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Thirty-Day Readmission Risk Factors of African American Adult COPD Patients With Tracheostomies

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2019

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MHA, Walden University, 2014

BS, Middle Georgia State University, 2010

Dissertation Submitted in Partial Fulfillment

Of the Requirements for the Degree of

Doctor of Philosophy

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Abstract

The purpose of this study was to assess the association between hospital readmission and demographic variables (age, BMI, gender, income, marital status, comorbidities, and smoking history), and size and type of tracheostomy among African American chronic obstructive pulmonary disease (COPD) patients with tracheostomies. The Andersen model was the theoretical framework for this quantitative study. Secondary data were obtained from a long-term acute care facility. The sample comprised 438 African American adult patients admitted between 2010 and 2017. Logistic regression was used to analyze each research question and assess the odds of 30-day hospital readmission. The results indicated that the odds of readmission did not differ based on age, gender, marital status, income, smoking history, BMI, sepsis, congestive heart failure, hypertension, stoma cellulitis or size of tracheostomy. There was a significant relationship between the type of tracheostomy and odds of readmission, diabetes diagnosis, and odds of readmission. These findings suggest when controlling for length of stay, there is no association between age, gender, marital status, income, smoking history, BMI, sepsis, congestive heart failure, hypertension, stoma cellulitis or size of tracheostomy and hospital readmissions among African American COPD patients with tracheostomies. The results of this study provide information that may be useful for discharge planning and program implementation research. Such planning and research might help to reduce rates of hospital readmissions and as a result lower healthcare costs for African American COPD patients with tracheostomies.

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Dedication

There is not a task on earth that can be done without my Heavenly Father, God. I give thanks to God for giving me grace and continued to sustain me while I fulfilled my dream of completing my doctorate. Thanks to my mother for her continued support and helping me with my son while I accomplished my goal. To my late father, who, is not present on earth, but in spirit, thank you for showing me that hard work pays off. To my son, Elias, for continuing to push me to keep going when mommy was tired and wanted to give up. You can officially say, “Dr. Mommy.” I love you, son! To my husband, who has not only supported me, but inspired me to keep going when I thought I wanted to give up. I thank you and love you!

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Chapter 1: Introduction to the Study

Introduction

Chronic obstructive pulmonary disease (COPD) is the fourth most common cause of mortality in the world (Mowls et al., 2013; Ozilmaz, 2013; Varrraso et al., 2015). Chronic COPD is a progressively growing disease characterized by other diseases such as emphysema, asthma, bronchiectasis, cystic fibrosis, and chronic bronchitis (National Institutes of Health [NIH], 2013). These diseases decrease the elasticity of lung tissue. Major risk factors for COPD include age, smoking, environmental factors, socioeconomic factors, and respiratory infections (Angarita, de Oca, Zabert, Wehrmeister, & Menezes, 2017). Among COPD patients, exacerbations occur an average of 1.3 (± 1.7) times per year (Ozyilmaz, 2013). Researchers define frequent exacerbations as two or more exacerbations per year (Blagev, Collingridge, & Rea, 2017). According to Goto et al. (2017), African American patients with COPD have higher hospital readmissions rates than the general population (20.8% compared to 19.2% in 2012).

COPD exacerbation is a sudden worsening of the patient's current stable status that may include shortness of breath, cough, and increased secretions (Baker, Lou, & Su, 2013). According to Baker et al. (2013), "Acute exacerbation of COPD is a leading cause of hospitalizations and readmissions in the U.S." (p. 551). Other risk factors associated with readmissions among patients with COPD are body mass index (BMI), age, gender, comorbidities, income, and marital status. These risk factors were the focus of the study.

A long-term acute care hospital (LTACH) is a facility specializing in treating people with chronic illnesses, such as COPD, who need acute care. COPD patients may

be transferred from intensive care units to LTACH facilities for continued care after initial treatment of acute exacerbations (Centers for Medicare and Medicaid Services [CMS], n.d.a). Hospitals, including LTACHs, are being penalized by the CMS for having higher re-hospitalization rates and failing to meet standards for reducing readmissions (Brahan, 2015; Prieto-Centurion et al., 2013; Pruitt, 2018). Reduction of hospital readmissions is a priority for the CMS. Financial penalties for hospitals began in October 2012 when the Hospital Readmissions Reduction Program (HRRP) for high readmission rates went into effect (Prieto-Centorion et al., 2013). According to Brahan (2015), there will be a financial penalty to facilities for increased rates of readmissions. COPD readmissions of patients of any race are a concern for the CMS. CMS and commercial third-party payers are concerned with readmissions for COPD patients due to the increased cost, especially in the Medicare population (Brahan, 2015; Shih et al., 2015).

A tracheostomy is a device placed surgically in the trachea, making a stoma to help oxygen get into the lungs (NIH, 2012). Tracheostomy tubes are available in a variety of sizes and styles. It is important that the differences are understood by respiratory therapists (RTs), nurses, physicians, and others caring for the patient. A tracheostomy tube must be an appropriate fit for patients (Hess & Altobell, 2014). Chronic COPD patients may receive tracheostomies to improve airflow. Among tracheostomy patients, there is a 33% rate of readmission (Spataro, Durakovic, Kallogjeri, & Nussenbaum, 2017). However, no research examining the effect of risk factors on readmission rates among COPD patients with tracheostomies exists. Because both tracheostomies and African American race imply higher hospital readmission rates, there is a need to

examine risk factors in the high-risk population of African American COPD patients with tracheostomies.

My aim for this study was to increase knowledge regarding readmission risk factors for African American adults with COPD who have tracheostomies. Tracheostomies are tubes used for patients with airway obstruction and require long-term ventilator management for patients with respiratory illnesses, such as COPD (Morris, Whitmer, & McIntosh, 2013). A tracheostomy is created to deliver adequate oxygen to the lungs to reduce shortness of breath for patients who require ventilator support for more than 2 weeks (NIIH, 2012). According to Durbin (2010), tracheostomies are placed when patients have been on life support for more than fourteen days. According to Durbin (2010), 10% of 75 patients require tracheostomies for airway support.

In this chapter, I provided a background to the study and explain why this study was needed. I also present the research questions and hypotheses, study limitations, and scope of the study.

Background of the Study

In the United States, COPD affects 12 to 24 million individuals and is the third leading cause of mortality (Krishnan & Prieto-Centurion, 2014; Pruitt, 2018). COPD causes at least 800,000 hospitalizations. Of those hospitalizations, about 20% of those patients are readmitted within 30 days after discharge (Krishnan & Prieto-Centurion, 2014). COPD is a progressive lung disease characterized by respiratory symptoms and airway obstruction (Braman, 2015; Krishnan et al., 2015).

COPD readmissions pose concerns in the United States' healthcare delivery

systems. COPD is the third most common cause of readmission 30-days post discharge in the United States (Garrison et al., 2013; Hijjawi et al., 2015; Pruitt, 2018, Stellefson, Tennant, & Chaney, 2012). COPD affects more than 6.2% of adults in the United States (Garcia-Parez, 2011; Sharif, Park, Pierson, Kuo & Sharma, 2014) and is the third most common cause of death (Sharif et al., 2014). According to Prieto-Centurion et al. (2013), African Americans have a higher rate of 30-day readmission compared to White patients with COPD (23.1% vs. 20.5%). Researchers have shown this higher readmission rate in several studies (Hiijaow et al. 2012; Joynt, 2011; Rottue et al., 2011).

Among those patients readmitted with COPD are patients with tracheostomies. A tracheostomy is a surgical procedure in the cervical trachea performed on patients who are hard to wean off a ventilator (Lindman & Byrd, 2016; Morris, Whitmer, & McIntosh, 2013). According to Mehta et al. (2015), tracheostomies are common in patients discharged to long-term acute care facilities and patients who are racial minorities.

Comorbidities are multiple conditions from which a patient suffers simultaneously, and they are significant risk factors for rehospitalizations (Donze, Lipsitz, Bates, & Schnipper, 2013). Patients with COPD have a higher rate of comorbidities than the general population (Putcha et al., 2014; Mannino & Thomashow, 2013). Patients who receive tracheostomies have an average of 3.4 comorbidities (Liu et al., 2014).

Risk factors including BMI, age, gender, comorbidities such as congestive heart failure, hypertension, stoma cellulitis, and diabetes, income, and marital status of COPD patients have been found to be significantly associated with COPD (Almagro et al., 2014;

Donze et al., 2013; Gajanan et al., 2013; Gershon et al., 2017). I have thus included them as variables in this study of a population of African American COPD patients aged 18 years and older. I provide details on previous research on these risk factors in Chapter 2. The aim of this study is to contribute to the limited scientific data available regarding readmission of African American patients who have COPD and a tracheostomy.

Problem Statement

COPD is a primary cause of readmissions within 30 days of discharge from a hospital (Garrison et al., 2013). In the United States, among Medicare patients with COPD, respiratory symptoms account for around 50% of 30-day readmissions (Shih, Churpek, Perraillon, & Konetzka, 2015). One in 12 COPD patients is readmitted to the hospital within 30 days of discharge, and the total cost of such readmissions is $7 billion annually (Finger & Washington, 2015). African Americans are 43% more likely than Whites to be readmitted to the hospital for all diagnoses (Yin, 2010).

Some researchers have shown that tracheostomies are performed for approximately 4% of COPD patients admitted to intensive care units (Yang, Tan, Devanand, Fook-Chong, & Eng, 2012). To date, there is no literature on 30-day rates of readmission among African American COPD patients who have received tracheostomies. This subpopulation requires study because both African Americans and tracheostomy patients have higher readmission rates compared to the general population, so African Americans with tracheostomies constitute a high-risk, high-impact group. In addition, the literature includes numerous studies exploring the ways in which age, marital status, gender, income, smoking history, and comorbidities (congestive heart failure,

hypertension, stoma cellulitis, and diabetes) influence rates of hospital readmission, but I was not able to identify any published studies exploring these factors specifically related to African American COPD patients with tracheostomies. In this study, I addressed this gap in the literature and identified the risk factors associated with 30-day readmission rates among African American adult COPD patients with tracheostomies.

Purpose of the Study

The purpose of this study was to understand the relationship, if any, between 30-day long-term acute care hospital (LTACH) readmission rates and risk factors including comorbidities (congestive heart failure, hypertension, stoma cellulitis, and diabetes), smoking history, and demographic characteristics (age, gender, income, marital status, and BMI). Researchers have identified these risk factors as being associated with rates of readmission among COPD patients (Gajanan, Jyothi, & Alisha, 2013); however, this association has not previously been examined among African American COPD patients.

Research Question(s) and Hypotheses

RQ1: What is the relationship between demographics (age, gender, income, marital status, and BMI) and 30-day hospital readmissions among African American COPD patients with tracheostomies?

$H_0$1: There is not a relationship between any of the demographics (age, gender, income, marital status, and BMI) and 30-day hospital readmissions among African American COPD patients with tracheostomies.

$H_1$1: There is a relationship between some or all of the demographics (age, gender, income, marital status, and BMI) and 30-day hospital readmissions among

African American COPD patients with tracheostomies.

RQ2: What is the relationship between smoking history and 30-day hospital readmissions among African American COPD patients with tracheostomies?

$H_0$2: There is no relationship between smoking history and 30-day hospital readmissions among African American COPD patients with tracheostomies.

$H_1$2: There is a relationship between smoking history and 30-day hospital readmissions among African American COPD patients with tracheostomies.

RQ3: What is the relationship between presence of comorbidities (sepsis, congestive heart failure, hypertension, stoma cellulitis, and diabetes) and 30-day hospital readmissions among African American COPD patients with tracheostomies?

$H_0$3: There is a relationship between presence of comorbidities (sepsis, congestive heart failure, hypertension, stoma cellulitis, and diabetes) and 30-day hospital readmissions among African American COPD patients with tracheostomies.

$H_1$3: There is not a relationship between the history of comorbidities (sepsis, congestive heart failure, hypertension, stoma cellulitis, and diabetes) and 30-day hospital readmissions among African American COPD patients with tracheostomies.

RQ4: What is the relationship between trach type and trach size and 30-day hospital readmissions among African American COPD patients with tracheostomies?

$H_0$4: There is a relationship between trach type and trach size and 30-day hospital readmissions among African American COPD patients with tracheostomies.

$H_1$4: There is not a relationship between trach type and trach size and 30-day hospital readmissions among African American COPD patients with tracheostomies.

Theoretical Framework

The Andersen healthcare utilization model (henceforth the Andersen model) was developed in the late 1960s to study health services utilization (or "access") from a behavioral perspective (Andersen, 1968). The model is currently in its sixth iteration, having developed to include a focus on community-level factors that influence healthcare access and to include health outcomes in a broader theoretical perspective (Andersen, Davidson, & Baumeister, 2013). Broadly, Andersen (1968, 1995) identified three types of factors influencing healthcare-seeking behaviors:

> (1) existing conditions that predispose people to use or not use services even though these conditions are not directly responsible for use [called predisposing conditions], (2) enabling conditions that facilitate or impede use of services, and (3) need or conditions that laypeople or healthcare providers recognize as requiring medical treatment [called need conditions]. (p. 36).

The Andersen model was appropriate for this study because it includes a focus on the equality or inequality of healthcare systems. Specifically, healthcare systems are viewed as equitable when access to care is determined by need factors alone (possibly alongside certain demographic factors such as genetic predispositions to illness). Healthcare systems are characterized by inequality in access to care when enabling conditions, such as income and access to transportation, and predisposing conditions, such as race, beliefs about healthcare, and social status, begin to make a difference to care-seeking behaviors and health outcomes (Kim & Lee, 2016).

According to Kim and Lee (2016), the Andersen model is particularly appropriate for exploratory research on topics that researchers have not previously addressed empirically. For this reason, the model was a good fit for my research, which addressed a gap in literature related to the high-risk population of African American COPD patients with tracheostomies.

The Andersen model guided the design of this study in two ways. First, the model guided variable selection. In determining which variables to include in the model, I compared the variables implicated in the Andersen model with my variables on COPD and hospital readmissions. I chose to include variables whose importance was supported by the Andersen model and by empirical research. Therefore, the study included predisposing factors (age, gender, BMI, smoking history), enabling factors (marital status, income), and need factors (comorbidities) in hospital readmissions among African American COPD patients with tracheostomies. Second, the model guided my interpretation of results, during which I took into consideration whether the significant factors fell into the predisposing, enabling, or need categories. Additionally, in light of the results, the Andersen model implies particular implications for future research and practice.

Nature of the Study

For this study, the quantitative method using a cross-sectional design with logistic regression analysis was the most appropriate. Researchers use cross-sectional study designs to investigate associations between risk factors and the outcome of the study. According to Levin (2006), cross-sectional studies allow for the assessment of outcomes

and exposures of participants at a given point in time (Campbell & Stanley, 1963). It was appropriate to use a cross-sectional design because this design allowed for an examination of the independent and dependent variables at the same time. Using a correlational, cross-sectional design allowed me to determine the association between 30-day hospital readmissions and specific demographic variables and comorbidities of African American adult COPD patients with tracheostomies. To determine the relationship between the demographic variables (age, marital status, BMI, income, comorbidities, and gender) and readmission greater than 30 days post discharge from the hospital, I used logistic regression. Logistic regression is used when the dependent variable is dichotomous. The dependent variable for all the research questions was readmission within 30 days (0 = no, 1 = yes).

I used secondary data for this study. Data were obtained from electronic medical records (EMR) from a LTACH located in southern Georgia in the United States. I identified African American adult COPD patients with tracheostomies and reviewed the medical records for admissions, readmissions, and emergency department visits. Comorbidities (stoma cellulitis, hypertension, congestive heart failure, and diabetes), demographics (marital status, age, gender, income, and BMI), and smoking history were also examined to determine if a correlation existed between these factors and hospital readmissions. No data were collected regarding insurance type or other medical information not related to the research questions I examined in this study.

I examined data from the years 2010 to 2017. The facility admits approximately 300 patients per year, including African American COPD patients with tracheostomies.

Therefore, the data set was large enough to supply the requisite sample size of 438 participants (see Chapter 3 for a description of the sample size calculation).

To determine the relationship between the independent variables (age, marital status, BMI, income, comorbidities, and gender) and 30-day readmission, I used logistic regression. The dependent variable for all the research questions was readmission (0 = readmitted within 30 days, 1 = readmitted more than 30 days after discharge, or not readmitted). The omnibus chi-square was examined first to determine if the variables taken as a group affect the dependent variable. Then I examined the coefficients in the model to determine if their *p* values were significant, which would indicate if the variable significantly contributed to the model. If the coefficients were found to be significant, I examined the odds ratio (OR) to determine the odds of 30-day readmission for the levels of the independent variable. The data analysis plan is described in more detail in Chapter 3.

Definitions

Affordable Care Act (ACA): The ACA became law in 2010 to provide Americans with healthcare (Assistant Secretary for Public Affairs, 2017).

Acute exacerbation of COPD (AECOPD): Exacerbation is an acute change in patient status (Papi et al., 2006). COPD exacerbation is a sudden worsening of the patient's current stable status that may include shortness of breath, cough, and increased secretions (Baker et al., 2013). In the context of COPD, acute exacerbation requires hospitalization in an intensive care unit (Baker et al., 2013).

BMI (body mass index): A patient's weight in kilograms divided by square of height in meters. Individuals whose BMI is under 18.5 are underweight; those with BMI 18.5–24.9 are normal weight; those with 25.0-29.9 are overweight; and those with BMI 30 or above are obese (Centers for Disease Control and Prevention [CDC], 2017).

Centers for Medicare and Medicaid Services (CMS): the federal agency that runs the Medicare Program and monitors Medicaid programs offered by each state (CMS, n.d..).

Chronic Obstructive Pulmonary Disease (COPD): A progressive disease that allows less air to flow in and out of airways causing air sacs to lose an elastic quality (NHLBI, 2013).

Comorbidity: More than one acute and chronic diseases present in an individual at the same time (CDC, 2017).

Exacerbation: An exacerbation of COPD is defined as a period of "acute worsening of respiratory symptoms" (GOLD, 2017, p. 1).

The Global Initiative for Chronic Obstructive Lung Disease (GOLD): An international organization founded in 1997 that "aims to provide a non-biased review of the current evidence for the assessment, diagnosis, and treatment of patients with COPD that can aid the clinician" (GOLD, 2017, p. 1). Physicians use GOLD's guidelines to determine the stage of COPD (Ozmilyaz et al., 2012).

Hospital Readmission Reduction Program (HRRP): This program, established by section 3025 of the Affordable Care Act, requires the CMS to reduce payments to inpatient and long-term care facilities that have "excess readmissions," which the CMS

defines using a payment adjustment formula (Centers of Medicare and Medicaid Services, 2018).

Length of stay: Length of stay is how many days a patient stays in an acute care or long-term healthcare facility (Pezzani, n.d.)

Long-term acute care hospital (LTACH): A facility specializing in treating people with chronic illnesses, such as COPD, who are in need of acute care. The CMS defines LTACHs as those "that provide treatment for patients who stay, on average, more than 25 days. Most patients are transferred from an intensive or critical care unit. Services provided include comprehensive rehabilitation, respiratory therapy, head trauma treatment, and pain management" (CMS, n.d.).

Readmissions: For this study, readmission was defined following the definition used by the CMS in the HRRP. According to the CMS, a patient is readmitted if he or she returns to the LTACH or to another acute care facility within 30 days of being discharged to any setting. The CMS calculates readmission ratios based on readmission for the following causes: COPD, heart attack, heart failure, pneumonia, hip/knee replacement, and coronary artery bypass surgery. Experiencing serious complications soon after discharge is the typical reason for readmission (CMS, n.d.).

Smoking: The use of tobacco products as indicated from their health records (Vestobo et al., 2013; Ryan et al (2012).

Tracheostomy: A device placed surgically in the trachea making a stoma to help oxygen get into the lungs (NIH, 2012). The type of tracheostomies presented for this study includes Shiley, Bivona, XLT, and SCT.

Assumptions

I used secondary data from an EMR for the study. I assumed that the coding for COPD, tracheostomy, comorbidities, and the other demographics were recorded in the EMR accurately. I also assumed that the patients admitted for COPD to the LTACH would be readmitted for COPD-related complications. Finally, I examined readmission both to the same LTACH and to other facilities, and assumed that this procedure would capture all or most 30-day readmissions among the sample; however, I recognized that some leakage to facilities not reported in the EMR (i.e., outside of the network covered by the EMR) may have occurred.

Scope and Delimitations

In this study, I focused on the risk factors for readmissions among African American adult COPD patients who have tracheostomies. Patients who had tracheostomies but did not have COPD, as well as patients of other racial and ethnic groups, were not included in the study. The study included data collected in a South Georgia LTACH, and data on readmission was limited to patients who were readmitted to the same LTACH or other facilities in the EMR network within 30 days of discharge to any location. Children under age 18 were excluded from this sample because there is already literature regarding children who have tracheostomies.

Limitations

A limitation in the study was the use of secondary data through a review of the EMR at the LTACH. Inconsistent documentation may have caused missing data points. I assumed that the medical records were complete as the LTACH must use EMR

information for billing and collections. The Quality Control department at the facility uses regular medical record audits to ensure EMR completion. External validity is the extent to which the results of the study can be applied to other groups of people (Campbell & Stanley, 1966). Threats to external validity occur when there are incorrect conclusions generalized to participants from others of the population (Creswell, 2009). The use of a convenience sample may limit the generalizability of the study findings; the results yielded information that was useful in understanding the associations I examined because positive associations in a convenience sample can guide future confirmatory research with random population-based samples.

Significance of the Study

The results of this study lead to positive social change by providing new information to healthcare clinicians, physicians, families, and administrators to aid in their understanding of risk factors for readmission of African American patients with COPD who have tracheostomies. Such an understanding may lead to alterations in the care of patients discharged to home, potentially leading to better outcomes and reduced readmission rates. Readmission reduction may improve the quality of life of patients and caregivers. For healthcare administrators, it is important to understand the importance of risk factors on readmission rates in order to adequately direct resources to treatments and interventions that could potentially reduce readmission rates in at-risk patients.

Summary

High rates of COPD readmissions are a complex problem that needs to be addressed. My review of literature indicated that risk factors to reduce readmissions are

lacking for African American COPD patients with tracheostomies. The purpose of this study was to understand the relationship between the 30-day LTACH readmission rate and risk factors, including the comorbidities (congestive heart failure, hypertension, stoma cellulitis, and diabetes), demographic factors (age, gender, income, marital status, and BMI), and smoking history, among African American patients with COPD who have tracheostomies. Chapter 2 includes an overview of the literature on COPD readmissions and presents in more detail the theoretical framework for this study.

Chapter 2: Literature Review

Introduction

In this quantitative study, I examined the relationships between readmissions and demographic factors, comorbidities, and smoking history among African American patients who were diagnosed with COPD and have tracheostomies. My aim in this study was to identify the risk factors for readmissions in African American COPD patients who have tracheostomies. In previous studies, researchers have focused on risk factors affecting readmission in the form of malnutrition and obesity, lack of physical activity, comorbidities, and poor social support (Chan et al., 2011; Park et al., 2014). However, there is a gap in the existing literature related to the possible risk factors examined herein.

In this chapter, I present findings from recent studies on hospital readmission, avoidable and unavoidable, that have focused on racial and ethnic minority groups such as African Americans (Davidson et al., 2013; Prieto-Centurion et al., 2013). I synthesize findings from the literature regarding the association between COPD readmissions and risk factors, including the comorbidities (congestive heart failure, hypertension, stoma cellulitis, and diabetes), demographic factors (age, gender, income, marital status, and BMI), and smoking history. This chapter also includes background information on the relevance of the study, including psychosocial factors related to readmission and risk factors for COPD exacerbation. The Anderson model formed the theoretical framework for this study.

Literature Search Strategy

I used the Walden University Library to access Google Scholar, MEDLINE Pub Med, Medline, Academic Search Premier, and EMBASE. I searched these databases using the keywords *COPD, chronic obstructive pulmonary disease, tracheostomies, tracheostomy, trach, trachea, hospital readmissions, hospital readmissions, COPD, readmitted, COPD, readmitted, readmit, African American, black, blacks, risk factors, and re-hospitalization, socioeconomic risk factors, comorbidities, comorbidity, and fluvaccination*. To ensure that the review covered the most recent literature, I included peer-reviewed articles published in scholarly journals between 2014 and 2019. In some cases, especially relevant or seminal articles from before 2014 were also included for the sake of completeness.

Tracheostomies, Risk Factors, and Readmissions

Population-based rates of patients receiving tracheostomies have increased by 106%, rising from 16.7 to 34.3 tracheostomies per 100,000 U.S. adults from 1993 to 2012 ($p < .0001$; Mehta et al., 2015). Independent research by Spataro et al. (2017) showed a 33% all-cause readmission rate among tracheostomy patients. Patients receiving a tracheostomy have increased implications for cost, readmissions, resource use, and outcomes (e.g., improved patient comfort, reduced sedative use, decreased 30-day mortality) during acute hospitalization and following hospital discharge (Mehta et al., 2015). According to a study conducted by Mehta et al. (2015), certain demographic risk factors are associated with tracheostomy use among adults. Using a multivariable logistic regression model to examine the characteristics of patients receiving tracheostomies by

using a hospital-level random intercepts, the researchers were able to adjust for patient demographics (age, sex, race/ethnicity, and Medicaid insurance payer). They found that patients receiving a tracheostomy between 1993 and 2012 were 61.8 years old on average (*SE* = 0.03), 55.4% were male, and 55.8% were Caucasian American. Furthermore, the researchers examined trends over time in the demographic characteristics of tracheostomy patients. They observed that, over their study period, patients grew more likely to belong to a racial/ethnic minority group and more likely to have Medicaid. This research indicates a growing importance of understanding the implications of tracheostomies among minority populations, such as African American COPD patients, who form the population of my study. Mehta et al. did not examine readmission rates or address COPD, which underscores a need for additional research to analyze factors associated with readmissions for COPD.

In my literature research, no studies examined how tracheostomy use among adults in the United States impacted readmissions for patients with COPD, although Spataro et al. (2017) found a 33% all-cause readmission rate among tracheostomy patients. However, at least one adult study exists on risk factors for readmission following laryngectomy. A tracheostomy may follow a laryngectomy to remove all or part of the larynx. A recent study has shown that, among laryngectomy patients, the most common readmission diagnoses were stoma cellulitis, a bacterial infection in the stoma (16%; *n* = 7), and pharyngocutaneous fistula (27%; *n* = 11; Graboyes, Yang, Kellogeri, Diaz, & Nussenbaum, 2014). These researchers noted that patients with these diagnoses had unplanned readmissions and a median stay of 7 days (range of 1–28 days). According

to Graboyes et al. (2014), 34% of readmissions (14 of 41) occurred within 3 days of discharge, while 27% ($n = 11$) occurred between 4 and 10 days after discharge, and 39% ($n = 16$) occurred more than 10 days after discharge. Researchers found that patients were at increased risk for 30-day readmission with the following risk factors: postoperative complication (OR = 11.50; 95% CI, 4.10-32.28), visit to the emergency department within 30 days after discharge (OR = 5.25; 95% CI, 1.84-14.99), and salvage total laryngectomy (the entire larynx was removed; OR = 3.52; 95% CI, 1.56-13.12). No associations were found with nearly 50 other variables considered, including socioeconomic variables. This study is particularly important to the background of my study because it focuses specifically on readmission among laryngectomy patients, who are often associated with tracheostomies. Given the lack of positive findings regarding demographic risk factors and comorbidities, the Graboyes et al. (2014) study calls into question the findings of other studies (particularly pediatric studies, described below) that implicate socioeconomic and other factors in 30-day readmission rates. The need for more research is therefore evident.

Despite the lack of research among adult populations, a body of pediatric research has shown that pediatric patients with chronic illnesses and with tracheostomies have a readmission rate ranging from 20% to 40%. To provide the reader with background on the relationship between tracheostomies and readmission, I review the pediatric studies in the following paragraphs, but the reader should bear in mind that the risk factors and associations may be different among adult populations. In this study, I aimed to fill the research gap.

Kun, Edwards, Ward, and Keen (2012) conducted a study on ventilator-dependent children with tracheostomies. In this retrospective cohort study, Kun et al. identified risk factors for non-elective readmissions for children with respiratory failure at a Los Angeles hospital. Researchers found that 40% of the 109 patients had unplanned readmissions within 12 months of discharge, most commonly due to pneumonia and tracheitis. Over half of the readmissions were tracheostomy related (64%), indicating the importance of understanding tracheostomy-related risk factors for readmission, and thereby supporting the need for my study. Patients with public insurance accounted for 68% of the readmissions (n = 30), indicating a large prevalence of low-income families among those readmitted (Kun et al., 2012), and supporting the inclusion of income as a variable in this study. Although the Kun et al. study sheds light on the factors related to readmission among pediatric tracheotomy patients, it is not clear whether these findings are transferrable to adult populations.

Another study focusing on pediatric readmissions was conducted by Jurgens, Spaeder, Payuluri, and Waldeman (2014). The retrospective cohort study involved a multivariate analysis examining pediatric patients with chronic complex conditions (CCCs) readmitted into an acute care facility. The researchers found that children with CCCs discharged from a sub-acute facility were readmitted at rates similar to those discharged from acute care facilities (Jurgens et al., 2014). Out of 272 patient discharges, 52 patients (19%) had at least one acute care facility readmission within 30 days of discharge (Jurgens et al., 2014). Researchers found that patients with a tracheostomy were more likely to be readmitted into an acute care facility (p = .003), emphasizing the

importance of understanding the specific risk factors that could affect readmission rates of tracheotomy patients. Furthermore, the researchers found that the number of discharge medications was associated with increased odds of readmission (OR= 1.11 [95% CI, 1.03–1.20]; p = .01; Jurgens et al., 2014), supporting the use of comorbidities (which could be associated with the number of medications at discharge) as variables in my study.

Although the Jurgens et al. (2014) study found a lower rate of readmission than the Kun et al. (2012) study, it should be noted that Kun et al. examined readmission over a period of 12 months, whereas Jurgens et al. looked only at 30-day readmissions. Because the CMS (n.d.) defines readmission on a 30-day basis for the purpose of hospital readmission rate reduction, the 30-day statistic is more relevant from a practical point of view. Therefore, I followed Jurgens et al. in examining readmissions after 30 days.

Neither Jurgens et al. (2014) nor Kun et al. (2012) included smoking exposure in their studies. Among pediatric populations, this omission was addressed in a study by Groenendijk, Booth, Dijk, Argent, and Zampoli (2016). They conducted a retrospective examination of data from 2008 to 2012 among 157 children with tracheostomies in Cape Town, South Africa, and low socioeconomic status. The researchers included variables such as parents' education, second-hand smoke exposure, and history of substance abuse in the home. Groenendjik et al. (2016) found that 72 (45.9%) patients experienced unplanned readmissions to the hospital. When accounting for smoking exposure, the researchers found children with tracheostomies who were exposed to cigarette smoke were 2.6 times more likely to be readmitted into the hospital than those who were not

exposed. This finding supported my inclusion of smoking history as a variable in this study. Groenendjik et al. also provided support for the examination of comorbidities, as patients with an underlying medical condition were independently at significantly greater risk for mortality compared to those without an underlying condition (OR= 5.1, 95% CI, 1.8–14.3) (Groenendjik et al., 2016). As with the other readmission studies reviewed herein, Groenendjik et al. focused exclusively on pediatric tracheostomy patients.

The research reviewed in this section has demonstrated the need for this study by indicating high readmission rates (approximately 33%) among patients with tracheostomies, suggesting a need to understand the risk factors that contribute to this increased prevalence. Additionally, the research supports my inclusion of income, smoking history, and comorbidities as variables in this study. However, each of these studies took place among pediatric populations, and none focused on tracheostomy patients with COPD. Therefore, further research is needed on adults with tracheostomies who are readmitted into the hospital post 30-day discharge.

The GOLD Guideline on COPD

The GOLD guidelines serve as the reference standard to help guide clinicians in diagnosing and treating patients with COPD (GOLD, 2017). The GOLD guideline also contains useful information and research synthesis related to comorbidities and other COPD-related data. GOLD was founded in 1997 and, in the intervening years, its guidelines have undergone numerous revisions, and it has changed its position along with the latest empirical research and theoretical understandings of COPD.

In the most recent revision of its guidelines, the 2017 Report, GOLD introduced

several amendments to the classification of COPD and the recommended treatment strategies. According to the GOLD-published executive summary (Vogelmeier et al., 2017), there were five principle amendments introduced in the 2017 Report. First, GOLD now recommends grouping COPD according to patient symptoms and exacerbations, rather than using spirometric assessment to define disease severity. Second, GOLD introduced strategies for escalating pharmacologic treatments for GOLD according to the four disease severity groups (A, B, C, and D). Third, the organization defined guidelines and conditions for deescalating therapy in appropriate circumstances. Fourth, the 2017 Report presents the most comprehensive to-date description and guidelines for the use of nonpharmacological treatments. Fifth and finally, as well as most important in the context of the present study, the 2017 revision emphasizes the relevance of comorbidities in COPD management (Vogelmeier et al., 2017). This latter amendment supports the present study's focus on comorbidities as a potential risk factor for readmission in COPD patients, since inappropriate management of patients with high numbers of comorbidities could lead to increased readmission risk.

Singh (2016) provided an assessment of the GOLD 2017 revision, arguing that the changes to the guideline constitute a turn away from the one-size-fits-all approach of assessing COPD using the spirometric measurement, and are in favor of individualized treatment that takes each patient's personal circumstances and characteristics into account. The author also suggested that some of the changes to the guideline were more theoretical than evidence-based, predicting some controversy surrounding the treatment guidelines for certain types of COPD. Nevertheless, Singh underscored the inevitability

of the GOLD guidelines reassessing its new recommendations pending the results of ongoing clinical trials. These issues are relevant to the present study because COPD patients who are diagnosed and/or treated using the GOLD recommendations, or in contradiction to the GOLD recommendations, may be more or less at risk for hospital readmission. Although the present study does not take treatment strategy into account, the GOLD recommendations are frequently used among researchers to classify and diagnose COPD.

Factors Associated with COPD Readmissions

One important study to focus on overall readmission rates among adults with COPD was conducted by Ford (2015). Ford examined 30-day readmission rates of three types: readmissions with the same primary diagnosis, readmission with the same diagnosis, whether primary or not, and readmissions for any reason. Results from the study revealed that, among patients whose primary diagnosis at admission had been COPD or bronchiectasis, 7% were readmitted within 30 days with the same primary diagnosis, 18% were readmitted with COPD or bronchiectasis listed as "any diagnosis," and 21% were readmitted under the listing of "any reason" (Ford, 2015). The latter statistic is most relevant to the present study because this study will not distinguish between diagnoses at readmission. The 21% readmission rate is similar to that observed by Jurgens et al. (2014) among pediatric tracheostomy patients. Over the study period, Ford (2015) observed a slight decline in the rates of readmission of all types, although the statistical significance of this trend was not reported.

The Ford (2015) study is especially relevant to the present study because it is one

of the only pieces of research to date to focus on 30-day readmission rates among adult COPD patients. However, the researcher did not look at risk factors associated with readmission in the research sample, demonstrating a lack of understanding about the factors involved in readmission, and highlighting a need for the present research study.

Recently, Gershon, Thiruchelvam, Aaron, and To (2017) conducted a comprehensive study on factors associated with readmission rates among COPD patients. They examined 130,137 patients with COPD hospitalized from 2004 to 2014, and found an overall 30-day unplanned readmission rate of 15.0%, the same range as the rate observed by Ford (2015). They found that patients initially hospitalized for longer were more likely to be readmitted than those with shorter initial hospital stays, as were those who left their initial hospitalization contrary to medical advice (Gershon et al., 2017). The researchers also reported on a number of other specific risk factors, which are reported separately in the sections below.

Although many studies, like those of Ford (2015) and Gershon et al. (2017) found COPD readmission rates in the vicinity of 20%, at least one study has revealed a much lower rate. According to Zhang, Higgins, Wongtrakool, and Sadikot (2017), only 6.2% of their sample of 6,596 hospitalized COPD patients met the criteria for 30-day readmission. This finding calls into question the overall national readmission rate for COPD patients; nevertheless, scholars agree that COPD patients are readmitted more frequently than individuals with other illnesses. In the Zhang et al. (2017) study, researchers found that certain factors predicted readmission rate, including hemoglobin level, albumin level, treatment with prednisone, and myocardial infarction. Other risk factors found in multiple

studies are discussed in the sections below.

Demographic Variables Associated with COPD Readmissions

Twenty percent of patients with COPD are readmitted to the hospital within 30 days (Elixhauser et al., 2011). That rate is 30% higher for African Americans than it is for other ethnic groups, such as Hispanics and Asians (Elixhauser et al., 2011). Half of individuals with COPD are readmitted at least once in the six months after discharge (Gajanan et al., 2013). In a study conducted with 235 patients admitted with COPD to a tertiary hospital over a period of 36 months, Gajanan et al. (2013) found that variables such as socioeconomic factors, age, sex, BMI, duration of COPD, and marital status were significantly associated with frequent readmissions in COPD (Gajanan et al., 2013). Gershon et al. (2017) also found that the male sex was associated with a higher likelihood of 30-day readmission among their sample of COPD patients. Research on the most prevalently noted demographic variables, age and socioeconomic status, is reviewed in the following subsections.

Age and COPD readmissions. COPD is considered a disease that is diagnosed at an older age, with 50% of new COPD diagnoses occurring among patients over the age of 65 (Fletcher et al., 2011). According to the Agency for Healthcare Further and Quality, the readmission rates decreased from 2009 to 2013, falling from 2 million to 1.8 million for patients older than 65 years. However, further research is needed to identify risk factors that influence the burden of COPD readmissions related to age (Fletcher et al., 2011).

Research from recent studies shows that age has an impact on the readmission

rate of patients with COPD. Older age was associated with greater risk of readmission in the above-reported Gershon et al. (2017) study. Additionally, Elixhauser et al. (2011) conducted a study on the readmission of COPD patients from 40 to 64 years of age. The researchers observed that COPD patients older than 40 years of age were 15% more likely to be readmitted to the hospital than patients under the age of 40. This was 5 percentage points higher than the readmissions rate for all other illnesses (Elixhauser et al., 2011). This finding strongly suggests that age should be included as a variable in the present study because it could influence the rate of readmission among the adult population of this study.

Similar to Elixhauser et al. (2011), Hasegawa, Gibo, Tsugawa, Shimada, and Camargo (2016) conducted a study examining the age-related differences in the frequency of 30-day readmission among patients with asthma. During the cohort study, researchers obtained information on 30-day readmission among asthma patients in 3 states (California, Florida, and Nebraska) (Hasegawa et al., 2016). Researchers found that, compared with younger adults with asthma, older adults with asthma had a significantly higher readmission rate 10.1% vs. 16.5%; OR = 2.15; 95% CI, 2.07-2.23; $p < .001$. This finding supports that of Elixhauser et al. and underscores the need to examine age as a potential factor associated with readmission among patients with COPD, asthma, and other pulmonary illnesses.

A retrospective study by Baker et al. (2013) identified risk factors of readmission among patients with COPD. The analysis included 6,095 patients between the ages of 40-65 years old. Twelve-month and 30-day readmission rates were examined, and the

researcher evaluated clinical risk factors associated with readmission. The only demographic variable found to be associated with COPD-related readmission was age, with readmitted patients being significantly likely to be older than those not readmitted ($p = 0.0301$). The researchers concluded that age is related to readmissions among patients with COPD.

Not all studies have found an association between age and COPD readmissions. (Baker et al. 2013). The 30-day readmission rate was 8.25% ($n = 503$) overall.

Exploring readmissions related to COPD exacerbations specifically, Hunter et al. (2016) found that, although older age was associated with the first admission for COPD exacerbation, there was no association between age and subsequent readmissions. However, the researchers did not account for admissions and readmissions for other reasons. Similarly, Kim et al. (2013) failed to observe an age association in their study among 77 COPD patients, dividing the sample into those older than 65 ($n = 31$) and those younger than 65 ($n = 11$). Overall, 54.6% had one readmission, and 45.4% had two or more readmissions for COPD exacerbation within the first year of discharge. Notably, these readmission rates are similar to those reported by Gajanan et al. (2013). Age was not a statistically significant independent predictor of frequent readmission ($p = 0.466$). The researchers did not specify whether the patients had tracheostomies (Kim et al., 2013). Although this study perhaps contraindicates the inclusion of age as a variable in the present study, it should be noted that the researchers excluded patients younger than 40. Therefore, age may be associated with hospital readmission for COPD patients across the entire age spectrum. The present study focuses on adult patients aged 18 and older.

After analyzing all of the studies reviewed in this section, I conclude that not enough is known to exclude the possibility that age as a risk factor for readmission among African American COPD patients with tracheostomies. Therefore, age is included as a variable in this study.

Socioeconomic status and COPD readmissions. It is often noted that COPD patients with a low socioeconomic status have a higher rate of readmission (Park et al., 2014; Silvers & Lang 2012). According to Silvers and Lang (2012), living in a low-income urban area as an African American with COPD is associated with an increased risk of readmission. This increased risk is attributed to a lack of resources available to the patients with COPD, which further enhances the severity of COPD cases resulting in readmissions (Silvers & Lang, 2012). Recent studies suggest that low-income areas do not have resources to treat asthma, a form of COPD, at home (Silvers & Lang, 2012).

Medicare claim data from 2006 to 2011 revealed Medicare and Medicaid insurance affects readmissions for patients with COPD (Medicare, n.d.). There were 26,798,404 inpatient admissions to IPPS hospitals, and 191,698 (20.2%) of those index admissions resulted in readmission (Shah et al., 2016). Using a multivariable logistic regression model, researchers found readmitted beneficiaries for patients with COPD were more likely to be dually enrolled in Medicare and Medicaid than patients with COPD not readmitted into the hospital 30.6% vs. 25.4%, $p < .001$ and have a longer median length of stay, 5 days vs. 4 days, $p < .0001$ (Shah et al., 2016). Almost one-third (95% CI [31, 32]) of readmissions for patients with COPD occurred by day 7, and 60.6% of readmissions for patients with COPD occurred by day 15 (95% CI [60.4, 60.8], the

median timeframe for COPD readmission (Shah et al., 2016). It is evident that patients with COPD who have Medicare and Medicaid insurance are more likely to be readmitted into the hospital than patients with COPD who have private insurance.

Researchers have examined socioeconomic status related to readmissions and how it affects patients with COPD who have tracheostomies. It is evident that the lack of insurance and the type of insurance that patients with COPD have is related to readmission rates. Given that readmissions are common among patients with COPD, 20% of Medicare patients are readmitted within 30 days of discharge (Park et al., 2014).

Researchers from one study found contrasting evidence. According to Gershon et al. (2017), whose sample consisted of over 130,000 COPD patients, socioeconomic status was not related to risk of 30-day readmission after adjusting for other patient factors. Although this study represents an outlier, since most researchers find that socioeconomic status is important, future studies are needed to examine socioeconomic burdens known to cause readmissions among patients with COPD.

COPD Comorbidities and Hospital Readmissions

Readmissions might be reduced if the reasons for those readmissions are better understood. Understanding COPD readmissions among patients with comorbidities can lead to effective interventions (Almagro et al., 2012; Baker et al., 2013; Donze, et al., 2013). According to the 2017 GOLD report, lung cancer is a frequent comorbidity with COPD and is often a cause of death among COPD patients. Other important comorbidities listed by GOLD (2017) include cardiovascular disease, osteoporosis, and gastroesophageal reflux. GOLD recommended minimizing overtreatment and

polypharmacy by simplifying treatment for patients with multiple comorbidities (GOLD, 2017).

Although comorbidities may be present at the initial diagnosis of COPD, the frequency of comorbidities has been shown to increase as COPD progresses (Almagro et al., 2014). Moreover, studies have found that comorbidities are risk factors to 30-day readmissions for COPD patients. Additional research is needed to explore how comorbidities among patients with COPD who have had tracheostomies may affect mortality rates and hospital readmissions.

Comorbidities and Hospital Readmissions in General

Although the research is limited regarding factors associated with readmission among COPD patients specifically, some additional work exists on comorbidities as a risk factor for 30-day hospital readmission generally. In one prominent study, Donze et al. (2013) analyzed data from 10,731 consecutively discharged patients in Boston. The study showed that 2,398 patients were readmitted into the hospital after 30 days discharged, and that the avoidable readmissions were often due to complications with comorbidities (Donze et al., 2013). The most common comorbidities for readmission were neoplasm 16.8%; $n = 402$, infection 10.9%; $n = 260$, and heart failure 4.9%; $n = 11$. Although this study does not specifically focus on COPD patients, it does support the importance of considering comorbidities as a risk factor for readmission in the present study.

Like Donze et al. (2014), Graboyes et al. (2013) conducted a retrospective cohort study to examine readmission rates associated with comorbidities. Rather than examining

all discharged patients, Graboyes et al. focused on patients admitted to the otolaryngology department from January 2011 to December 2011. Using a univariate logistic regression model and a multivariate regression model, the researchers found six risk factors associated with readmission: presence of a complication, new total laryngectomy, discharge destination of skilled a nursing facility, severe coronary artery disease or chronic lung disease, and current illicit drug use. These risk factors were significant at the 0.5 alpha level. Importantly, patients with new tracheostomies were also more likely to be readmitted OR = 3.54, 95% CI, 1.85-6.77 (Grayboyes et al., 2013). These results underscore the relationship between comorbidities, such as coronary artery disease and readmission among patients with otolaryngology admissions, which could include patients with COPD. After evaluating readmissions for patients with comorbidities, researchers have found that these manifestations are associated with readmissions among patients in general, supporting the inclusion of comorbidities as a variable in the present study.

Other Risk Factors for COPD Readmission

The above review, I emphasized literature justifying the inclusion of the variables for the present study, but there are some other potential risk factors for readmission that should be noted. Not all risk factors examined in existing literature are included in the present study, due to scope limitations as well as restrictions of availability in the EMR for patients in this study. However, for the sake of completeness, a few other notable risk factors are included here.

Physical activity. GOLD recommended that patients with COPD should have

daily physical activity (GOLD, 2017). Empirical research supports this recommendation. Physical wellness and exercise are associated with improved patient outcome and reduced readmission rates (Troosters, Polkey, Rabinovich, Vogiatzis, Weisman, and Kulich, 2013). Patients with COPD have been found to have low levels of activity per month after discharge from the hospital, which led to a significant risk of readmission within a year of discharge (Nguyen et al., 2014). Another team of researchers found that after the first week of discharge, patients with COPD who engaged in less activity were readmitted to the hospital more frequently compared to those with higher physical activity (OR = 6.7, $p = 0.02$) (Chawla, Bulathsinghala, Tejada, Wakefield, & ZuWallack, 2014). Physical activity data are not uniformly available in the EMRs of patients in this study, so the variable is not included, but research indicates that it could be an important factor in understanding readmission rates among COPD patients.

Psychological Stress in Readmission

The Gerontological Society of America reported in 2012 that African Americans who suffer from COPD are also diagnosed with depression at a rate 3 times higher than those without COPD (Lowe, 2014). Since stress and depression affect performance, sleep cycle, and diet, they are also associated with the likelihood of exacerbation of COPD (Lowe, 2014). A nationwide telephone survey included 39,691 African Americans with COPD. The survey found that 2,925 (38.1%) of those respondents exhibited depression (Lowe, 2014). Lowe (2014), also found 8.1 percent of African Americans with COPD reported they had depression, compared to 12.5 percent of AA patient who did not have COPD (Lowe, 2014).

Coventry, Gemmel, and Todd (2011) studied the relationship between the amount of social support and depressive symptoms for re-hospitalization, along with the frequency of re-hospitalizations. Among patients with COPD, psychological risk factors such as depression and anxiety are associated with increased readmission into the hospital (Coventry et.al, 2011). The study was carried out via telephone interview and included 79 participants who were discharged home a week after hospitalization. Baseline data revealed that 58% of the participants had anxiety, 43% had depressive symptoms, and readmitted patients had a severe case of depression (Coventry et al., 2011). Researchers found that patients who are depressed are predicted to have higher 365-day readmission rates (OR= 1.30; 95% CI, 1.06–1.60; p = .013). Forced expiratory volume in 1 second (FEV_1) was also associated with readmission rates in their multiple logistic regression model (OR = .962; 95% CI, 0.93-0.99; p = .021). Patients who own their own homes were associated with the total number of readmissions (B -0.46, 95% CI [-0.86 to -0.06], p = 0.024) (Coventry et al., 2011). Post follow-up, 60 patients were readmitted, and 26 patients were readmitted after 90 days discharged (Coventry et al., 2011).

Iyer et al. (2015) conducted a similar study by examining medical records for all patients with COPD at the University of Alabama at Birmingham Hospital between November 2010 and October 2012 (Iyer et al., 2017). The researchers investigated the role that depression played in 30-day readmissions (Iyer et al., 2015). A total of 901 participants were included in the study, 146 (34.6%) were African American, and 212 were male. Forty-seven (35.6%) of these participants were readmitted into the hospital within a year. Researchers found that the presence of depressive symptoms and anxiety

are risk factors for COPD readmissions (OR, 3.83; 95% CI [1.84–7.96]; p <0.001). Iyer et al. (2015) and Coventry et al. (2011) both prospectively examined risk factors related to depressive symptoms and psychosocial factors in a small cohort study of patients with COPD. Depression with COPD and the severity of the disease may warrant further investigation to decrease readmissions.

Kuo et al., (2016) also assessed readmission for COPD patients, however, the population included COPD patients 66 years of age and older. The study design created by the researchers featured a cohort study using ICD-9 codes for COPD hospitalizations. This study revealed that anxiety, psychosis, psychological disorders, alcohol abuse, and drug abuse contributed significantly to the 30-day readmission rate for elderly patients with COPD (Kuo et al., 2016). The multivariate analysis revealed different odds for 30-day readmission for COPD patients with anxiety (OR, 1.43; 95% Cl [1.37-1.50]), psychosis (OR, 1.18; 95% Cl [1.10-1.27]), drug abuse (OR, 1.30; 95% Cl [1.1-1.47]), and drug abuse (OR, 1.29; 95% Cl [1.11-1.50]). Research of Kuo et al. (2016) indicated that among patients with COPD, depression is independently associated with a higher risk of readmissions.

The literature suggests that depression and anxiety are important risk factors of readmissions among patient with COPD (Moulec, 2017). Depressed patients with COPD are likely to be readmitted due to lack of self-confidence and anxiety, thus leading to ineffective COPD management (Moulec, 2017). Future research is needed to focus on ways to support the psychosocial care of patients with COPD discharged home from the hospital, especially those with anxiety and depressive symptoms (Moulec, 2017).

COPD Exacerbations and Risk of Readmissions

Exacerbations of COPD are defined as acute periods of worsening respiratory symptoms (GOLD, 2017). Exacerbations are found to be common among patients with COPD (Ozyilmaz et al., 2013; Baker et al., 2013; Brahan, 2015; Sigh and Yu, 2016; Augusti & Barnes, 2011). In particular, exacerbations are more frequent among older patients (Santibanez, Garrastazu, Ruiz-Nunez, Helguera, & Arenal, 2016) and those who received their COPD diagnosis 10 years earlier or more (Alisha, Gajanan, & Jyothi, 2013).

Exacerbation is inflammation caused by irritation and swelling in the lungs (ATS, 2014). The infection in the lung is caused by bacterial and viral organisms (ATS, 2014). Acute exacerbations in patients with COPD have an impact on readmissions (Gajanan, Jyothi, Alisha, 2013; Brahan, 2015). Reflecting upon the prognosis and the rate of readmission, most physicians suspect the impact of readmission is due to acute exacerbations in patients with COPD (Gajanan et al., 2013). Gajanan et al. (2013) conducted a prospective study from January 2008 to December 2011 in a tertiary hospital on readmissions to hospitals within a month of discharge for patients who have AECOPD (acute exacerbation COPD). Gajanan et al. (2013) found that patients with COPD previously hospitalized for acute exacerbation in COPD are readmitted to the hospital ($p < 0.0001$). Wark et al. (2013) conducted a multivariate analysis on patients with COPD required readmissions for acute exacerbations relating to low immunity and poor prognosis within 6 months of initial treatment (Wark et al., 2013). The study included 199 patients with COPD exacerbations (Wark et al., 2013). Wark et al. (2013) found that

a virus was detected in 79 patients with COPD (40%), bacteria in 41 (21%), and 18 had both (bacterial and viral) (Wark et al., 2013). Furthermore, exacerbations are associated with increased lung impairment amongst patients with COPD and a poorer prognosis for COPD. Studies have shown acute exacerbations are associated with patient readmission into the hospital.

Nantsupawat et al. (2012) conducted a study of patients with COPD exacerbations. From October 1, 2010, to March 31, 2011, 81 patients with COPD were found out of 103 readmissions into the hospital (Nantsupawat et al., 2012). Researchers of the study found that early re-hospitalization rates for patients with COPD were 13.6% lower than that of studies conducted on patients with COPD exacerbations. Of the 103 COPD patients, 14 patients ranging from ages 50 to 98 years of age were found to have had early readmissions (Nantsupawat et al., 2012). Similar to the Nantsupawat et al. (2012) study, Ozyilmaz, Kokturk, Teksut, and Tatlicioglu (2013) also conducted a study of patients with COPD and exacerbations from November 2008 to November 2009. Researchers found in their study that of 107 patients with COPD, 37.4% had severe exacerbations. Researchers also found that readmission rates within 2 months after hospital discharge was 39.3% compared to 27.6% off all readmissions (Ozyilmaz et al., 2013; Shah et al., 2015). It has been shown that severe exacerbations of COPD are associated with readmission within 2-months post discharge from the hospital (Ozyilmaz et al., 2013).

Nantsupawat, Limsuwat, and Nugent (2012) have examined patient risk of re-hospitalization after being hospitalized for acute exacerbation of COPD among older

adults. Repeated hospitalizations are common in older patients with COPD. Research has found that patients with COPD who have acute exacerbations have an increased risk of readmission as well as mortality. Further research is needed to evaluate the acute exacerbations of COPD readmissions for patients with tracheostomies.

Bacterial Infections, Viral Infections, and Exacerbations

There are multiple indicators for the cause of COPD exacerbations (i.e., periods of acute worsening of respiratory symptoms) such as bacterial and viral infections within the lungs. Exacerbations of COPD have been associated with readmission, shortness of breath, worsening of COPD symptoms, and are often associated with bacterial and viral infections. Virus and bacterial infections are risk factors for readmissions in patients with COPD (Wedzicha, 2013). Wedzicha (2013) noted that respiratory viral infections are likely to cause COPD exacerbations that lead to hospitalizations. Respiratory viral infections cause increased chances of bacterial secondary infections, especially in winters when respiratory viral infections are more prevalent (Wedzicha, 2013). In a study of 50 adult patients with COPD, viral infections were associated with increased risk for exacerbations (Ikura et al., 2015). In this study, researchers found that 70% of these patients were diagnosed with viral and bacterial infections in clinical practice (Ikura et al., 2015). Wedzicha (2013) and Ikura et al. (2015) have demonstrated the relationship between viral and bacterial infections that induce COPD exacerbations, which cause patients to be readmitted into the hospital.

Wark, Webster, Scott, and Emery (2013) also conducted a study similar to Ikura et al. (2015) on COPD exacerbations related to viral and bacterial infections. Wark et al.

(2013) noted that COPD exacerbations are complicated by bacterial infections associated with airway inflammation, thus causing readmission into the hospital. Acute exacerbation is found to heighten new bacterial strains. Subjects in this study included patients over the age of 16 with acute exacerbation of COPD and asthma at John Hunter Hospital in Newcastle, Australia (Wark et al., 2013). Researchers used a total sample size of 199 participants in the study. A sample of sputum from 103 COPD patients was obtained and cultured to identify bacteria using standard techniques. Researchers discovered that a virus was detected in 79 COPD patients (40%), and 41 COPD patients (21%) had bacterial infections. Of that 41, 18 COPD patients had both viral and bacterial infections. From the sample, 103 COPD patients ages 16 and older were readmitted into the hospital for acute exacerbations caused by bacterial infections (Wark et al., 2013).

Wark et al. 2013 determined the impact of virus and bacterial infections on COPD hospitalization. Researchers constructed a multivariate logistic regression model to determine the odds of readmission (Wark et al., 2013). In the said population, patients with COPD had a longer length of stay (LOS) and were more likely readmitted to the hospital within 60 days (Wark et al., 2013). Researchers found 79 patients had a viral infection, and 41 subjects had a bacterial infection (Wark et al., 2013). Researchers found the most prevalent infections in the study were *Haemophilus influenzae, followed by Moxorella catarrhalis, Pseudomonas aeruginosa, and Staphylycoccus aureus* (Wark et al., 2013). Infections are important triggers for COPD readmissions. Patients with COPD are more likely to be readmitted to hospitals due to the prevalence of viral and bacterial infections (Wark et al., 2013).

After reflecting upon the results of the study, it was clear that exacerbations based on bacterial infections often led to a severe outcome in patients, especially since bacterial infections are found to be secondary infections, and are the only one for which the possibility of antibiotics is available. Meanwhile, there is no option for treatment of viral infections in the initial stages and they are often ignored during the diagnostic stages. In the case study by Wark et al. (2013), researchers noted that 22 participants were readmitted for bacterial infections and 21 participants were admitted for viral infections from the COPD population. While there are other factors that exacerbate a COPD infection, researchers noted that viral infections were associated with acute exacerbations in COPD. Bacterial infections were a result of predisposition caused by viral infections in patients with COPD (Wark et al., 2013). Bacterial infections also contributed to the severity and readmission of COPD patients (Wark et al., 2013). The research failed to address the presence of tracheostomies in the population. In conclusion, the results of the study indicated that virus infections are independent predictors of acute exacerbations in COPD. It is unclear that viral and bacterial infections alone increase the chance of readmission to hospitals (Wark et al., 2013).

Viral and bacterial infections play an important role in patients with COPD exacerbations. Different types of infections require further research on how the immune system responds to them. It is evident that bacterial and viral infections lead to severe complications for patients with COPD.

Bacterial and Viral Infections and Readmission

As discussed in the previous section, exacerbations of infections through bacterial and viral means have been associated with a high readmission rate in the COPD population. Respiratory viral infections are associated with severe acute disease. In this respect, Wark, Tooze, Powell, & Parsons (2015) noted that such incidences worsened the disease progression since the risk of airway inflammation is increased by bacterial infections in the lungs and are often associated with lung ailments and the severity of COPD. Bacterial and viral infections have a significant impact on the length of stay (LOS), readmissions, and exacerbations (Wark et al., 2015). Patients with COPD that had bacterial and viral infections had a longer LOS, and were more likely to be readmitted post discharge (Wark et al., 2015). Perhaps the most common infection that accounts for readmissions of COPD patients with tracheostomies is community acquired pneumonia (Wark et al., 2015). According to Coxton, Weinmann, Senior, and Hoidal (n.d.), bacteria products and colonization are a result of acute exacerbations of COPD.

Research has been done to understand the impact that bacterial and viral infections have on patients and the association with the increased rate of readmissions. Edwards, Keens, Kun, and Ward (2012), conducted a retrospective cohort study on hospital readmissions. Researchers determined a 12-month risk factor for non-elective readmissions in children with tracheostomies. The retrospective cohort study on tracheostomy patients was done between January 2003 and October 2009. However, patients included in the study were 21 years of age and younger. The study found that one hundred and nine children and young adults were readmitted into the hospital with

infections at least once within a year of discharge (Edwards et al., 2012). Researchers found that patients with a tracheostomy had an increased risk for readmission (AOR 1.79, 95% CI [0.97–3.3], $p = 0.06$) (Edwards et al., 2012).

Studies have examined the link between infections, the 30-day readmissions, and high healthcare costs of $17.4 billion for patients readmitted to the hospital. Like Edwards et al. (2012), Emerson et al. (2012) also conducted a study on hospital readmissions related to bacterial infections in adults older than 18 years of age. The researchers of this cohort study examined 136,513 patients readmitted between January 1, 2001, and December 31, 2008, from the University of Maryland in Baltimore. Researchers found 7,898 (6%) of those patients were admitted with a positive culture. Moreover, 35% percent of patients were readmitted within 365 days post discharge from the hospital (Emerson et al., 2012). The median time of re-hospitalization among patients that had a positive culture was 27 days (95% confidence interval), compared to 59 days without a positive culture upon readmission (Emerson et al., 2012). Hospital readmissions are common with patients who have exacerbations due to bacterial and viral infections, however, hospital readmissions increase healthcare costs.

COPD Exacerbation, Readmissions, and Gender

Few published studies have examined COPD exacerbations by gender. The readmission and mortality rates of women with COPD has risen in contrast to that of men since 2000 in the United States due to higher rates of exacerbations (Aryal, Diaz-Gunzmann, and Mannino, 2014). Thirty-day readmission rates for patients with COPD were 13 percent higher among males (7.6 percent) compared to females (6.7 percent)

(Elixhouser et al., 2011). In relation to gender, further research is needed for this population with COPD exacerbations who have tracheostomies and strategies to prevent readmissions.

There are few studies about gender differences in exacerbation characteristics of COPD. However, studies have attempted to describe the possible gender-associated differences in exacerbations of COPD (Aryal, Diaz-Gunzman, and Mannino 2014). Aryal (2014) studied gender-associated differences of patients with COPD. Researchers found out of 384 COPD patients admitted into the hospital, 40% were female. Researchers also found that COPD mortality rates were 30% higher for men than women (3.0% versus 17.8%). Females also had a longer period from the onset of symptoms until the admission and had longer hospital stays than males. According to the study, women had the longest hospital stay (>15 days), which was greater than males 23.9% vs. 4.7%, P=0.001. The influence of gender on COPD risk of readmissions is due to many factors such as genetic and environmental factors. In addition, the roles that gender play in readmissions may lead to improvement of readmissions as well as the improvement of COPD prognosis.

Bae, Bortulucci, Coultas, Jackson, Lo, Singh, Su and Suzuki (2011), examined demographic variations of COPD readmission rates among patients in Texas hospitals. Variables in this study included gender, race, and age of 100,000 admissions from urban areas. In the metropolitan areas, rates were higher in females than males ($p < 0.0001$). Female rates were higher than males among NH Whites and NH Blacks. In Texas, there was a substantial significance in the variation of gender based on hospital admissions (Bae et. al., 2011).

In a study of 65,497 adults in Hong Kong, 50,456 (77 %) were male and 15,041 (23 %) were female, researchers found that unplanned readmissions were associated with the male gender (Chan, Wong, Yam, Cheung, Wong, and Yeah 2011). Readmissions of patients with COPD are common after an acute exacerbation. However, COPD exacerbations and gender may warrant further research to support the association of readmissions among African Americans patients with COPD. In contrast, Kilic and Chikir (2015) examined 678 patients with COPD for COPD exacerbations that might be prevalent. Researchers found out of 678 COPD patients, 109 (28%) female COPD patients, and 275 (72%) male COPD patients had exacerbations (Kilic et al., 2015). The number of exacerbated female patients with COPD was greater than males, p =0.001 (Kilic et al., 2015). Patients with COPD who had two hospitalizations for exacerbations was greater in men than women, p=0.01 (Kilic et al., 2015). Data revealed females with COPD exacerbations were more prevalent than males with COPD exacerbations readmitted to the hospital. Women were more likely than men to have exacerbations and be hospitalized.

In conclusion, studies reveal that gender plays an important role in the number of hospitalizations, COPD exacerbations, and prolonged length of stay regarding hospitalization. Women having COPD exacerbations are more likely to have worsening of lung functions and more prone to smoking cigarettes than men in the United States (Kilic et al., 2015). There is little research about gender differences in COPD exacerbations. Research is needed to determine the lack of human resources, misdiagnoses, and mistreatment associated with COPD exacerbations.

COPD exacerbation-related readmissions pose a burden to patients with COPD as well as to the healthcare system. The findings reviewed in this section support that COPD exacerbations are related to certain demographic risk factors, especially gender. Earlier in this chapter, I reviewed literature related to readmission among COPD patients, which showed that older patients and those with lower socioeconomic status are more likely to experience readmission, including readmission for exacerbation. In conclusion, these demographic variables are important to include when studying hospitalization, including readmission among COPD patients.

Malnutrition, Obesity, and COPD

Obesity is common in patients with COPD (Liu et al., 2015; Zapatero et al., 2013). According to the World Health Organization (WHO), obesity has doubled since 1980 (Hanson et al., 2014). In 2008, 1.4 billion adults (35%) were considered overweight around the world, and of these, over 200 million (11%) adults were considered obese (Hanson, Rutten, Wouters, and Rennard 2014). Obesity has been found to cause decreased lung functions, increase the prevalence of several lung diseases, and compromises pulmonary function leading to COPD (Hanson et al., 2014). Studies have shown evidence of the role that obesity and malnutrition play in the progression of COPD (Hanson et al., 2014).

Liu et al. (2015) examined the association between body mass index (BMI), obesity, and respiratory conditions such as COPD among 12,000 adults in South Carolina. The study conducted found that 12-25% of COPD patients were underweight (Liu et al. 2015). A longitudinal method using cross-sectional surveys was used to

conduct the study. The study was conducted using the South Carolina Behavioral Risk Factor Surveillance System (BRFSS) survey (Liu et al., 2015). Researchers found patients with COPD had a significantly higher percentage of obesity, 32.0% vs. 26.1%, p=0.01 and morbid obesity, 10.3% vs. 4.7%, p<0.001, but not underweight status 2.4% vs. 1.4%, p=0.10, than those without COPD. Patients with COPD are not more likely to be underweight or morbidly obese.

BMI (body mass index) is an independent risk factor that impacts readmissions (Hanson et al., 2014). Like Liu et al. (2015), Hanson et al. (2014) studied the body composition and COPD status of 650,000 participants using the Canadian National Health Survey. The study revealed that obesity was significantly higher in patients with COPD and they had a higher risk of readmission compared to those who did not have COPD, 24.6% and 17.1%, respectively, P<0.001 (Hanson et al., 2014). Researchers of the adult multiethnic cohort study found there was a higher percentage of obesity and early stages of COPD. Moreover, 54% of the participants had a BMI measurement of 30 compared to 20-24% of the population in general (Hanson et al., 2014). Participants who received tracheostomies were included in the study, however, the role of tracheostomies was not assessed in the study (Hanson et al., 2014).

Similar to Hanson et al. (2014); Zapatero et al. (2013) examined the association between obesity, and malnutrition of patients with chronic obstructive pulmonary disease and the risk of readmissions in less than 30 days (Zapatero et al., 2013). Zapatero et al., 2013 used a cross-sectional study to determine readmissions of patients with malnutrition and obesity by using their BMI. Zapatero et al. (2013) aimed to assess the association of

obesity and malnutrition of patients with chronic obstructive pulmonary disease and the risk of readmissions in less than 30 days (Zapatero et al., 2013). The study was conducted in Spain between 2006 and 2007 using a retrospective review of the charts of those admitted with COPD (Zapatero et al., 2013). The hospital data was gathered from the Basis Minimum Data Set (BMDS) to conduct the study. The data set contained socioeconomic data, which excluded sex, age, and secondary diagnoses for 313,333 patients discharged from the hospital (Zapatero et al., 2013). Researchers found obese patients had early re-admittance risk, OR = 0.87; 95% CI [0.85-0.92] compared to non-obese patients. Malnourished patients had a much higher risk of death when in the hospital OR = 1.73; 95% CI [1.62-1.85] or of being readmitted within 30 days after discharge OR = 1.29; 95% CI [1.22-1.38]. There was an association between BMI and readmission among COPD patients. Compared to COPD patients of normal weight, readmissions were 29% higher in obese patients; malnourished patients were older versus normal weight patients with COPD, 75.3 versus 72.8%; $p < 0.001$ (Zapatero et al., 2013).

In conclusion, the relationship between COPD, malnutrition, and obesity has been broadly studied. Most commonly, malnutrition has been examined in relation to COPD, and it is evident that malnutrition in COPD patients contributes to unfortunate outcomes for patients with this disease. Underweight patients with COPD, overweight patients with COPD, and low BMI are independent risk factors for mortality, as well as readmissions for patients with COPD.

Influenza and COPD

According to the Centers for Disease Control (2011), the flu increases

complications in patients with COPD. Adults with COPD are at risk of invasive diseases, such as the flu, which is preventable with flu vaccinations (Pesek, 2011). Hence, the influenza vaccination is recommended for patients 65 and older and patients with comorbidity conditions such as COPD (Holt, 2013). According to Pesek (2011), there are more than 200,000 hospitalizations for patients with COPD because of seasonal influenza. U.S. hospitalizations as a result of the flu cost an estimated 4.6 billion dollars annually (Pesek, 2011). COPD influenza contributes to acute exacerbation and leads to increased risk of hospitalizations (Pesek, 2011). According to Ayache, Boyagi, and Pile (2014), influenza vaccinations reduce the risk of readmissions.

Mowls, Cheruvu, and Zullo (2013) found 30-day hospital readmissions decreased following the administration of influenza vaccinations in adult COPD patients. Researchers of the study utilized a cross-sectional data analysis in 2011 using the Behavioral Risk Factor Surveillance System data. Overall, 49% of participants with COPD had an influenza vaccination within the past year. The prevalence of the flu shot was greater in those diagnosed with COPD (Mowls et al., 2013). Researchers found that patients with COPD had an influenza vaccination within twelve months compared to patients without COPD (65% vs. 29%, respectively; $p<0.0001$) (Mowls et al., 2013). The CDC urges older adults to get flu vaccinations to protect themselves from other diseases (CDC, n.d.).

Influenza vaccinations result in a decline in morbidity and healthcare utilization (Manish, Chandra, Mittadodla, and Bartter, 2015). Researchers in this cross-sectional study determined that COPD patients were more likely to be admitted to the ICU during

the 2013-2014 flu season (Manish et al., 2015). Researchers found patients with pulmonary disorders had greater odds of contracting influenza virus pneumonia (OR 11.88; 95 % [CI 8.56–16.48]). Despite higher rates of the influenza vaccination, the influenza virus increases complications for COPD patients, and COPD patients have greater odds of contracting the influenza virus that may require admission into the hospital.

Koul et. al. (2014) examined 498 adults with COPD over 40 years of age in Kashmir, India. The study was conducted between October of 2010 and September of 2012. Koul et al. (2014) found that out of 498 patients with COPD, only 40% of those patients received seasonal flu vaccinations. Within the 2-year period, 33% of patients with COPD were hospitalized for influenza. From October of 2010 to September of 2011, 8% of patients with COPD were admitted to the hospital for influenza, compared to 9% from October of 2011 to September of 2012, (p = 0·6) (Koul et al., 2014). Researchers also found that 14% of patients with COPD were readmitted into the hospital for influenza within 30 days of discharge from the hospital (Koul et al., 2014).

The World Health Organization recommends influenza vaccinations for groups at risk of severe influenza, such as patients with COPD. Influenza vaccinations also reduce exacerbations of the disease (Koul et al., 2014). Moreover, 30-day readmissions have decreased for patients with COPD who have received influenza vaccinations. Further research is needed for patients with tracheostomies receiving influenza vaccinations to determine if 30-day readmission rates have also decreased for that population.

Patient-Provider Communication

Patient-provider relationships are important for COPD patients (Sanders and Lang, 2012). It is imperative that hospitals have effective communication when patients discharge for optimal transition and to avoid adverse events such as readmissions (Karliner, Auerbach, Napoles, Schillinger, and Nickleach, 2013). According to Karliner et al., (2013), readmissions are prevalent due to the lack of education about medications and their purpose and communication between the caregivers and their patients (Kaliner et al, 2013). Researchers found that patients had lower odds of understanding medication category (OR 0.63; 95% CI [0.42-0.95]), and category/purpose (OR 0.59; 95% CI [0.39-0.89]). Researchers also found patients with the lowest educational attainment had significantly lower odds of knowing their appointment type (OR 0.37, 95% CI [0.15-0.95]) and purpose for the medication (OR 0.50; 95% CI [0.26-0.94]), compared to patients graduating high school and attaining a higher education level. Communicating with patients who have less education versus those with more education can affect the communication between healthcare providers and patients.

Patient education has been found to reduce admissions (Irani and Hicks, 2014; Messenger, 2013). COPD patients who are effectively educated have fewer challenges and should begin self-management and education of their disease in the hospital prior to discharge (Messenger, 2013). According to Messenger (2013), education sessions should not stop at discharge and should continue once the patient is discharged. Messenger (2013), also investigated that the phone calls from pulmonologists to their patients concerning their care have no difference in 30-day readmissions. Many factors contribute

to the treatment plan for each patient, including provider experience. Moullec et. al. (2012) conducted a study on using integrated care of patients with COPD. The research of this logistic regression analysis study showed that there was a lower probability of re-hospitalization over the follow-up year in the integrated care program (IC) group, compared to patients receiving usual care (OR =0.44; 95% CI [0.23–0.85]). The findings of these studies suggest that providing COPD patients with the proper education and case management can decrease readmissions.

A cohort study conducted in 2014 found that home visits and communication about the patient treatments at home by general practitioners decreased the number of readmissions. The aim of this study was to summarize the tendency of general practitioners to make home visits to cut down the number of readmissions of patients with COPD (Lykkgaard et al., 2015). This Danish study used a sample of 14,425 patients with COPD. It included variables such as participants hospitalized for the first time, age (mean age of 70 years), gender, and household income. According to Lykkegaard et al., (2015), a 30-day readmission free-survival was used to conduct the study. An ICD 10 code with a J41-44 was used to conduct the study as a primary diagnosis (COPD, chronic bronchitis, and emphysema). Lykkegarrd et al. (2015) found that nearly 31% of the patients with COPD received visits from general practitioners after their first visit of hospitalization, and within 30 days after discharge from the hospital, 19% were readmitted into the hospital. Among the 14,425 patients who were discharged alive, 31% had received a home visit from their general practitioners in the year before being hospitalized; 30 days from discharge 2,771 patients (19%) were readmitted to hospital;

and 228 patients (1.6%) died without readmission (Lykkegarrd et al., 2015) Additionally, 1.6% had died without being readmitted into the hospital.

These findings indicate that the risk of readmission decreases when patient-provider communication is provided during discharge. Communication can effectively reduce readmissions if healthcare providers, physicians, and patients. Despite the importance of patient-care communication, the effects of communication on patient outcomes are infrequently researched.

Care Bundles, Discharge Planning, and COPD Readmissions

Care bundles are patient care plans, smoking history, patient demographics, smoking education, and a patient checklist to see if patients were involved in their care. They have been used by researchers to reduce readmissions (Mathews, Tooley, Nicholls, and Lindsey-Halls, 2013; Laverty et al., 2015). According to Laverty et al., (2015), care bundles are recommended for patients who are admitted with COPD and received interventions from healthcare professionals such as the respiratory team. Care bundles also involve self-management plans and assessing patients for the correct use of medications, such as inhalers (Laverty et al., 2013). According to Laverty et al. (2013) and Jennings et al. (2015), a care bundle approach is necessary to help focus attention in COPD care, and decrease readmissions and ED visits. According to Irmain and Hicks (2015), ED care bundles that were provided in the study included supplemental oxygen, arterial blood gas (ABG) results, and the COPD outreach program.

Laverty et al. (2013) examined the impact of care bundles on COPD readmissions by monitoring patients 45 years of age on a 7-day to 90-day basis following the

implementation of a care bundle. The study was conducted between April and September of 2010. Clinicians found that 7-day readmissions decreased among both groups at -2.5% of physical activity for the national group receiving a care bundle, and -7.4% physical activity for the bundle group, p for difference (p = 0.213). The 90-day readmissions continued to rise before implementing the care bundle, then fall after implementing the care bundle post discharge (Laverty et al., 2013). Only 53% of patients admitted with COPD were under the care of a respiratory team at discharge from the hospital (Laverty et al., 2013). Researchers found the care bundle was associated with the reduction of readmissions among patients with COPD (Laverty et al., 2013). Care bundles given to patients post discharge are associated with reducing the rate of readmissions for patients with COPD.

Adamson, Burns, Camp, Sin, and van Eeden (2015) conducted a study examining patients with COPD in two teaching hospitals between March 1, 2012, and March 1, 2013. The study was done to determine the impact that individualized care plans have on 30-day to 90-day readmissions. The study consisted of 271 patients with COPD prior to admission. Researchers found that individualized care plans significantly reduced 90-day readmissions for females (p=0.0205), however, it did not significantly reduce readmissions for males (p>0.05). Overall, the goal of individualized care plans for patients with COPD is to provide transitioning back into the community, provide self-management, disease education, provide care coordinators, and mobilizing resources.

Lennox, Green, Howe, Musgrave, Bell, and Elkin (2015) used a retrospective chart review of 405 participants with COPD from 2007 -2013 to examine hospitalization

services and discharge planning. The study examined the challenges in implementing a COPD care bundle in the acute hospital. Previous studies suggest that a number of challenges were thought to be associated with the use of care bundles such as staff being too busy, staff shortages, lack of staff engagement, added workload of the bundle, and patient coding issues (Lennox et al., 2015). The study used two cohorts consisting of COPD patients and patients with COPD utilizing hospital services. Researchers found the first cohort of 210 COPD patients (p=.049) and the second cohort of 118 COPD patients (p=0.017) (Lennox et al., 2015). In similarity, Parkh et al. (2015) used a prospective analysis to examine 44 COPD patients given care bundles at discharge. Researchers found 30-day readmission rates, 9.1% vs. 54.4% ($p < 0.01$), and 60-day readmission rates, 22.7% vs. 77% ($p <0.03$), decreased in the care bundle group (Parkh et al., 2015). This study may allow future healthcare providers to establish the challenges associated with implementing care bundles to patients with COPD early on.

COPD discharging tools can be used as a way to save costs, as well as educating patients with COPD by providing them with self-management mechanisms. Implementing discharge care bundles at hospitals for patients with COPD successfully decreases hospital readmissions and improves outcomes for patients. Care bundles have been shown to improve readmissions for patients with COPD and reduce the length of hospital stay.

Theoretical Framework

The Andersen Healthcare Utilization Model (henceforth the Andersen Model) was developed in the late 1960s to explain factors that predict healthcare utilization

(Andersen, 1968). Since its inception, the model has undergone several modifications and is currently in its sixth iteration (Andersen et al., 2013). This section contains, first, a theoretical description of the Andersen Model and, second, a review of existing research applying the Andersen Model to hospital readmissions, COPD, and healthcare access among African Americans. For a description of how the Andersen Model influenced the design of the present study, see Chapter 1.

The Andersen Healthcare Utilization Model

According to the Andersen Model, healthcare access is determined by three types of factors: predisposing factors, enabling factors, and need factors (Hirshfield, Downing, Horvath, Swartz, & Chiasson, 2018). Each type of factor can be present at the level of contextual characteristics or at the level of individual characteristics. The contextual level describes characteristics of whole communities, such as their demographic status, population health indices, and social norms (Andersen et al., 2013). Because the present study focuses on the individual level, contextual characteristics will not be discussed in depth here. Indeed, according to Andersen et al., "the ultimate focus of the model remains on health behavior of individuals" (p. 36). Therefore, the following discussion will focus on predisposing, enabling, and need characteristics at the individual level.

Individual *predisposing characteristics* include demographic factors such as age and sex, genetic factors, and social factors, all of which can influence an individual's predisposition to access healthcare services (Andersen et al., 2013). Race falls into this category as a social factor, because race may influence an individual's status within the community or within the healthcare system, partly determining that individual's health

behaviors. The category of individual predisposing characteristics also includes attitudes, beliefs, values, and knowledge about health and healthcare (Andersen et al., 2013). Whether someone decides to access healthcare services can depend on these attitudes and beliefs.

Enabling characteristics are "conditions that facilitate or impede the use of services" (Andersen et al., 2013, p. 36). At the individual level, such characteristics include having the income or wealth available to pay for healthcare services, insurance status, social support, transportation, and having a primary care doctor available for consultation in non-emergent matters.

Finally, *need characteristics* relate to perceptions of an individual's requirement for medical treatment, whether by the individual or by a healthcare practitioner (Andersen et al., 2013). For example, some individuals may worry more about their symptoms, leading them to perceive a greater need for care than individuals less prone to anxious responses. Practitioners also determine individual need characteristics when they assess a patient's condition or conduct objective measurements to determine and make judgments about a patient's status and consequent care needs (Andersen et al., 2013).

According to the Andersen Model, predisposing, enabling, and need characteristics interact to determine an individual's healthcare access behaviors and outcomes (Andersen et al., 2013). In an equitable healthcare system, demographic and need variables alone should determine access to care. However, in reality, social factors and enabling factors (e.g., income) play a key role, indicating continued inequalities in the United States healthcare system (Hirshfield et al., 2018). Used as a framework for

empirical research, the model can guide the selection of variables and the interpretation of results in light of healthcare behaviors at the individual level and healthcare equality at the system-wide and social levels (Hirshfield et al., 2018).

The present study addressed variables that are both identified in the Andersen Model and whose relevance is empirically supported in existing literature. Thus, the study includes several individual predisposing variables (age, gender, BMI, smoking history, comorbidities) and two enabling variables (income, marital status). Although it would be important to include need variables for a complete understanding of factors influencing hospital readmission rates among African American COPD patients with tracheostomies, need characteristics were excluded from the present study owing to the difficulty of measuring perceived need quantitatively, and owing to the absence of relevant variables from the EMR serving as the data source for this study. However, it might be supposed that medical variables like smoking history and comorbidities could be closely related to need characteristics, influencing both individuals' and practitioners' perceptions of patients' healthcare needs. Indeed, some researchers (e.g., Heider et al., 2014) have explicitly defined comorbidity as a need factor.

Prior Research Employing the Andersen Healthcare Utilization Model

Researchers in the field of health services have used the Andersen Model to show associations between variables, such as patient behaviors and demographic characteristics (e.g., gender, age, cultural background). This model provides a theoretical framework for thinking about why patients are readmitted frequently based on risk factors (Kirby et al., 2010). The model theorizes that health services are determined by predisposing factors

such as race, age, marital status, BMI, and socioeconomic factors (Bradley et al., 2002), which are all included as variables in the current study.

Chen, Papoola, Rhadakrishnan, Suzuki, and Homan (2015) were guided by the Andersen Model in their study of 30-day readmissions among patients with diabetes who transitioned from the hospital to home healthcare. The study identified risk factors for readmission including age, gender, and various comorbidities (COPD or asthma in older adults, hypertension, heart failure, dehydration, bacterial pneumonia) (Chen et al., 2015).

Bradley, McGraw, Curry, Buckser, King, Kasl, and Andersen (2002) examined the use of long-term care using focus groups of African American (five groups) and white (seven groups) participants, aged 65 and older, residing in Connecticut during the year 2000 (Bradley et al., 2002). Bradley et al. (2002) used the Andersen Model to examine psychosocial factors associated with race, ethnicity, and long-term care among African Americans aged 65 years and older. Their results shed light on the participants' caregiving expectations and self-determination. The Andersen Model was applied to better understand the role of ethnicity in long-term acute care and the effectiveness of programs to limit disparities of minorities. However, the study does not identify which disparities.

Kirby, Dennis, Jayasinghe, and Harris (2010) used the Andersen Model to examine the link between readmission of chronic disease patients to emergency departments. Heider et al. (2014) examined the link between sex, age, BMI, marital status, and education, and a patient's likelihood of healthcare utilization. These studies

demonstrate the applicability of the Andersen Model to studies about the effect of demographic and personal variables on readmission rates.

Walter, Webster, Scott, and Emery (2012) used the Andersen Model to examine age, gender, socioeconomic factors, and marital status. The researchers were interested in understanding how these variables relate to delays in diagnosis. The review study was conducted by researchers using four electronic databases in the UK. It focused on cancer diagnosis and, explicitly, the stages of the Andersen Model in data collection (Walter et al., 2012). Walter et al. (2012) used the Andersen Model for their study to increase consistency in reporting the findings and increase the validity of future research. Walter et al. (2012) examined cancer survival rates compared with European countries in the healthcare setting. Applying the theoretical framework allowed the authors to identify variables related to delays in cancer diagnosis and cancer treatment (Walter et al., 2012).

Brown, Barner, Bohman, and Richards (2009) used the Andersen Model to examine how variables such as age, insurance, and medical conditions are related to complementary and alternative medicine (CAM) use among African Americans (Brown et al., 2009). The study concluded that African American CAM users are middle-aged or older, female, educated, and have more medical conditions (especially pain-related). A similar study was done in the St. Louis metropolitan area to determine the magnitude of readmissions for African American children with asthma (Bloomberg, Trinkaus, Fisher, Musick, & Strunk, 2003). The study concluded that the probability of readmission to the hospital increased to 30% for asthma within 2.5 years post discharge from the hospital for African American children (Bloomberg et al., 2003). It supported the conclusion that

African Americans with Medicaid and self-pay insurance were at a significantly higher risk of readmission (Bloomberg et al., 2003). This study is particularly relevant in the context of the current study because it specifically addresses the association between risk factors and readmissions among African Americans.

Kirby et al. (2010) and Dunlay, Weston, Killian, Bell, Jaffe, and Roger (2010) conducted studies using the Andersen Model in relation to frequent readmissions caused by illnesses. The model was used to determine the rate of readmissions of patients with COPD. Kirby et al. (2010) conducted a retrospective analysis study of emergency department services and frequent readmissions. The Andersen Model indicates that health service utilization is dependent on factors that include age, gender, and resources in this study (Kirby et al., 2010). The study revealed that the emergency department had 20,000 patients a year, 20% of whom were readmitted. The most frequent readmissions were among older adults with COPD or chronic heart failure (Kirby et al., 2010).

Stein, Andersen, and Gelberg (2007) used the Andersen Model to predict health service utilization among vulnerable populations such as women. The researchers of the study used the Andersen Model to examine the impact of demographics, psychological distress, alcohol and drug problems, health insurance, source of care, barriers, and illness variables on hospitalizations (Stein et al., 2007).

Methodological Considerations

This section provides a summary of the methods used in previous studies related to the research topic, with the aim of supporting and justifying the use of logistic regression analysis in the present study. The content and findings of the studies described

in this section are presented in detail elsewhere in this chapter. Therefore, this section focuses on methodology exclusively and does not recapitulate the details of each of the studies described. Additionally, this section focuses on literature pertaining to readmission risk factors among patients with tracheostomies and patients with COPD, since such studies are conceptually the closest to the present study, and considering their methodology is the most pertinent here.

Among studies on readmission risk factors among tracheostomy patients and COPD patients, logistic regression analysis is by far the most common method used. Of 16 key studies on readmission risk factors among COPD and tracheostomy patients, the following 11 (68.8%) used logistic regression models (whether uni-, bi-, or multivariate): Mehta et al. (2015), Spataro et al. (2017), Graboyes et al. (2014), Jurgens et al. (2014), Groenendijk et al. (2015), Gershon et al. (2017), Hasegawa et al. (2016), Baker et al. (2013), Kim et al. (2013), Shah et al. (2016), and Donze et al. (2013). The other five studies varied widely in their statistical analysis approaches. Kun et al. (2012) used generalized estimating equations (GEEs) to estimate odds ratios. GEEs were also used in combination with logistic regression models in two other studies (Donze et al., 2013; Gershon et al., 2017) to account for the number of encounters per patient. Ford (2015) used weighted least-squares regression to examine trends in hospital discharge and readmission rates among COPD patients. Zhang et al. (2015) used generalized multilevel modeling, including binary response and log link functions. Hunter et al. (2016) used a Prentice-Williams-Peterson recurrent event model, which is an extension of the Cox regression model. Interestingly, Hasegawa et al. began by testing a Cox regression model,

but found the model unsuitable, and turned instead to logistic regression. Finally, Elixhauser et al. (2011) focused on descriptive statistics alone.

Given the overwhelming prevalence of logistic regression analysis to test the effects of risk factors on hospital readmission rates in patients with COPD and tracheostomies, there is good support for the use of the method in the present study. Furthermore, the majority of the studies listed were, like the present study, cross-sectional retrospective cohort studies using secondary electronic chart data. This indicates that the results of the present study will have good comparability with existing research on the topic, facilitating interpretation and discussion in light of past studies.

All the studies reported here included descriptive statistics in addition to the analytic statistics noted. Furthermore, several of the studies began with univariate statistical tests to examine associations between individual variables and the outcomes of interest. The most common of these were chi-squared tests (Baker et al., 2013; Hasegawa et al., 2016; Jurgens et al., 2014; Kim et al., 2013; Shah et al., 2016), Fisher exact tests (Groenendijk et al., 2014; Hasegawa et al., 2016; Jurgens et al., 2014), and Wilcoxon's rank-sum tests (Jurgens et al., 2014; Shah et al., 2016). By contrast, Graboyes et al. (2014) favored univariate logistic regression as the initial modeling step. The present study follows the latter approach, using bivariate logistic regression to test each research question with each variable independently. However, the omnibus chi-square will be examined first to determine if the variables taken as a group affect the dependent variable. For more details on the data analysis plan, see Chapter 3.

Literature Review Summary and Conclusion

African American adults with COPD who have had tracheostomies are a unique population at high risk for 30-day readmission—for which healthcare facilities may be financially penalized. Risk factors for 30-day readmission among African American COPD patients with tracheostomies is an under-researched area, with no research articles that specifically address this population. Many factors, such as lack of physical activity, socioeconomic factors, and comorbidities, relate to readmissions for COPD patients in general. Findings in the literature suggest that patients with COPD require multiple treatment strategies to avoid readmissions, but study descriptions rarely indicated whether study participants had tracheostomies. The published literature lacks specific factors that may increase the risk of hospital readmission for this population. Collected data on demographics, comorbidities, and clinical and laboratory variables that could be related to long-term prognosis for those patients are needed (Kojicic, Guangxi, Ahmed, Thakur, Trillo-Alverz, Cartin-Cebo, ... & Gajic 2011).

Although there was no identified literature on tracheostomies of adults with COPD related to readmissions, there were several studies in the literature on pediatric patients with tracheostomies. Socioeconomic risk factors contribute to readmissions among patients with tracheostomies. The study found that children discharged from the hospital with a tracheostomy were at risk for readmission due to the lack of education, access to healthcare, and socioeconomic circumstances in South Africa.

Chapter 3 will introduce the methodology used in this study. Also, Chapter 3 will present the study design, population, and sample, human rights protection of participants,

data collection, and analysis. Chapter 4 and 5 examine the implications and results of this study.

Chapter 3: Research Method

The purpose of this study was to examine the risk factors for readmissions of African American patients diagnosed with COPD who have tracheostomies. In this chapter, I will discuss the methodology, including research design, data collection instruments, data collection procedures, and data analysis. Also, I discuss measures taken to protect patient confidentiality and ensure the security of data. The study research questions focused on risk factors that may increase the probability of readmission. I collected data for this study by using chart reviews from all patients at the study site who had COPD with tracheostomies. The CEO of the LTACH chosen for this study granted me permission to conduct data collection.

Research Design and Rationale

I used a quantitative method with a cross-sectional, logistic regression research design for this research study. Quantitative researchers use numbers as the basis for generalizing about a phenomenon. These numbers originate from objective scales of measurement of the units of analysis, called variables. The measurements (numbers) are analyzed using the appropriate statistical method. The output from the analyses serves as the basis for making decisions as to whether or not to retain the null hypothesis and thus draw conclusions and generalizations from the results. The main characteristics of quantitative research are that (a) data are gathered using structured research instruments or case records, (b) the research can be replicated, (c) the researcher has a clearly defined research question, (e) the study is designed prior to data collection, and (f) data are in the

form of numbers and statistics. Because my goal in this study was to determine statistical associations between numeric variables, quantitative research was appropriate.

Qualitative and mixed methods designs were not chosen for this study because I was seeking to measure the associations between previously defined variables, whereas qualitative methodological approaches do not allow for this sort of measurement. Qualitative research is also used to conceptualize research and provide descriptions of phenomena (Sofaer, 1999).

Researchers use cross-sectional designs in social sciences to describe the relationship between independent and dependent variables (Frankfort-Nachmias & Nachmias, 2008). Cross-sectional studies assess the outcomes of participants in a given point in time. This design is also appropriate for this study because I estimated the prevalence of COPD related readmissions for a population at a given point in time (see Levin, 2006). Logistic regression is used when the purpose of the analysis is to determine if multiple independent variables predict the membership in one of the two categories of the dependent variable. The dependent variable for this study was readmission (yes, no) which is dichotomous. I also used logistic regression to determine the strength of the relationship between the dependent variables (30-day readmission) and each independent variable (age, marital status, BMI, income, comorbidities, smoking history, and gender). I examined the omnibus chi-square first to determine if the variables taken as a group affected the dependent variable. Then I examined the coefficients in the model to determine if their *p* values were significant, indicating that the variable significantly contributed to the model. If the coefficients were found to be significant,

then I examined the OR to determine the odds of readmission within 30 days from discharge for the levels of the independent variable.

Research Question(s) and Hypothesis

RQ1: What is the relationship between demographics (age, gender, income, marital status, and BMI) and 30-day hospital readmissions among African American COPD patients with tracheostomies?

$H_0$1: There is a relationship between some or all of the demographics (age, gender, income, marital status, and BMI) and 30-day hospital readmissions among African American COPD patients with tracheostomies.

$H_1$1: There is no relationship between any of the demographics (age, gender, income, marital status, and BMI) and 30-day hospital readmissions among African American COPD patients with tracheostomies.

RQ2: What is the relationship between smoking history and 30-day hospital readmissions among African American COPD patients with tracheostomies?

$H_0$2: There is a relationship between smoking history and 30-day hospital readmissions among African American COPD patients with tracheostomies.

$H_1$2: There is not a relationship between smoking history and 30-day hospital readmissions among African American COPD patients with tracheostomies.

RQ3: What is the relationship, between the history of comorbidities (sepsis, congestive heart failure, hypertension, stoma cellulitis, and diabetes) and 30-day hospital readmissions among African American COPD patients with tracheostomies?

$H_0$3: There is a relationship between presence of comorbidities (sepsis, congestive

heart failure, hypertension, stoma cellulitis, and diabetes) and 30-day hospital readmissions among African American COPD patients with tracheostomies.

$H_1$3: There is not a relationship between presence of comorbidities (sepsis, congestive heart failure, hypertension, stoma cellulitis, and diabetes) and 30-day hospital readmissions among African American COPD patients with tracheostomies.

RQ4: What is the relationship between trach type and trach size and 30-day hospital readmissions among African American COPD patients with tracheostomies?

$H_0$4: There is a relationship between trach type and trach size and 30-day hospital readmissions among African American COPD patients with tracheostomies.

$H_1$4: There is not a relationship between trach type and trach size and 30-day hospital readmissions among African American COPD patients with tracheostomies.

Population, Sample, and Sampling Procedures

The target population for this study was African American adult patients who had been diagnosed with COPD and had a tracheostomy at a LTACH facility between 2010 and 2016. I used a non-probability convenience sample to obtain a sample that consisted of African American patients diagnosed with COPD who had had tracheostomies. The use of nonprobability convenience sampling allows for the swift gathering of data. The cost and time to carry out a convenience sampling is small. Utilizing nonprobability convenience sampling helped me to gather readily available data. Probability simple random sampling was not chosen for this study even though it makes it easier to estimate the parameters of the population and minimizes the risk of bias (Frankfort-Nachmias & Nachmias, 2008). One weakness of probability simple random sampling is that it is

costly. In addition, it is also very time consuming. Given the cost-effectiveness of non-probability sampling compared to the costliness and time-consuming nature of probability-based sampling, I selected a non-probability sampling procedure for this study.

The study setting was a LTACH in South Georgia. This LTACH performs numerous tracheostomy procedures yearly. The typical patient at the LTACH under investigation has been transferred out of a critical care setting but is still weak and has ongoing medical needs that are best served in a facility setting. The LTACH facility that I used provides care for patients on and off ventilators who have or had tracheostomies with COPD and other comorbidities. I focused only on those who had tracheostomies. The patient population at the LTACH facility includes patients with acute or chronic respiratory disorders.

Inclusion Criteria

The inclusion criteria for this study included African American adults diagnosed with COPD with a tracheostomy treated at the selected facility between 2010 and 2017. Individuals who received a tracheostomy but were not African American, were younger than 18 years of age, or without a COPD diagnosis were not included in the sample.

Sample Size and Power Analysis

In order to determine an adequate sample size (*n*), a desired statistical power, Type I error (α), an effect size must be indicated (Cohen, 1992). According to Trochim (2006), the effect size, the power, and the alpha level are three components necessary to compute the required sample size. Based on standard assumptions and most common

value, I set the statistical power for this study at .80 (or 80%; see Trochim, 2006). I set alpha at .05 in reference to the standards that would prevent premature rejection of the null hypothesis (see Cohen, 1992). Last, the OR is expressed for the effect size for logistic regression analysis to represent the constant effect of predictor X (Cohen, 1992).

I used G*Power to perform a power analysis to determine the sample size. For all research questions, using logistic regression, I determined that a sample size of 438 participants was required to achieve 80% power with an *OR* of 1.3 (see Fault, Erdfelder, Buchner, & Lang, 2009). The calculation was based upon the assumption that the logistic regression would have 5 predictor variables, a power of .80 (80% chance of detecting a significant effect), OR of 1.3, and alpha level of .05 (G*Power, 2013).

Data Collection

Data collection began once my proposal was approved by the Walden University Institutional Review Board. I collected data at a LTACH facility in Southern Georgia. Readmission data on African American adult patients with COPD who have had tracheostomies were obtained from the EMRs using MEDHOST. MEDHOST is an EMR system used nationwide by over 1,000 facilities (MEDHOST, n.d.). I requested data on 438 African American patients with COPD who had tracheostomies between 2010 and 2017 and met the inclusion criteria for the study. The data for patients that met the study criteria were manually entered into an Excel spreadsheet, then double-checked against the original data for quality control. Patients were assigned a random number using a random number table. This procedure ensured that no identifying information was retained from the medical record.

Data Analysis Plan

I used SPSS version 22 to analyze the data collected for this study. I calculated descriptive statistics to describe my study sample based on demographic characteristics and my variables of interest to compare the sample population to data from the literature review. Bivariate logistic regression was used to test my study hypotheses. I reported ORs and 95% confidence intervals in my results. The assumptions for logistic regression are as follows:

1. Logistic regression does not assume a linear relationship between the dependent and independent variables.
2. The dependent variable must be a dichotomy (2 categories). The dependent variable is hospital readmission within 30 days (yes, no). This is a dichotomous variable. This assumption is supported.
3. The independent variables need not be interval, nor normally distributed, nor linearly related, nor of equal variance within each group. For this study, the independent variables were both interval and categorical. BMI and comorbidities are interval variables, and the remaining variables are categorical.
4. The categories (groups) must be mutually exclusive and exhaustive; a case can only be in one group, and every case is a member of one of the groups. The categories for all categorical variables in this study are mutually exclusive. For example, it is not possible to have both a low and high BMI. Therefore, this assumption was supported.

A further consideration with logistic regression is the *n* in the cells. Cells with low or no count can affect the results of the logistic regression. Because there could have been no or low count in some of the cells, in the independent variables and covariates for the logistic regression analyses, I planned to collapse the following variables' levels : age (1 = 18-25, 2 = 26-45, 3 = 46-65, 4 = older than 65), marital status (1 = married, 2 = single or not married), and income (1 = $15,000-$30,000, 2 = $30,001-$50,000, 3 = $50,001$70,000, 4 = more than $70,000).

To investigate Research Question 1, logistic regression was used to test if demographics (e.g. age, gender, income, BMI) are related to the odds of COPD readmissions. The covariates for this analysis included the number of days the patients have been in the hospital, types of tracheostomies, and different size tracheostomies. Logistic regression was used to test Research Question 2, which aimed to determine if smoking history is associated with odds of COPD readmission. Patients' length of stay (1 = 0-30 days, 2 = more than 30 days), type of tracheostomy (1 = Shiley, 2 = Bivona or SCT, 3 = XLT), and size of tracheostomy (1 = size 4 or size 6, 2 = size 8) were included as covariates. Logistic regression was used to determine if comorbidities increase risk for COPD readmissions for Research Question 3. Logistic regression was also used to test Research Question 4, which aimed to determine if trach size and type was associated with odds of COPD readmission. Table 1 presents a summary of the research questions, variables of interest, and the proposed statistical analysis.

Table 1

Research Questions, Variables, Variables Measured, and Statistical Analysis

Research Question	Variable	Coding for Variable Measured	Statistical Analysis
1) What is the relationship, if any, between demographics (i.e., age, gender, income, marital status, and BMI) and 30-day hospital readmissions among African American COPD patients with tracheostomies?	IV: Age	1=18-24 years 2=25-44 years 3=45- 64years 4=65+ years	Logistic Regression
	Marital Status	1=Married 2=Divorce 3=Single 4=Widower	
	Gender	0=Male 1=Female	
	Income	1= $15,000-$30,000, 2=$30,001 -$50,000, 3=$50,001 -$70,000 4=$70,001 or More a Year	
	BMI	BMI Score	
	DV: Hospital Readmission from 30 Days of Discharge	1=Yes 0=No	
	Covariates: Length of Hospital Stay	1= 0 – 2 Weeks 2= 2 Weeks – 30 Days 3= More Than 30 Days	

	Type of Trach Size of Trach	 1=Shiley 2=Bivona or SCT 3=XLT 1 = Size 4 or 6 2= Size 8	
2) Is there an association between smoking history and 30-day hospital readmissions among African American COPD patients with tracheostomies?	IV: Smoking History DV: Hospital Readmission within 30 days of Discharge Covariates: Length of Hospital Stay Type of Trach Size of Trach	0=Yes 1=No 1=Yes 0=No 1= 0 – 2 Weeks 2= 2 Weeks – 30 Days 3= More Than 30 Days 1=Shiley 2= Bivona or SCT 3=XLT 1= Size 4 or 6 2= Size 8	Logistic Regression

3) What is the relationship, if any, between a history of comorbidities (sepsis, congestive heart failure, hypertension, stoma cellulitis, and diabetes) and 30-day hospital readmissions among African American COPD patients with tracheostomies?	IV: Comorbidities (of Sepsis, Stoma Cellulitis, Hypertension, Congestive Heart Failure, and Diabetes)	For Each Comorbidity: 0 = Yes 1 = No	Logistic Regression
	DV: Hospital Readmissions from 30 Days of Discharge	1 = Yes 0= No	
	Covariates: Length of Stay	1= 0 – 2 Weeks 2= 2 Weeks – 30 Days 3= More than 30 Days	
	Size of Trach	1=Size 4 or 6 2=Size 8	
	Type of Tracheostomy	1=Shiley 2=Bivona or SCT 3=XLT	

RQ4: What is the relationship between trach type and trach size and 30-day hospital readmissions among African American COPD patients with tracheostomies?	IV: Trach Size Trach Type DV: Hospital Readmissions from 30 Days of Discharge Covariates: Length of Stay	1=Size 4 or 6 2=Size 8 1=Shiley 2=Bivona or SCT 3=XLT 1 = Yes 0 = No 1= 0 – 2 Weeks 2= 2 Weeks – 30 Days 3= More than 30 Days	Logistic Regression

In the majority of cases, variable measurements and categories are determined following the way in which they are recorded in the EMR. For example, the EMR used for data collection records smoking history as a "yes/no" dichotomous variable. Income and age categorizations are determined in the same way. Given the small size of the sample, it was appropriate to impute values for missing variables. Therefore, each record was complete for all variables of interest.

Validity

There may be threats to the validity of the data included in the medical records for the study participants because medical records are a secondary data type. It is possible that there may be missing information in a patient's medical record. In addition, it is possible that the medical procedures were not documented correctly. Diagnosis codes are assigned to all hospital admissions and data can be misinterpreted by the way the diagnosis of the patient is coded. Although there is a possibility for errors in coding and incomplete records, the facility has a department of Quality Control which conducts ongoing audits to ensure coding accuracy. Because these mechanisms are in place for reviewing the data, I have reason to believe this data is coded appropriately. Threats to external validity occur when there are incorrect conclusions generalized to participants from others of the population (Creswell, 2009). The use of one facility in one specific location limits the generalizability of this study. However, it is expected that these results will provide information that can be useful in understanding factors contributing to readmissions among African American COPD patients who have had tracheostomies.

Reliability

Medical records can be used to retrieve secondary data. COPD patients misdiagnosed with an illness other than COPD may not appear in the database. How the data set is generated in the database is important in understanding how the diagnosis is coded, and who coded it. The Quality Control department that monitors documentation and patients' history of diagnosis ensures accuracy in coding also serves to ensure

reliability. All coding is reviewed to ensure consistency, which supports the reliability of the data obtained in the medical records at this facility.

Limitations and Delimitations

Limitations of this study include the restrictions associated with using secondary data. Unmeasured factors that are not available in the dataset could affect COPD with tracheostomies outcomes, therefore the interpretation of findings can be limited. The use of a convenience sample of the population could lead to limited generalizability of the study findings.

This study focuses on the risk factors for readmissions among adult African American COPD patients who have tracheostomies. This study included data collected in a South Georgia LTACH. This study did assess morbidity rates or other outcomes other than 30 day readmissions. Children were excluded from this sample due to the literature that is already present.

Ethical Procedures

There is no IRB committee at the facility where the data was collected. Approval for data collection was given by the CEO at the LTACH. There was a submission for IRB approval by the Walden University IRB Committee for approval of this study. Data were collected until Walden University IRB granted permission to do so. The medical records department at the facility also ensured that patients' information was secure by requiring a password to open the data file.

Employees in the medical records department compiled the medical information for each patient at the facility. All data collected for this study were kept private on my

personal computer. I removed identifiers for the analysis. All data were stored on the hard drive. All data entered into SPSS were stored in a password protected folder. Data collected for my study will be destroyed 7 years after the conclusion of the study.

I received Walden University's IRB approval number once the IRB approved this study. I also adhered to the facility's request and process related to obtaining an IRB approval. Prior to conducting my research, I obtained certification from the NIH Office of Extramural Research (Certification Number 2390820). I also completed the NIH Web-based training course Protecting Human Research Participants. Completing the course indicated that I received training in protecting the confidentiality and rights of participants in the study (NIH, 2017).

Summary

The goal of this chapter was to describe the methods that will be used to examine the odds of readmission among a sample of African American COPD patients who have received tracheostomies. In this chapter, I provided an overview of the methodology that will be used to answer the proposed research question. I also described the sampling strategy, the cross-sectional study design, sample size calculation, data collection procedures, and data analysis plans. Chapter 4 will present the results and discussion of the collected data from the study.

Chapter 4: Results

Introduction

The purpose of this quantitative cross-sectional study was to assess risk factors for COPD hospital readmissions within 30 days of discharge among African Americans with tracheostomies using the Andersen model as a theoretical framework. I examined the relationships between hospital readmissions within 30 days of discharge and demographic factors, comorbidities, size and type of trach, and smoking history among African American patients who were diagnosed with COPD and had tracheostomies. In chapter 4, I provide a description of the data collection process, data analysis, results, and summary. Included is a baseline report of descriptive and demographic characteristics of the sample, followed by the statistical analysis findings organized by research questions and hypotheses. The final phase is a summary of answers to the research questions and hypothesis statements. I analyzed the data to produce results for the following research questions and hypothesis statements:

Data Collection

I collected the secondary data for this study from a long-term acute care facility in South Georgia. After obtaining the approval of Walden's IRB (12-17-18-0305711), I requested data on patients who met my inclusion criteria and were admitted to the facility between 2010 and 2017. I requested data for 7 years according to the signed data user agreement. The medical records department at the facility provided an Excel file with the variables requested for 438 patients who met the inclusion criteria. There were no

missing data, and all cases were complete. I converted the Excel file into an SPSS data file for analysis.

Statistical Analyses

To determine the relationship between (a) demographic variables (age, marital status, BMI, income, gender), (b) smoking status, (c) type of comorbidity, (d) size and type of trach, and (e) hospital readmission within 30 days of discharge, I used logistic regression. Researchers use logistic regression when the dependent variable is dichotomous. The dependent variable for all the research questions was readmission (0 = not readmitted within 30 days, 1 = readmitted within 30 days). The omnibus chi-square was examined first to determine if the variables taken as a group affected the dependent variable. I then examined the coefficients in the model to determine if their *p*-values were significant, indicating if the variable significantly contributed to the model. If the coefficients were found to be significant, I examined the OR to determine the odds of hospital readmission within 30 days from discharge.

Assumptions

Statistical assumptions were as follows:

1. Logistic regression does not assume a linear relationship between the dependent and independent variables.
2. The dependent variable must be a dichotomy (2 categories). The dependent variable is hospital readmission within 30days of discharge (yes, no). This is a dichotomous variable. This assumption is supported.

3. The independent variables need not be interval, nor normally distributed, nor linearly related, nor of equal variance within each group.

Independent variables were both interval and categorical. BMI was an interval variable. Categorical variables included type of tracheotomy (Shiley, Bivona, SCT, XLT), size of trach (4, 6, 8), length of hospital stay (0 = 2 weeks, 1 = 30 days, 3 = >30 days), and smoking history (yes, no, type of comorbidity (yes, no)).The categories (groups) must be mutually exclusive and exhaustive; a case can only be in one group, and every case is a member of one of the groups. The categories for all these categorical variables are mutually exclusive. This assumption is supported that the independent variables need not be interval, nor normally distributed, nor linearly related, nor of equal variance within each group.

A consideration with logistic regression is the *n* in the cells. Cells with low or no count can affect the results of the logistic regression. All cells were complete, and for the logistic regression, I collapsed the following variables' levels: age (1 = 18 – 65 years, 2 = older than 65); marital status (1 = married, 2 = single or not married); income (1 = less than $30,000, 2 = $30,000 - $50,000, 3 = 50,000 -$70,000, 4= more than $70,000); gender (0 = male, 1 = female); size of tracheotomy tube (0 = size 4 or size 6, 1 = size 8); type of tracheotomy tube (1 = Shiley, 2 = Bivona or SCT, 3 = XLT); BMI (1= yes, 0 = no); length of stay in the hospital (1= 0 – 2 weeks, 2 = 2 weeks – 30 days, 3= more than 30 days); comorbidity—including congestive heart failure, hypertension, stoma cellulitis, diabetes, and sepsis (0 = no, 1 = yes). These categories reflect those I initially proposed,

with the exception of the age category. The categories for the age variable were revised to aid in meaningfulness of interpretation.

Results

In this section, I present the findings of this study, beginning with a description of the study sample, followed by the results for each research question.

Sample Characteristics

The sample included 438 patients treated between January 1, 2010, and December 31, 2017. The distribution of the patients by gender was about equal. There were 221 (50.5%) males and 217 females (49.5%). The majority of the patients were 65 years or older (*n* = 269, 61.4%) but 20.6% (*n* = 90) were between the ages of 18 and 25. Slightly more than half of the participants were married (*n* = 230, 52.5%). The majority of participants earned less than $50,000 annually, with the largest percentage of participants earning $15,000-30,000 (*n* = 195, 44.5%). During the initial hospitalization, the majority of participants had a length of stay of more than 30 days (*n* = 341, 77.8%). Smaller percentages stayed 0-2 weeks (52, 11.9%) or 2 weeks-30 days (45, 10.3%). The majority of the patients had a history of smoking (327, 74.3 %). The highest percentage of the participants had sepsis (*n* = 407, 92.9%) followed by hypertension (*n* = 173, 39.5%), diabetes (*n* = 131, 29.9%), and congestive heart failure (*n* = 126, 28.8%). Only 12 (2.7%) had soma cellulitis. The mean BMI was 20.74 (*SD* = 5.21). The participant characteristics are displayed in Table 2.

Table 2

Participant Characteristics (N = 438)

Variable	*n*	%
Gender		
Male	221	50.5
Female	217	49.5
Age		
18 – 25 years	90	20.6
26 – 45 years	25	5.7
46 – 65 years	54	12.3
65 + years	269	61.4
Marital Status		
Married	230	52.5
Divorced	96	21.9
Single	70	16.0
Widow/Widower	42	9.6
Income		
$15,000-$30,000	195	44.5
$30,001-$50,000	123	28.1
$50,001-$70,000	92	21.0
$70,001 or more	28	6.4

Length of Stay		
0 – 2 weeks	52	11.9
2 weeks – 30 days	45	10.3
More than 30 days	341	77.8
Smoking History[a]	327	74.7
Comorbidities[b]		
Soma Cellulitis	12	2.7%
Hypertension	173	39.5%
Congestive heart failure	126	28.8%
Diabetes	131	29.8%
Sepsis	407	92.9%
BMI	Mean = 20.74	Stan Dev = 5.21

Note. [a]values in cells represent the n and % of those with smoking history. [b]values in the cells represent the *n* and % who had the comorbidity

Tracheotomy Characteristics

The majority of the patients had Size 8 tracheotomies *(n=372, 84.9%) followed by Size 6 (n=52, 11.9%). The majority of the patients had Shiley tracheotomies (n=378, 86.3%). Fewer patients had XLT (n=47, 10.7%) and Bivona (n=9, 2.1%). SCT was the least frequent type of tracheotomy for participants in this study (n=4,* 0.9%).

Tracheotomy characteristics are displayed in Table 3.

3

Health Characteristics, N = 438

Variable	*N*	%
Size of Tracheotomy		
Size 4	14	3.2
Size 6	52	11.9
Size 8	372	84.9
Type of Tracheotomy		
Shiley	378	86.3
Bivona	9	2.1
SCT	4	0.9
XLT	47	10.7

Research Question 1

RQ1: What is the relationship, if any, between demographics (i.e., age, gender, income, marital status, and BMI) and 30-day hospital readmissions among African American COPD patients with tracheostomies?

$H_0$1: There is a relationship between demographics and 30-day hospital readmissions among African American COPD patients with tracheostomies.

$H_1$1: There is not a relationship between the demographics and 30-day hospital readmissions among African American COPD patients with tracheostomies.

To answer this question, I conducted binary logistic regressions that utilized the independent variables (age, gender, income, marital status, and BMI). The dependent variable was hospital readmission (0 = not readmitted within 30 days, 1 = readmitted within 30 days). When examined individually, the independent variables (age, gender, income, marital status, and BMI) were not significantly associated with 30-day hospital readmission.

Age. The model was significant, $\chi 2$ (2, n = 438) = 8.416, p = .015. Because the model was significant, I examined the p-values for the coefficients. The p-value for age was not significant (p = .053). The p value for length of stay was significant (p = .026). Because the p-value for length of stay was significant, I examined the OR and the CI. The OR = .503, and the 95% CI = .247, .942. These findings are shown in Table 4. There is not an association between age and hospital readmission within 30 days of discharge among African American COPD patients with tracheostomies when controlling for length of stay. The null hypothesis was retained.

Table 4

Logistic Regression Analysis for Readmissions Regressed on Age

Variable[a]	B	S.E.	Wald	Sig.	OR	95% C.I.	
						Lower	Upper
Age	-0.469	0.243	3.730	0.053	0.625	0.388	1.007
LoS <30 days	-0.688	0.310	4.935	0.026*	0.503	0.274	0.922

Note. Omnibus test of model coefficients χ^2 (2, n = 438) = 8.416, p = .015. [a]reference categories – age = 65 or older, LoS > 30 days = more than 30 days.*p < .05;
**p < .01.

Marital status. The model was not significant, $\chi 2$ (6, n = 438) = 5.596, p = .061 (Table 4). Because the model was not significant, I did not examine the *p*-values for the coefficients and the OR and CI. When controlling for length of stay, marital status was not found to be associated with odds of hospital readmission within 30 days of discharge. The null hypothesis was retained.

Table 5

Logistic Regression Analysis for Readmissions Regressed on Martial Status and Other Demographics

Variable[a]	B	S.E.	Wald	Sig.	OR	95% C.I.	
						Lower	Upper
Marital status	0.231	0.229	1.020	0.312	1.260	0.805	1.974
LoS <30 days	-0.629	0.307	4.185	0.041*	0.533	0.292	0.974

Note. Omnibus test of model coefficients χ^2 (6, n = 438) = 5.596, p = .061
[a]reference categories – marital status = not married, LoS>30 days = more than 30 days
*p < .05 **p < .01

Gender. The model was not significant, $\chi 2$ (2, n = 438) = 4.581, p = .101 (Table 6). As the model was not significant, the *p*-values for the coefficients and the OR and CI were not examined. Gender was not significantly associated with the odds of hospital readmission within 30 days of discharge. These findings indicated that when controlling for length of stay, there is no association between gender and hospital readmissions

among African American COPD patients with tracheostomies. The null hypothesis was retained.

Table 6

Logistic Regression Analysis for Readmissions Regressed on Gender and other Demographics

Variable[a]	B	S.E.	Wald	Sig.	OR	95% C.I.	
						Lower	Upper
Gender	-0.024	0.227	0.011	0.917	0.977	0.626	1.524
LoS <30 days	-0.627	0.307	4.172	0.041*	0.534	0.293	0.975

Note. Omnibus test of model coefficients χ^2 (2, n = 438) = 4.581, p = .101
[a]reference categories – gender = female, LoS>30 days = more than 30 days
*p < .05 **p < .01

Income. The model was significant, $\chi 2$ (3, N = 438) = 8.216, p = .043. Because the model was significant, I examined the *p*-values for the coefficients. The overall *p*-value for income was not significant (p = .169). Because the *p*-value was not significant, the OR and CI were not examined for income levels. The *p*-value for length of stay was significant (p = .059). Since the *p*-value for length of stay was also not significant, the OR and confidence were not examined. These findings are presented in Table 7. When controlling for length of stay, there is not an association between income and hospital readmissions within 30 days of discharge among African American COPD patients with tracheostomies. The null hypothesis was retained.

Table 7

Logistic Regression Analysis for Readmissions Regressed on Income and other Demographics

Variable[a]	B	S.E.	Wald	Sig.	OR	95% C.I.	
						Lower	Upper
Income			3.550	0.169			
< $30K	0.255	0.277	0.852	0.356	1.291	0.751	2.219
$30K-$50K	-0.275	0.325	0.718	0.397	0.759	0.401	1.436
LoS <30 days	-0.586	0.310	3.568	0.059	0.557	0.303	1.022

Note. Omnibus test of model coefficients χ^2 (3, n = 438) = 8.216, p = .042
[a]reference categories – income = more than $50K, LoS>30 days = more than 30 days
*p < .05 **p < .01

BMI. The model was not significant, $\chi 2$ (2, n = 438) = 5.477, p = .065 (Table 8). As the model was not significant, the *p*-values for the coefficients and the OR and CI were not examined. BMI was not significantly associated with the odds of hospital readmission within 30 days of discharge. These findings suggest when controlling for length of stay, there is no association between BMI and hospital readmissions among African American COPD patients with tracheostomies. The null hypothesis was retained.

Table 8

Logistic Regression Analysis for Readmissions Regressed on BMI and other Demographics

Variable[a]	B	S.E.	Wald	Sig.	OR	95% C.I.

						Lower	Upper
BMI	0.021	0.022	0.914	0.339	1.021	0.978	1.067
LoS <30 days	-0.672	0.312	4.653	0.031*	0.511	0.277	0.940

Note. Omnibus test of model coefficients χ^2 (2, n = 438) = 5.477, p = .065
[a]reference category – LoS>30 days = more than 30 days
*p < .05 **p < .01

Combined demographics. To examine the impact of all of the demographic characteristics when considered as a group, the omnibus was examined. The full model was not significant, χ^2 (7, n = 438) = 13.761, p = .056. The independent variables and covariate taken as a group significantly predicted hospital readmissions (Table 9). In the full model only the p-values for BMI (p = .017) and length of stay (p = .030) were significant. BMI was significantly associated with hospital readmission, OR = 0.022 (95% C.I., 0.580, 0.017). Patients with a higher BMI were 97.8% less likely to be readmitted within 30 days of discharge. Patients with a lower BMI were more likely to be readmitted within 30 days of discharge. The null hypothesis was retained. Length of stay less than 30 days was significantly associated with lower odds of being readmitted to the hospital within 30 days of discharge, OR = 0.502 (95% C.I., 0.269, 0.936). Patients whose length of stay was less than 30 days are 49.8% less likely to be readmitted within 30 days of discharge.

Table 9

Logistic Regression Analysis for Readmissions Regressed on Demographics, N = 438

Variable [a]	B	S.E.	Wald	Sig.	OR	95% C.I. for OR

						Lower	Upper
Age	0.263	0.233	1.278	0.258	1.301	0.824	2.053
Marital status	0.358	0.239	2.242	0.134	1.431	0.895	2.286
Gender	-0.054	0.234	0.053	0.818	0.947	0.599	1.499
Income			3.087 540	0.214			
$15K-30K	0.234	0.279	0.705	0.401	1.264	0.731	2.185
$30K-$50K	-0.270	0.328	0.676	0.411	0.763	0.401	1.453
BMI	0.017	0.022	0.580	0.017*	0.022	0.580	0.017
LoS <30 days	-0.690	0.318	4.704	0.030*	0.502	0.269	0.936

Note. Omnibus test of model coefficients χ^2 (7, n = 438) = 13.761, p = .056
[a]reference categories – Age = 65 years or older, Marital status = not married, gender = female, income = more than $50K, LoS>30days = more than 30 days
*p < .05 **p < .01

Research Question 2

RQ2: What is the relationship, if any, between smoking history and 30-day hospital readmissions among African American COPD patients with tracheostomies?

$H_0$2: There is a relationship between smoking history and 30-day hospital readmissions among African American COPD patients with tracheostomies.

$H_1$2: There is no relationship between smoking history and 30-day hospital readmissions among African American COPD patients with tracheostomies.

The model was not significant, χ2 (2, n = 438) = 5.105, p = .078 (Table 10). As the model was not significant, the p-values for the coefficients and the OR and CI were

not examined. Smoking history was not significantly associated with the odds of hospital readmission within 30 days of discharge. These findings suggest when controlling for length of stay, there is no association between smoking history and hospital readmissions among African American COPD patients with tracheostomies. The null hypothesis was retained.

Table 10

Logistic Regression Analysis for Readmissions Regressed on Smoking History, N = 438

Variable[a]	B	S.E.	Wald	Sig.	OR	95% C.I. for OR	
						Lower	Upper
Smoking Hist	-0.190	0.258	0.542	0.462	0.827	0.499	1.371
LoS <30 days	-0.645	0.308	4.372	0.037*	0.525	0.287	0.960

Note. Omnibus test of model coefficients χ^2 (2, n = 438) = 5.105, p = .078
[a]reference categories – smoking history = no smoking history, LoS>30 days = more than 30 days
*p < .05 **p < .01

Research Question 3

RQ3: What is the relationship, if any, between the type of comorbidities (including congestive heart failure, hypertension, stoma cellulitis, and diabetes) and 30-day hospital readmissions among African American COPD patients with tracheostomies?

$H_0$3: There is a relationship between the type of comorbidities and 30-day hospital readmissions among African American COPD patients with tracheostomies.

$H_1$3: There is not a relationship between the type of comorbidities and 30-day hospital readmissions among African American COPD patients with tracheostomies.

The associations of the comorbidities with 30-day hospital readmissions were analyzed using separate logistic regressions. The length of stay was used as a covariate in all the models.

Stoma Cellulitis

The model was not significant, $\chi 2$ (2, n = 438) = 4.598, p = .100 (Table 11). As the model was not significant, the *p*-values for the coefficients and the OR and CI were not examined. When examined independently, stoma cellulitis was not significantly associated with the odds of hospital readmission within 30 days of discharge. These findings suggest when controlling for length of stay, there is no association between stoma cellulitis and hospital readmissions among African American COPD patients with tracheostomies. The null hypothesis was retained.

Table 11

Logistic Regression Analysis for Readmissions Regressed on Stoma Cellulitis, N = 438

Variable[a]	B	S.E.	Wald	Sig.	OR	95% C.I. for OR

						95% C.I. for OR	
						Lower	Upper
No Stoma Cellulitis	-0.114	0.680	0.028	0.867	0.892	0.235	3.386
LoS <30 days	-0.628	0.307	4.179	0.041*	0.534	0.292	0.974

Note. Omnibus test of model coefficients χ^2 (2, n = 438) = 4.598, p = .100
[a]reference categories – stoma cellulitis = has stoma cellulitis, LoS>30 days =more than 30 days
*p < .05 **p < .01

Hypertension

When controlling for length of stay, the model hypertension was significant, χ^2 (2, n = 438) = 8.117, p = .047 (Table 12). The p-value for hypertension was not significant (p = .217). When controlling for length of stay, hypertension was not associated with the odds of hospital readmission, indicating the odds of hospital readmission within 30 days post discharge are the same whether or not the patient presented with hypertension. The null hypothesis was not retained.

Table 12

Logistic Regression Analysis for Readmissions Regressed on Hypertension, N = 438

Variable[a]	B	S.E.	Wald	Sig.	OR	95% C.I. for OR	
						Lower	Upper
No Hypertension	0.293	0.237	1.522	0.217	1.340	0.842	2.134
LoS <30 days	-0.630	0.308	4.202	0.040*	0.532	0.291	0.973

Note. Omnibus test of model coefficients χ^2 (2, n = 438) = 8.117, p = .047
[a]reference categories hypertension = has hypertension, LoS>30 days = more than 30 days
*p < .05 **p < .01

Congestive Heart Failure

The model was not significant, $\chi 2$ (2, n = 438) = 5.779, p = .056 (Table 13). As the model was not significant, the *p*-values for the coefficients and the OR and CI were not examined. Congestive heart failure was not significantly associated with the odds of hospital readmission within 30 days of discharge. These findings suggest when controlling for length of stay, there is no association between congestive heart failure and hospital readmissions among African American COPD patients with tracheostomies. This indicates the odds of hospital readmission within 30 days post discharge are the same whether or not the patient presented with the comorbidity congestive heart failure. The null hypothesis was retained.

Table 13

Logistic Regression Analysis for Readmissions Regressed on Congestive Heart Failure, N = 438

Variable[a]	B	S.E.	Wald	Sig.	OR	95% C.I. for OR	
						Lower	Upper
No Heart failure	0.283	0.260	1.178	0.278	1.326	0.796	2.209
LoS <30 days	-0.628	0.307	4.179	0.628	0.307	4.179	-0.628

Note. Omnibus test of model coefficients χ^2 (2, n = 438) = 5.779, p = .056
[a]reference categories – congestive heart failure – has congestive heart failure, LoS>30 days = more than 30 days
*p < .05 **p < .01

Diabetes

When controlling for length of stay, the model was significant, $\chi 2$ (2, n = 438) = 10.038, p = .007 (Table 14). The p-value for no diabetes was significant (p = .016). Since diabetes was significantly associated with hospital readmission OR, the OR and CI were examined (OR = .563 95% C.I., 0.353, .900) (Table 14). Patients who did not present with the comorbidity diabetes are 43.7% less likely to be readmitted within 30 days of discharge. The null hypothesis was not retained.

Table 14

Logistic Regression Analysis for Readmissions Regressed on Diabetes, N = 438

Variable[a]	B	S.E.	Wald	Sig.	OR	95% C.I. for OR	
						Lower	Upper
No Diabetes	-0.574	0.239	5.766	0.016*	0.563	0.353	0.900
LoS <30 days	-0.623	0.309	4.060	0.044*	0.536	0.293	0.983

Note. Omnibus test of model coefficients χ^2 (2, n = 438) = 10.038, p = .007
[a]reference categories – diabetes = has diabetes, LoS>30 days = more than 30 days
*p < .05 **p < .01

Sepsis

When controlling for length of stay, the model for sepsis was not significant, $\chi 2$ (2, n = 438) = 4.572, p = .102 (Table 15). As the model was not significant, the p-values for the coefficients and the OR and CI were not examined. Sepsis was not significantly associated with the odds of hospital readmission within 30 days of discharge. These

findings suggest when controlling for length of stay, there is no association between sepsis and hospital readmissions among African American COPD patients with tracheostomies. This indicates the odds of hospital readmission within 30 days post discharge are the same whether or not the patient presented with the comorbidity sepsis. The null hypothesis was retained.

Table 15

Logistic Regression Analysis for Readmissions Regressed on Sepsis, N = 438

Variable[a]	B	S.E.	Wald	Sig.	OR	95% C.I. for OR	
						Lower	Upper
No Sepsis	0.019	0.449	0.002	0.966	1.020	0.423	2.458
LoS <30 days	-0.628	0.308	4.167	0.041*	0.534	0.292	0.975

Note. Omnibus test of model coefficients χ^2 (2, n = 438) = 4.572, p = .102
[a]reference categories –sepsis = has sepsis, LoS>30 days = more than 30 days
*p < .05 **p < .01

Research Question 4

RQ4: What is the relationship, if any, between the size and type of trach and 30-day hospital readmissions among African American COPD patients with tracheostomies?

$H_0$4: There is a relationship between trach type and trach size and 30-day hospital readmissions among African American COPD patients with tracheostomies.

$H_1$4: There is no relationship between trach type and trach size and 30-day hospital readmissions among African American COPD patients with tracheostomies.

The model was significant, $\chi 2$ (4, n = 438) = 15.721, p = .003 suggesting that length of stay, size of trach, and type of trach do a good job predicting the odds of hospital readmission for this sample (Table 16). The p-value for size of trach (p = .605) was not significant, indicating that when controlling for length of stay, the size of the trach was not associated with the odds of hospital readmission within 30 days. The overall p-value for type of trach was .006, indicating that the type of trach was associated with hospital readmission within 30 days. Shiley (p = .414) was not significant, indicating that using Shiley instead of XLT does not affect readmission within 30 days of discharge. The p-value for Bivona/SCT (p = .017) was significant. As the coefficient for Bivona/SCT was significant, the OR and CI were examined. The OR = 5.010 and the 95% CI = 1.333, 18.837, which indicated the odds of readmission within 30 days of discharge was almost 5 times more likely for patients with Bovina or SCT tracheotomies compared to those with XLT.

Table 16

Logistic Regression Analysis for Readmissions Regressed on Size and Type of Tracheotomy, N = 438

Variable[a]	B	S.E.	Wald	Sig.	OR	95% C.I.

						Lower	Upper
Size of trach (4,6)	0.166	0.321	0.268	0.605	1.181	0.629	2.215
Type or trach			10.327	0.006**			
Shiley	-0.296	0.362	0.667	0.414	0.744	0.366	1.513
Bivona/SCT	1.612**	0.676	5.688	0.017*	5.010	1.333	18.837
LoS <30 days	-0.764**	0.321	5.670	0.017*	0.466	0.249	0.874

Note. Omnibus test of model coefficients χ^2 (4, n = 438) = 15.721, p = .003
[a]reference categories –size of Tracheotomy = 8, type of Tracheotomy = XLT, LoS>30 days = more than 30 days
*p < .05 **p < .01

Summary of Hypotheses Testing

Table 17 displays the summary of the decisions for the four null hypotheses. Hypothesis 1 (no relationship between demographics and hospital readmission within 30 days of discharge) was rejected. Hypotheses 2 (relationship between demographics and hospital readmissions within 30 days of discharge) was retained. No differences were found for age, gender, marital status, income, and BMI. Hypothesis 2 (no relationship between smoking history and hospital readmission within 30 days of discharge) was retained. Smoking history was not significantly associated with the odds of hospital readmission within 30 days. Hypothesis 3 (no relationship between the type of comorbidity and hospital readmission within 30 days of discharge) was rejected. The odds of hospital readmission within 30 days post discharge are the same whether or not the patient presented with the comorbidities of stoma cellulitis, congestive heart failure, or sepsis. There were significant differences for the comorbidity diabetes. Patients who

did not present with the comorbidity diabetes are 43.7% less likely to be readmitted within 30 days of discharge. Hypothesis 4 (no relationship between trach type and trach size and hospital readmission within 30 days of discharge) was rejected. The odds of readmission within 30 days of discharge are the same for the different sizes of the trach. However, the type of trach was significantly associated with the odds of readmission. The coefficient for Shiley was not significant, indicating that using Shiley instead of XLT does not affect readmission within 30 days of discharge. The coefficient for Bivona/SCT was significant, indicating the odds of readmission within 30 days of discharge was almost 5 times more likely for those with Bivona or SCT tracheotomies than those with XLT.

Table 17

Summary of Hypothesis Testing Results, N = 438

Hypothesis	Decision
H1: No relationship of demographics to readmission within 30 days post discharge	
Age	Retained
Gender	Retained
Marital	Retained
Income	Retained
BMI	Retained
H2: No association between smoking history and readmission within 30 days post discharge	Retained

H3: No association between comorbidities and readmission within 30 days post discharge	
Stoma cellulitis	Retained
Congestive Heart Failure	Retained
Hypertension	Retained
Diabetes	**Not Retained**
Sepsis	Retained
H4: No association between trach size and trach type and readmission within 30 days post discharge	
Size of Trach	Retained
Type of Trach	**Not Retained**

Summary

Chapter 4 presents the findings of the four research questions and hypotheses. There was no significant association between readmission within 30 days and the independent variables (age, gender, marital status, income, smoking history, comorbidities of soma cellulitis, congestive heart failure, sepsis, and trach size). Significant effects were found between readmission within 30 days of discharge and the covariate, length of stay. Significant associations were found with comorbidity (diabetes), and type of trach (Bivona/SCT). In Chapter 5, I will discuss the significance of the results.

Chapter 5: Discussion, Conclusions, and Recommendations

Introduction

The aim of this study was to understand readmission risk factors among African American COPD patients with tracheostomies. In this quantitative study, I assessed secondary cross-sectional data for 438 participants. The purpose of this study was to examine the relationship between risk factors and COPD hospital readmissions within 30 days of discharge. Four research questions were tested using logistic regression. I assessed the relationship between readmission and demographic variables (age, gender, marital status, income, and BMI) smoking history, type of comorbidity, size of trach, and type of trach. In this chapter, I summarize the study findings and discuss their relation to the current body of literature on this topic. I also discuss the limitations associated with this study and present recommendations for health services practice and research. The chapter will conclude with a discussion of the implications for social change.

Interpretation of the Findings

To date, there is only literature on the relationship between readmissions among pediatric patients with tracheostomies. In this study, I focused on African American adults with COPD who have tracheostomies. It was important to investigate whether any relationship existed between sociodemographics and COPD hospital readmissions within 30 days of discharge.

Research Question 1

This study was guided by the Andersen model, which holds that health service utilization is dependent on factors such as age, gender, and resources (Babitsch et al., 2012). I found that the demographic variables age, gender, marital status, income, and BMI were not associated with the odds of 30-day hospital readmission among African American COPD patients with tracheostomies. This finding contrasts with previous studies in the literature that indicate demographic characteristics impact the odds of readmission among COPD patients. For example, Gajanan et al. (2013) found socioeconomic factors, age, sex, BMI, duration of COPD, and marital status were all significantly associated with frequent readmissions among COPD patients (Gajanan et al., 2013). In a study of 65,497 COPD patients in Hong Kong, the male gender was associated with unplanned hospital readmissions (Chan et al., 2011). Gershon et al. (2017) also found that male gender was associated with a higher likelihood of 30-day readmission among their sample of COPD patients. My study findings might have differed from those in the previous study because of the focus on COPD patients with trachs.

Baker et al. (2013), found age to be the only demographic characteristic associated with COPD-related readmission ($p = 0.0301$). However, similar to Kim et al. (2013), age was not a statistically significant independent predictor of frequent readmission ($p = 0.466$). In comparison, Elixhouser et al. (2011) observed that COPD patients older than 40 years of age were 15% more likely to be readmitted to the hospital than patients under the age of 40. This was five percentage points higher than the

readmissions rate for all other illnesses (Elixhauser et al., 2011). However, in my study, age was not found to be associated with hospital readmission within 30 days of discharge. These findings may differ because Elixhauser et al. did not include patients with tracheostomies, although they did include African Americans. The findings of my study indicate that the demographic risk factors for hospital readmission identified in the literature may not be significant risk factors for African Americans.

In a study of Canadians, Hanson et al. (2014) found a higher percentage of COPD readmissions among obese patients. According to researchers, 54% of participants had a BMI measurement of 30 compared to 20-24% of the population in general (Hanson et al., 2014). Other studies have shown high and low BMI can both increase odds of readmission. Zapatero et al. (2013) used a cross-sectional study to determine readmission rates among COPD patients with malnutrition and obesity and found a positive association between obesity and malnutrition and the risk of readmissions within 30 days. In my study, higher BMI was not associated with decreased odds of readmission. The mean BMI in this study was 20.74, which is lower than the mean BMI for COPD patients observed in other studies. It is possible that the association between BMI and readmissions that I observed differed from those in previous studies because of the overall lower BMI for the study sample.

Research Question 2

In keeping with the Andersen model, I examined smoking history as a possible factor contributing to hospital readmission. In this study, smoking history was not significantly associated with odds of hospital readmission post 30 days of discharge,

indicating the odds of readmission within 30 days of discharge are the same for both smokers and nonsmokers. The relationship observed in this study is not consistent with the findings in the literature. Gajanan et al. (2013) studied a total of 278 participants. Ninety-seven COPD patients (65.1%) were either ex-smokers or current smokers, compared to the current study of 74.4%. In similarity, this study examined the odds of readmission and smoking status and also found no association among COPD patients. Among a sample of 150 COPD patients, Groenendjik et al. (2016) found smoking to increase odds of readmission by 45.9%. These researchers did not examine rates for African Americans separately, nor did they select only patients with tracheostomies. This finding is in contrast to those in my study, which did not show any association between smoking status and hospital readmission. This suggests that for African American COPD patients with tracheostomies, smoking status is not driving readmission rates. One possible explanation for this different association is the higher rates of smoking among African American adults (CDC, n.d.).

Research Question 3

The relationship between COPD readmissions and comorbidities is worth noting. Groenendjik et al. (2016) also provided support for the examination of comorbidities, as patients with an underlying medical condition were independently at significantly greater risk for mortality compared to those without an underlying condition (OR= 5.1, 95% CI, 1.8–14.3). As with many other readmission studies in the literature, Groenendjik et al. focused exclusively on pediatric tracheostomy patients. In another study, researchers showed that 22.3% of patients were readmitted into the hospital after 30 days of

discharge and that the avoidable readmissions were often due to complications of comorbidities (Donze et al., 2013). In my study, African American COPD patients with tracheostomies and diagnosed with stoma cellulitis, hypertension, congestive heart failure, or sepsis were not more likely to be readmitted to the hospital within 30 days. These findings were inconsistent with previous studies that have shown a relationship between comorbidities and the odds of readmissions (Donze et al., 2014). However, I did find a significant association between diabetes diagnosis and increased odds of hospital readmission, suggesting that comorbidities be examined individually to determine their relationship to 30-day hospital readmission.

Research Question 4

In this study, the odds of readmission within 30 days of discharge was the same for patients regardless of the size of the trach. However, the type of trach was significantly associated with the odds of readmission. While Shiley, instead of XLT, was not found to affect readmission within 30 days of discharge, presence of Bivona and SCT resulted in odds of hospital readmissions that were 5 times the odds of patients who had an XLT trach.

Few researchers have explored the association between the size and type of trachs on hospital readmission rates. However, Kun, Edwards, Ward, and Keen (2012) found that the presence of trachs increased the odds of hospital readmission. In my study, the readmission rate for African American COPD patients with tracheostomies was 23.3%. Spataro et al. (2017) found a 33% all-cause readmission rate among tracheostomy patients. However, the study did not examine the type and size of trachs.

Limitations of the Study

In this study, I used secondary data from EMRs. The results of this study are only applicable to African American adults diagnosed with COPD. The sample included patients at an LTACH facility in the Southeast. The findings may not reflect the experiences of other African American COPD patients with tracheostomies in other geographic locations. In addition, I did not include comorbidities such as depression, anxiety, and other psychological conditions that may impact hospital readmission rates for this population. Additionally, the selection of variables for the study was based on data available during secondary data collection. Because of this limitation, other variables were not included in the study.

Recommendations

The findings of the current study indicate that African Americans may have different risk factors for hospital readmission that are more difficult to identify in studies of the larger population. These findings lend support to a number of specific policy recommendations as well as specific recommendations for future research in this area. These recommendations include educating patients on how to care for any comorbidities before patients are discharged. In addition, discharge planners should clearly communicate the risk for readmissions based on the type of trach a patient receives.

In this study, I focused exclusively on African American COPD patients with tracheostomies and found that the associations present in the literature did not seem to hold true for this patient population. The same could also be true for other racial and ethnic subgroups. Additional research is recommended for other racial and ethnic groups

to determine the extent to which previous risk factors are associated with the odds of hospital readmission for those populations.

Future researchers should examine patients in other types of facilities such as acute hospitals, which treat patients in a short amount of time, compared to long-term acute care, which treats patients for an extended amount of time. Factors contributing to hospital readmission may differ for patients in other types of facilities. In addition, this study was focused on one facility in South Georgia. Subsequent researchers can focus on multiple facilities in other geographic locations. Conducting the study in other geographic locations may provide additional information on the factors relating to hospital readmission rates for this patient population.

Among patients with COPD, psychological risk factors such as depression are known to be associated with increased readmission into the hospital (Coventry et al., 2011). While these risk factors were not included in the present study, future studies assessing readmissions among African Americans should consider additional established COPD risk factors, including depression and anxiety.

In the present study, remaining in the hospital less than 30 days was found to decrease odds of 30-day readmissions. Patients that stay in the hospital longer are likely to be sicker than patients that stay a shorter time. Future studies might examine the severity of disease to determine if that may be contributing to the observed association between length of hospital stay and odds of readmission.

The current study utilized a cross-sectional study design, however, a longitudinal design would be useful for analyzing participants over time. Following these patients

over time would allow for a more thorough observation of patient characteristics that may serve as risk factors for this population. A longitudinal design will also allow for the identification of patterns in patient behavior and underlying health that may be associated with risks of readmission.

Based on the findings of the current study, educating patients on how to manage each of their health conditions while they are still in the hospital is a necessary component to prevent readmission, particularly among patients with specific comorbidities such as diabetes. This study also found that the type of trach a patient receives may increase the odds of hospital readmission. Case management and discharge plans should include specific actions for patients with COPD who have tracheostomies. Different tracheostomies require different care. Discharge planning should take into consideration the type of trach a patient has and provide additional education for patients at higher risk of readmission.

Positive Social Change

The positive social change implications of this study include providing evidence that could be used in long-term acute care facilities and hospitals, such as COPD and tracheotomy education, and discharge in service to case managers. Currently, long term acute care facilities provide patients and their families with education on how best to care for their tracheostomies and how to avoid being readmitted. Respiratory therapists are given a checklist that guides them regarding what areas to educate families and patients on. This study has provided findings and information that can be used to reduce readmissions for the specific population related to the type of trach and specific

comorbidities. The findings of this study could be used to develop programs targeting health leaders as well as clinicians.

The results of this study provide evidence to suggest that some risk factors of COPD readmissions are not significant for African American COPD patients who have had tracheostomies. Healthcare clinicians and leaders could use these findings for healthcare practices to reduce COPD readmissions. A better understanding of these factors may help healthcare providers find new approaches to reducing heart health disparities among this population, thereby providing for a better treatment platform and resulting in improvement of the disease itself. Addressing how patients with COPD manage their condition can improve the way they deal with it on a daily basis based on the type trach the patient has. When healthcare providers and educators can target and cater to families, confidence and feelings of empowerment within the caregiver will also improve readmissions.

Conclusion

Previous studies indicated that demographics play a significant role in COPD readmissions. There is literature on COPD readmission rates, but there is limited information on COPD readmissions among African American with tracheostomies. This study contributes to the limited literature on readmissions among African Americans with COPD who have had tracheostomies. Trach type and diabetes diagnosis were significantly associated with hospital readmissions within 30 days of discharge. The fact that certain African Americans with COPD who have had tracheostomies are at higher risk for readmission than others, is information that is important and needs to be

considered by healthcare professionals. The findings from this study can aid healthcare professionals and case managers to develop more detailed discharge plans which may help reduce COPD readmissions and lower the cost of healthcare utilization for this patient population.

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