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Understanding Characteristics of Chronic Obstructive Pulmonary Disease Readmissions in an Acute Care Hospital

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Walden University
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Abstract

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MS, University of St. Francis, 2015

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Dissertation Submitted in Partial Fulfillment

of the Requirements for the Degree of

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Abstract

Patients suffering from chronic obstructive pulmonary disease (COPD) not only face difficulties managing their disease but are also faced with a higher risk of being readmitted to a hospital after an initial visit for acute exacerbation of their condition. Despite hospitals' many attempts to offset this burden, readmission reduction programs are not effective. The purpose of this quantitative study was to further research an organization's specific population surrounding patient comorbidities, reasons for readmissions, and demographic characteristics that may lend insight into reasons for readmissions. The research design was a retrospective analysis of a health system's electronic medical record with a 3 manuscript approach. A sample of more than 800 COPD inpatients discharged over an 18-month period were examined for these studies using a variety of methods such logistic regression and survival analysis. Of the top 10 comorbid conditions identified, only those with acute and chronic respiratory failure with hypoxia were significantly more likely to be readmitted within 30 days (odds ratio = 2.38), and patients who were readmitted were most likely to come back for a respiratory condition, including COPD exacerbation. Although most demographic factors did not show statistical significance, readmissions were more likely among those discharged to home versus a skilled nursing facility or those who had a Medicare fee-for-service payor type. Further research into more clinical data versus administrative data can lend additional insights into further risk factors. These findings could lead to the development of more direct and effective readmission reduction strategies that enhance the quality of care for patients.

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Part 1: Overview

Introduction

Chronic obstructive pulmonary disease (COPD) restricts airflow and causes breathing-related issues (Centers for Disease Control and Prevention [CDC], 2018). Several disorders, including emphysema and chronic bronchitis, fall into the COPD category and affect more than 16 million in the United States. Symptoms include tightness in the chest, excessive phlegm, wheezing, and frequent respiratory infections, all of which can impact and limit a person's activities of daily living. Many patients with COPD will have a period of exacerbation which may require hospitalization for specialized treatments, such as breathing treatments with a nebulizer, inhalers, or antibiotics. Despite initial treatment, nearly 1 in 5 people will have to go back to a hospital and be admitted (also known as readmitted) within 30 days of initial discharge (Shah, Press, Huisingh-Scheetz, & White, 2016).

Evidence identified potential risk factors that lead to rehospitalizations, including having a low-income, living in a rural area, certain behavioral factors such as smoking and improper nutrition, and noncompliance with treatments (Braman, 2015). Evidence from interventions designed to reduce hospital readmissions among COPD patients include early outpatient follow up, education and training on proper inhaler usage, and pulmonary rehabilitation (Sha et al., 2016). These have been shown to significantly reduce rehospitalization both for inpatients as well as emergency department visits within 30 days.

Hospitals have used published research to implement their own programs to reduce the number of readmissions in COPD patients; however, the rate remains unacceptably high to both organizations as well as patients. Patients do not want to spend their time in the hospitals, nor do organizations want to incur the cost of these readmissions. To prevent these frequent visits, it is important for hospitals to investigate their own populations to determine what barriers lead to subsequent readmissions (Shah et al., 2016). Though hospitals have used published research to create their own readmission avoidance programs, most of these programs apply after patients are discharged from the hospital, and few interventions are done while they are still in-house. Further research may be able to lead to identified risks of readmission while the patient is still in the hospital, allowing providers to add additional treatments and resources that lead to better patient outcomes when they are discharged.

Problem Statement

Hospitals and health systems addressed readmissions in the COPD population since 2014, when it became a focus for the Centers for Medicare and Medicaid Services (CMS) Hospital Readmission Reduction Program. The CMS tried to incentivize organizations to reduce their readmissions by tying reimbursement penalties to performance. If the rate fell below the established threshold, hospitals would face up to 3% reduction from their annual payment update, equating to millions of lost revenues (CMS, 2017). Despite this initiative, readmission rates have not drastically improved (DeVore et al., 2016). Some patients are being readmitted for the same reason as the initial visit (COPD exacerbation; see Jennings, 2015), whereas others might be related to

a comorbidity not specifically addressed during the last visit, and others may be completely unrelated. Organizations need to address the comorbidities that patients have, which could be potential causes for them to be readmitted. Comorbid conditions may not be properly treated during their time in the inpatient unit, or COPD treatments may interfere with patient comorbidity treatment plan and contribute to subsequent visits. Should providers have a proper list of comorbidities and interactions, particularly in treatments, care plans for the patient may be enhanced during times of exacerbation.

Despite care giver efforts to avoid subsequent hospital admissions, tertiary care factors affect risk of readmission. When patients are readmitted, they may deal with different care team staff who may be unfamiliar with the patient's recent visit for their COPD. This new visit may be unrelated, but the new treatment plans may hinder the COPD progress or cause further exacerbation. Although some electronic medical records may have provisions that help identify recent diagnoses, providers may not always be able to easily identify them, nor do their workflows always include this review. If the patient is coming back for their COPD, they may have had an ineffective treatment plan. Without knowing the readmission reasons, care teams continue to struggle with properly addressing and treating COPD.

Not only are patients struggling with this respiratory disease, but they may also face other non-health related barriers that contribute to their reasons for readmissions. Certain demographic factors may mean that some patients are at a higher risk for exacerbation or readmissions. If care teams had a better understanding of these non-

health related characteristics that their patients have, perhaps proactive approaches could be made to help address them and keep patients out of the hospital.

Background

Epidemiology of Chronic Obstructive Pulmonary Disease

Persons with COPD may be identified through a confirmed diagnosis with a provider or may self-report, based on their symptoms. More than 15 million Americans have a confirmed case, though millions more may be living with it unknowingly or undiagnosed (CDC, 2018). This disease is currently the third leading cause of death in the United States, according to the CDC (2018). Though smoking tobacco has and continues to be the main source or cause for COPD, secondhand smoke, and other air pollutants such as dust and fumes may also cause the disease or lead to periods of exacerbation.

Data from certain states show the prevalence of COPD as well as the factors that may relate to the diagnosis. For instance, in the state of Illinois, more than 6% of residents answered on the Behavioral Risk Factor Surveillance Study that they had COPD. In the state of Iowa, it was just over 5% (CDC, 2018). In both states, however, around 60 % of them reported to have shortness of breath to the extent where it affects the quality of their lives. In both Iowa and Illinois, the largest age group of impacted people were people between the ages of 65 and 74, though Illinois also had a large population greater than age 75, according to data from 2014 through the CDC (2018). COPD patients are more likely to be Caucasian, women, who were both unemployed and physically unable to work, had less than a high school diploma, an income less than 25,000 dollars annually, and were divorced/widowed/or separated (CDC, 2018).

Literature Review

Studies of readmission rates. Previous researchers have attempted to address readmission rates for COPD patients. For example, Goto et al. (2017) examined the readmission rates of COPD hospitalizations for eight, geographically dispersed states over a 6-year period. They found that in the 6 years, the 30-day readmission rate dropped slightly from 20.0% to 19.2%, leading to a conclusion that more effective strategies were needed for greater reductions. Other researchers took the CMS readmission data and conducted a study to see if COPD readmissions were associated with other quality measures (Rinne et al., 2017). They saw that COPD readmission rates were associated with readmissions among other conditions, particularly heart failure and pneumonia, both of which are a part of the hospital readmission reduction program and thus populations of interest. The researchers concluded that hospitals begin to transition to value based contracts, understanding the relationships between COPD and other comorbidities to improve quality (Rinne et al., 2017).

Another group of researchers attempted to take a proactive approach to readmissions. They looked at more than 2,600 patients in Liverpool Hospital in Sydney Australia for a period of 10 years. These 2,600 patients had nearly 6,000 hospitalizations for COPD. A quarter of them were readmitted within 30 days, with more than half of them with COPD as the primary reason for visit, but the hospital was not able to predict readmissions even with an index to calculate patient's length of stay, acuity of admission, acuity of admission, and emergency department visits within 6 months (Hakim, Garden, Jennings, & Dobler, 2017).

Others have looked at other care settings to try to reduce readmissions to inpatient settings. Rezaee et al (2018), for instance, looked at emergency department utilization after encounters for COPD exacerbation over a 6-year period to better understand readmissions and determine any characteristics or subgroups most at-risk and in need of intervention (Rezaee, 2018). Of more than the 1,000 emergency department visits studied, they found that less than 20% were released to go home, with the other 80% being readmitted. Of the admitted patients, only 16% had a length of stay for less than 48 hours. The research team concluded that despite readmission reduction initiatives such as the CMS Hospital Readmission Reduction Program, there is a lack of explicit guidelines for hospitals and providers to follow to keep their patients out and that more sophisticated clinical algorithms are needed to determine the need for a readmission or further intensive outpatient follow up (Rezaee, 2018).

Identified risk factors. Other published studies have a focus of risk factors for COPD readmissions. Tsui et al (2016) recruited 250 patients who were admitted to a hospital for COPD exacerbation over a 1-year period and found that nearly three quarters were readmitted at least once for COPD and a large portion of their cohort had anxiety, which was strongly associated with frequent readmissions of at least four times in 1 year (Tsui, 2016).

Other researchers have looked at characteristics that patients had when they were first given a COPD diagnosis from their primary care provider and what may predict a hospital admission and subsequent readmissions. For example, Hunter et al. (2016) conducted a longitudinal, retrospective study in Scotland and found that patients who had

at least one hospitalization were older and had more severe cases of COPD when they were first diagnosed than those who did not have hospitalizations. Moreover, these patients also had lower body mass index and were current smokers. However, Hunter et al. concluded that these characteristics had little association with the likelihood of readmission.

Further, researchers like Lau, Siracuse, and Chamberlain (2017) tried to develop a readmission prediction model for COPD patients. Hundreds of thousands of patient records were examined from state inpatient datasets and the team developed the Readmission After COPD Exacerbation Scale. Lau et al. determined that factors of age between 40-65 years, male sex, ethnicity of African American, having Medicaid or Medicare payor types, and a few diagnoses of anemia, heart failure, depression, or drug abuse, were highly associated with increased readmission rates. These factors helped explain more than 90% of readmission variability when the scale was applied (Lau et al., 2017).

Readmission reduction initiatives. To control the readmission rates, a variety of treatment and program options are being trialed among COPD patients. However, many approaches have been general and not specific to COPD. Organizations have utilized some programs such as Better Outcomes through Optimizing Safe Transitions (BOOST), Project Re-Engineering Discharge (Project RED), Transitional Care Models, and Care Transitions Interventions (Pruitt, 2018). Each one has a similar base—health care providers go into the home, assist with medication reconciliation, promote self-management, and provide follow up phone calls. For instance, an intervention in an acute

care hospital setting, called SPACE for COPD, used a self-management approach to help patients manage their day-to-day activities. These interventions offered advice, include a home-based exercise program, and action plans when faced with exacerbation; however, when used to reduce hospital readmissions, it had no more affect than patients who were not in program and saw rates just as high (Johnson-Warrington, Rees, Gelder, Morgan, & Singh, 2016). Further, these broad approaches are not individualized to meet the needs of a COPD patient nor address their comorbidities (Pruitt, 2018).

To address comorbidities outside of COPD and help reduce hospital readmissions, a group of researchers in North Carolina initiated a care plan focused on transitions of care, treatment of COPD, treatment of common comorbidities, and a focus on hospice and palliative care (Ohar, Loh, Lenoir, Wells, & Peters, 2018). However, their common comorbidities only included vascular and heart disease and chronic kidney disease. Their results did show a lower likelihood for these patients to be readmitted than their counterparts that did not receive a specialized care plan (16 less likely to be readmitted), but it took a lot of resources to assist these patients, including increased diagnostics and a staffed call center. Nonetheless, participation in pulmonary rehabilitation was still poorly attended, with less than 2% of participants attending within 30 days of their discharge (Ohar et al., 2018).

Further, to aid in transitions of care from the hospital, an interprofessional team comprised of physicians, nurses, pharmacists, respiratory therapists, and cardiopulmonary rehabilitation specialists created a discharge checklist to ensure that the COPD patient's needs were being addressed (Saunier, 2017). This checklist included educational material

on how to use their inhaler as well as a magnet of a traffic light that depicted green for "having a good day," yellow for a "bad day," and red for a "bad day." Each color also had phrases to represent examples of what may constitute as a "bad day" or a reason for "danger." However, this program also saw about a 2% reduction in their readmission rates (Saunier, 2017).

In addition to these interventions or programs to address COPD readmissions, hospitals may reduce barriers by reimbursing the out-of-pocket expenses that patients face for transportation to various doctor's appointments such as their primary care provider, pulmonologist, or pulmonary rehab. This may incentivize patients to be more compliant with their treatment plans, which could help them stay healthy enough to stay out of the hospital (Lee et al., 2019). However, organizations would have to determine if the cost would offset the penalties from having an excessive readmission rate or if incentivizing improves value for the patients.

Synthesis. Research on COPD readmissions has been done to understand which patients are at risk, why patients are coming back, and what interventions may be successful in preventing rehospitalizations (Arne, 2016; Chalder, 2016; Hakim et al., 2017). However, many of these researchers have concluded that their findings did not show much impact in readmission reduction (Johnson-Warrington, Rees, Gelder, Morgan, & Singh, 2016; Laverty, 2015). Some risk factors for readmissions, such as a comorbidity of heart failure, that have been examined have been limited to those that regulatory bodies, such as CMS, are interested in. Further, though various interventions have implemented to reduce readmissions, many of these interventions have not had

much impact (Jennings, 2015; Johnson-Warrington et al., 2016) . Lastly, to search for socioeconomic status impact on COPD readmissions, there were few large-scale published studies available.

Key Constructs

The literature review had several key constructs that relate to the overarching readmission problem. Despite the many publications regarding interventions to decrease readmission rates, organizations have continually reported little change, leading to questions if the interventions were cost effective or quality added. Furthermore, many approaches have been too general and did not properly address the needs of COPD patients nor address any additional barriers that they may face. Neither follow up phone calls nor a referral to a pulmonologist addressed the many other facets of the patient's comorbidities. But COPD patients are nearly 2 times as likely to have cardiovascular comorbidities, gut and renal disorders, and hypertension disease (Yin, 2017). They also face a large likelihood of psychiatric disorders and are nearly 3 times as likely to have other non-COPD respiratory comorbidities (Yin, 2017).

There has also been a lack of patient demographic information and how it relates to COPD readmissions. Collected information from the Behavioral Risk Factor Surveillance Survey showed that people who had COPD were more likely to be unemployed (unable to work), be less educated, and have a low income (CDC, 2018). All of these factors help make up their socioeconomic status and can be used to determine certain communities of need, including access, transportation, or identify food deserts but does not give adequate patient demographic characteristics that could show if certain age

groups, sex, marital status, or religious preferences may also impact likelihood of readmissions. These factors may weigh into a person's ability to be able to effectively manage their COPD and may predict if they are more at risk of returning to the hospital.

Overview of the Manuscripts

Why Three Studies

The purpose of these studies was to examine the potential causes for hospital readmissions and treatment barriers that COPD patients must overcome. This included looking at the top comorbidities that COPD patients had to determine whether COPD or their comorbidities influenced the reason for subsequent visits as well as the impact of socioeconomic status on the likelihood for readmissions. Having three different studies allowed a further investigation into a multifaceted problem. For instance, looking only at the comorbidities of a COPD patient would not address their socioeconomic status and whether COPD or a comorbidity is the reason for subsequent hospitalizations. Each of these studies presented its own research questions, but these questions all related to having a proactive approach to tackling hospital readmissions in the COPD patient population.

Integration of the Studies

Findings from the studies may assist hospitals and care teams in providing more specialized readmission avoidance programs for their COPD patients or allow them to enhance their treatment plans based on the relationships with other comorbidities. Findings from this COPD focused study may lead to risk prediction models that determine who is most at risk for hospital readmissions as well as potential reasons why.

This can be done through proper identification of triggers, a list of potential diagnoses or characteristics that a patient has, or perhaps patient demographics that could send an alert to the provider that the patient is at high risk through the electronic medical record. This proactive approach, while the patient is still in the hospital, could allow providers to address the needs and barriers that the patient faces before they leave and hopefully avoid a subsequent inpatient visit. This not only improves the quality of life for the patient by allowing them to stay out of the hospital but also frees up hospital resources and personnel for other critically sick patients.

Manuscript 1

Specific problem. Each person in a hospital has a unique medical history. Someone with COPD may also have a unique panel of comorbidities. Though a reason for hospitalization may be related to COPD exacerbation, it does not mean that their other ailments may not soon arise or that their COPD related treatments may not interfere with other treatments. Patients who present to the hospital with COPD exacerbation may not have their comorbidities addressed during their visit, which could also be impacted and be a cause for a readmission.

Research question. The independent variables were the coded diagnoses that the patients had during their visit, using the International Statistical Classification of Diseases and Related Health Problems, version 10 (ICD-10). The dependent variable was whether the patient was readmitted to the hospital within 30 days of being discharged or not.

Research Question 1: Is there an association between multiple comorbidities and the likelihood of a hospital readmission?

H_0: There is no association between multiple comorbidities and the likelihood of a hospital readmission.

H_a: There is an association between multiple comorbidities and the likelihood of a hospital readmission.

Nature of study and design. To answer the research question, a quantitative, retrospective, cross-sectional design was utilized. This type of study allowed for identification of COPD patients and exploration of their outcomes without the need to conduct interviews or experiments. This approach also allowed the specific research question to be explored while observing the relationship it had with the overall COPD population. Data taken from the electronic medical record included all the ICD-10 diagnoses and procedure codes that were addressed during the patient's hospital visit. These diagnoses served as the independent variable, as they answered the question about what comorbid conditions the COPD patients had and served as a predictor for whether the patient was readmitted (the dependent variable). Understanding what other diseases these patients had predicted whether certain comorbidities influenced the likelihood of a patient returning to the hospital. Descriptive statistics were first used to determine a list of diagnoses that most commonly appeared. Then logistic regression was used with each one to determine the odds ratio of each diagnosis contributing to the likelihood of a readmission.

Sources of data. The source of data was from a bi-state health system, utilizing the data collected in their electronic medical record system. De-identified data were screened to select patients who had any diagnosis of COPD within an 18-month period

from July 2017 through December 2018, including a list of all other accompanying diagnoses and procedure ICD-10 codes, and discharge dispositions from each encounter. This timeframe allowed for a minimum sample size of 220 patients. The de-identified data file was then analyzed accordingly to seek answers to the research question.

Manuscript 2

Specific problem. The specific problem was related to whether COPD was the reason for the readmission, as determined by the diagnostic related group (DRG), which is the primary reason for an inpatient encounter. If COPD was not the reason, then the possibility existed that it could have been a comorbidity that was documented or addressed in the previous visits. But care plans may not have been addressing these other needs, resulting in another hospitalization, or if COPD was the reason for the visit, then the interventions that were given during the initial visit may not have been enough to avoid further exacerbation.

Research question. Only patients that returned to the hospital within 30 days after a COPD visit (dependent variable) were examined. The DRG that was assigned to the encounter served as the independent variable. It dictated what the nature of that particular hospitalization was about.

Research Question 2: Is there an association between initial COPD admission and COPD hospital readmission within 30 days of the initial discharge?

H_0: There was no association between initial COPD admission and COPD hospital readmission within 30 days of the initial discharge.

H_a: There was an association between initial COPD admission and COPD hospital readmission within 30 days of the initial discharge

Nature of study and design. To answer the research question, a quantitative, retrospective, cross-sectional design was utilized that measured what percentage of COPD patients were returning to the hospital within 30 days for the same problem along with a survival analysis using the time to readmission (in days). This approach allowed for inferential statistics to be conducted without the need for qualitative, patient interviews. Information was taken from the electronic medical record, and the coded diagnoses and procedures from both the initial as well as the subsequent hospital encounters were observed. The independent variable was the DRG, which was the primary reason for the visit, and served as the outcome variable. Additionally, the data were categorized into COPD as one group and all other non-COPD reasons into another. This allowed for a bivariate analysis to be done to see not only what percentage made up the reason for readmission but also if there was statistical significance in these groupings when using the survival analysis for time to readmission. This may lend insight into whether the COPD diagnosis is being adequately addressed during the initial visit. If COPD accounted for a large percentage of the subsequent visits, then perhaps more resources or treatments are needed to prevent exacerbation.

Sources of data. Electronic medical record information was a primary source of data in this study and the dataset used was from Genesis Health System, a small system that has acute care hospitals in both Illinois and Iowa (Genesis Health System, 2020), where a patient had an initial visit with a diagnosis related grouping of COPD. A sample

of at least 220 patients was needed for a .95 power and a medium effect size as calculated by the G*Power calculator. Therefore, 18 months of patient information was gathered and screened to meet the minimum sample size.

Manuscript 3

Specific problem. A look into patient demographics has been a staple in public health and social research but is still underutilized when applying it to healthcare systems. However, hospital readmissions play a pivotal role in public and population health and a look into the demographics can be used to determine certain populations of risk. Certain patients may have relatively high risk if they are of a certain age, sex, or practice certain religions and may face more challenges and a higher expected rate of return than those in other demographic categories. Organizations could use these results to determine populations of risk, whether they are observing a higher than expected hospital readmission rate, and whether more intervention is needed to mitigate the risks.

Research question. The patients' age, sex, race, marital status, and religion were all used as the independent variables to determine if they impacted readmission risk, while readmissions to the hospital served as the outcome variable.

Research Question 3: What patient demographics predict a hospital readmission in the COPD population?

H_0: There was not a statistically significant relationship with the demographic characteristics and whether the patient was readmitted.

H_a: There was a statistically significant relationship with the demographic characteristics and whether the patient was readmitted.

Nature of study and design. The third manuscript once again was retrospective in nature, using a cross-section of data that explored the research question. This approach allowed for the demographics to be analyzed to determine the likelihood of certain groups to be readmitted. Many factors may contribute to COPD exacerbation and perhaps certain demographic factors may warrant further investigation or different treatments. Regression analysis was used to see the impact of these factors and whether it was statically significant.

Sources of data. The health system captured this information in the electronic medical record, which can show if certain characteristics had a higher expected value to be readmitted within 30 days. The information was used to look at the initial visits for the patients with COPD and what their expected values were and whether they were subsequently readmitted. Three years of data were gathered in order to meet a minimum sample size of 220 patients.

Significance

Given the gaps in the literature, this research can contribute additional insights into COPD readmissions. Hospitals have struggled to address this problem and better assist their patients while reducing costs and avoiding readmission penalties. Further, patients are trying to combat frequent lung infections, difficulty breathing, anxiety, mounting medical costs, and physician appointments. Their quality of life is dependent on the health care system’s ability to treat their condition as well as their comorbidities. Findings from Manuscript 1 may give insights into what the top comorbidities are, which could alert providers to be on the lookout for those in their other COPD patients. They

may also become more in tune to treating those conditions while the patient is there during a period of COPD exacerbation. Findings from Manuscript 2 may lend some insight into whether the treatments given to treat COPD are enough to keep exacerbation under control or if patients are having to come back with the same problem. The results could also point to comorbidities, as in Manuscript 1, not being addressed properly and leading to rehospitalizations for those conditions. These findings could lead to changes in treatment plans or protocols for COPD patients. Lastly, the impact of demographic factors could reveal that some patients face a higher burden than others. This may lead to different types of treatment plans such as a referral for home health if access or transportation are areas of concern. Or perhaps these patients live in a certain zip code where socioeconomic burdens exist that would require further investigation. Providers can use these insights that may not have been seen just by looking inside the electronic medical record.

Summary

If providers can identify top comorbidities in their population, address and treat them, as well as account for external, non-health related barriers, then perhaps both patient and organization can see improvements. The following manuscripts will go into details about each of these problems and research questions, giving way to results and findings and that means for hospital readmissions in COPD patients.

Part 2: Manuscripts

Likelihood of Comorbidities in a COPD Patient Leading to a Hospital Readmission

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Outlet for Manuscript

One of the journals that Walden University publishes is called the *Journal of Social, Behavioral, & Health Science*. This peer-reviewed journal publishes the collaborated works from the colleges of Health Sciences and the College of Social and Behavioral Sciences. This study is a good addition because it explores the complexities of public health like patient comorbidities to see what could be contributing to a patient's likelihood of being readmitted to a hospital. The journal focuses on articles that contribute research to contemporary national and international issues. Hospital readmissions fit into this focus, as it has been a nationwide quality improvement initiative, driven by regulatory requirements in recent years. Articles are required to be in American Psychological Association, 7th Edition. Furthermore, the manuscript should be submitted as a Microsoft document. Their publishing guidelines can be found here: https://scholarworks.waldenu.edu/journals/publishing_guidance.pdf

Abstract

Patients with chronic obstructive pulmonary disease (COPD) may have multiple comorbidities, any of which could be a reason for a subsequent hospital visit. The purpose of this study was to examine the top comorbidities that these COPD patients have and determine odds ratios for them to see whether certain conditions are more likely to result in a readmission. These patterns could help providers begin treating these ailments while a COPD patient is having exacerbation and could help prevent further treatment needs for one of the comorbidities during the exacerbation recovery. This retrospective study included 874 inpatient discharges from July 2017 through December 2018 from Genesis Health System. The top 10 comorbidities were analyzed and run through a multiple logistic regression model. Of those comorbidities, only those who had a diagnosis of acute and chronic respiratory failure with hypoxia were more likely to be readmitted, with an odds ratio of 2.38 (.572-3.603). Although not every diagnosis had a statistical relationship, the findings can help providers treat the hypoxia to avoid a subsequent hospitalization.

Introduction

Like many people, patients with chronic obstructive pulmonary disease (COPD) are likely to face more than just one ailment (Jacobs et al., 2018). Smoking tobacco has been linked to be a main cause of COPD by the American Cancer Society (2018), which is also a risk factor for several other diseases, including diabetes, heart disease, and stroke. Therefore, patients who developed COPD may have multiple comorbid conditions. If a patient presents to the hospital with acute exacerbation of COPD, they may also need checked or treated for one of these other conditions. This manuscript focused on diagnosed COPD patients who had one or more inpatient admissions over an 18-month period and the top frequent listed comorbidities. These comorbidities were examined to see if they impacted the likelihood of the patient having more than visit and being readmitted to the hospital within 30 days of their initial discharge.

Significance

Hospitals and health systems have used 30-day readmissions as a measure of quality of their care. In October of 2012, the Centers for Medicare and Medicaid Services (CMS) implemented their Hospital Readmission Reduction Program, which provided monetary incentives to organizations to reduce the number of people who are readmitted for a hospitalization within 30 days of an another acute care inpatient visit (American Hospital Association, 2016). In 2015, COPD was added to the list of populations of interest. Hospitals that had excess readmissions faced payment penalties that could amount to millions of dollars in a single health system (CMS, 2020). Since the program started just 7 years ago, hospitals have been sanctioned nearly 2 billion dollars in

penalties (American Hospital Association, 2016). Organizations have strived to get a handle on these excessive stays, but still struggle, as evident by the continued number of payment penalties. Given this situation, this study aims to examine the COPD population by looking at all the comorbidities they have, which may also impact their likelihood of a readmission. Other studies that surround the readmission topic tend to focus on ideas and processes that may keep patients out of the hospital, such as discharge phone calls, or referrals to pulmonologists (Arne, 2016) (Collinsworth, et al., 2018) (Perry, 2018), but this study looked at other causes for readmissions, not just focus on the one diagnosis. The framework for this study looked at a holistic approach, meaning that patients with COPD may not only need treatment for that one ailment, but rather, need a more comprehensive exam, given their fragile state. Doing so may help the patient leave the hospital in a better state, and keep them out longer, giving them a better quality of life, while also relieving the organizations from unnecessary readmissions.

Relevant Scholarship

Researchers have been trying to address readmissions in the COPD population for several years, looking at patterns of readmissions, reasons for readmissions, and trying to determine what post-acute processes could help avoid unnecessary rehospitalizations. A team of researchers ventured to look at the COPD readmissions and found that a quarter of these patients were readmitted for the same exacerbation reasons, and overall, that half of the patients readmitted were seen because of a respiratory related illness (Shah, Press, Huisingh-Scheetz, & White, 2016). They also looked for ways to try to predict patients at risk for a COPD readmission. One of the factors that they looked at was the number of

comorbidities that patients had. They found that 68% of the patients had at least one comorbidity, and 16% had two or more (Shah, Press, Huisingh-Scheetz, & White, 2016). Despite this information, they did not identify what the top comorbidities were or if any in particular were more likely to be attributed to a readmission cause.

Lau et al. (2017) did try to determine top comorbidities for readmissions though. This team of researchers from Saint Barnabas Medical Center in New Jersey, came up the Readmission After COPD Exacerbation (RACE) Scale. After analyzing hundreds of thousands of COPD encounters through claims data, they determined top comorbidities and tested whether they were predictors for readmissions (Lau et al., 2017). They found that more than half of the patients had hypertension, and more than 25% had diabetes and/or heart failure. Patients who had a diagnosis of psychoses or a history of drug abuse were also more likely to be readmitted after COPD exacerbation (Lau et al., 2017).

Relative to the psychosis findings, there have been other studies done that looked at the association of psychological disorders and their impact on COPD patients with likelihood of 30-day hospital readmissions. Singh et al (2016) analyzed a dataset with ten years of Medicare claims, where a patient would have a primary diagnosis of COPD but also had a secondary diagnosis of anxiety, depression, psychosis, or alcohol and/or drug abuse, to determine if they had an association with increased readmissions (Singh, 2016). A multivariate analysis showed that patients with these psychological disorders were independently associated with higher readmission rates within 30 days for patients with COPD (Singh, 2016).

Another group of researchers did a literature review and looked at prevalence rates between COPD and no COPD patients (Yin H. Y., 2017). They found that patients with COPD were more likely to have cerebrovascular comorbidities, gut and renal disorders, musculoskeletal disorders, diabetes, and psychiatric disorders than patients without COPD. However, it is unknown if these comorbidities contribute to frequent hospitalizations (Yin H. Y., 2017).

Some other researchers did not look specifically at the types of comorbidities that COPD patients had, rather, how many the patients had. Jacobs et al. (2018) wanted to examine factors that lead to early readmissions after encounters for acute exacerbation of COPD to find predictors. After looking at the Nationwide Readmission Database over a two-year period, they found that patients who were readmitted within that 30-day window were more likely to have more comorbidities than those who did not (Jacobs, et al., 2018). Patients who had 9 or mor comorbidities were 1.38 (1.30-1.47) times more likely to readmit than those with five or fewer.

Research Questions and Design

Given that much of the focus in literature is on the readmission itself, and methods organizations are deploying to try to prevent them, this study focused on comorbidities that a COPD patient presented with during their initial visit and the likelihood that they contributed to a subsequent visit, within 30 days of their discharge. Retrospective data was used from Genesis Health System, a small system in the bi-state region of Illinois and Iowa with two acute care hospitals and two critical access hospitals (Genesis Health System, 2020). Data was analyzed to determine the top frequently

documented comorbidities, then tested to determine the correlation that each had with the outcome of a readmission. This could lend insight to types of issues that providers ought to look at when treating their patients for acute exacerbation of COPD, to see if these are potential risk factors for another visit.

Methods

Participants

This retrospective data used a population of patients who were older than the age of 18, who had a visit for COPD, and were discharged from an acute care hospital between the dates of July 2017 and December 2018. There were 874 encounters during this time frame. The mean age was 68.49 years, with a range of ages from 39–99. Of the 874 patients, 513 or 58.7% were females, and 361 or 41.3% were males.

Variables/Sources of Data

The dataset was gathered from Genesis Health System and included many variables, such as demographic factors including age, sex, marital status, race as well as the first 25 documented diagnoses, the diagnosis related grouping, and up to 20 documented procedures. Outcome metrics were also included such as the discharge disposition and a flag to alert whether this patient had a readmission within 30 days or not.

To answer the research question, the study utilized the documented diagnoses codes for each inpatient encounter, along with the medical record number to see how many visits each patient had. The admit and discharge dates were also included to see how far apart the admissions were but limited to those that occurred within 30 days from

the initial discharge date. Additional coding took place with the data to calculate the days between the visits and to show chains of visits that occurred within the immediate 30 days of the last visit.

Instrumentation or Measure

The instrument used to collect the data was called Midas+, a system that the host organization uses, which interfaces information from the electronic medical record into the Midas solution for quality reporting purposes. All of that information has been vetted by the organization, and it matches what is in the electronic medical record. The data extract from the system contained information such as age, sex, diagnoses, and procedures. In efforts to clean the data, encounters that did not have a principle diagnosis were excluded from the final data set, as there needed to be at least one diagnosis that would link the encounter to having COPD.

Design and Analysis

This retrospective study used a cross-sectional research design in order to assess the effects of multiple comorbidities, in association with COPD, and the risk that might be associated with subsequent hospitalizations. Other designs, such as a case-control study, could have also been used, but looks at different types of relationships such as prognosis or harm. In this study, the relationships of the top comorbidities experienced by these patients, were tested with the health outcome of having observed a readmission within 30 days of being discharged from an initial visit, therefore meeting the objective of this type of study design as well.

Results

Execution

The data were collected by first identifying patients who had a principle diagnosis of COPD and were discharged from an inpatient encounter between July 1, 2017 through December 31, 2018. Patients who did not have a diagnostic related grouping code were excluded, as this code is essential for payment and classification. This signified that the coding was completed on this encounter and that it went out the payors for payment. Additionally, encounters that did not have a discharge disposition, or where the disposition equaled expired, discharged to rehab, or the patient left against medical advice, were also excluded from the final data set. This is because patients who were discharged with these dispositions would not be eligible for a readmission according to regulatory standards (CMS, 2020). Lastly, patients who were transferred to an inpatient rehabilitation facility or to another acute care facility were also excluded because those patients needed a higher level of care. Additionally, I did not want these encounters to portray a false readmission should they have been admitted to the rehabilitation unit or to a higher level of care within the same health system or facility. This left a cohort of 874 encounters.

Results

The top 10 frequent secondary diagnoses were examined to help answer the research question. Of all patients from the cohort, the top 10 diagnoses included essential hypertension (n = 340), nicotine dependence, cigarettes (n = 300), personal history of nicotine dependence (n = 302), acute and chronic respiratory failure with hypoxia (n =

250), atherosclerosis heart disease of native coronary artery (*n* = 236), COPD with acute lower respiratory infection (*n* = 406), dependence on supplemental oxygen (*n* = 206), hyperlipidemia (*n* = 195), acute respiratory failure with hypoxia (*n* = 184), and pneumonia, unspecified organism (*n* = 190).

Multiple logistic regression was used to test whether these diagnoses predicted the likelihood of patient readmission within 30 days of discharge. Table 2 shows the model summary for these diagnoses (see Appendix). Both the Cox & Snell R^2 and the Nagelkerke R^2 tests were less than 6%, meaning that there was a small chance of readmissions occurring due to these independent variables. Table 2 also gives the statistical significance and odds ratio of each of these variables.

Discussion

Interpretation

Of these 10 top comorbidities documented in the population, the only variable that had significance, $p < .05$, was the "acute and chronic respiratory failure with hypoxia" diagnosis. The patients who were diagnosed with acute and chronic respiratory failure with hypoxia were 2.38 (1.572-3.603) times more likely to be readmitted within 30 days of discharged, compared to patients who did not have it. None of the other variables were close to a *p*-value of less than 0.05.

Limitations

There are several limitations that can be attributed to this study. For example, only the first 25 diagnoses were documented and captured in this data collection. This practice is often the case in hospitals, as many payors do not collect more than that. Some

patients may have exhibited some of these other comorbidities, but they were not included in the coding. Additionally, the study looked at the frequency of coded diagnoses, versus a class of codes. What is meant by this is that ICD-10 coding can be quite specific, and many codes can be similar but represent something just a bit different (CMS, 2020). For example, a patient may have a code for heart failure, but there are different codes based on the type of heart failure, the location (left ventricular, systolic, diastolic), and whether it is an acute episode or chronic. Because of this, the top 10 comorbidity list may not be as broad as far as disease class.

Another inherent limitation is how a readmission is defined. Hospitals and payers alike tend to define a hospital readmission as an inpatient visit, given the ties with the CMS Hospital Readmission Reduction Program (CMS, 2020). This means that if a patient goes to the emergency department or an observation unit, but does not become an inpatient status, then they would not be counted as a readmission. This does not mean that the patient did not need additional care, but that they did not require that certain level of care.

Lastly, another inherent constraint is that this would only capture readmissions that occurred at this organization. Patients may have discharged from this hospital but could have been readmitted to a separate organization. In this case, it would not be captured with the initial organization’s electronic medical record and therefore not seen as a readmission here.

Implications

Findings from the regression model indicate that with the exception of respiratory failure with hypoxia, there is no evidence to suggest there are strong associations between the top ten comorbidities and a patient's likelihood to be readmitted. In that instance, 28% of the patients in this cohort population had that diagnoses, and they were twice as likely to be readmitted than those who did not. In all other cases though, there was no statistical significance.

Recommendations

Further research into comorbidities ought to be done that can utilize a method to accurately reflect diagnostic categories versus individual codes. This would allow for a broader perspective and perhaps gather more patients into the mix. Additionally, it could be helpful to expand the definition of readmission and instead look at patients that received other levels of care, including trips to the emergency department or observation units, as this is still costly to both the patient and health system, and detracts from the patient's quality of life.

Conclusions

Patients with COPD may have a variety of health ailments, not just their breathing problems. This study aimed to see if any of those comorbidities had a relationship on whether they would need to be hospitalized within 30 days of initial discharge. There are tens of thousands of possible diagnoses codes, and therefore the top ten most frequently used ones in this population were examined. Of those common ailments in this population, only acute and chronic respiratory failure with hypoxia played a role. The rest

of the diagnoses did not have a relationship; therefore, it is concluded that the null hypothesis cannot be rejected. Future research without as many limitations may have different results though.

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Relationship of COPD to Rehospitalizations

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Outlet for Manuscript

Walden University publishes a journal that is a collaboration between the colleges of Health Sciences and Social and Behavioral Sciences. The peer-reviewed journal houses information on contemporary issues both nationally and internationally in regard to public policy and administration, criminal justice, political science, human health, public health, medicine, and others. Implications from this study include lending insight into clinical practices and showing if patients are likely to be hospitalized for the same reasons or if exacerbation of one of their other ailments is leading them to be readmitted. Given that this could be both a public health as well as health administration issue, this study is a suitable submission for this journal. Articles submitted are required to be in American Psychological Association, 7th edition. Furthermore, the manuscript should be submitted as a Microsoft document. Their publishing guidelines can be found here: https://scholarworks.waldenu.edu/jsbhs/submission_guidelines.pdf.

Abstract

Hospital administrators and providers have contemplated the relationship between length of stay for inpatient admission and the impact on readmissions, especially when patients are returning to the hospital in a short time with the same chief complaints. Therefore, the purpose of this study was to review reasons for readmissions, looking at the diagnostic related grouping (chronic obstructive pulmonary disease [COPD]), to see if the reason for the readmission was for exacerbation of COPD, as was the case for their index visit, or if it was something different. This study examined whether patients with COPD continued to require hospitalization for this disease or if there is something else requiring this higher level of care. This retrospective study used patient discharge data from July 2017 through December 2018 from Genesis Health System, examining patients who had an initial inpatient discharge of COPD. The data set included the reason for readmission and whether subsequent visits were related to COPD or for other reasons. Additionally, the time to readmission as expressed from 0 to 30 days was examined using linear regression with the variable of COPD reason for readmission to see if patients with exacerbation were coming in sooner than those who came back for other reasons. Although there was a difference in the mean number of days to readmission for those with COPD versus other readmission reasons, the findings were not statistically significant. However, overall, half of all readmissions came back for a respiratory illness, with 36% of those being for COPD exacerbation alone, showing some clinically significant association.

Introduction

Hospitals and health systems have continued to struggle to reduce their 30-day readmissions in various populations, including in those who have chronic obstructive pulmonary disease (COPD; Buhr, 2019; Goto et al., 2017). Payors have taken to incentivizing providers to reduce their overall readmissions by not paying for subsequent hospitalizations and will penalize them no matter the reason for the readmission (Centers for Medicare and Medicaid Services, 2020). Therefore, this study was conducted to look at patients who would be deemed as having COPD based on the diagnosis related grouping (DRG) that the hospital inpatient visit was assigned. I looked for any inpatient readmission within 30 days of that initial visit and determined if it was related to the patient's COPD by looking at the coded DRG for the subsequent visit.

Significance/Importance

Determining if subsequent hospitalizations are related to the initial visit is significant for providers and administrators. If patients are released from a hospital too soon, they may not be well enough to fight their ailments on their own, which risks patients coming back to the hospital for further treatment. However, staying too long also poses risks such as patients could catch something else while they are there, and it causes undue burden on the health system, adding costly days, which, the patient may not medically need (Alqahtani, 2020; Rinne, 2017). If the COPD patient is returning for further hospitalizations within such a short amount of time for the same reason, the patient may have been discharged too soon. Patients who have had an increased length of stay were more likely to return for an all-cause readmission after their COPD

hospitalization compared to those who stayed between 3 to 4 days (Alqahatani et al., 2020). However, if the reasons for readmissions are not for COPD, all the comorbidities may not have been addressed during the initial visit. Although the results of this study cannot answer this question, it can lend insights into further investigation and research.

Relevant Scholarship

Many researchers have published studies related to ways of trying to decrease readmissions through means of chronic care management such as with education, post discharge phone calls, and medication adherence (Chalder, 2016) (Collinsworth, et al., 2018) (Johnson-Warrington, Rees, Gelder, Morgan, & Singh, 2016) (Saunier, 2017). Other studies took a broader approach and looked at nationally published data by the Centers for Medicare and Medicaid Services to see the impact on COPD readmissions with the Hospital Readmission Reduction Program (Buhr, 2019). Buhr saw that overall, COPD readmissions were on the decline, but that they remained higher than other cohorts that Centers for Medicare and Medicaid Services looks at in their reduction program. Jacobs et al (2018) wrote a similar study that also looked at the nationwide readmissions database from 2013 to 2014 and looked at the time to readmission after a hospitalization for acute exacerbation of COPD (Jacobs, et al., 2018). They found that 19% of their population was readmitted within 30 days and that more than half occurred within the first 15 days of discharge. COPD was the most common reason for the subsequent visit. Another study of interest was published early in 2020. Those researchers looked at the number of comorbidities and if COPD patients who had them (one, two to three, or four or more) were as likely to be readmitted within 30 days as those who did not have any

comorbidities (Lin, Xue, Deng, & & Chukmaitov, 2020). They found that multiple comorbidities did not play a role into the chance of being readmitted, but they did not state if those other comorbidities were related to the readmission or not or if COPD played the role as the reason for readmission.

Some researchers have looked at reasons for readmissions across a spectrum of chronic conditions, stating that patients may come back for any one of their comorbidities. Hans-Peter Brunner-La Rocca et al (2020) completed a cohort study, using discharge data over a five-year period from across the globe, studying 12 chronic conditions, including COPD. The team saw almost a 20% readmission rate in the COPD population, within 30 days, of which, more than 50% of those patients came back for the same reason: COPD exacerbation (Brunner-La Rocca, 2020).

Shah et al (2016) also looked at reasons why COPD patients get readmitted within 30 days, and saw that of Medicare patients, a quarter of them came back for acute exacerbation of their COPD (same reason as their initial discharge), where another quarter are due for any other respiratory-related illness, meaning that half of the readmissions are respiratory/COPD related (Shah, Press, Huisingh-Scheetz, & White, 2016).

Research Questions and Design

In this study, I aimed to examine the relationship between the reason for the readmission and whether or not it was related to COPD exacerbation. The outcome variable was being readmitted to the hospital, where the reason for the subsequent visit was being analyzed as the predictor variable. I also looked at time to readmission as my

dependent variable with COPD as a predictor variable, so see if patients who came back for COPD exacerbation were coming back sooner, as other literature sources have mentioned. This entailed looking at the DRGs to see if the reason was COPD or for a different reason altogether. Each patient had an initial visit reason for COPD, but what was the reason for the second visit if they were readmitted? Therefore, the research question was "Is there an association between initial COPD admission and COPD hospital readmission within 30 days of the initial?" The hypothesis was there was a significant association between initial COPD admission and COPD hospital readmission within 30 days of the initial discharge as compared to other DRGs.

Methods

Participants

To answer the research questions, a retrospective, cross-sectional study was used. Data were gathered from Genesis Health System, a small system with acute care hospitals in both Illinois and Iowa that has more than 24,000 inpatient discharges a year (Genesis Health System, 2020). Information was collected from their quality reporting system, which is fed by the electronic medical record. Encounters to include in this population were identified by having an inpatient discharge date between July 2017 and December of 2018 and had a DRG of COPD. This means that the primary reason for the initial hospitalization was related to their COPD. Data were then scrubbed to exclude patients that expired, left without medical advice, transferred to hospice care, or to another facility or level of care, as this would exclude them from counting as a readmission by Centers for Medicare and Medicaid Services standards (Centers for Medicare and Medicaid

Services, 2020). This left an initial population of 874 participants between the ages of 39 and 99, with a mean age of 68 years. Fifty-eight percent of the participants were female, and 41.3% of them were male. Of these participants, 144 (16.5%) of them had a 30-day inpatient readmission that were examined, which could have been for any cause.

Variables/Sources of Data

This bi-state data set included many variables, such as: demographic information, the first 25 documented diagnoses, up to 20 procedure codes, the diagnosis related grouping, as well as outcome metrics including discharge disposition, indicators of readmission, and if so, the second admission DRG.

To answer this research question, the study utilized the DRGs that were coded for both the index visit as well as the secondary visit. The admit and discharge dates were also included to see how far apart the admissions were to see if the readmission occurred within 30 days of the initial discharge. The dependent variable here is whether or not the patient was readmitted (dichotomous variable with either yes or no), and the independent variable is the DRG grouper for the second visit. A coded variable was included to state whether the readmission was related to COPD (yes or no) in addition to what the actual readmission DRG was. For the survival analysis, the time to readmission was measured against a dichotomous variable of being readmitted for COPD or not. If patients were in the “not” category, it implied that they were readmitted for something other than COPD.

Instrumentation or Measures

Data for this study was collected using a system called Midas+, a quality improvement reporting system that takes information from the organization’s electronic

medical record system. The information has been vetted with the health system and matches what is coming from the electronic medical record. Additionally, it tracks hospital readmissions and links them to the index visit, which is why it was chosen for this study. In efforts to ensure clean data, only those hospital encounters that had complete information were used, meaning that visits that did not have a DRG listed, had age, sex, discharge disposition, diagnoses, or procedure codes missing, then they were not included in this data pull.

Design and Analysis

A retrospective cohort study was used to answer these questions. Each participant had a confirmed diagnosis of COPD and an initial visit to the hospital for such. Those encounters were then examined to determine who had a 30-day readmission, and if they did, what the reason was. The aim was to determine if they were returning for COPD or if it was something unrelated.

Results

Execution

Additional coding for the data set was used to examine the reason for the readmission. Patients who had a DRG of COPD were additionally coded as “yes” or 1, to signify that the reason for the subsequent visit was related to the first visit. If the DRG was not for COPD, then the encounter received a “no” or 0, as it was not related to COPD. Additionally, other reasons were also grouped to show what the DRG was for in order to establish some groupings of other conditions such as heart failure, or septicemia, which could be further analyzed.

A first process of the data utilized frequencies to see how often patients were coming back with COPD or for non-COPD related ailments, determined by the DRG. This showed that patients who were returning for an inpatient admission were likely returning for COPD exacerbation, as it accounted for 36.1% of the readmissions. Other reasons included cardiac disorders, other respiratory ailments, and septicemia. In all, respiratory reasons accounted for nearly 50% of the readmission reasons. Table 3 has further details on the breakout (see Appendix).

Given that COPD exacerbation did account for many readmissions, I wanted to determine whether there was an association between time to readmission (days) compared to non-COPD exacerbations and determine a hazard ratio for those patients. Cox regression hazard analysis was used to view the relationship with the days to readmission, a continuous dependent variable, with a coded variable of DRG readmission for COPD (either *yes* or *no)*. I tested to see if COPD reasons for readmissions were coming in sooner for their subsequent visits than non-COPD related readmissions and what the hazard ratio was for those patients. The Cox model showed that patients who readmitted with COPD as their DRG had a hazard ratio of 0.897 (confidence interval of .637 to 1.265) compared to those who came back for other reasons; however, this was not statistically significant as the p-value was greater than .05. Tables 4 and 5 as well as Figure 1 show the results of this analysis (see Appendix).

Results

Of the 874 encounters in the patient population, 16.5% of them had a readmission (144 encounters). There were 34 different DRG group categories why patients came back

for an additional admission, with the majority having returned for further COPD exacerbation (52 readmissions, or 36%) and all respiratory reasons accounting for nearly 50% of the readmissions. The second most common visit was for heart failure and shock, with 18 encounters (12.5% of the readmissions), followed by pulmonary edema and respiratory failure, as well as septicemia or sever sepsis, with 13 encounters each (see Table 3 in Appendix).

Discussion

Interpretation

Most of the patients who returned for a second hospitalization within a month of their discharge were coming back for COPD exacerbation, the same primary reason for their visit during their first hospitalization, with half of all readmissions being attributed to a respiratory condition. Furthermore, though not statistically significant, patients who were readmitted specifically for COPD had a higher hazard ratio of returning sooner than those who were coming back for any reason. Thus, the patient may not have been ready to be discharged when they first left, or they could have benefited for another few days in the hospital. However, the other top reason for readmissions also included things like pulmonary edema and heart failure. This could lead to questions about whether the patient had these diagnoses during their initial visit or if they came on after the patient was discharged. If the patient originally had these illnesses, they may be addressed while the patient is in the hospital.

Limitations

This study was limited in a few ways, based on the nature of data. For instance, DRGs are determined by coding staff at a hospital, based on documentation and coding hierarchical rules. The DRG should represent the primary reason for a visit, however, a patient may have both heart failure and COPD, but based on documentation, COPD may be chosen as the primary reason for the visit. During the next encounter, if the patient is again being treated for both, a different coder may interpret what they are seeing as heart failure being the primary reason, instead. Many of these patients have multiple comorbidities, and be readmitted for any of them, but despite the fact that they may all be contributing to the reason for the visit, only one of them can be deemed as the primary reason and selected as the DRG. Patients cannot have more than one.

Additionally, the sample size may be a limiing factor in this study. Even though more than 800 encounters are in this COPD population, only 16% of them had a readmission within 30 days of the initial discharge. This organization has seen patterns of 20 to 25% of their COPD population being readmitted, but this date range did not provide similar patterns.

Implications

Although the majority of patients came back for the same reason as to why they were in the hospital to begin with, this study did not provide any significant results that would provide much implication to this area of research. The model was not predictive of the variability, nor could much be seen with the time to readmission. However, there

were some additional recommendations and other research questions that came about if the proper data was had.

Recommendations

Several recommendations for further research came from this study. It would be interesting to see in a population of readmitted patients, a time to readmission survival analysis done to see when the patients were coming back, as well as which DRG groupings were coming back the soonest (if patients being readmitted for further COPD exacerbation or those with heart failure, etc., were coming back to the hospital sooner than others). This could lead to further insights about extending length of stays to ensure proper relief before the patient discharges or bring about treating other prominent comorbidities while the patient is still in the hospital.

Another recommendation is to look at the length of stay that the patients had during their initial visit, particularly in those patients who came back for further COPD exacerbation. This, too, may lend insight into whether staying a couple of extra days may have prevented the secondary visit.

Conclusion

In the end, the hypothesis of whether there was a statistically significant association between COPD initial admission and COPD readmission was not supported; therefore, the null hypothesis was not rejected. Further research into this subject is needed in order to better understand the population and what is keeping them coming back to the hospital for episodes of exacerbation.

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COPD Patient Demographics and their Impact on Hospital Readmissions

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Outlet for Manuscript

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Abstract

Hospitals and health systems continue to pursue ways to decrease the number of patient readmissions for inpatient stays within 30 days of an initial discharge. Payors, particularly the Centers for Medicare and Medicaid Services, have tied financial penalties to this metric as a way to incentivize hospitals to make this happen. These organizations have put numerous programs in place to try to reach this goal, but little progress has been made in some populations, including the chronic obstructive pulmonary disease (COPD) population. Health care providers need to better understand the reasons why their patients are returning, what circumstances may contribute to their coming back, or if certain demographics pose a greater chance for patients to be readmitted. Therefore, this retrospective, cross-sectional study was done to look at demographic factors that COPD patients have and determine the odds ratio that they have on contributing to hospital readmissions. Inpatient discharge information from Genesis Health System between July 2017 and December 2018 was examined related to age, sex, race, religion, marital status, and payor types. Frequencies and Pearson Chi-square tests were used to analyze each of the categorical variables and their association with patients being readmitted. Of all the variables, only payor type and discharge disposition were found to be statistically significant. Though there were limitations to this dataset., these findings may garner insights that providers can use to help mitigate risks for their patients.

Introduction

Researchers use demographic statistics to understand their populations of interest. This study examined the various demographic information collected in a hospital's electronic medical record system for patients with chronic obstructive pulmonary disease (COPD) to try to determine areas of risk for hospital readmissions. Results may lead to future insights to identify who is most at risk for a readmission and try to mitigate some risk prior to the patients being discharged.

Significance/Importance

The study of demographics is used in several industries. In healthcare, researching demographics can allow providers to target their interventions and treatments to patients most as risk. I examined demographic data obtained through the electronic medical record to determine which characteristics possessed the greatest attributable risk for a hospital readmission in the COPD population. These findings may help target certain people as being higher risk and allow providers to intervene, if possible, to avoid the subsequent hospitalization.

Relevant Scholarship

Looking at demographic trends in populations is not new to research. In the COPD population, researchers like Goto et al. (2017) have looked at 30-day readmission trends in COPD patients, using a retrospective cohort study in publicly available data. The team utilized state data files for eight states over a 6-year period. They found that the mean age for readmitted patients was 69 years of age and over half were female (Goto et al., 2017). They were also able to look at household income and the type of areas that

patients lived in (rural vs urban). Through their analysis, they saw a statistically significant decline in overall 30-day readmissions between the first and last years of their study, after adjusting for age, sex, and other demographic factors (Goto et al., 2017). They found that the readmission rate remained highest in those patients that were greater than 65 years of age and those with multiple comorbidities.

Another group of researchers examined socioeconomic status and 30-day readmissions amongst COPD patients in Ontario, Canada, looking at a 10-year study between 2004 and 2014, using health administrative data (Gershon et al., 2019). Socioeconomic status was determined by the patient's zip code listed. Canadian Census data from 2006 expressed socioeconomic status in quintiles based on four domains: residential instability, material deprivation, ethnic concentration, and dependency (Gershon et al., 2019). The team ran multivariate analysis for several demographic characteristics such as age and sex, by each of the quintiles for socioeconomic status. They found that patients who were readmitted were also greatest marginalized and were those of older age, were female, and lived in urban areas (Gershon et al., 2019).

Demographics were also studied in an emergency department to find factors that predicted readmissions (Bartels et al., 2018). Their study looked at a year's worth of patients that came through the emergency department at a tertiary hospital in Canada. They concluded that thirty-day readmissions occurred more often in younger age patients, whom also were single, and had comorbidities of mental illness and/or cardiovascular disease (Bartels et al., 2018). They were also able to examine smoking status and found

that the majority of readmissions occurred in current smokers and that substance abuse also was a strong predictor.

Even studies that were done to look at effectiveness of interventions concluded that there may be disproportionate disparities in underserved populations who have COPD (Brunner-La Rocca, 2020). For instance, in the first year that Centers for Medicare and Medicaid Services looked at COPD in their hospital readmission reduction program, there were many hospitals that had a large financial penalty placed on them and they were the ones providing care to these underserved areas (Caracciolo, 2017). Caracciolo et al. (2017) found that hospitals that were penalized, tended to be in counties with lower socioeconomic status than those patients and hospitals that did not get penalties for excess readmissions, meaning more with COPD were being readmitted than what was expected in those underserved communities, begging the question of if the hospitals were actually underperforming, or if there more social factors to be worked out for the disadvantaged population.

The Centers for Medicare and Medicaid Services does not include race or ethnicity in their risk adjustment models for the Hospital Readmission Reduction Program, which lead a group of researchers to study the impact those demographic factors may have (Nastars, 2019). The team examined Medicare claims of patients that were discharged between January of 2013 and September of 2014 with COPD. 17% of the patients had an unplanned readmission within 30 days of their initial discharge. They found that those in the African American population high the highest unadjusted 30-day readmission rates (17.7%) while Hispanic populations had the lowest (16%), with

Caucasians having a readmission rate of 17.4%. However, African Americans had the highest, or most severe clinical profile and 5 or more comorbidities (Nastars, 2019). In contrast, however, a study published in by a group of physicians in New York in 2016, looked at 12 months' worth of COPD hospital discharges from Columbia University and New York Presbyterian Hospitals (Regalbuto, 2016). In these two urban teaching hospitals, they found that African-Americans were 3.1 times more likely (confidence intervals of 1.1-8.4) than Caucasians to be readmitted, and Hispanics 2.8 times more likely (confidence intervals of 1.1-7.3), both of which were statistically significant (Regalbuto, 2016).

These resources show that demographic factors are often key constructs in a research study and may lend insights to which populations are most at risk. It further supports the reasoning for conducting this study and the principle inquiry about which factors may influence likelihood to rehospitalization.

Research Questions and Design

Because demographics have played a vital role in social science research, studying them amongst COPD patient populations seems to be a starting point in an attempt to look at potential readmission factors. Of these patients with COPD, which demographics were statistically significant in attributing to hospital readmissions? Did a person's sex determine their likelihood of subsequent hospitalizations? Did a person's age or marital status signify a likelihood for a second visit? It was hypothesized that there was not a statistically significant relationship between demographic factors and the outcome of hospital readmissions. To answer these questions, a retrospective, cross-

sectional study was conducted, viewing data from Genesis Health System, a small system with acute facilities in the states of Iowa and Illinois (Genesis Health System, 2020)

Methods

Participants

The data for this study came from a solution called Midas+, a quality reporting system that Genesis Health System uses. It takes data directly from the electronic medical record and looks at outcome measures, including readmissions. Criteria for the data collection included patients who had an inpatient hospital discharge after a visit primarily due to COPD and were discharged between July 2017 and December 2018. Patients also had to be at least 18 years of age at the time of the encounter and had a discharge disposition that did not include expired, discharged to hospice, transferred to rehabilitation (or another level of care), or leaving against medical advice. This left 874 encounters during for this period. The mean age was 68.49 years, with a range between 39-99. Of the 874 patients, more than half were females, and 361 were males.

Variables/Sources of Data

The data set included more than 100 variables, with demographic data that were gathered when the patient registered as well as clinical data such as the first 25 documented diagnosis codes and procedure codes. Demographic variables included age, sex, religion, marital status, language, race, and insurance payor. These are standard factors that are gathered when a patient gets registered to the hospital. Payor information is entered in two ways, as the insurance company name and payor type. For example, there are hundreds of commercial insurance companies. The payor name is entered into

the system and included in the dataset, but it is also mapped to “commercial” as a payor type. Supplemental Medicare plans are also mapped together as “Medicare Other” to help differentiate them from Medicare fee-for-service plans. This helps narrow down the many possibilities when using these metrics to report. Unfortunately, other demographic factors that could be useful such as education attainment level and income levels, are not standard questions that are embedded in the electronic medical record and therefore were not available to pull into this data set. Furthermore, discharge disposition and a 30-day readmission flag were included. The codes were determined by the documentation provided during the encounter by the physician. A health information management team reviews the documentation and discharge paperwork to determine all of the necessary and proper codes to include. To answer the research questions for this study, the various demographic variables were tested along with the independent variable of the readmission flag.

Instrumentation or Measures

Midas+ is a quality metric reporting system that the information was collected from. It takes information from multiple sources including the electronic medical record system and the coding system, which allowed for all of the variables to be pulled from one central repository. This repository and its contents have been vetted by the host health organization and matches what is held in the source systems.

The data pulled were also scrubbed so that encounters that were used were complete and accurate. That means that if encounters did not have elements such as a principle diagnosis or discharge disposition, they were excluded from the final data set,

as these elements were crucial in order to properly identify the desired population and meet the inclusion criteria. There were not any missing values in the demographic variables; however, there were a few “unknowns” that were documented in the data, which accounted for less than one percent. They were kept in the analysis.

Design and Analysis

A retrospective cross-sectional design was used for this research study. Here, patient demographics were analyzed with chi-square tests against the readmission flag variable to assess their association with readmissions. Those factors that had a p-value of .05 or less would be considered statistically significant and viewed to be a risk association for a readmission within 30 days of their initial discharge.

Results

Execution

Frequency tables were first executed to view the various demographic variables to look for any missing values and examine the patient population. These demographic variables included sex, marital status, language, race, religion insurance payor type, discharge disposition, and age from the initial visit. These frequencies can be seen in Table 7 (see Appendix). Additionally, age was looked at as a continuous variable to view the mean and median as well as get the range of ages; however, it was later transformed into a categorical variable in order to assess the ages of the population within 10-year time frames. Table 22 shows that break out (see Appendix). Once the frequency tables were run and the age groups recoded, chi-square tests were performed on each of the

independent demographic variables separately to see which ones were statistically correlated with a 30-day readmission.

Results

Tables 8-33 show the results of the chi-square tests for each of the variables. For patients' sex, 84 females were readmitted compared to 60 males. There was low association with the Pearson Chi-square score of .009 (as seen in Table 9 in Appendix) with low correlation, which was not statistically significant (p-value = .497, as seen in Table 10). Marital status was similar, with a chi-square association of 7.057 (Table 12), low correlation of .090, and a p-value of .316 (Table 13). Table 11 shows the distribution of marital status, with nearly a third of patients reporting that they were married (30%), 17% divorced, 20% single, and 28% widowed.

Tables 14-16 show the language results. Ninety-nine percent of the patient population spoke English, with Spanish, Vietnamese, and Other included as well. However, all patients who were readmitted spoke English, with the exception of just one Vietnamese speaking patient. Therefore, the results for this correlation had a Phi score of .037 and a p-value of .878.

The tables on racial status (Tables 17-19, see Appendix) show that the population was predominately White (89% of patients). There was again low correlation with a Phi score of .124 and p-value of .709. Patient religion was included in Tables 20-22 (see Appendix). Most patients were recorded as being non-religious. They also had most of the readmissions. There was a low correlation score though of .124 and a p-value of .709. None of the reported demographics to this point were statistically significant. However,

payor type and discharge disposition did have statistical findings. Tables 23-25 in the Appendix include the payor type, and Tables 26-28 have the discharge disposition. Payor type had low correlation with a Phi score of .153 but a p-value of .002. However, more than half of the patients in this population were included in the Medicare payor type (Medicare fee-for-service). Another quarter of the population had Medicare Other, which is a Medicare Advantage plan. Discharge disposition showed that 90% of the patients were discharged to home. The correlation score was also low (.075) but the p-value was .027. Lastly, the age groupings were also looked at (see Tables 31-33 in Appendix). There was weak association and a p-value of .103, meaning that they were not statistically significant either.

Discussion

Interpretation

The population was largely uniform in several areas including in language spoken (99% spoke English), race (89.2% were Caucasian), payor Type (nearly three quarters were a type of Medicare), and discharge disposition. Therefore, the results cannot be used to predict readmission, when so much of the population was similar. Although differences did exist in religion (62% reported none, whereas the rest was made up of Baptists, Catholics, Lutherans, and a number of others), and marital status (only 32% married, 20% single, and 28% widowed), they did not provide a statistical relationship either.

Limitations

There are a few limitations to this study. First, this information is collected when a patient presents to the hospital, but it is not always accurately updated. For example, a marital status may have been entered as “married” at one point, but during the relationship with the health organization, the patient may have gotten divorced or separated, but the demographic was not updated. This information is not always verified upon every admission. Secondly, a limiting factor was that this population was very uniform in their demographics, as mentioned earlier. Most patients were Caucasian, English speaking, non-religious, with Medicare as their primary payer type. Additionally, 90% of them went home, versus to a skilled nursing facility. With this type of uniformity, it was difficult to see which of those demographics could have led to an indication of a potential readmission. Lastly, this type of demographic information comes from administrative type data and does not get into more of the socioeconomic determinants such as income, education level, or job classification. This further break down of information is not available through hospital claims data but may be more insightful into whether those types of demographics had more impact.

Implications

Given the limitations and the results of this study, I must fail to reject the null hypothesis that demographic factors had a predictive relationship with leading to a hospital readmission within 30 days in this population. The only statistically significant relationship was with the principal payer type, which, the majority of patients already shared. Clinically, it also seems irrelevant given that the average age of the population

was greater than 65 (as was the average age of those that were readmitted), which means the patient qualified and was likely to have Medicare coverage anyway. The other factors that were examined, such as age, sex, race and language, did not have an impact on the readmission relationships and were not significant.

Recommendations

Further research into other variables such as the socioeconomic indicators of education, income, or job class (if applicable), may lend further insight to hospital readmissions, due to health literacy, ability to pay for medications, or ability to work. The administrative demographics could not differentiate the population enough, but perhaps these further details could help delineate and show potential high-risk areas. Another potential study could be a mixed methods approach where patients who were readmitted could be interviewed to determine reasons for readmissions, such as medication compliance – were the patients taking their prescriptions as prescribed, were the medications even filled, etc. It may also reveal some health literacy themes – perhaps patients were unaware of what to do with certain symptoms and came to the hospital versus calling their primary care provider or pulmonologist. Lastly, a study with clinical data that looks at decomposition rates between the visits may be indicative of certain themes as well, such as oxygen saturations when the patient discharged and when the patient arrived for their next visit. Perhaps if the patient had a remote monitoring system in place, data could be analyzed to see when patients started to deteriorate, and what interventions could have been put in place to help them stay at home, or at least out of an

inpatient setting. This type of research may lead to future interventions or service lines for patients that could be more cost effective than additional inpatient stays.

Conclusion

Administrative demographic data can be useful to show organizations what type of patients they are working with, which can help focus treatment plans, marketing materials, and many other things. However, it appears that it might not be granular enough to show predictive relationships about who may be at high risk for severity of illness, or in this case, hospital readmissions. Further details into the patients' lives would be necessary in order to show the type of risk that the patient would be at and what type of interventions could be helpful to care for their ailments. Additionally, as seen in this study, some populations in a certain cohort may be too similar to draw any conclusions, and a more individualized approach would be necessary to help prevent the readmission.

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Part 3: Summary

Integration of the Studies

These three studies surrounding COPD hospital readmissions all had different research questions but were focused on what characteristics may lend insight into potential readmissions. The same population and data set were used for each in order to answer these questions on a constant cohort. Study 1 addressed potential comorbidities, Study 2 addressed reasons for the subsequent readmission, and Study 3 addressed the demographic factors. In the first study, patients who were diagnosed with the diagnosis of "acute and chronic respiratory failure with hypoxia" were more than 2 times likely to come back to the hospital than those who did not have this diagnosis. In the second study, patients with COPD were almost 3 times more likely to come back for a second admission for their COPD. Lastly, in the third study, COPD patients with Medicare as their payor type were more likely to return for a readmission. However, there were no statistically significant findings.

Despite the lack of significant findings, the first study lends insight into the respiratory failure; patients with the combination of COPD and "acute and chronic respiratory failure with hypoxia" were more likely to be readmitted, which could lend insight into further treatment plans and post-acute services to help keep the patients out of the hospital for subsequent readmissions. With the other two studies, further research using different approaches is needed to draw any meaningful conclusions. This broader picture of hospital readmissions could benefit from both qualitative and quantitative

research to not only look at clinical indicators but also at the patients' perspectives of their health and why they are needing additional higher levels of care.

Conclusion

Regulatory agencies are trying to incentivize organizations to reduce their hospital readmissions through penalties, and hospitals want to decrease their rates, as it not only costs them money but resources and is not providing the top quality of care to their patients. However, these standard data sets, which are used for quality improvement by thousands of hospitals across the United States, may not lend all of the insights that they need to focus on keeping patients safe and out of the hospital. Many third-party vendor companies offer this similar type of data set to hospitals as a way to improve their quality efforts, but it does not pinpoint why patients are coming back. Further analysis and work with the patients are necessary rather than a reliance on hospital claims data. Although this information can be useful, it needs to be more granular in order to identify new trends and themes. Further research is needed in this area to draw these conclusions.

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Appendix: Tables and Figure

Table 1

Top Ten Frequent Secondary Diagnoses from a Cohort of COPD Patients

Type of Diagnosis	*N*	%
Essential hypertension	340	38.9%
Nicotine dependence, cigarettes	300	34.3%
Personal history of nicotine dependence	302	34.6%
Acute and chronic respiratory failure with hypoxia	250	28.6%
Atherosclerosis heart disease of native coronary artery	236	27.0%
Chronic obstructive pulmonary disease with acute lower respiratory infection	406	46.5%
Dependence on supplemental oxygen	206	23.6%
Hyperlipidemia	195	22.3%
Acute respiratory failure with hypoxia	184	21.1%
Pneumonia, unspecified organism	190	21.7%

Note. Data were coded to signify whether a patient had the diagnoses or did not, and whether the patient was readmitted or not. Percent is not mutually exclusive across diagnoses.

Table 2

Logistic Regression Model

							95% C.I. for EXP(β)	
	β	S.E.	Wald	df	Sig.	Exp(β)	Lower	Upper
Essential (primary) hypertension	-.058	.198	.087	1	.769	.943	.640	1.390
Nicotine dependence, cigarettes, uncomplicated	-.267	.236	1.274	1	.259	.766	.482	1.217
Personal history of nicotine dependence	-.151	.227	.442	1	.506	.860	.552	1.341
Acute and chronic respiratory failure with hypoxia	.867	.212	16.785	1	.000	2.380	1.572	3.603
Atherosclerosis heart disease of native coronary artery w/o angina pectoris	.330	.207	2.548	1	.110	1.391	.928	2.085
Chronic obstructive pulmonary disease w acute lower respiratory infection	-.098	.226	.189	1	.664	.906	.581	1.412
Dependence on supplemental oxygen	.300	.219	1.875	1	.171	1.350	.879	2.075
Hyperlipidemia, unspecified	.070	.225	.096	1	.757	1.072	.689	1.668
Acute respiratory failure with hypoxia	.088	.270	.106	1	.745	1.092	.643	1.854
Pneumonia, unspecified organism	.300	.264	1.293	1	.256	1.350	.805	2.265
Constant	-1.998	.255	61.531	1	.000	.136		

Note. Logistic Regression Model Summary, -2 Log likelihood = 751.449, Cox & Snell R^2 = .035, Nagelkerke R^2 = .058.

Table 3

Top Readmission Diagnostic Groupings from a Cohort of COPD Patients

Diagnostic grouping	*N*	%	Cumulative %
Chronic Obstructive Pulmonary Disease	52	36.11%	36.11%
Heart Failure & Shock	18	12.50%	48.61%
Pulmonary Edema & Respiratory Failure	13	09.03%	57.64%
Septicemia or Severe Sepsis	13	09.03%	66.67%
Simple Pneumonia & Pleurisy	6	04.17%	70.84%
Infectious & Parasitic Diseases w O.R. Procedure	4	02.78%	73.62%
Other diagnostic related groups	38	26.39%	100.00%
Not Readmitted	730	-	-
Total	874	-	-

Note. Data were coded to signify the percentage of readmissions by diagnostic related group.

Table 4

Omnibus Tests of Model Coefficients

				Change from previous step					
-2 Log	Overall (score)						Change from previous block		
Likelihood	Chi-square	df	Sig.	Chi-square	df	Sig.	Chi-square	df	Sig.
1169.591	.382	1	.536	.378	1	.539	.378	1	.539

Note. a. Beginning Block Number 1. Method = Enter

Table 5

Variables in the Equation

							95.0% CI for Exp(B)	
	B	SE	Wald	df	Sig.	Exp(B)	Lower	Upper
COPD Readmit diagnostic related group	-.108	.175	.382	1	.537	.897	.637	1.265

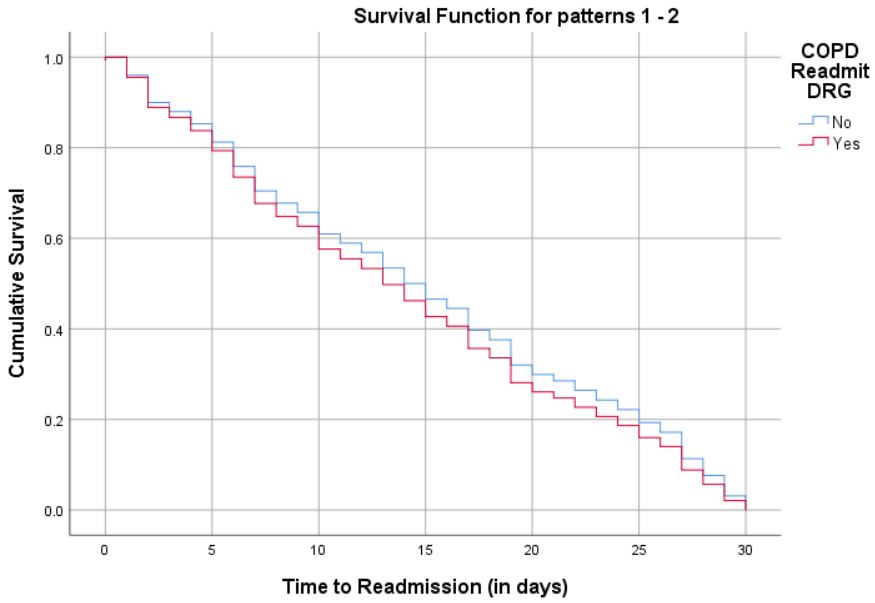

Figure 1. Days to Readmission by COPD vs Non-COPD Groups.

Table 6

Overall Demographic Statistics

		Sex	Marital Status	Language	Race	Religion	Principal Payor Type	Mapped Discharge Disposition
N	Valid	874	874	874	874	874	874	874
	Missing	0	0	0	0	0	0	0

Table 7

Demographic Frequencies

		Frequency	Percent	Valid %	Cumulative %
Sex					
Valid	F	513	58.7	58.7	58.7
	M	361	41.3	41.3	100.0
	Total	874	100.0	100.0	
Marital Status					
Valid		1	.1	.1	.1
	Divorced	148	16.9	16.9	17.0
	Legally separated	16	1.8	1.8	18.9
	Married	284	32.5	32.5	51.4
	Single	172	19.7	19.7	71.1
	Unknown	9	1.0	1.0	72.1
	Widowed	244	27.9	27.9	100.0
	Total	874	100.0	100.0	
Language					
Valid		1	.1	.1	.1
	English	865	99.0	99.0	99.1
	Other	4	.5	.5	99.5
	Spanish	1	.1	.1	99.7
	Vietnamese	3	.3	.3	100.0
	Total	874	100.0	100.0	
Race					
Valid					
	African American/Black	78	8.9	8.9	8.9
	Asian	4	.5	.5	9.4
	Caucasian/White	780	89.2	89.2	98.6
	Declined	4	.5	.5	99.1
	Unknown	8	.9	.9	100.0
	Total	874	100.0	100.0	
Religion					
Valid	Baptist	53	6.1	6.1	6.1
	Buddhism	1	.1	.1	6.2
	Catholic	91	10.4	10.4	16.6
	Christian	41	4.7	4.7	21.3
	Church of Christ	1	.1	.1	21.4
	Church of god	1	.1	.1	21.5
	Episcopal	2	.2	.2	21.7
	Greek orthodox	2	.2	.2	22.0
	Jehovah's witness	2	.2	.2	22.2
	Lutheran	52	5.9	5.9	28.1
	Methodist/United Methodist	22	2.5	2.5	30.7
	None	545	62.4	62.4	93.0
	Pentecostal	9	1.0	1.0	94.1
	Presbyterian	9	1.0	1.0	95.1
	Protestant	11	1.3	1.3	96.3
	Unable to ask	30	3.4	3.4	99.8
	United church of Christ	1	.1	.1	99.9
	Wesleyan	1	.1	.1	100.0
	Total	874	100.0	100.0	

(table continues)

		Frequency	Percent	Valid %	Cumulative %
Principal payor type					
Valid		36	4.1	4.1	4.1
	Commercial	63	7.2	7.2	11.3
	Medicaid	107	12.2	12.2	23.6
	Medicare	446	51.0	51.0	74.6
	Medicare Other	214	24.5	24.5	99.1
	Self Pay	7	.8	.8	99.9
	Tricare/Champus/Champva	1	.1	.1	100.0
	Total	874	100.0	100.0	
Mapped discharge disposition					
Valid	Home	790	90.4	90.4	90.4
	SNF	84	9.6	9.6	100.0
	Total	874	100.0	100.0	

Table 8

Readmission Observed Crosstabulation for Sex

			Readmission Observed		
			No	Yes	Total
Sex	F	Count	429	84	513
		% within Sex	83.6%	16.4%	100.0%
		% within Readmission Observed	58.8%	58.3%	58.7%
		% of Total	49.1%	9.6%	58.7%
	M	Count	301	60	361
		% within Sex	83.4%	16.6%	100.0%
		% within Readmission Observed	41.2%	41.7%	41.3%
		% of Total	34.4%	6.9%	41.3%
Total		Count	730	144	874
		% within Sex	83.5%	16.5%	100.0%
		% within Readmission Observed	100.0%	100.0%	100.0%
		% of Total	83.5%	16.5%	100.0%

Table 9

Chi-Square Tests for Sex

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.009[a]	1	.923		
Continuity Correction[b]	.000	1	.997		
Likelihood Ratio	.009	1	.923		
Fisher's Exact Test				.926	.497
N of Valid Cases	874				

Note. a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 59.48.
b. Computed only for a 2x2 table

Table 10

Symmetric Measures for Sex

		Value	Approximate Significance
Nominal by Nominal	Phi	.003	.923
	Cramer's V	.003	.923
N of Valid Cases		874	

Table 11

Readmission Observed Crosstabulation for Marital Status

			Readmission Observed		
			No	Yes	Total
Marital Status		Count	1	0	1
		% within Marital Status	100.0%	0.0%	100.0%
		% within Readmission Observed	0.1%	0.0%	0.1%
		% of Total	0.1%	0.0%	0.1%
	Divorced	Count	118	30	148
		% within Marital Status	79.7%	20.3%	100.0%
		% within Readmission Observed	16.2%	20.8%	16.9%
		% of Total	13.5%	3.4%	16.9%
	Legally separated	Count	13	3	16
		% within Marital Status	81.3%	18.8%	100.0%
		% within Readmission Observed	1.8%	2.1%	1.8%
		% of Total	1.5%	0.3%	1.8%
	Married	Count	240	44	284
		% within Marital Status	84.5%	15.5%	100.0%
		% within Readmission Observed	32.9%	30.6%	32.5%
		% of Total	27.5%	5.0%	32.5%
	Single	Count	151	21	172
		% within Marital Status	87.8%	12.2%	100.0%
		% within Readmission Observed	20.7%	14.6%	19.7%
		% of Total	17.3%	2.4%	19.7%
	Unknown	Count	9	0	9
		% within Marital Status	100.0%	0.0%	100.0%
		% within Readmission Observed	1.2%	0.0%	1.0%
		% of Total	1.0%	0.0%	1.0%
	Widowed	Count	198	46	244
		% within Marital Status	81.1%	18.9%	100.0%
		% within Readmission Observed	27.1%	31.9%	27.9%
		% of Total	22.7%	5.3%	27.9%
Total		Count	730	144	874
		% within Marital Status	83.5%	16.5%	100.0%
		% within Readmission Observed	100.0%	100.0%	100.0%
		% of Total	83.5%	16.5%	100.0%

Table 12

Chi-Square Tests for Marital Status

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	7.057[a]	6	.316
Likelihood Ratio	8.748	6	.188
N of Valid Cases	874		

Note. a. 4 cells (28.6%) have expected count less than 5. The minimum expected count is .16.

Table 13

Symmetric Measures for Marital Status

		Value	Approximate Significance
Nominal by Nominal	Phi	.090	.316
	Cramer's V	.090	.316
N of Valid Cases		874	

Table 14

Readmission Observed Crosstabulation for Language

			Readmission Observed		
			No	Yes	Total
Language		Count	1	0	1
		% within Language	100.0%	0.0%	100.0%
		% within Readmission Observed	0.1%	0.0%	0.1%
		% of Total	0.1%	0.0%	0.1%
	ENGLISH	Count	722	143	865
		% within Language	83.5%	16.5%	100.0%
		% within Readmission Observed	98.9%	99.3%	99.0%
		% of Total	82.6%	16.4%	99.0%
	OTHER	Count	3	1	4
		% within Language	75.0%	25.0%	100.0%
		% within Readmission Observed	0.4%	0.7%	0.5%
		% of Total	0.3%	0.1%	0.5%
	SPANISH	Count	1	0	1
		% within Language	100.0%	0.0%	100.0%
		% within Readmission Observed	0.1%	0.0%	0.1%
		% of Total	0.1%	0.0%	0.1%
	VIETNAMESE	Count	3	0	3
		% within Language	100.0%	0.0%	100.0%
		% within Readmission Observed	0.4%	0.0%	0.3%
		% of Total	0.3%	0.0%	0.3%
Total		Count	730	144	874
		% within Language	83.5%	16.5%	100.0%
		% within Readmission Observed	100.0%	100.0%	100.0%
		% of Total	83.5%	16.5%	100.0%

Table 15

Chi-Square Tests for Language

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	1.199[a]	4	.878
Likelihood Ratio	1.990	4	.738
N of Valid Cases	874		

a. 8 cells (80.0%) have expected count less than 5. The minimum expected count is .16.

Table 16

Symmetric Measures for Language

		Value	Approximate Significance
Nominal by Nominal	Phi	.037	.878
	Cramer's V	.037	.878
N of Valid Cases		874	

Table 17

Readmission Observed Crosstabulation for Race

			Readmission Observed		
			No	Yes	Total
Race	African American/Black	Count	61	17	78
		% within Race	78.2%	21.8%	100.0%
		% within Readmission Observed	8.4%	11.8%	8.9%
		% of Total	7.0%	1.9%	8.9%
	Asian	Count	4	0	4
		% within Race	100.0%	0.0%	100.0%
		% within Readmission Observed	0.5%	0.0%	0.5%
		% of Total	0.5%	0.0%	0.5%
	Caucasian/White	Count	655	125	780
		% within Race	84.0%	16.0%	100.0%
		% within Readmission Observed	89.7%	86.8%	89.2%
		% of Total	74.9%	14.3%	89.2%
	Declined	Count	3	1	4
		% within Race	75.0%	25.0%	100.0%
		% within Readmission Observed	0.4%	0.7%	0.5%
		% of Total	0.3%	0.1%	0.5%
	Unknown	Count	7	1	8
		% within Race	87.5%	12.5%	100.0%
		% within Readmission Observed	1.0%	0.7%	0.9%
		% of Total	0.8%	0.1%	0.9%
Total		Count	730	144	874
		% within Race	83.5%	16.5%	100.0%
		% within Readmission Observed	100.0%	100.0%	100.0%
		% of Total	83.5%	16.5%	100.0%

Table 18

Chi-Square Tests for Race

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	2.811[a]	4	.590
Likelihood Ratio	3.328	4	.505
N of Valid Cases	874		

Note. a. 5 cells (50.0%) have expected count less than 5. The minimum expected count is .66.

Table 19

Symmetric Measures for Race

		Value	Approximate Significance
Nominal by Nominal	Phi	.057	.590
	Cramer's V	.057	.590
N of Valid Cases		874	

Table 20

Readmission Observed Crosstabulation for Religion

			Readmission observed		
			No	Yes	Total
Religion	Baptist	Count	45	8	53
		% within Religion	84.9%	15.1%	100.0%
		% within Readmission Observed	6.2%	5.6%	6.1%
		% of Total	5.1%	0.9%	6.1%
	Buddhism	Count	1	0	1
		% within Religion	100.0%	0.0%	100.0%
		% within Readmission Observed	0.1%	0.0%	0.1%
		% of Total	0.1%	0.0%	0.1%
	Catholic	Count	77	14	91
		% within Religion	84.6%	15.4%	100.0%
		% within Readmission Observed	10.5%	9.7%	10.4%
		% of Total	8.8%	1.6%	10.4%
	Christian	Count	32	9	41
		% within Religion	78.0%	22.0%	100.0%
		% within Readmission Observed	4.4%	6.3%	4.7%
		% of Total	3.7%	1.0%	4.7%
	Church of Christ	Count	1	0	1
		% within Religion	100.0%	0.0%	100.0%
		% within Readmission Observed	0.1%	0.0%	0.1%
		% of Total	0.1%	0.0%	0.1%
	Church of God	Count	1	0	1
		% within Religion	100.0%	0.0%	100.0%
		% within Readmission Observed	0.1%	0.0%	0.1%
		% of Total	0.1%	0.0%	0.1%
	Episcopal	Count	2	0	2
		% within Religion	100.0%	0.0%	100.0%
		% within Readmission Observed	0.3%	0.0%	0.2%
		% of Total	0.2%	0.0%	0.2%
	Greek orthodox	Count	2	0	2
		% within Religion	100.0%	0.0%	100.0%
		% within Readmission Observed	0.3%	0.0%	0.2%
		% of Total	0.2%	0.0%	0.2%
	Jehovah's witness	Count	2	0	2
		% within Religion	100.0%	0.0%	100.0%
		% within Readmission Observed	0.3%	0.0%	0.2%
		% of Total	0.2%	0.0%	0.2%
	Lutheran	Count	44	8	52
		% within Religion	84.6%	15.4%	100.0%
		% within Readmission Observed	6.0%	5.6%	5.9%
		% of Total	5.0%	0.9%	5.9%
	Methodist/United Methodist	Count	16	6	22
		% within Religion	72.7%	27.3%	100.0%
		% within Readmission Observed	2.2%	4.2%	2.5%
		% of Total	1.8%	0.7%	2.5%

(table continues)

			Readmission observed		
			No	Yes	Total
	None	Count	453	92	545
		% within Religion	83.1%	16.9%	100.0%
		% within Readmission Observed	62.1%	63.9%	62.4%
		% of Total	51.8%	10.5%	62.4%
	Pentecostal	Count	7	2	9
		% within Religion	77.8%	22.2%	100.0%
		% within Readmission Observed	1.0%	1.4%	1.0%
		% of Total	0.8%	0.2%	1.0%
	Presbyterian	Count	9	0	9
		% within Religion	100.0%	0.0%	100.0%
		% within Readmission Observed	1.2%	0.0%	1.0%
		% of Total	1.0%	0.0%	1.0%
	Protestant	Count	10	1	11
		% within Religion	90.9%	9.1%	100.0%
		% within Readmission Observed	1.4%	0.7%	1.3%
		% of Total	1.1%	0.1%	1.3%
	Unable to ask	Count	27	3	30
		% within Religion	90.0%	10.0%	100.0%
		% within Readmission Observed	3.7%	2.1%	3.4%
		% of Total	3.1%	0.3%	3.4%
	United church of Christ	Count	0	1	1
		% within Religion	0.0%	100.0%	100.0%
		% within Readmission Observed	0.0%	0.7%	0.1%
		% of Total	0.0%	0.1%	0.1%
	Wesleyan	Count	1	0	1
		% within Religion	100.0%	0.0%	100.0%
		% within Readmission Observed	0.1%	0.0%	0.1%
		% of Total	0.1%	0.0%	0.1%
Total		Count	730	144	874
		% within Religion	83.5%	16.5%	100.0%
		% within Readmission Observed	100.0%	100.0%	100.0%
		% of Total	83.5%	16.5%	100.0%

Table 21

Chi-Square Tests for Religion

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	13.402[a]	17	.709
Likelihood Ratio	14.898	17	.603
N of Valid Cases	874		

Note. a. 21 cells (58.3%) have expected count less than 5. The minimum expected count is .16.

Table 22

Symmetric Measures for Religion

		Value	Approximate Significance
Nominal by Nominal	Phi	.124	.709
	Cramer's V	.124	.709
N of Valid Cases		874	

Table 23

Readmission Observed Crosstabulation for Principal Payor Type

			Readmission Observed		
			No	Yes	Total
Principal Payor Type		Count	35	1	36
		% within Principal Payor Type	97.2%	2.8%	100.0%
		% within Readmission Observed	4.8%	0.7%	4.1%
		% of Total	4.0%	0.1%	4.1%
	Commercial	Count	61	2	63
		% within Principal Payor Type	96.8%	3.2%	100.0%
		% within Readmission Observed	8.4%	1.4%	7.2%
		% of Total	7.0%	0.2%	7.2%
	Medicaid	Count	90	17	107
		% within Principal Payor Type	84.1%	15.9%	100.0%
		% within Readmission Observed	12.3%	11.8%	12.2%
		% of Total	10.3%	1.9%	12.2%
	Medicare	Count	354	92	446
		% within Principal Payor Type	79.4%	20.6%	100.0%
		% within Readmission Observed	48.5%	63.9%	51.0%
		% of Total	40.5%	10.5%	51.0%
	Medicare Other	Count	182	32	214
		% within Principal Payor Type	85.0%	15.0%	100.0%
		% within Readmission Observed	24.9%	22.2%	24.5%
		% of Total	20.8%	3.7%	24.5%
	Self Pay	Count	7	0	7
		% within Principal Payor Type	100.0%	0.0%	100.0%
		% within Readmission Observed	1.0%	0.0%	0.8%
		% of Total	0.8%	0.0%	0.8%
	Tricare/Champus/Champva	Count	1	0	1
		% within Principal Payor Type	100.0%	0.0%	100.0%
		% within Readmission Observed	0.1%	0.0%	0.1%
		% of Total	0.1%	0.0%	0.1%
Total		Count	730	144	874
		% within Principal Payor Type	83.5%	16.5%	100.0%
		% within Readmission Observed	100.0%	100.0%	100.0%
		% of Total	83.5%	16.5%	100.0%

Table 24

Chi-Square Tests for Principal Payor Type

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	20.561[a]	6	.002
Likelihood Ratio	27.043	6	.000
N of Valid Cases	874		

Note. a. 3 cells (21.4%) have expected count less than 5. The minimum expected count is .16.

Table 25

Symmetric Measures for Principal Payor Type

		Value	Approximate Significance
Nominal by Nominal	Phi	.153	.002
	Cramer's V	.153	.002
N of Valid Cases		874	

Table 26

Readmission Observed Crosstabulation for Mapped Discharge Disposition

			Readmission Observed		
			No	Yes	Total
Mapped DC Disposition	Home	Count	667	123	790
		% within Mapped discharge disposition	84.4%	15.6%	100.0%
		% within Readmission Observed	91.4%	85.4%	90.4%
		% of Total	76.3%	14.1%	90.4%
	SNF	Count	63	21	84
		% within Mapped discharge disposition	75.0%	25.0%	100.0%
		% within Readmission Observed	8.6%	14.6%	9.6%
		% of Total	7.2%	2.4%	9.6%
Total		Count	730	144	874
		% within Mapped discharge disposition	83.5%	16.5%	100.0%
		% within Readmission Observed	100.0%	100.0%	100.0%
		% of Total	83.5%	16.5%	100.0%

Table 27

Chi-Square Tests for Mapped Discharge Disposition

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	4.907[a]	1	.027		
Continuity Correction[b]	4.245	1	.039		
Likelihood Ratio	4.428	1	.035		
Fisher's Exact Test				.031	.023
N of Valid Cases	874				

Note. a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 13.84.
b. Computed only for a 2x2 table

Table 28

Symmetric Measures for Mapped Discharge Disposition

		Value	Approximate Significance
Nominal by Nominal	Phi	.075	.027
	Cramer's V	.075	.027
N of Valid Cases		874	

Table 29

Frequencies for Age Group

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	30-39	1	.1	.1	.1
	40-49	34	3.9	3.9	4.0
	50-59	164	18.8	18.8	22.8
	60-69	262	30.0	30.0	52.7
	70-79	255	29.2	29.2	81.9
	80-89	134	15.3	15.3	97.3
	90-99	24	2.7	2.7	100.0
	Total	874	100.0	100.0	

Table 30

Descriptive Statistics for Age

	N	Range	Minimum	Maximum	Mean	Std. Deviation
Age	874	60	39	99	68.49	11.325
Valid N (listwise)	874					

Table 31

Readmission Observed Crosstabulation for Age

			Readmission Observed		
			No	Yes	Total
Age Groups	30-39	Count	1	0	1
		% within Age Groups	100.0%	0.0%	100.0%
		% within Readmission Observed	0.1%	0.0%	0.1%
		% of Total	0.1%	0.0%	0.1%
	40-49	Count	30	4	34
		% within Age Groups	88.2%	11.8%	100.0%
		% within Readmission Observed	4.1%	2.8%	3.9%
		% of Total	3.4%	0.5%	3.9%
	50-59	Count	146	18	164
		% within Age Groups	89.0%	11.0%	100.0%
		% within Readmission Observed	20.0%	12.5%	18.8%
		% of Total	16.7%	2.1%	18.8%
	60-69	Count	216	46	262
		% within Age Groups	82.4%	17.6%	100.0%
		% within Readmission Observed	29.6%	31.9%	30.0%
		% of Total	24.7%	5.3%	30.0%
	70-79	Count	200	55	255
		% within Age Groups	78.4%	21.6%	100.0%
		% within Readmission Observed	27.4%	38.2%	29.2%
		% of Total	22.9%	6.3%	29.2%
	80-89	Count	116	18	134
		% within Age Groups	86.6%	13.4%	100.0%
		% within Readmission Observed	15.9%	12.5%	15.3%
		% of Total	13.3%	2.1%	15.3%
	90-99	Count	21	3	24
		% within Age Groups	87.5%	12.5%	100.0%
		% within Readmission Observed	2.9%	2.1%	2.7%
		% of Total	2.4%	0.3%	2.7%
Total		Count	730	144	874
		% within Age Groups	83.5%	16.5%	100.0%
		% within Readmission Observed	100.0%	100.0%	100.0%
		% of Total	83.5%	16.5%	100.0%

Table 32

Chi-Square Tests for Age

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	10.557[a]	6	.103
Likelihood Ratio	10.885	6	.092
Linear-by-Linear Association	1.341	1	.247
N of Valid Cases	874		

Note. a. 3 cells (21.4%) have expected count less than 5. The minimum expected count is .16.

Table 33

Symmetric Measures for Age

		Value	Approximate Significance
Nominal by Nominal	Phi	.110	.103
	Cramer's V	.110	.103
N of Valid Cases		874	