced expiration of air in one second (FEV_1) (Global Initiative for Chronic Obstructive Lung Disease, 2019). Spirometry is the gold standard for diagnosing COPD (Global Initiative for Chronic Obstructive Lung Disease, 2019). COPD is usually not diagnosed until it is in its advanced stages (Feinberg et al., 2017). Many times, it will go undiagnosed (Hvidsten et al., 2008). Many patients that have not had spirometry or a PFT are not clinically diagnosed based on the severity of COPD, which does not follow clinical guidelines (Stein et al., 2012). A history and physical examination cannot make an accurate clinical diagnosis of COPD (Spero et al., 2017: Kenealy et al., 2011: Shah, Press, Husingh-Scheetz & White, 2016: Global Initiative for Chronic Obstructive Lung Disease, 2019).

If a diagnosis is missed, a patient will not benefit from the appropriate treatment or be treated for a disease that they do not even have (Gershon et al., 2013). Many of those patients in the non-readmit group did not have a PFT, possibly because of not presenting with worsening symptoms (Sandelowsky et al., 2011. Nearly 40% of those in the readmitted group had a PFT. Depending on when the PFT was performed may give variance to study results. If the PFT was not done in the last five years, it was not considered valid (Global Initiative for Chronic Obstructive Lung Disease, 2019).

A clinical diagnosis of COPD is intended to be confirmed by spirometry or a pulmonary function test (Hyun-Kyoung Koo et al., 2018). In this study, if a patient had a processed medical claim by their insurance company and it was accepted, the patient diagnosis was labeled COPD. To have a clinical diagnosis, the FEV_1 FVC ratio is < 0.70. The GOLD guidelines, American College of Physicians, the American College of Chest Physicians, and the European Respiratory Society of COPD guidelines use < 0.70. This is fixed regardless of gender, age, and BMI (Global Initiative for Chronic Obstructive Lung Disease, 2019). Along with spirometry symptoms, the number of exacerbations in a year must be considered (Montuschi, 2006).

Recommendations to healthcare for completion of a pulmonary function test that classifies airflow limitation in a COPD patient are described. The existence of a post-bronchodilator Forced Expiratory Volume of Air in one second (FEV_1) < 0.70 can verify the presence of limited airflow along with the patient's identification of symptoms and noted exposure to harmful toxins of a COPD patient (Global Initiative for Chronic Obstructive Lung Disease, 2019). Pelligrino et al., 2005 stated, "Spirometry is the most accurate and factual measurement of airflow limitation. Spirometry should measure the

volume of air forcibly exhaled from the point of maximal inspiration (forced vital capacity, FVC), the volume of air exhaled in the first second of the test (forced expiratory volume in one second, FEV_1), and the ratio between the forced vital capacity and forced expiratory volume FEV_1/FVC ratio (Pelligrino et al., 2005). The presence of a post-bronchodilator $FEV_1/FEV < 0.70$ confirms the presence of persistent airflow limitation and determines if a patient has COPD (Pelligrino et al., 2005).

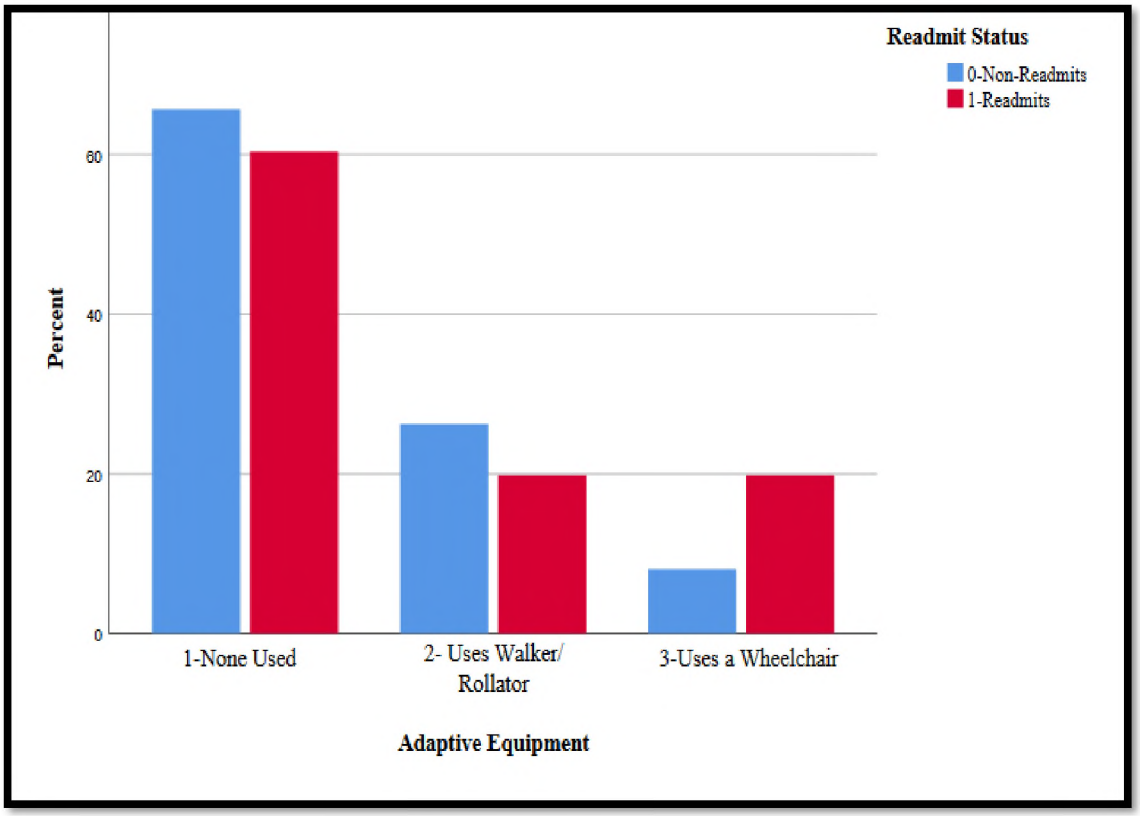

Figure 4.13 **Percent of Adaptive Equipment by Readmission Status.**

Figure 4.13 demonstrates that individuals who used a wheelchair daily who readmitted was significantly greater than the proportion that did not readmit, X^2 (3, N = 233) = 6.2, p = 0.04. The readmit group had 60.4 %, as documented, with no adaptive equipment, those having a walker/rollator or a wheelchair, the medical records indicated a report of 19.8 % in each group. The non-readmit group had 65.7 %, as documented as

having no adaptive equipment, 26.3 % of those patients that used a walker/rollator and 8.1 % as reported using a wheelchair.

Physical/Occupational therapy is provided at SUCH for patients with COPD. Activity limitation is a major consequence of dyspnea in COPD patients. Sociodemographic characteristics may impede the functionality of those with COPD, especially when living in the central neighborhood surrounding SUCH (Cuyahoga County Health Needs Assessment, 2016). Because of the abundance of patients using rollators, having limited green space, and having to use supplemental oxygen, this prohibits high activity levels and increases the disease's severity (Yam et al., 2010).

Many of the patients, especially in the readmit group, did not receive or refused physical/occupational therapy during their hospital stay. With the search through the therapist's notes, clinicians may have tried to initiate therapy, and the patient was receiving breathing treatments, or sleeping interventions, and therapy was not completed. In many cases, it may have been well documented that a patient declined therapy. Recent illness exacerbation requiring hospitalization and accompanied by a decline in functional status would receive inpatient physical rehabilitation (Harth, 2009). A patient's exercise tolerance is not specifically limited to shortness of breath; it may be due to other orthopedic issues or fatigue, general, physical, cognitive, or mental (Spruit et al., 2013). Despite the documented benefits of exercise and the reduction in shortness of breath, enhanced physical endurance, patients were not using pulmonary rehabilitation, which created a gap in their quality of health care and may have caused increased 30-day readmissions (Seamark, Seamark & Halpin, 2007). Most patients are not referred to pulmonary rehabilitation (Johnston & Grimmer-Sommers, 2010). Linking health care

professionals such as exercise physiologists, respiratory therapists, nurses, dieticians, pharmacists, and physicians have demonstrated improved outcomes (Derdak, 2017).

Many SUCH patients decline a 6-minute walk test due to the low levels of physical activity they have before hospitalization. The 6-minute walk test can be a predictor of mortality and quality of life (Karanth & Awad, 2017). A specialized pulmonary rehabilitation program can help with the disease's symptoms and limitations (Spruit et al., 2013). Unfortunately, there is a low referral rate of patients with COPD to attend pulmonary rehabilitation at SUCH and across the nation (Johnston & Grimmer-Sommers, 2010).

Adaptive equipment is sometimes necessary with COPD because it restricts mobility and other activities due to shortness of breath and diminished exercise capacity (Gupta, Goldstein & Brooks, 2006). A lot of the patients that are admitted to SUCH with COPD need the use of a walker/rollator or powered wheelchair to get around. As many as 60% of both the non-readmit and readmit group did not indicate the use of any adaptive equipment to help with mobility. The wheeled walker is useful when a patient uses a portable oxygen tank and has to rest when walking short distances and can improve with walking performance over time (Gupta et al., 2006).

Based on the literature, extra efforts should be made to refer patients to pulmonary rehabilitation for symptom improvement (Simmering et al.,2016). Pulmonary rehabilitation should ideally start within 30 days of discharge from the hospital (Johnston & Grimmer-Sommers, 2010). Spruit et al., 2013 reviewed pulmonary rehabilitation as a multidisciplinary intervention based on patient assessment followed by an individualized treatment plan that includes exercise training, education, medication management, and

self-management of symptoms aiming at behavior change designed to improve COPD's physical and psychological conditions (Spruit et al., 2013).

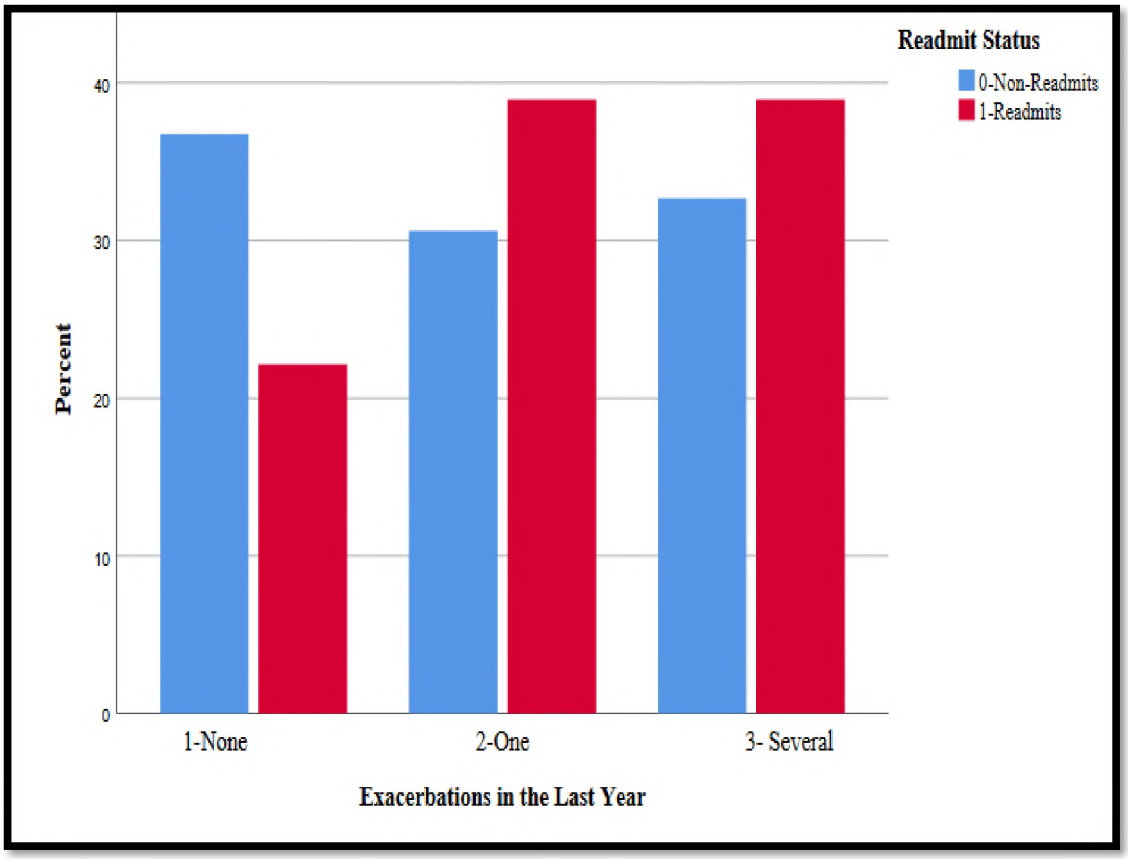

Figure 4.14 **Percent of Patients and the Number of Exacerbations by Readmission Status.**

Figure 4.14 shows the proportion of individuals that did not have any previous exacerbations readmitted significantly less than those that did not readmit, X^2 (3, N = 233) = 5.5, p = 0.06. The readmit group had 38.9 % of one exacerbation, 38.9% of several exacerbations, and 22% did not have an exacerbation in the last year. The non-readmit group reported that 36.7 % did not have an exacerbation in the previous year, 30.6 % had at least one exacerbation in the last year, and 32% had more than one exacerbation within a year.

An exacerbation is defined as a flare-up or worsening respiratory symptoms. The literature identifies that 10 to 55% of readmissions for an acute exacerbation of COPD may be prevented (Centers for Disease Control and Prevention, 2021). As Montuschi, 2006 suggests, when a patient is treated, they may require antibiotics or corticosteroids and those patients that listed none in the number of exacerbations were medically managed whereas those that readmitted were not and therefore were more likely to require hospitalization (Montuschi, 2006). Pharmacologic therapy is used to reduce the symptoms of COPD patients and the frequency and severity of exacerbations, and they also improve health status and the ability to exercise (Montuschi, 2006). Twenty-five percent of patients with an acute exacerbation of COPD do not recover lung function by day 30, leaving readmission as an appropriate remedy (Donaldson et al., 2015).

Alfagame et al., 2006, indicated that receiving a pneumonia or influenza vaccinations were found to significantly reduce the likelihood of a COPD exacerbation. An exacerbation can last for days or several weeks. As lung function declines, exacerbations may increase in frequency. Every time this occurs, it leaves behind irreversible lung damage. Exacerbations can be caused by a lung infection or triggered by pollutants or situations in which it is difficult to breathe, especially exposure to smoke (Alfagame et al., 2006).

The data represents a good picture of those that had more exacerbations readmitted back to SUCH at an increased rate. Having one or several exacerbations increased the chance of being readmitted within 30 days (Kenealy et al., 2011). It is essential to understand the causes and reasons for early readmission, such as comorbidities, hypertension, diabetes, electrolyte disorders, and anemia (Simmering et al., 2016). Stein

et al., 2012, documented the challenges with the management of COPD indicating, that hospitals are significantly underestimating the burden of hospitalizations for an acute exacerbation of COPD (Stein et al., 2012). There has been a lack of evidence to recommend specific interventions to reduce recurrent 30-day readmissions in those patients with COPD that have had an acute exacerbation of COPD (Prieto-Centurion et al., 2014; Shah et al., 2016).

A recommended step is to develop and validate a risk scale to predict better patient patterns that have readmitted back to the hospital within 30-days. The barriers associated with low economic status represent a challenge beyond the control of SUCH and will independently increase the likelihood of 30-day readmissions (Portillo et al., 2018).

Non-Significant Variables

The first variable from the covariate table was age, and it was evenly distributed between the non-readmits and readmitted with the highest scores in the 60-80 years old category. The average age at SUCH admitted to SUCH with a primary diagnosis of COPD is 64 years old for both males and females. Age is a non-modifiable risk factor (CDC, 2021). There was a moderate risk for both the readmitted and non-readmitted patients between ages 60 and 80. COPD often occurs most of the time in older adults (Bahodori, 2007).

The living arrangements were equally distributed among the non-readmits and readmitted with the highest score category in those that live alone category. The living arrangements of the SUCH patients who have COPD were at almost 80% for those that did not readmit and those that readmitted within 30-days. The quality of the housing and

conditions associated with poor income may increase the chance of being exposed to molds, roaches and mites, lead, carbon monoxide and other compounds. Individuals may be exposed to high temperatures which can lead to adverse health outcomes (Gan et al., 2017).

The comorbidities of each score category was remarkably similar with groups 1, 2, and 3. The highest number of both readmits and non-readmits had greater than five comorbidities in scoring level 3. The second category was 15-20% of having 3 or 4 comorbidities in both groups, and less than 10% of both groups had less than three comorbidities. Many of the patients at SUCH have multimorbidity which means having several comorbidities. Having multiple comorbidities can significantly impact health, health care utilization, and associated costs with healthcare treatment (Stephens & Yew, 2008; Jenks, Williams and Coleman, 2009; Global Initiative for Chronic Obstructive Lung Disease, 2019; Simmering et al., 2016; Prieto-Centurion et al., 2014).

The covariate group of hypertension on medication was distributed equally with almost 60% of both the readmits and non-readmits having hypertension with a measure of 120/80- 140/90 and 30% of both groups above 140/90 and a little over 10% being without hypertension. Having hypertension is a condition in which the more blood the heart pumps the narrower the arteries become creating high blood pressure. When the lungs are damaged there is a reduced amount of oxygen that goes to the blood. The diseased lung can produce more red blood cells making the blood viscous and harder to pump which makes a person take on more oxygen by breathing faster (Imaizumi, Eguchi, & Kario, 2014).

As expected in the study, smoking and smoking history is one of the leading causes of COPD. Both groups were close to 40% as having quit for five or more years, or being a current smoker. Many patients may be unaware that secondhand smoke can be a contributory factor in COPD development. Many patients or family members smoke in their homes, and individuals can be exposed during childhood and teenage years which, slows lung growth and development (Stephens & Yew, 2008). With having limited education or smoking cessation opportunities, many patients will not be truthful about how much they smoke (Bantus, 2013). Some of the influences of smoking are mentioned in lieu of the urban disadvantaged population (Calvillo-King et al., 2013). This includes occupation, low education level, living in a deprived area, low income, low-income level due to respiratory diseases, higher frequency of respiratory symptoms such as productive cough, dyspnea and shortness of breath that affects activities of daily living, airborne exposure, untreated bronchitis and emphysema, unemployment, manual workers, communities with a lot of smokers, marital status, lack of insurance, physical impairment, access to health care, not having a primary care physician, health literacy, seasonal influences, and the lack of clinical diagnosis of COPD due to patients being a poor historian or embarrassed about their use of tobacco (Pleasants, Riley & Mannino, 2016), (United States Public Health Service, 2008) .

Among the covariate of heart failure symptoms on admission, the readmitted group had the highest percentage of 45% of patients with no symptoms. Approximately 42% had heart failure symptoms on exertion, and 13% had documented orthopnea upon admission. The non-readmit group had 52% of patients with heart failure symptoms on exertion, while 30% had no heart failure symptoms, and 18% had reported orthopnea

upon admission. Heart failure symptoms may reveal themselves as being virtually the same as COPD. From around 10-40% of patients with heart failure have reported concurrent COPD because of pathologic changes that can define the clinical presentation (Hawkins, Virani & Ceconi, 2013).

The covariate group of LABA/ICS drug combination medications had the readmitted group with taking medications as PRN at almost 70%. The non-readmit group was slightly above 60%. The readmit group had a little above 20% as non-compliant with medications, and the non-readmit group had under 20% of non-compliance with medication. The readmit and non-readmit groups had under 20% of those patients who did not take LABA/ICS drug combinations.

The most popular medications distributed to patients during a hospital stay is Ventolin (SABA), Symbicort (LABA), and Atrovent (SAMA). A combination of Albuterol Sulfate and Ipratropium Bromide may be used and the addition of Symbicort or LABA/ICS drug combinations (Montuschi, 2006). It has been found that 1 in 10 patients with a metered dose inhaler performs all the steps correctly (Montuschi, 2006). Patient's health beliefs, experiences and behaviors play a big role in the management of pharmacological therapy (Restrepo et al., 2008).

The covariate weight classification is evenly distributed with the normal/overweight weight classification; over 40% of the readmits and non-readmits are ranked in this grouping. The non-readmits were classified at almost 40%, and the readmits at 25% of the obese category. In the morbidly obese category, the readmits at nearly 30%, and the non-readmits were a little less than 20%. The weight classification of patients was equally distributed in both groups. The most prevalent of those that

readmitted was almost 50% as normal, 25% obese, and nearly 30% as morbidly obese. There were significantly fewer patients in the non-readmit group that were morbidly obese at less than 20%. Guo et al., 2016 investigated body mass index and mortality in COPD, it was shown that those patients that had a BMI in the normal weight category had a higher risk of death. An increase in BMI was associated with a decreased risk of death (Guo et al, 2016).

The wheezing covariate was distributed evenly across each level of none, expiratory and constant wheezing. The most significant group was in the expiratory group with both readmits and non-readmits at 50%. The readmits at 37% with none and the non-readmits at less than 35%. The readmits were at 12% with the constant wheezing, and the non-readmits were slightly higher at 17% of wheezing category groups. Wheezing is a common and very noticeable symptom of COPD. When wheezing is absent this does not exclude COPD. Some wheezing may be undetected. Wheezing will typically occur when COPD is getting worse with worsening shortness of breath, increased mucous production and cough, headaches, and fever. Dependent of how the wheezing was assessed and reported in the patient's chart was documented accordingly. Physical examination, purse-lip breathing, breath sound intensity, forced expiratory time, abdominal paradox, Hoover's sign, barrel-shaped chest, accessory muscle use should all be used for evaluation (Sarkar et al., 2019).

The covariate severity of disease was very equally distributed. Almost 80% of the patients in both the readmit and non-readmit categories had a nasal cannula while being admitted to the hospital. Less than 20% of both groups had 4L of oxygen or a CPAP. Less than 5% of both groups required intubation during their stay in the hospital. Oxygen

has one of the most value clinical importance factors in the care of COPD in a medical emergency. Oxygen is given to virtually all patients that are short of breath. Three reasons oxygen may be used in a hospital environment would be to correct hypoxemia, to prevent hypoxemia, and is administered because a clinician believes that oxygen can help reduce breathlessness (O'Driscoll et al., 2008). It is important to consider all factors when oxygen is administered to COPD patients, those with chest wall problems or those that have taken opiates (O'Driscoll et al., 2008). The purpose of administering oxygen therapy is to increase oxygen delivery to the tissues and not to just increase oxygen carried to the blood (Seifi, Khatony & Moradi, 2018). If a patient is critically ill blood gases will need to be taken upon arrival to the hospital for assessments of hypercapnia, hypoxemia and acidosis to determine if a patient needs oxygen therapy (Glouberman et al., 2017)

With the covariate FEV_1., the readmit group that scored the highest was almost 40% in the severe level of 49% or less. Thirty-five percent were at the mild level, which is greater than 80%. Almost 30% of the readmitted group were at the moderate level of 50-79%. The non-readmit group that scored the highest was almost 45% in the severe level of 49% or less. Thirty-five percent were at the moderate level, which is 50-79%. Almost 18% of the non-readmit group were at the mild level in the level greater than 80%.

The forced expiratory volume of air in one second (FEV_1) is determined accurately post-bronchodilator (GOLD, 2020). Any FEV_1 determined pre-bronchodilator to determine GOLD classification may not reflect a bronchodilator response, which could determine asthma, and this is a reversible disease (Griffiths et al, 1999). The data

represent only a small sample with less than 30% of patients of both the non-readmits and readmit groups having a completed spirometry performed. Patients may have had a completed PFT but there was not a documented FEV_1 and whether or not a bronchodilator was administered during their PFT in their patient chart to have a clearly defined severity.

In the covariate previous ECHO, the groupings were similar. Both the readmits and non-readmits were above 60% as a yes, the test was completed. For both the readmits and the non-readmits, both were close to 20% of being completed within two years of their visit to the hospital. With the group that indicated no, the test was not performed, the non-readmit group was slightly above 20%, and the readmitted group was at about 18%. An ECHO is frequently performed in patients with COPD with or without cardiovascular disease. Approximately 80% of all COPD patients in both the non-readmit and readmit groups had the test performed as it was used to look for cardiac alterations and left/right heart disorders (Morgan et al., 2018). Any cardiac issues were self-reported by the patient. Having a cardiac comorbidity should always be considered with a diagnosis of COPD (Hvidsten et al., 2008).

With the evaluation of systolic heart failure by ejection fraction, the readmitted group scored the highest in the normal ejection fraction category with the covariate systolic heart failure, which would mean 55 – 70 percent, which was 70%. The readmit group had 20 percent of the patients with an ejection fraction greater than or equal to 40-50%. The readmit group that had less than 40% as an ejection fraction was less than 20%. The non-readmit group scored the highest in the normal ejection fraction category, which would mean 55 – 70 percent, at 63%. The non-readmit group had 20 percent of the

patients with an ejection fraction greater than or equal to 40-50%. The non-readmit group that had less than 40% as an ejection fraction was 17%. Because clinical signs and symptoms of both COPD and congestive heart failure (CHF) overlap both a pulmonary function test and echocardiography should be performed on every patient (Sin & Man, 2003). Left-sided heart failure can cause fluid buildup in the lungs and exacerbate the symptoms of COPD (Zulman et al., 2013).

With the covariate right ventricular systolic pressure (RVSP). The readmit group had 70% of the patients in the mild range of 25-40 mmHg. Almost 30% of the patients had an RVSP of moderate with a range of 41-55 mmHg. The readmit group had 10% of those in the severe category with a pressure greater than 55 mmHg. The non-readmit group had 61% of the patients in the mild range of 25-40 mmHg. Almost 21% of the patients had an RVSP of moderate with a range of 41-55 mmHg. The readmit group had 18% of those in the severe category with a pressure greater than 55.

Right ventricular systolic pressure is an indicator or pulmonary hypertension which can be a complication of COPD (Barst et al., 2004). Pulmonary hypertension develops in 30% to 70% of COPD patients (Barst et al., 2004). Over 60% of the readmits and non-readmits had normal RVSP. This is a report of only the patients that had a documented echocardiogram in their medical history. If this was not documented the patient received a zero in the covariate scoring table. This was an inadequacy of the study data. Of those patients that had the reported data, almost 20% of the non-readmits were at the severe range. The "gold standard" for the measurement of pulmonary arterial pressure is through cardiac catheterization, very few of the patients at SUCH have this test performed (Barst et al., 2004). Some of the cardiologists that perform an

echocardiogram may not include the RSVP in the test results. It would be an important consideration to screen all clinically diagnosed COPD patients for pulmonary arterial hypertension in the future for increased treatment of their multi disease condition. It has been shown that those patients with a RVSP > 55 also had a FEV_1 that was severe in nature (Sim, 2007).

The covariate physical/occupational therapy was the documentation of whether the patient received physical or occupational therapy during their hospital stay. The readmit group that scored the highest was no PT/OT completed during their stay and calculated as 62%. Twenty percent were reported as having active services during their stay. The readmit group that reported that the patient declined therapy was 18%. The non-readmit group reported from the assessment part of the patient's medical record that there was no PT/OT completed during their stay was 50%. Thirty-two percent were reported as having active services during their stay. The readmit group that reported that the patient declined therapy was 19%.

The goal for inpatient physical/occupational therapy for a COPD patient is to maximize their endurance and functional independence (Clini et al., 2009). Patients may reduce the length of their hospital stay and return home sooner (Seemungal et al., 1998). Patients take considerable time to recover to baseline levels of their physical functioning after a COPD exacerbation, with 25% of them who do not fully recover the peak-flow level after three months after a hospital stay (Clini et al., 2009).

CHAPTER V

CONCLUSION

The current study explored the 30-day readmission status among the COPD patients at the small urban community hospital in Cleveland, Ohio. The results of the current study may be an initial step toward understanding COPD readmissions in the Central Cleveland area. It encourages more investigation focusing on the readmission phenomenon in this urban population with COPD. Variables can be identified during admission using a comprehensive assessment and can be used to create an individualized discharge plan according to the evaluation of risk with each patient. Upgraded care of the patients in the hospital and in the community could create a cost savings if discharge planning is aware of patients at high risk of readmission and the patient is provided disease specific interventions.

The newly identified patient factors of SUCH acknowledges that the COPD disease burden is influenced by health-related factors and the socioeconomic, environmental, cultural, and behavioral characteristics of the patient. From a clinical perspective, it is incredibly challenging with SUCH because the disease factors interact with the patient's environmental and social factors. Some factors may underlie with each patient when two or more conditions exist, especially with how patients with multiple

conditions view their illness and how that perspective relates to professional medical treatment (Kennedy et al, 2017).

There were two primary objectives for this study. The first objective of this study primarily focused on the examination of each post-discharge care pathway chosen and, which patients readmitted within 30 days. This objective was met and it was found that HHC readmitted the most within 30-days. The second objective of this study focused on the characteristics of each patient that readmitted within 30-days individually and by discharge group. Each patient's medical chart was examined for demographics, respiratory symptoms, risk variables, comorbidities, diagnostic groups, hospital testing and medications and all physician documentation and patient history for the clinical practice management of each patient diagnosed with COPD. When reviewing the patient medical charts, each patient was scored by variable according to severity by the listed numerical documentation.

With the identification of significant variables from this study, a system's process can create an awareness with alerts to case management that patients with certain characteristics can be at risk of 30-day readmission at the Small Urban Community Hospital (SUCH) with COPD. The future development of a clinical pathway can help clinicians determine the route of post-discharge care and management of COPD. The identification of variables to predict readmission, and the determined pathway of care will promote the adherence to a program to increase the most significant improvement in the patient's COPD, improve quality and practice and decrease the financial expenditures for readmissions (Simons-Morton, McLeroy & Wendel, 2012).

Both hypotheses were accepted from a research question standpoint. Hypothesis ($\mathbf{H_{a1}}$) was accepted because the HHC group readmitted at a higher rate than the other groups and the second hypothesis ($\mathbf{H_{a2}}$) was accepted because 48% of the covariates that were analyzed were statistically different between those that readmitted and those who did not.

Strengths of This Study

This research study has several strengths as compared to other studies with the evaluation of 30-day readmissions and post-discharge care. First, this evaluation occurred in a small, urban community teaching hospital amidst three other larger hospitals, data was extrapolated with care with this only being a single hospital. This hospital is considered the downtown hospital in the heart of the central neighborhood in an urban area with a very diverse population.

Second, to review the post-discharge care accuracy, the records were reviewed comparing discharge status to that in which the patient was billed and reported to Medicare/Medicaid and private insurance. The data was reviewed by the clinical documentation specialists at the hospital before proceeding with data interpretation.

Third, not every patient was clinically diagnosed with COPD. Patients may have been diagnosed with COPD based on symptoms and smoking history. Many of the patients with COPD did not have a pulmonary function test to clinically diagnose the severity of the disease. The degree of accuracy was ensured by verifying that each COPD patient had a processed and approved claim by Medicare/Medicaid with COPD as the primary diagnosis for both the whole patient sample and the 30-day readmissions. All

patient's, disease diagnoses, and post-discharge care settings were verified through paid medical claims.

Fourth, the model's framework was used to identify the covariates that would be most representative to the SUCH patient population, as well as the rating scale used from 1 being mild to 3 being severe based on biologic or numerical markers. All patient records were reviewed individually to rank the covariates by severity to begin the development of a post-discharge care plan. Patient medical records were evaluated individually which allowed the reviewer to get an exact representation of each post-discharge care category and those characteristics that were shown as having the highest risk level. Previous studies stopped at the investigation of what post-discharge care setting was chosen and why. This study evaluated the commonalities of the variables in each setting to create a platform for developing a systematic plan for the discharge process.

Fifth, this project involved using clinical data generated by healthcare providers, and the healthcare system to create new knowledge about post-discharge care and improve outcomes of COPD patients. The researcher worked on translating data into knowledge and knowledge into a future action plan. One of the goals of this research was to provide information on characteristics to improve the directive for the coordination of services and enhance the identification of the best choice of post-discharge care for COPD patients with identified variables. With the statistical analysis of patient covariates, this study provided insight into recognition of the characteristics (covariates) that were presented in the patients that presented a low, medium and high-risk score for those that did not readmit within 30 days and those that did readmit within 30-days.

Sixth, A covariate scoring chart was developed from an extensive review of the literature that used several different predictive models (ADO, BODEX, DOSE, and LACE) for identifying those individuals at high risk for readmission. The covariate scoring chart was a model that was developed using 30 different variables. The scored results gave indications of how the variables measured proportionally with readmits versus non-readmits by severity.

Seventh, additional information was gained as to the common characteristics with the patients discharged to all discharge dispositions that readmitted within 30-days and those that did not. The data from this study provided the building blocks of a model to evaluate each patient's risk that is diagnosed with COPD. Maintaining efforts to prevent readmissions at SUCH can be targeted by the known risk factors that may trigger awareness with each patient's identified demographics and characteristics.

Limitations/Challenges of the Research Study

This study had some limitations. First, by using patient charts, misclassifications of patient's records and characteristics may have been possible when the variable scored was interpreted into a score. Second, we did not account for some of the patient information including transportation, severity of disease was determined by what type of device was used to deliver oxygen because the severity of disease was not declared in the clinical documentation with spirometry. Third, a lot of the patient symptoms were self-reported and clinically documented and not all testing was completed in the same manner for each patient. Fourth, because of the relatively small sample size for the post-discharge dispositions of SNF and LTAC a model was not developed to compensate for the low patient numbers. Fifth, not all the patient data was available for each covariate

the score for that characteristic was left blank and was not accounted for in the statistical analysis for the sample size. Sixth, the grouping of 30 variables into 7 categories (demographics, respiratory symptoms, risk variables, comorbidities, diagnostic group, hospital testing and medications did not yield a predictive model with the covariates. Seventh, the covariate comorbidities were represented in the measure by a number (<5, 5 to 10, > 10), to get a more realistic representation of the variable, the identification of the most frequent conditions that present with a COPD such as cancer, pulmonary vascular disease and heart disease could have been included in a statistical model to measure the comorbidity burden. Eighth, some of the variables that had a subjective result instead of an objective result would need to be changed. For example, cough and sputum. A cough would need to be verified by a measurement scale and sputum should be measured on quantity and not colored and the sputum should be evaluated to determine if white blood cells exist in the specimen.

Future Research

The results were very well represented in the clinical population it serves. This fact is of great importance with the need to evaluate a patient's situation, including demographics, respiratory symptoms, risk variables, comorbidities, diagnostic groups, hospital testing and medications. The evaluation and recognition of a patient's clinical characteristics may give more insight into the patient's overall health. There is a host of patient-level factors in the urban population independent of their disease pathway, which may complicate their care and affect patients' outcomes, especially with multiple comorbidities.

Due to the lack of clear consensus and clinical guidelines on how best to predict and prevent readmissions there should be more research in the multifactorial nature of COPD readmissions especially highlighting multi-comorbidities. The search should continue for interventions, which are practical, sustainable and suitable for a diverse population of patients with COPD exacerbations.

Development and testing of the standardization of the clinical content of this study would prove that the significant variables are indicators for measurement and feasible for the clinical teams to consider when developing a quality improvement in clinical care. A Model for Improvement (MFI) could be developed with a step-by-step approach for best practices in COPD management. Teaching the practices to healthcare workers and carrying out the system's processes for testing could use a data driven approach to effect change in discharge of the patients with COPD.

Conclusions

This dissertation identifies some of the intricate mechanisms involved with COPD that can heighten the awareness and be pre-identified prior to discharge. It has been demonstrated that post-discharge care guidelines for HSC, HHC, SNF and LTAC may need to be developed for patients that have been diagnosed with COPD. Further studies will be needed to understand the factors involved in discharge planning and patient care to determine the relative conclusions

The answers to the two research questions in this study can provide information to clinicians that would normally have common assumptions about how a COPD readmission patient would look, but this is not always true. The criteria for this study provided insight into an urban population. This was a look into the characteristics of the

small urban hospital that has a unique patient population and that it showed that post-discharge care settings matter and there are differences that we can pick up on between patients that readmit and those who do not. The patient characteristics may not be explained clinically but through an influence of other factors that would further be investigated. Clinicians should be educated to take a global approach to identifying patients that are more risk to readmit within 30-days.

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Appendix A

ST. VINCENT CHARITY
MEDICAL CENTER

2351 East 22nd Street
Suite 308W
Cleveland, OH 44115
216-363-2674
(Fax) 216-363-3334

Office of Institutional Review Board
Memorandum (sent via email)

TO INVESTIGATOR: Michele Barton Verdi
2351 E. 22nd St.
Cleveland, Ohio 44115

CO-INVESTIGATOR (S): Randol Kennedy, MD
Luana Hearn, MD
Vasant Ternull, MD
Dr. Kenneth Sparks
Douglas Wajda, PhD, Emily Kullman, PhD Eric Van Iterson PhD (CSU)

IRB # 530

PROTOCOL: Chronic Obstructive Pulmonary Disease (COPD) Algorithm Development

Approval Period: 3/10/2019 – 3/9/2020

DATE: 3/12/2019

FROM: **Tracy Sharp, CME/IRB Coordinator**

NOTIFICATION OF IRB ACTION

DOCUMENT	VERSION/DATE	IRB ACTION
Protocol	2/23/2019	Expedited Approval 3/10/2019
Waiver of Inform Consent	2/23/2019	Expedited Approval 3/10/2019

Type of Review: This proposal has been reviewed via the expedited approval process and was approved on 3/10 /2019. **The approval period for this study is 12 months**; a continuing review will be required prior to the study approval expiration date if you wish to keep this study active. **The approval period is 3/10 /2019 – 3/9/2020.**

Waiver of consent was approved based on the following criteria:

1. The research presents no more than minimal risk of harm to subjects
2. The waiver will not adversely affect the rights and welfare of the subjects
3. The research could not practically be carried out without the waiver or alteration

If it is necessary to continue the study beyond the expiration date, a request for continuation of approval must be submitted **6 weeks prior to your expiration date of 3/9/2020**. There is NO grace period beyond one year from the last approval date.

1

Appendix B

Office of the Institutional Review Board
2351 East 22nd Street
Cleveland, OH 44115
216-363-2674
(Fax) 216-363-3334

ST. VINCENT CHARITY
MEDICAL CENTER

INVESTIGATOR:	Michele Barton- Verdi St. Vincent Charity Medical Center 2351 E. 22nd Cleveland, Ohio 44115
CO-INVESTIGATOR:	Randol Kennedy, MD, Luana Hearn, MD, Vasant Ternull, MD, CSU -Kenneth Sparks, Douglas Wajda, PhD, Emily Kullman, PhD, Eric Van Iterson, PhD
RE:	**Investigator's Addendum to Approved Protocol**
PROTOCOL:	COPD Algorithm Development
IRB:	#530
Approval Period:	3/10/2019 - 3/9/2020
DATE:	June 12, 2019

NOTIFICATION OF IRB ACTION

DOCUMENT	VERSION/DATE	IRB ACTION
Addendum to Protocol to extent data collection timeframe	5/30/2019	Approved 6/12/2019

Please be advised that the addendum listed below was approved following an expedited review on June 12, 2019. This approval includes the following changes.

- Extension of data collection timeframe for the study

These changes do not significantly alter the basic study design and do not increase patient risk

If you have any questions, please do not hesitate to contact the IRB Office at 216-363-2674.

Tracy Sharp

Tracy Sharp
IRB Coordinator

Appendix C

CLEVELAND STATE IRB APPROVAL

From: system@cayuse424.com <system@cayuse424.com>
Sent: Thursday, March 21, 2019 4:07 PM
To: Kenneth E Sparks
Cc: Cayuse IRB
Subject: IRB-FY2019-191 - Initial: IRB Approval

CLEVELAND STATE UNIVERSITY

March 21, 2019

Dear Kenneth Sparks,

RE: IRB-FY2019-191
The Development of an Algorithmic Pathway to Determine Post Discharge Continuum of Care of COPD Patients in a Small Urban Community Hospital

The IRB has reviewed and approved your application for the above-named project under the category noted below.
Application renewal is not necessary unless indicated below.

Approval Category: Expedited Category 5
Approval Date: March 21, 2019
Expiration Date: --

Study received Expedited Review Approval from St. Vincent Charity Hospital and Medical Center IRB on 20190310.

By accepting this decision, you agree to notify the IRB of: (1) any additions to or changes in procedures for your study that modify the subjects' risk in any way; and (2) any events that affect that safety or well-being of subjects. Notify the IRB of any revisions to the protocol, including the addition of researchers, prior to implementation.

Thank you for your efforts to maintain compliance with the federal regulations for the protection of human subjects. Please let me know if you have any questions.

DO NOT REPLY TO THIS EMAIL. IF YOU WISH TO CONTACT US, PLEASE SEND AN EMAIL MESSAGE TO cayuseirb@csuohio.edu.

Sincerely,

Mary Jane Karpinski

IRB Analyst
Cleveland State University
Sponsored Programs and Research Services
(216) 687-3624
m.karpinski2@csuohio.edu

Appendix D

Covariate Scoring Data Sheet

Covariates to be investigated in COPD patients that readmitted within 30 days of indexed admission

Patient ID	Covariate	Description	Score 1	Description	Score 2	Description	Score 3
	Age	< 60		60 - 80		> 80	
	Living Arrangements	Married		Family Support		Lives alone	
	Length of Stay	4 Days or Less		5 Days		6 Days or More	
	Insurance	Private Insurance		Only Medicare		Medicaid	
	Comorbidities	< 3		3 or 4		> 5	
	Home O2	None		2L or 3L		4L or More	
	Previous CAD Disease	None		Stable		Symptomatic	
	Sleep Apnea	None		CPAP		BIPAP	
	Hypertension on Medication	No/Normal		120/80 - 140/90		Above 140/90	
	Diabetes on medication	None		1st FBG < 200 mg/dL		1st FBG > 200 mg dL	
	Smoking History	None		Quit 5 years =		Current Smoker	
	Sputum	White		Yellow		Green	
	Cough	None		Increased		Severe/Vomit	
	Heart Failure sx on admission	None		On exertion		Orthopnea	
	LABA/ICS Drug combinations	None		PRN		Non-Compliant	
	SaO2 in 1st VS	94% to 100% RA		89% to 93% or Less than 3L		< 89% / > 4L O2 /CPAP	
	Weight Classificaton	Normal/Overweight		Obese		Morbid Obesity	
	Wheezing	None		Expiratory		Constant	
	Severity of Disease	Nasal Canula		4L O2 or CPAP		Requires Intubation	
	Hypoxia/hypoxemia PaO2	80-100 mm Hg		60-80 mm Hg		40-60 mm Hg or below	
	Hypercapnia/hypercarbia	None/Normal		PCO2 > 45		75 mmHg	
	Pulmonary Function Test	Yes		Within 2 years of visit		No	
	FEV 1	Mild - > 80%		Moderate - > 50 - 79%		Severe - 49 or Less	
	Previous Echo	Yes		Within 2 years of visit		No	
	Systolic Heart Failure	Normal EF		> 40 - 50 EF		EF < 40	
	Right Ventricular Systolic Pressure	Mild 25 - 40		Moderate 41 - 55		Severe > 55	
	PT/OT During Hosp Stay	None		Active Services		Declined Therapy	
	Adaptive Equipment	None		Walker/Rollator		Wheelchair	
	Exacerbations in the last year	None		One		Several	

Appendix E

Summary of Groups that Scored Highest with each Covariate

Patient Characteristic	Non-Readmits	30-Day Readmissions
Length of Stay	4 Days or Less	4 Days or Less
Insurance	Medicare	Medicaid
Home O2	2L or 3L	None
Previous CAD	Stable	None
Sleep Apnea	None	None
Diabetes	1st FBG < 200 mg/dL	None
Sputum	Yellow	White
Cough	Increased	Increased
Heart Failure Symptoms	On Exertion	None
SaO2	94% to 100% Room Air	94% to 100% Room Air
Hypoxia	80-100 mm Hg	80-100 mm Hg
Hypercarbia	PCO2 > 45 mm Hg	None/Normal
PFT	None	None
FEV1	Severe 49 or Less	Severe 49 or Less
Systolic Heart Failure	Normal Ejection Fraction	Normal Ejection Fraction
RVSP	Mild 25 – 40 mm Hg	Mild 25 – 40 mm Hg
PT/OT	None	None
Adaptive Devices	None	None
Exacerbations	None	Several