2021

Length of Stay and Readmission Rates Observed on Closed Medical-Surgical Units

Kristine Jordan
Walden University

Walden University

College of Health Professions

This is to certify that the doctoral study by

Kristine Marie Jordan

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Review Committee
Dr. Karin Polifko, Committee Chairperson, Health Sciences Faculty
Dr. Magdeline Aagard, Committee Member, Health Sciences Faculty
Dr. Michael Furukawa, University Reviewer, Health Sciences Faculty

Chief Academic Officer and Provost
Sue Subocz, Ph.D.

Walden University
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Abstract

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by

Kristine Marie Jordan

MHA, University of Phoenix, 2017

BS, Columbia Southern University, 2014

Doctoral Study Submitted in Partial Fulfillment

of the Requirements for the Degree of

Doctor of Healthcare Administration

Walden University

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Abstract

The United States consistently experiences the highest health consumption per capita, caused, in part, by the fragmented and inefficient care delivery within hospitals. Both excessive length of stay and undesirable readmission rates are prime opportunities for hospitals to correct inefficiencies and improve patient outcomes, as well as lower healthcare costs. The advent of the hospital-medicine specialty in 1996 began addressing these concerns, however, opportunity still exists to refine the medical model used by hospitalists caring for the high volumes of patients admitted to medical-surgical units. The purpose of this quantitative study was to compare the effect of open and closed models in medical-surgical units on length of stay and readmission rates. Both linear and logistic regression models were used to address a gap in the literature regarding whether the closed model would provide similar benefits previously seen in critical care. Donabedian's triad structure-process-outcome model provided the theoretical framework. Retrospective data analysis of adult patient admissions to medical-surgical units at a two-hospital system in Naples, Florida, from June 2018 through January 2019 (n = 1547) indicated a significant relationship between the closed model and lower length of stay but did not result in increased readmission rates. Covariate analysis showed a clear link between patients' comorbid/chronic conditions and both length of stay and readmission risk. Reducing length of stay and lowering readmission rates in medical-surgical units may improve hospital efficiency, cost-effectiveness, and quality of care leading to positive social change.

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Dedication

This dissertation is dedicated to my mother, Patti, who has shown me unyielding support throughout my doctoral journey. Her pride and love for me are felt every day and have often served as the light I have needed to keep pushing to fulfill my dreams and complete this amazing process. Mom, I thank you for raising me the way you did and instilling in me the strength needed to persevere.

Acknowledgments

I would like to acknowledge my Walden team of professors and staff who have assisted me while obtaining my doctoral degree. First, I would like to express my gratitude to my chair, Dr. Karin Polifko, who has shown me steadfast support and understanding during my doctoral study process. She has believed in my project since day one and has helped me to shape it in a way that others would understand it as well. I would also like to acknowledge and thank my committee member, Dr. Magdeline Aagard, who agreed to step in in the middle of my journey. Your input pushed me to make my writing even more robust and meaningful and I am grateful. Finally, I would like to acknowledge and express many thanks to my URR, Dr. Michael Furukawa, who has encouraged me to expound on my statistical knowledge, which has ensured my study's success.

Lastly, I would like to acknowledge my beautiful, spunky, and truly amazing children, Sebastian Tate and Jillian Kate. You both light up my life and are the reason why I strive for greatness. I love you both and appreciate your patience with Mom during all the times I have had to study instead of play.

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Section 1: Foundation of the Study and Literature Review

Introduction

In the last decade, healthcare costs in the United States have reached an all-time high, comprising almost 18% of the total economy (Agha et al., 2019). Evidence reveals significant concerns related to disintegration and incongruent care delivery across the continuum contributing to the spiraling costs (Barker, 2017; Hirschman, 2015). Hospitals are not immune to fragmentation of care, which contributes to excessive length of stay for patients (Epstein et al., 2010). Due to this pattern, the healthcare sector has experienced an outcry from the Centers for Medicare and Medicaid Services (CMS), private payers, and consumers requiring hospitals to focus on decreasing length of stay, as well as readmission rates to promote increased quality of care for patients and decrease costs (Andriotti et al., 2019). Influences on both length of stay and readmissions are many and quite intricate, including system, patient, and community factors. Despite the complexities, it has been established that hospital characteristics such as the patient care model used for inpatient care are a fundamental factor that affects length of stay (Abela et al., 2019), as well as readmission rates (Krumholz et al., 2017). More than 2 decades of empirical evidence suggests that the closed model improves efficiency and key patient outcomes, compared to the open model, in critical care units (McIntosh, 2017; Multz, 1998).

Elements of a closed model include a primary and geographically stationed physician responsible for making all decisions related to admission, care, and discharge, as well as providing staff, patients, and families the constant presence of the attending physician, often resulting in streamlined patient care and improved throughput (Chowdhury & Duggal, 2017). As hospital leaders, physicians, and institutions continue to refine their quest to decrease length of stay and reduce readmissions. To date, the effects of applying the closed model used in critical care units to a medical-surgical unit have not been studied, based on my review of the literature. In this study, I evaluated length of stay and readmission rates on medical-surgical units (hospital units that house patients admitted for a variety of medical diagnoses or those recovering from many different general surgical procedures) by comparing open and closed models.

Donabedian's (1968) structure-process-outcome conceptual model provided a practical framework to assess whether decreasing length of stay and reducing readmission rates can be addressed through the implementation of the closed physician care delivery model on a medical-surgical unit. I compared the length of stay and readmission rates on medical-surgical units that used a closed model compared to those medical-surgical units that used an open model. Despite the relatively small scale of this study, there are clear implications for social change given the importance of the healthcare system for all citizens and the clear struggle between costs and quality within the industry. This chapter includes background information, the research problem, the purpose of the study, the research questions (RQs) and hypotheses, the theoretical foundation, and the nature of the study. I also review relevant literature and explore the assumptions, scope and delimitations, limitations, and significance of the study.

Background

Hospitalized patients require safe and efficient care that resolves the catalyst illness or injury that prompted admission. The length of stay for each admitted patient requires a delicate balance of anticipated reimbursable days and the judicious use of resources. Further required is sufficient care to avoid short-term readmissions, all while ensuring that patients are satisfied with the care rendered and optimal outcomes are achieved. Vinh et al. (2019) argued that a hospital with an average daily census of 200 patients could experience a $13.3 million cost savings by reducing the average length of stay by just 0.08 days. At the epicenter of reduced length of stay is bettering throughput (moving hospitalized patients through all the necessary steps in their care) or developing a macro-system approach to achieve improved health and readiness for a safe discharge (Baker & Esbenshade, 2015). Specifically, there exists a crucial understanding that hospitals are complex entities with many moving, interdependent parts, necessitating high-level, homogenous, and multidisciplinary approaches to patient care (Abela et al., 2019). A more standardized patient care approach such as the closed model may be an important component in the exquisite harmony necessary to achieve enhanced efficiency.

When examining strategies to reduce hospital length of stay, simultaneous evaluation of patient readmissions is imperative (Chopra et al., 2016). Improper early departure from the hospital can result in a need for a short interval return to the hospital if the first admission does not adequately resolve the patient's illness or injury. Thirty-day readmissions constitute a large proportion of avoidable expenditures within the healthcare industry, resulting in an excess of $17 billion in increased costs and signify poor patient outcomes (Zuckerman et al., 2016). Ultimately, length of stay and readmissions are tied to the overarching financial performance of a hospital, making the betterment of these metrics crucial to a healthcare organization. For example, reductions in the average length of stay for a hospital results in cost savings per patient day (Vinh et al., 2019). Further, Vinh et al. (2019) linked less time in the hospital to potentially minimized risks for adverse events such as medical errors and infections, known to be quite costly for hospitals. Last, value-based purchasing initiatives such as the Hospital Readmission Reduction Program (HRRP) can penalize hospitals financially for excessive readmissions (Upadhyay et al., 2019).

Substantial research has been conducted through the years to establish the ideal unit structure and medical care delivery model necessary to achieve optimal care outcomes in critically ill patients requiring admission to the critical care unit. Factors including mortality, ventilator weaning rates, rates of infection, costs, and length of stay have all been shown to improve in closed intensive care units (Chowdhury, 2017; El-Kersh, 2016; Ko, 2019). Despite the overwhelming evidence and success in establishing a preferred care delivery model in critical care, there is a lack of similar work and understanding of the best way to deliver medical care on a medical-surgical unit. Research about the medical care delivery model used on medical-surgical units, is justified given that there are over 28 million admissions to these types of units annually in the United States (Jeffery et al., 2018). The closed model is ideal in critical care, yet it is unclear how the model might affect outcomes on a medical-surgical unit. However, costly utilization patterns continue to plague most hospitals, making the ongoing investigation of appropriate care delivery of paramount importance.

Problem Statement

The problem addressed is the lack of evidence of the optimal medical care delivery model necessary to reduce length of stay on a medical-surgical unit without affecting readmission rates. CMS, regulatory bodies, third-party payers, and healthcare consumers deem length of stay and readmissions the most urgent issues for the healthcare sector (Andriotti, 2019; Upadhyay, 2019; Yakusheva, 2020). Despite overwhelming pressure, suboptimal length of stay and readmission rates continue to plague most hospitals (Chopra et al., 2016). Reducing length of stay without increasing readmission rates for hospitalized patients is a paramount priority for all healthcare organizations (Andriotti, 2019; Ong, 2018; Thorsten, 2018).

Over the last 2 decades, the rapidly changing reimbursement landscape forced hospitals to reduce length of stay as one primary strategy to control costs to ameliorate reduced payments from government insurers such as Medicare and Medicaid, commercial payers, and care provided to uninsured patients (Baek et al., 2018). Healthcare organizations’ quest to reduce length of stay requires an overhaul of all aspects of operations, including changes to how patients are admitted to the hospital and cared for. Specifically, in 1996, the hospital medicine specialty was born out of a substantial need to provide hospital care differently and more efficiently (Park & Jones, 2014). In the past, the patient’s primary care physician or any number of other types of physicians, such as internal medicine or a variety of specialists, cared for patients in the hospital (Maresh et al., 2017). More than 2 decades later, the prevalence of the hospital medicine specialty has grown exponentially, with estimates exceeding 50,000 physicians currently practicing in this field in the United States (Kisuule & Howell, 2018). The utilization of hospitalists results in cost savings for most participating hospitals (Vinh et al., 2019). Despite the growth of the profession, there is contradictory evidence as to whether the use of hospitalists alone is sufficient to achieve the desired improvements in key metrics such as length of stay (Vinh et al., 2019). The lack of consensus in the research is concerning, which made the topic meaningful to healthcare because developing a care delivery model that appropriately uses hospitalists to attain desired patient outcomes is vital to the industry's success in achieving meaningful reductions in length of stay without sacrificing readmissions. An integral part of the closed model centers on the geographical presence of each hospitalist on a unit, which differs from today's practice where a hospitalist's patient load often is spread across many hospital units when the open model is used. Evidence has shown in critical care that the closed model improves physician efficiency and communication with both patients and other hospital staff and leads to better patient outcomes (Vincent, 2017).

Despite evidence that patients admitted by hospitalists tend to have a more appropriate length of stay (Salim et al., 2019), contemporary methods of delivering patient care in medical-surgical units still consist of care provided by many different types of providers, including primary care physicians, hospitalists, concierge physicians, and specialty physicians (Maresh et al., 2017). The traditional physician care-delivery model, or open model, can result in disjointed care, a poor patient experience, and extended hospital stays necessary to resolve the patients' illness or injury (Park & Jones, 2014). However, evidence has shown that the closed model improves outcomes and efficiency in critical care (Howell, 1998; Multz, 1998; van der Sluijs et al., 2017; Vincent, 2016). To date, no linkage has been shown between the ability to improve these metrics and the adoption of the closed model specifically in medical-surgical units. What is known is that hospitalists' workloads have been directly associated with increased length of stay and costs (Elliott et al., 2014), and physician communication significantly influences patient satisfaction (Biglu et al., 2017). Because of this evidence, identifying the optimal medical model for physicians to provide care to hospitalized patients is vital. Although the closed model encompasses more than just hospitalists and provides benefits to the entire multidisciplinary team, the focus of this study was on the medical model because hospitalists are the primary drivers of metrics such as length of stay and readmissions.

Importantly, over the last 2 decades, similar gains were achieved in the field of critical care medicine, but to date, the findings and evidence that support a closed model in the critical care setting in terms of improved patient outcomes have not been applied to medical-surgical units. Evidence supports better outcomes, improved efficiency, and lower lengths of stay in closed critical care units, where all patients are admitted and managed by a select group of dedicated intensivists versus the open model where there are a variety of types of attending physicians (Howell, 1998; Multz, 1998; van der Sluijs et al., 2017; Vincent, 2016). Studies aimed at identifying the best medical care model in critical care ultimately began in a quest to understand the optimal overall environment in which to care for the most seriously ill and injured patients (Chowdhury & Duggal, 2017). Over the last several decades, there has been an explosion of advanced knowledge and technological advances in critical care. However, the expansion and specialization of critical care created a power struggle between general medical physicians and critical care specialists. Chowdhury and Duggal (2017) found that the struggle led to the exploration of the preferred medical model and subsequent significant gains in quality and key outcomes. Despite the gains in critical care brought about by the closed model, the prevailing literature is void of similar studies applied to a medical-surgical unit, providing a gap in the literature.

Purpose of the Study

The purpose of this retrospective quantitative study was to compare the effect of open and closed models in medical-surgical units on both length of stay and readmission rates. The dependent variables of this study included average length of stay and readmission rates of hospitalized adult patients admitted to a medical-surgical unit within a hospital in Naples, Florida. The independent variable was the medical care delivery model used on a medical-surgical unit, which was either an open or a closed model.

Research Questions and Hypotheses

The study's two RQs and their corresponding hypotheses, which focus on the potential ability of a closed medical-surgical unit to affect length of stay and readmission rates, were as follows.

RQ1 Quantitative: What is the association between open and closed medical-surgical units and the average length of stay for the most common primary diagnoses in adult patients admitted to a medical-surgical unit in a hospital in Naples, Florida, between the summer of 2018 and January of 2019?

$H_0$1: Open and closed medical-surgical units are not associated with differing average length of stay for the most common primary diagnoses in adult patients admitted to a medical-surgical unit in a hospital in Naples, Florida, between the summer of 2018 and January of 2019.

H_a1: Open and closed medical-surgical units are associated with differing average length of stay for the most common primary diagnoses in adult patients admitted to a medical-surgical unit in a hospital in Naples, Florida, between the summer of 2018 and January of 2019.

RQ2 Quantitative: What is the association between adult patients readmitted to the hospital within 30 days and whether their anchor admission for the most common primary diagnoses occurred in an open or closed medical-surgical unit in a hospital in Naples, Florida, between the summer of 2018 and January of 2019?

$H_0$2: There is no association between adult patients readmitted to the hospital within 30 days and whether their anchor admission for the most common primary diagnoses occurred in an open or closed medical-surgical unit in a hospital in Naples, Florida, between the summer of 2018 and January 2019.

H_a2: There is an association between adult patients readmitted to the hospital within 30 days and whether their anchor admission for the most common primary diagnoses occurred in an open or closed medical-surgical unit in a hospital in Naples, Florida, between the summer of 2018 and January 2019.

Theoretical Foundation of the Study

Donabedian (1968) proposed a quality outcome model, which conceptualizes that in general, quality patient care is comprised of structure and processes that result in some outcome for patients. Specifically, Donabedian understood that altering either the structure, the process, or both results in changes to the outcomes for patients. Further, Donabedian contended that the triad approach to assessing quality links good structure to an increased likelihood for strong processes, which in turn produces an atmosphere prime for optimal patient outcomes. The closed model includes dedicated multidisciplinary staff working in conjunction with the more continuous nature of the hospitalist physician care and more frequent rounds to coordinate care. Achieving the benefits of the closed model likely only includes hospitalists, given their ability to be present on the unit consistently and throughout the day. By design, this negates the use of other types of generalists such as primary care or family practice physicians that have the competing priority of an office-based practice. By changing both the structure and processes or how physician care is provided to hospitalized patients, it is hypothesized that patient outcomes (length of stay and readmissions) will improve with the proposed care delivery model. The use of Donabedian's quality outcome framework supported an integrated examination of the factors that result in fragmented care on medical-surgical hospital units, in addition to whether key strategies contained within the closed model achieve the desired patient outcomes.

Influences on the length of stay for hospitalized patients are both intricate and multifactorial (Buttigieg et al., 2018). The independent variables in this study, which include the medical care delivery method (open or closed model) on a medical-surgical unit, are an element of the healthcare system's structure. Buttigieg et al. (2018) indicated that this structure (the way physician care is delivered) produces variation within processes such as physician availability, enhanced communication, and the multidisciplinary approach to patient care. For example, in the traditional, or open, model, physicians only see patients once per day, which often produces a delay in care or discharge. I examined these components to understand the effect on outcomes or the dependent variables, including length of stay and readmission rates. Donabedian understood that the culture of an organization deeply affects physician practice and either results in the promotion of quality patient care or its fracture (Ayanian & Markel, 2016). Certainly, the medical care delivery model is a facet of organizational culture in a hospital, and the model in which physicians practice substantially affects their ability to achieve quality outcomes.

Moreover, the synergy between many different disciplines and departments is necessary to complete the care of a hospitalized patient under the direction of the physician (Kara et al., 2015). The organizational culture of a hospital and the medical model used promote (or deter) this synergy. I propose that this notion further translates to the underpinnings of a particular medical-surgical unit. The foundation of patient care on a medical-surgical unit includes such factors as how patients are admitted and discharged, the availability of the primary physician to both the clinical staff and the patients, and the efficiency in which patient data are evaluated to advance the medical plan for the hospitalized patients. These attributes become inherently altered when the overall structure is transformed such as going from an open to a closed model. In sum, Donabedian's (1968) theoretical framework provides a clear path to improve the quality of care in healthcare. Given that the theory's foundation focuses on structure and processes to affect change to outcomes, this theory was ideal to serve as the foundation for this study.

Nature of the Study

The nature of this study consisted of a correlational quantitative design based on secondary data analysis. To reveal how the suggested patient-care delivery model affects factors described in the RQs, I analyzed objective data from patients admitted to the closed unit over time and compared to the same metrics for patients admitted to similar, open medical-surgical units during the same period. Specifically, the two dependent variables, length of stay and readmissions, were analyzed within the context of the independent variable, an open versus closed model on a medical-surgical unit. Length of stay is defined as the amount of time between a hospitalized patient's admission and discharge (Amrita, 2015). The term *readmission* is used to denote a patient who returns to the hospital after being previously discharged from the hospital within a particular time period (Upadhyay et al., 2019). The quantitative comparative analyses align with the problem and purpose in that they should reveal the ability of initiatives such as the closed model that provides dedicated hospitalists stationed within, to result in improved patient outcomes from the beginning to the end of the project. Importantly, key covariates that may influence length of stay and readmissions were evaluated in this study. Specifically, the covariates identified included age, gender, race, and comorbidities.

The acceptable length of stay for a patient is generally recognized as the geometric mean length of stay (GMLOS), which is known as a more precise representation of the central value of a data set given that it is not sensitive to outliers (Mastrangelo, 2014). As such, CMS publishes a list of the GMLOS per diagnosis-related group (DRG) annually. The absolute or actual length of stay is the number of days a patient is hospitalized. Because acceptable length of stay varies across diagnosis, studying absolute length of stay will likely be of little value. Instead, overcoming this constraint requires exploration of options to develop a useful model. Specifically, secondary data including the average length of stay and readmission rates, from the most frequent primary diagnoses identified during the study period, were examined from medical-surgical units using the closed model and compared to other similar hospital system medical-surgical units providing traditional care delivery using the open model. I used a frequency distribution table to determine the top occurring diagnoses, which were included in the study. Furthermore, I included sufficient numbers of patients admitted with the most frequent diagnoses to ensure a sufficient sample size.

Researchers have previously established that length -of-stay data frequently possess a particular distribution described as exceedingly right-skewed, discrete, and positively distributed, with many tied observations of the same value, and many data points converged around the median (Chazard et al., 2017). In this study, the predictor variable (open or closed model) was categorical. The outcome variable (length of stay) was a quantitative variable with two groups being compared. Because of this assessment, I considered using an independent samples *t* test to compare the means of length of stay for patients admitted to both the closed medical-surgical units, as well as the comparison open medical-surgical units. However, examination of the data revealed right skewness. Because the use of the *t* test requires an assumption of normality, which was violated, a nonparametric test, the Mann-Whitney was used. Readmission data were examined using chi-square methodology where readmissions were dichotomous or a simple *yes* or *no* for a 30-day readmission occurring for any patient whose anchor admission occurred during the study period on the open or closed unit.

The statistical analyses provided an unadjusted examination of the differences in length of stay and readmission rates between open and closed medical-surgical units. To add rigor to the study, I used regression models to examine the effects of key confounding variables on each of the outcome variables. Specifically, the effects of age, gender, race, and comorbid conditions were analyzed for both length of stay and readmissions. For length of stay, a linear regression model was developed. For readmissions, binary regression was used to explore the potential effects of the confounders.

Secondary Data Types and Sources of Information

I retrieved secondary data sets from a two-hospital system that collects data related to average length of stay and readmission rates by hospital unit. This community-based hospital system includes approximately 700 licensed beds, with a marked increase in census noted during the winter months related to a substantial influx of wintering residents. The study included two closed medical-surgical units, one on each campus. Two open medical-surgical units were used for comparison, one on each campus. The total number of hospital beds contained within this study was 233 beds. In my role within the healthcare system, I do not collect these data or have independent access to the data. The data were retrieved from the revenue cycle department of the healthcare system. I evaluated the data to identify the prevailing primary diagnoses of the patients admitted to each study unit, and the appropriate number of diagnoses with the highest numbers of admitted patients were included in the study. Using G*Power 3.1 with an effect size of 0.2, an error probability of 0.05, and a power of 0.95, a minimum sample size of 542 patients from each type of unit yields a power of 0.95. This indicates adequate power to discriminate a true association of length of stay on medical-surgical units using either the open or closed model, if one exists, instead of simple random variation. Literature Search Strategy

I examined multiple websites and databases to locate research previously conducted on the topic of closed and open medical-surgical units and their relationship to the length of stay and readmission rates, as well as to further explore the identified gap in the evidence. The websites and databases I searched included PubMed, CINAHL Plus, BioMed Central, ProQuest, Ehost, and CMS. My search focused on previous efforts to reduce hospital length of stay, readmission rates, preferred medical models to utilize hospitalists most effectively, and the benefits of the closed-unit model in critical care. In total, 141,672 articles were identified using key search terms including *length of stay*, *strategies to lower length of stay*, *medical-surgical hospital units*, *readmissions*, *hospitalists*, *closed intensive care units*, *outcomes by physician types*, and *Donabedian.* From here, articles were scaled down to approximately 100 relevant studies based upon the year of publication, ability to contribute to historical perspectives, relevance, and perceived quality of the research conducted Almost solely, the literature review was confined to articles published between 2015 and 2020, ensuring that the most recent work was considered, reflecting present-day beliefs, barriers, and opportunities within the field of hospital operations. The exception was studies reviewed to elucidate the particular history of a key variable and thus illustrate changes of understanding over time related to a particular topic. Examples include the review of early work related to length of stay and readmissions, as well as some research from the first decade of the 21st century that were consulted because they embodied early work completed on the study of the closed model in critical care, given that this is when the concept first emerged within predominant literature. Only peer-reviewed studies were included in this literature review, and Ulrich was consulted when there was a question whether a particular journal or article was peer reviewed.

Literature Review Related to Key Variables and Concepts

In this research study, I sought to ascertain whether changing the medical model practiced in a medical-surgical unit would result in similar benefits to important metrics, specifically length of stay and readmission rates, as previously appreciated in the field of critical care. To prime the understanding of the clear gap evident within the present body of literature related to the preferred medical model best suited to reduce hospital length of stay while maintaining appropriate readmission rates, several key topics must be introduced and understood. First, it is vital to grasp how length of stay affects all key stakeholders including hospitals, physicians, patients, and payers, as well as the existing strategies known today to keep this metric at an appropriate level. Following this overview, I explore the short-interval readmission of patients to the hospital to understand known causes and existing strategies to mitigate readmissions and, probably most important, to outline the relationship between length of stay and readmissions. Next, tracing the advent of hospitalists and their contribution to date to the healthcare industry provided an essential understanding of existing medical models and the need to refine the way medical care is delivered further, to best impact the dependent variables addressed in this study, which were length of stay and readmissions. Finally, I based this study upon gains made in critical care, where the closed model has produced significant improvements in key patient outcomes (Katz, 2017; Ko, 2019; van der Sluis et al., 2017). The closed model is outlined and provides the basis for the identified gap in the literature that is central to this study.

Through the comprehensive review of prevailing literature, I explored the importance of length of stay and readmission rates to all key stakeholders. Further, the robust evidence published related to the use of the closed model within the critical care setting and the effect on the significant patient and operational metrics was reviewed. To date, applying this concept to a medical-surgical unit has not been studied to the best of my knowledge. Subsequently, the conceptual framework section reveals the model best aligned with this study and supports the ability to improve outcomes when structure and processes are refined. Finally, an in-depth exploration of the recent literature published on each of the dependent and independent variables is presented.

Length of Stay

Healthcare costs are skyrocketing globally, and the uncontrollable rate of increased consumption and expense is unmanageable (Rahman et al., 2019). To illustrate, Rahman et al. (2019) indicated that global healthcare costs will be nearly three times higher in 2040 compared to 2014. Over the last decade, there has also been a globalized prioritization of improving health outcomes for humans (Dzau et al., 2017). Although the health priorities differ among nations, clear priorities have emerged for the United States. Dzau et al. (2017) found that an obvious need exists to control spending related to healthcare in this country, while simultaneously improving the overall health of citizens and decreasing health-related disparities that occur regionally. Figure 1 illustrates health consumption or spending per capita for the United States compared to other countries with similar overall wealth.

Figure 1.

Global Comparison of Health Consumption Expenditures per Capita in U.S. Dollars, 2019

Note. The figure shows health consumption expenditures per capita in U.S. dollars, with purchasing power parity adjusted, for 2019. From *How Does Health Spending in the U.S. Compare to Other Countries?*, by R. Kamal, G. Ramirez, and C. Cox, 2020, Health System Tracker (https://www.healthsystemtracker.org/chart-collection/health-spending-u-s-compare-countries/#item-star). CC BY-NC-ND 3.0 US.

Given the unprecedented global push to control costs, length of stay has catapulted to the center of attention for U.S. hospitals, which are under immense pressure from consumers, payers, and governmental bodies to decrease healthcare costs, achieve a more resourceful utilization of healthcare services, and become better stewards of the country's healthcare resources (Abela et al., 2019). Ultimately, there is significant evidence that length of stay is a strong indicator of a healthcare system's efficiency and overall quality (Abela, 2019; Amrita, 2015; Androtti, 2019; Zolbanin, 2020). As such, a health system that achieves a reduction in its average length of stay typically experiences decreased costs including labor, supplies, and procedural costs (Vinh et al., 2019). Additionally, the failure to address appropriate length of stay for patients admitted to the hospital may result in a risk for infection and untoward effects of medications (Baek, 2018), damage to the necessary throughput to ensure adequate beds for patients requiring hospital admission (Abela, 2019), iatrogenic injuries (Androtti, 2019), decreased patient satisfaction (Thorsten, 2018), and decreased revenue (Zolbanin, 2020). It can be concluded that addressing length of stay reductions is of paramount importance for health systems, given the direct and indirect cost savings, which can result in savings in the millions of dollars annually (Vinh et al., 2019).

Very early work published on length of stay tended to focus on mental health (Parnell & Skottowe, 1959) and psychiatric hospitals (Brown, 1959; Lindemann, 1959; Penrose, 1947). Following this early work, several studies depicted a substantial decrease in hospital length of stay in the 1970s and 1980s for patients admitted for nonpsychiatric reasons. Specifically, the average length of stay for a Medicare beneficiary decreased by 1.9% in the 1970s (Kominiski & Witsberger, 1993). Improvements in this key metric were largely thought to be related to medical advances, the birth of ambulatory surgery that resulted in a smaller scope for inpatient surgery, and the beginning of Medicare's Prospective Payment System (Kominski, 1993; Lave, 1990; Pokras, 1990). Importantly, Lave and Leinhardt (1976) introduced a new paradigm known as medical necessity, which reflects a payer's right to deny payment for care deemed unnecessary or excessive, which is still prevalent today. This practice shaped future efforts from hospitals related to understanding and managing length of stay as it became uniquely intertwined with a hospital's ability to drive revenue.

During the 1990s and early 2000s, there was an explosion of evidence related to specific factors influencing length of stay. Research during this time period included an abundance of studies focused on the attributes of certain populations and clinical subpopulations in association with length of stay (Butterworth, 2000; Crystal, 1999; Hosaka, 1999; Kunik, 2001; Kyle, 2005; Ottenbacher, 2000; Zizza, 2004). Further, several researchers scrutinized the association between different pathologies and their respective lengths of stay (Bates, 2003; Berger, 2008; Bohmer, 2014; Fine, 2000; Krumholz, 1999; Morpeth, 2006; Silber, 2003). In addition, numerous disease-specific treatments and surgical approaches (Arabi, 2004; Collier, 1997; Hoh, 2010; Husted, 2009; Lindqvist, 2002; Still, 1996; Wilson, 2005) were studied with the aim of providing knowledge on lowering length of stay, while other researchers studied the importance of early discharge planning, a multidisciplinary approach, and post acute care (Farren, 1991; Hwabejire, 2013; Lee, 2006; Peiris, 2011; Preen, 2005; Wong, 1999) as a method to reduce length of stay. Despite these efforts, hospital care remained inefficient and costly.

More recently, researchers have begun to challenge disease and patient-specific factors as primary contributors of excessive length of stay and argue for a more urgent focus on healthcare system attributes, hospital operations, managerial and leadership functions, as well as physician-centered practices that affect length of stay (Abela, 2019; Maresh, 2017; Scott, 2017, Vicendese, 2020). For example, Vicendese et al. (2020) found that length of stay is strongly affected by organizational attributes specific to the healthcare sector such as processes, the integration of multidisciplinary teams, the adoption of evidence-based practices, and overall patient management methodology. Organizational leadership further drives a hospital’s ability to operate efficiently, where the lack of vision, adaptability, or a failure to proactively approach challenges produces a negative effect on a system’s average length of stay (Abela et al., 2019). Also, Maresh et al. (2017) studied the tendency for length of stay to be altered based upon the attending physician’s previous relationship with the hospitalized patient, concluding that there was not a benefit to this metric, despite betterment of other important quality outcomes such as mortality. However, this evidence has led to a narrow focus or perhaps a failure to combine the totality of the knowledge gained to produce a clearer picture of the necessary structure and medical model to truly enhance healthcare efficiency and resultant lower costs. What is clear is that no single approach or one standout factor has been identified in historical or contemporary research that pinpoints a clear road map to improved length of stay. Further work is required to better understand the system structure, medical model, and interdisciplinary attributes that result in adherence to appropriate hospital duration per admission diagnosis.

Existing Strategies to Reduce Length of Stay

Mitigation strategies aimed at achieving optimal length of stay will vary some across healthcare systems. However, there are several overarching tactics used commonly enough that are worth considering in terms of work being done in this arena to establish the direction for further work needed in the length of stay domain. Common approaches to combat excessive or inappropriate length of stay per a specific diagnosis include case management and utilization review, the use of nurse navigators, and targeted quality and safety programs and processes that address quality and patient safety issues such as medication safety, falls, and hospital-acquired infections. Specifically, Joo and Huber (2019) conducted a meta-analysis and found that most studies reviewed yielded evidence that case management interventions led to a decreased length of stay. Nurse navigators are deployed by the subject health system central to this study as a part of its overall plan to address both length of stay and readmissions. However, the evidence is mixed as to whether nurse navigators positively influence hospital length of stay. Specifically, Seldon et al., (2016) found nurse navigators lowered length of stay for hospitalized pneumonia patients and Dlott et al. (2020) found that nurse navigators, as an integral part of an overall program to optimize patients preoperatively by identifying and treating know risk factors, which resulted in lower hospital length of stay for patients undergoing total hip and knee arthroplasty. Conversely, several studies failed to yield evidence linking nurse navigators to improved hospital length of stay (Gordon, 2019; Ohlen, 2019).

It is well understood that iatrogenic injuries and complications can result in prolonged length of stay. As such, hospitals exert tremendous efforts to reduce the instances of adverse events, in part to keep length of stay in check. McCarthy et al., (2017) found statistically significant implications for the average length of stay for patients who experienced a medication error resulting in harm than those who did not at a large academic medical center. Strategies to prevent medication errors often include adopting electronic medical record software, computerized order entry systems, bar code scanning, smart infusion pumps, and error reporting systems (Riaz et al., 2017). Reviewing the scholarly evidence, several studies have implicated falls as a cause of prolonged hospital length of stay (Gettens, 2015; Lin, 2017; Sade, 2017; Tzeng, 2017). Interestingly, these studies offer a global perspective, indicating the association between falls and longer length of stay transcends cultural norms, hospital practice variation, and staffing levels that differ might differ between the United States and other countries (Lin, 2017; Slade, 2017). Prevention strategies to reduce falls often include hourly rounding programs, targeted toileting initiatives, robust fall risk analyses for all patients, patient education, and physical devices such as bed alarms, fall mats, and sitters (Chu, 2017; Tzeng, 2017).

Similarly, a plethora of evidence exists, here again on a global scale, underscoring that hospital-acquired infections contribute to excessive length of stay (Glied, 2016; Huixue, 2019; Rahmqvist, 2016; Watson, 2019). Recent works have argued for a more precise approach to understanding the association between hospital-acquired infections and length of stay, including one which accounts for the time-dependent nature of these types of infections (Giraldi, 2019; Wolkewitz, 2019). Despite this, substantial evidence exists that hospitals expend tremendous effort and resources on mitigating nosocomial infection as one strategy to preserve length of stay and control costs (Arefian, 2016; Gamalathge, 2019). Despite these strategies, length of stay is far from optimal at many hospitals signaling additional work is needed to ensure appropriate utilization of healthcare resources (Abela et al., 2019).

Readmissions

Along with length of stay, another relevant metric for consideration in this study is 30-day readmissions. Most experts agree readmissions are an indicator of the quality of care rendered by a hospital (Hekkert, 2018; Upadhyay, 2019). Further, readmissions affect hospital financial performance given a key CMS initiative, the Hospital Readmission Reduction Program that began in 2012, for which hospitals nationwide were penalized more than a half of a billion dollars in 2017 (Upadhyay et al., 2019). Furthermore, some evidence suggests length of stay can affect a patient's risk for readmission. Said another way, Oh et al., (2017) argued that a shorter length of stay for a hospitalized patient resulted in a greater risk for readmission. However, it is noteworthy that their study focused on congestive heart failure patients and it is unclear whether the study is generalizable across other diagnoses. Conversely, several studies found that the longer a patient's length of stay is, the greater the risk for readmission, thought to be most related to the severity of illness (Chopra, 2017; Rinne, 2017). Despite these conflicting studies, it seems prudent that a study focused on methods to lower length of stay should consider possible changes to readmission rates to avoid trading one problem for another.

Although readmissions have long been considered problematic for hospitals, physicians, and patients, the metric has only been highly scrutinized and on the list of problems to be solved by hospital administrators for about a decade. In 2009, as a part of President Obama's Patient Protection and Affordable Care Act, CMS began publicly reporting information for the readmission rates for three key diagnoses, heart failure, acute myocardial infarction, and pneumonia, on their website (Upadhyay et al., 2019). Moreover, Upadhyay et al. (2019) indicated this metric became central to value-based purchasing efforts in 2012 with the advent of the Hospital Readmission Reduction Program, another CMS initiative that provides reduced payments to hospitals that show excessive readmissions. In addition to the diagnoses of heart failure, acute myocardial infarction, and pneumonia, readmissions are now tracked for chronic obstructive pulmonary disease, elective hip and knee replacements, and patients who have undergone coronary artery bypass grafting surgery (Catalyst, 2018). Presently, hospitals stand to lose 3% of their total annual Medicare reimbursements for poor readmission performance. Additionally, Upadhyay et al. argued that today's consumer savvy patients may choose to obtain their healthcare needs elsewhere when a hospital demonstrates less than ideal readmission rates. One vital reason is that evidence has shown that for a patient who has a short-interval (usually defined as 30 days) readmission to the hospital, their mortality rate substantially increases (Goodwin, 2018; Kareliusson, 2015; Upadhyay, 2019). Notwithstanding this, Khera et al., (2020) showed a link between readmissions and increased mortality only in heart failure patients but not with acute myocardial infarction or pneumonia.

It is also noteworthy that some researchers have concluded there are negative unintended consequences of this targeted focus on readmissions. For example, Gupta et al., (2018) conducted a research study comprised of 115,245 Medicare beneficiaries readmitted for congestive heart failure. Gupta et al. found that while efforts of the last decade did produce slightly fewer readmissions post valued based purchasing implementation (the rate decreased from 57.2% to 56.3%), the odds of short-term (30 days) and long-term (1 year) mortality increased. Further, Gupta et al. surmised that pressure invoked by the steep penalties for readmissions have caused hospital systems to delay patient care or acute hospitalizations during the target 30-day window. Given the at least anecdotal concern for untoward or unintended consequences of system initiatives with undertones of a financial benefit on overall patient outcomes, this study monitored readmission rates during the study period.

Hospitalists

Physicians specially trained and dedicated to caring for hospitalized patients are known as hospitalists. This specialty began to gain recognition in the mid-nineties and the number of these physicians practicing continues to grow presently (Epane, 2019; Ivins, 2015). Moreover, Ivins reports evidence showing more primary care physicians opt for hospitalists to care for their hospitalized patients than assuming the care personally. Early on, evidence suggested the use of hospitalists had a positive effect on both length of stay and costs (Dynan, 2009; Everett, 2004; Lindenauer, 2007; Rachoin, 2012; White, 2011). However, Dynan argued these approaches were often cross-sectional in design yielding a narrow focus that lacked the robustness of a longitudinal study. Subsequent and more recent evidence yielded conflicting results regarding an association between hospitalists and lower lengths of stay for hospitalized patients (Ivins et al., 2015). For example, Salim et al. (2019), SooHoo and Owens (2015), and Vinh et al. (2019) found the use of hospitalists led to improved length of stay. Yet, Yousefi et al., (2020) failed to support the notion that hospitalists achieve lower length of stay when caring for hospitalized patients. Moreover, Stevens et al. (2017) revealed that hospitalized patients cared for by their primary care physician had a 4.5% greater rate of being discharged home and a statistically significant less risk for 30-day mortality compared to hospitalists. This study concedes only a slight increase to the average length of stay for patients cared for by their primary care physician (Stevens et al., 2017). Thus, it is important to consider whether a better length of stay achieved by hospitalists in previous studies potentially sacrifices other vital quality outcomes such as mortality. Further, prevailing literature highlights the importance of several other factors, besides the type of admitting physician, having clear influence over the time a patient remains hospitalized. Namely, factors such as payer mix and whether the institution is classified as a safety-net hospital (Coffield et al., 2020) and patient factors such as age and socioeconomic status (Rahman et al., 2019) largely affect hospital length of stay.

Additionally, a key study comprised of 13,710 admissions and 1,099 hospitalists found great variation in the length of stay for similar hospitalized patients signifying the influence of the overall practice environment on the practice styles of hospitalists affecting the duration of hospitalization of their patients (Goodwin et al., 2013). Given the inconsistent findings, possibly the use of hospitalists alone is insufficient to obtain the improvement in key quality and efficiency benchmarks. It is hypothesized that the medical model used matters as well. This study seeks to clarify if a specific care delivery model used by hospitalists within a health system further drives length of stay down lower than marks achieved solely by using hospitalists alone.

Comparing Open and Closed Models in Critical Care

The foundation of this study was born from prior work surrounding the concept of a closed model critical care unit. Presently, it is estimated that critical care beds account for roughly 10% of all hospital beds and utilize over 25% of a health system's available funds (Chowdhury & Duggal, 2017). Because of this prominence, there is a vested interest in determining the optimal medical model. Moreover, it has been previously estimated from a study including critical care units in 75 countries that 83% of the units operated under the closed model, with North America specifically reporting approximately 63% of their units functioning in the closed format (Vincent, 2017). Chowdhury and Duggal (2017) described six different medical care models with varying levels of contribution by the critical care physician, including open, closed, co-management (collaborative), hybrid model, multiple consultants, and the mixed model. Additionally, Chowdhury and Duggal argued that the closed model was likely the preferred medical care delivery model in critical care but cited cost as a major prohibitive factor in achieving this methodology in all Indian critical care units.

Other researchers only recognized three different models including open, closed, and collaborative (Wu et al., 2018). Wu et al. conducted a retrospective, observational study and found that both an open and closed model may be problematic for critically ill cardiac surgery patients. Instead, they determined that a collaborative model between the cardiac surgeon and intensivist provided optimal patient outcomes measured in terms of readmissions to critical care, operative complications, length of stay, ventilator weaning, and various mortality rates. This study is somewhat relevant in that it highlights the shortcomings of the open model and a need for more streamlined delivery of medical care to patients to improve outcomes.

Still, many other studies simply compare open and closed models (El-Kersh, 2016; Katz, 2017; Ko, 2019; Qian, 2019). El-Kersh et al.'s research centered on the optimal care model to reduce infections in the critical care setting. The primary findings were that the closed model resulted in a 52% reduction of cases of ventilator-associated pneumonia and a 25% reduction of central line-associated bloodstream infections, thought to be related to the closed model's ability to promote standardized care delivery to patients. Katz et al. (2017) conducted a single-institution study including 670 total patients as their critical care unit converted from an open to closed model, which yielded no change to mortality rates but improved length of stay for patients admitted to the closed unit. Further, Katz et al. indicated nurses and resident physicians involved in the study reported significant improvements to communication, collaboration, and overall education on the closed unit. Ko et al. (2019) conducted another single-institution study in a neuro-intensive care unit in Korea that converted from an open to a closed model. These researchers found that the unit length of stay improved by one day and the overall hospital length of stay improved by 1.5 days for patients admitted under the closed model. Ko et al. further reported mortality was unchanged but patient satisfaction also improved with the closed model. Finally, Qian et al. (2019) combined the results of five studies that included a total of 6160 patients admitted to either an open or closed critical care unit from 1992 to 2007 and found that mortality rates were significantly improved with the closed model compared to an open model. However, Qian et al. found patients admitted to a closed model unit were more likely to require a central venous line but there were no differences in the need for mechanical ventilation, arterial lines, or pulmonary artery catheters. Like all scientific inquiry, there are conflicting opinions as to the superior model; however, there is overwhelming evidence that supports better patient outcomes with the closed model (Chowdhury & Duggal, 2017).

A review of the literature on the closed model revealed several key benefits applicable to this study, including that the decision to admit a patient and all clinical decisions are rendered by one physician who serves as the captain of the ship; that physician is physically located on the unit at all times, making him readily available to the patient, family, and nursing staff; and decisions regarding discharges are made by one physician (Chowdhury & Duggal, 2017). A benefit of the closed unit model from the critical care environment included fewer readmissions (Ko et al., 2019), fewer nosocomial infections (El-Kersh et al., 2016), decreased mortality (Qian et al., 2019), and factors deemed more difficult to quantify such as the benefit to families and nurses stemming from streamlined communication coming from a single physician (Vincent, 2017). Importantly, the most germane benefit from the closed model is an improved length of stay (Katz, 2017; Ko, 2019; van der Sluis et al., 2017).

It follows that in addition to the benefits of the closed model, shortcomings of the open model would be included in the literature review. For instance, Chowdhury and Duggal (2017) stated that the open model leaves room for ambiguity in the medical care patients receive, which leads to poor throughput, unwarranted diagnostic tests and treatments, and higher costs. However, opponents of the closed model argue that the patient's private physician is estranged from the patient during a time of critical illness and an open model allows for one's physician to provide care during a hospitalization (Gutsche & Raiten, 2013). Further, those who favor the open model express concern regarding transitions of care inherent in a transfer from a closed critical care unit and step-down units below the critical care setting, as these changes in care provide a prime opportunity for miscommunication leading to medical errors (Weissman & Halperin, 2017). Despite these criticisms, Gutsche and Raiten supported the closed model and argued overcoming these stated barriers occurs with well-established communication methods with patients' private physicians, as well as distinct approaches for transitions in care outside of the critical care setting.

Despite the preponderance of evidence supporting the closed model for critical care units, there are study limitations and other weaknesses that should be considered. First, some of the early studies that compared historical data call into question whether the benefits appreciated by the closed model may have simply been the benefit of advanced techniques and treatments in the field of critical care medicine (Gutsche & Raiten, 2013). Second, some studies cite a small sample size (Ko et al., 2019) or the inclusion of only one center in the study (El-Kersh et al., 2016) as an inherent limitation. Third, several studies have been performed in other countries, even ones with differing medical scopes or lower overall socioeconomic status, making generalizing difficult when comparing the evidence to medicine practiced in the United States (Guidet et al., 2017). Finally, Weissman and Halperin (2017) pointed out that some earlier works were limited by system-level and patient-level factors given the cross-sectional design. Future longitudinal studies provided strong support for the closed model's ability to improve key outcomes in the critical care setting (Chowdhury & Duggal, 2017).

Literature Review Summary

Major themes emerged during the literature review. First, scrutiny of the cost of healthcare globally is at an all-time high (Meng et al., 2020). Although not a new concept, presently length of stay is under the microscope at most healthcare systems as a primary opportunity to control costs (Abela et al., 2019). Despite the robust inspection of strategies to optimize a patient's time hospitalized, Abela et al. found a certain amount of conflict remains regarding the best way to lower length of stay. What is known is that hospital length of stay is an intricate, complicated, and multi-faceted process rooted in not only patient and pathophysiologic factors, but is heavily influenced by physician and system elements, processes, and decisions. Given this knowledge, there is a clear need for continued work to understand at an individual system level the model best suited to control length-of-system. It is even possible that the best-suited medical model in one system may offer generalizability to other health systems. The results of this study may define that model.

The second theme uncovered centers on the use of hospitalists. Generally, it is accepted as a positive concept to use hospitalists in an acute care facility, despite the fact there are some contradictory beliefs regarding whether the use of hospitalists as a primary means to control costs is sufficient (Epane et al., 2019). Instead, building on the encouraging evidence amassed to date indicating that hospitalists are responsible for quality patient care and often reduce length of stay and identifying a specific practice model that promotes the ideal environment to care for hospitalized patients is vital to work still to be accomplished (White & Glazier, 2011). The results of this study might contribute to this body of work.

The final theme that materialized is that a closed model in critical care produces improved patient outcomes. Despite the criticisms discussed in this literature review, the evidence in support of this model is sustained and plentiful. A closed model produces cohesive medical management of the patient, streamlined communication, and a level of efficiency not found in other models (Vincent, 2016). In sum, much is known about the effects of the closed model for the critical care setting. However, little is known about applying the concept for use by hospitalists on a medical-surgical unit. This study sought to close this gap.

Conceptual Framework

Despite the relative age of Donabedian's structure-process-outcome paradigm to assess and better healthcare quality, the conceptual framework has stood the test of time and its sustained contribution to the healthcare industry is evident (Buttigieg et al., 2018). As stated before, the complexity of length of stay is evident and impacted by numerous competing forces (Abela et al., 2019). Some of the influences cannot be controlled but a great many are within a healthcare facility's ability to hone and regulate (Buttigieg et al., 2018). According to Fox and McCorkle (2018), all three components of this theory are interrelated, and the success of the desired outcome is shaped by the resilience of the structure and effectiveness of the processes included in a particular endeavor. In applying Donabedian's framework to this study, the structure included specifically the medical-surgical unit and hospitalists, but also all other factors that contribute to the ability to deliver medical care such as the hospital's financial resources. Processes inherent to the closed model concept learned from previous work in critical care, include a single physician orchestrating the patient's care, the consistent availability of this physician, and increased multidisciplinary collaboration and communication inherent in the model (Chowdhury & Duggal, 2017). Finally, the outcomes that are included in this study are length of stay and readmission rates (Fox & McCorkle, 2018).

Despite the prevalence of Donabedian's theory in the prevailing medical literature as a framework for many studies that seek to change some structure to influence processes resulting in better outcomes, there are key limitations to this conceptual context. Martinez et al. (2018) argued that this paradigm is unsuccessful in adjusting for patient and environmental dynamics that naturally influence the quality of care. However, these confounders will be addressed in this study by utilizing only patients admitted for the topmost prevalent diagnoses on both the study units and control units. Further, environmental factors will be addressed in selecting control medical-surgical units for comparison that are similar in terms of size, nurse-to-patient ratios, and types of patients housed within. Interestingly, Berwick and Fox (2016) criticized the age of Donabedian's theory somewhat, stating that he could not possibly have understood the advances in collective understanding that now require one to approach opportunities and issues in healthcare as a systems issue. A review of substantial available literature built upon Donabedian's frameworks seems to refute this notion. Instead, proponents of this framework highlight its ability to focus on the interdependence of the many cogs within the wheel that is healthcare, supporting a system's approach (Abela, 2019, Buttigieg, 2018; Liu, 2018). Notwithstanding the limitations of Donabedian's theory, which is worth considering, numerous studies have embraced the framework as the most appropriate in terms of guiding research related to patient flow and length of stay (Abela, 2019; Buttigieg, 2018; Liu, 2011; Martinez, 2018).

The dependent variables in this study included length of stay and readmission rates for patients admitted to medical-surgical units. The study's independent variable was whether the medical-surgical unit is open or closed, which dictates the medical care model. Schorr (2012) argued that no comprehensive theoretical framework exists to support the complexities inherent in the many inputs that determine or affect hospital length of stay. Further, the literature is void of studies directly on point for using

Donabedian's theoretical framework to improve length of stay on a medical-surgical unit specifically. Despite this, Chelluri (2008) highlighted the usefulness of Donabedian's theory in quality and performance improvement initiatives and specifically denoted length of stay as one outcome where this theory is useful because of the multiple variables involved in this metric that may not be amenable to a solitary change. Instead, Chelluri understood that the inherent complexities influencing length of stay in a hospital required attention to structures and processes to better this outcome. The construct of this study will follow a similar thought pattern, making Donabedian's framework appropriate to guide the work.

Gaps in the Literature Review

A substantial gap in the empirical evidence identified includes the failure to study the concept of a closed unit, prevalent in the critical care setting, in other types of hospital settings. Currently, most healthcare systems randomly assign patients to hospitalists upon admission and those hospitalists have patients scattered throughout many different units. This current practice is inadequate and leads to inefficient care, a longer length of stay, and even contributes to adverse patient events (Conway et al., 2019). Further, aligning with the conceptual theory that provides the framework for this study, Donabedian's structure-process-outcome paradigm, Abela et al. (2019) indicated a common gap in the known approaches to mitigate excessive hospital length of stay includes strategies to lessen disparities in organizational factors and in-house processes. Adopting the closed model outside of the critical care unit may fill this gap given the model's proven ability to provide structure, cohesion, and better communication processes in addition to improved efficiency (Chowdhury & Duggal, 2017). Another essential gap identified is that past researchers have not attempted to define a standard practice model for hospitalist physicians. For example, Scott et al. (2017) addressed in their study an increased propensity for hospitals to employ hospitalist physicians but indicated a limitation of the study was the lack of focus on care delivery and integration of clinical outcomes.

Medical-Surgical Units

Despite the high numbers of patients admitted to medical-surgical hospital units each year, there have been lacking research efforts in this domain (Jeffery et al., 2018). Jeffery et al. described opportunities for additional research include setting benchmarks for the medical-surgical hospital specialty, enhanced efforts from professional affiliations, or federal programs aimed at improving quality outcomes for patients admitted to medical-surgical units. Further, McClelland (2017) asserted that classic medical-surgical units fail to meet the ongoing demands confronting hospitals now and in the near future. A specific need to address the system issues that plague most health systems in terms of evidence-based practice and quality initiatives aimed at improving patient outcomes exists. Specifically, McClelland cited opportunities for continuity of care professionals, care coordination, and better interdisciplinary collaboration. The closed model could provide these benefits to the medical-surgical hospital unit.

Definitions

Following are definitions of key terms from the healthcare sector that are used within this study:

Anchor admission: A term that is used with readmissions to signify the first admission that occurred before the readmission hospital stay.

Average length of stay: The number of days patients spend in a hospital; the metric is frequently calculated by dividing the total number of days stayed by all patients during a time period by the number of admissions or discharges (Amrita, 2015).

Centers for Medicare and Medicaid Services (CMS): A part of the U.S. Department of Health and Human Services that administers numerous federal healthcare programs and initiatives and provides a federal health insurance program for older adults, children, and the medically needy (Rouse, 2020).

Closed model: A system in which admission and discharge to the unit, as well as all clinical decisions, are the responsibility of an onsite physician (Chowdhury & Duggal, 2017).

Diagnosis-related group (DRG): Sets that are used to organize patients based upon symptomatology and other information found within physician documentation; DRGs are used by payers to establish reimbursement amounts for hospitals per patient. The classification of a patient establishes an amount to be paid to hospitals from payers, especially Medicare, despite definite costs of providing care to the said patient (Mihailovic et al., 2016).

Geometric mean length of stay (GMLOS): A metric, published by CMS annually, that is a benchmark for acceptable length of stay by DRG by discounting length of stay outliers (Mastroangelo, 2014).

Hospitalist: A word that gained acceptance after first being used in *The New England Journal of Medicine* in 1996 to describe physicians caring for the medical needs of hospitalized patients (Park & Jones, 2014).

Length of stay: The amount of time a patient spends in the hospital from admission to discharge. Often, length of stay is characterized as a crucial contributing factor of acute care utilization and efficiency (Murphy & Noetscher, 1999). There exists a strong correlation between length of stay and hospital costs (Freitas et al., 2012).

Medical-surgical unit: A hospital unit where adult patients diagnosed with a plethora of different medical problems or recovering from surgery are admitted (Academy of Medical-Surgical Nurses, 2020).

Open model: A system in which patients are admitted and discharged from the unit by several different types of physicians, including surgeons, generalists, or primary care physicians; patients may be spread across multiple hospital units (Chowdhury & Duggal, 2017).

Patient Protection and Affordable Care Act: A U.S. law enacted in 2010 by President Obama that improved availability of health insurance, provided states with the option to expand their Medicaid programs, and dictated certain healthcare quality initiatives (Hamel, 2015).

Readmission: Any unplanned return to any hospital within 30 days of an initial hospital admission regardless of the reason for admission (CMS, 2021).

Safety-net hospitals: Hospitals that service high proportions of uninsured or underinsured patients from frail populations (Coffield et al., 2020).

Value-based purchasing: A federal initiative under which hospitals and providers are compensated for providing superior care while controlling costs and potentially penalized when these standards do not meet certain thresholds (Epane & Weech-Maldonado, 2015).

Assumptions

This study will be based on several assumptions. First, the assumption was made that the outside vendor used by the hospital to collect and aggregate data related to length of stay and readmissions provided data that is accurate and reliable. Another assumption made is that each hospitalist participating in the institution's pilot project adhered to the predetermined exclusion and inclusion criteria for patient selection for admission to the closed medical-surgical unit, which resulted in consistently appropriate patients contained within the study data. Finally, it was assumed that each patient discharged from the institution during the study period received appropriate discharge planning in adherence with best practices and was referred to appropriate post acute levels of care as determined by the collaboration between the physician, hospital rehabilitation staff, and case managers.

Scope and Delimitations

The scope of this study was to analyze the length of stay and readmission rates for the patients admitted to both open and closed medical-surgical units during the institution's pilot project time period. The study delimitations included adult patients $\geq$ 18 years of age who were diagnosed with one of the most frequently occurring diagnoses admitted to the medical-surgical units included in the study from a two-hospital system in

Naples, Florida. Patients admitted for planned readmission will not be included in the study's examination of readmission rates.

Limitations

There are several conceived limitations inherent to this study. First, the study was limited to a single hospital system. Therefore, geographic variation in standards of care may limit generalizability. The second limitation was specific physician characteristics of those physicians admitting patients to the medical-surgical units comprising this study will not be measured such as the number of tests ordered, or the timing of care ordered that could affect length of stay. Finally, hospital factors were not considered such as the day of the week of the admissions contained within the study data, wherein length of stay may be influenced by factors such as staffing patterns or the availability of various care modalities on certain days of the week. This study should allow for larger-scale studies in bigger institutions with more medical-surgical beds. Additionally, there may also be a benefit in generalizability outside of medical-surgical units. Similar to benefits appreciated in critical care, if this study's hypothesis is accepted, future work may center on other subpopulations or hospital units such as inpatient psychiatry, oncology, or pediatrics.

Significance

Traditionally, medical-surgical units have remained open with a myriad of physician specialties admitting and caring for patients within them, despite an ongoing, urgent need to improve length of stay. To date, there is no evidence that hospitals routinely capitalize on benefits gained in critical care through the closure of medical-surgical units, which could lead to improved length of stay. The results of this research study may provide senior healthcare leadership with crucial awareness and necessary data to support a hospital's ability to improve key patient outcomes by adapting an improved physician practice model. Information from this study should assist senior leaders in understanding the system changes required to achieve and sustain improved outcomes in key areas often very difficult to address within healthcare organizations. Specifically, there is an established need for hospital leadership, the nursing department, the governing board, and the physician leadership to work synergistically to drive changes related to the quality of care and patient satisfaction (Daly et al., 2014). Because of this paradigm, a study wherein change is applied to the core of how physicians care for patients and one that may promote an enhanced multidisciplinary culture as appreciated in critical care provides an innovative approach to sustaining change within the healthcare industry. Given a clear gap in prevailing literature related to the effect of closing a medical-surgical unit and the ability to improve key metrics, this study should provide additional information within the fields of hospital management as well as hospital physician practice.

If the results of this study support the hypothesis that a closed model within the medical-surgical setting results in better patient throughput leading to improved length of stay without causing higher numbers of patients to be readmitted, both hospital administrators and hospitalist physicians will be provided with an enhanced framework to provide care to patients admitted to medical-surgical units. The benefits of improving length of stay and readmission rates have been discussed herein, which can include higher reimbursement and improved profitability, as well as less chance for medical errors or adverse events for admitted patients. Specifically, Shrank et al., (2019) found waste between $102.4 to $165.7 billion annually for what they deemed the failure of care delivery as well as $27.2 to $ 78.2 billion for the failure of care coordination when they used existing data to create a model that estimated national healthcare waste. The results of this study may improve both care delivery and care coordination for patients admitted to medical-surgical units given the closed model's established ability to improve these features in critical care. Finally, the results of this study will be important because the evidence may promote larger-scale studies, which may ultimately promote change in the way physician care is operationalized on medical-surgical units.

Significance to Practice

The primary benefit of this study centered on improving length of stay. Given the significant pressure to improve healthcare costs discussed previously, hospital administration and hospitalists stand to benefit from adopting a model that may provide the necessary structure to sustain improvements in length of stay while maintaining acceptable readmission rates. Moreover, while the primary focus of this study was the improvement of the length of stay on a medical-surgical unit, it is also possible that this study may have the ability to change the practice of not only hospitalist physicians but also the practices of the many multidisciplinary roles that support physicians caring for hospitalized patients. Examples include, but are not necessarily limited to nursing, pharmacy, respiratory therapy, case management, and rehabilitation therapy. Specifically, the perceived benefits of the closed model include a more consistent presence of a particular physician on a particular unit and a cohort of patients and staff. This might result in improved interpersonal relationships, improved communication, more prompt attention given to patients, and more frequent patient and multidisciplinary rounding. Previous literature supported the realization of benefits to teamwork, communication, and collaboration in critical care units where the closed model was adopted (Vincent, 2017). Moreover, McIntosh et al. (2019) identified key factors that contribute to quality patient care in a critical care unit, which include physician staffing, patient care coordination, and rounding structure. The closed model affects how a unit is staffed by physicians, provides better care coordination, and an enhanced platform for multidisciplinary rounds. It is hypothesized that these effects will translate well to a medical-surgical unit and result in improved patient throughput necessary to result in lower length of stay.

Interestingly, Kara et al. (2015) developed an innovative care model, different than what was proposed in this study, but one that did include, in part, the geographic placement of hospitalists on certain units to improve physician efficiency. These researchers recognized the opportunity to better communication from physicians to patients and between physicians and the multidisciplinary healthcare team when trying to improve length of stay and hospital costs. Barnett (2001) stated one of the most crucial objectives for a hospitalist physician is the development of rapport with their patients. Finally, although these variables will not be included for formal evaluation, findings from this study may indirectly benefit physician practice by improving job satisfaction for hospitalists, who currently express dissatisfaction with the pace given they span the entire hospital oftentimes, among other factors contributing to burnout (Hinami et al., 2012).

Moreover, the closed model has resulted in enhanced communication between physicians and nurses in the critical care setting. Communication is often lacking and affects nursing satisfaction, patient satisfaction, and patient safety (Tipping et al., 2010). Findings from this study could be used to provide a platform for a future study aimed at improving physician-nursing communication.

Significance to Social Change

Social change is defined as "the way human interactions and relationships transform cultural and social institutions over time, having a profound impact on society" (Dunfey, 2019, para. 2). Given that in 2017 there were an estimated 36.5 million hospital admissions within the 931,203 available hospital beds in the United States that had a 65.9% occupancy rate (Elflein, 2019), healthcare efficiency and better stewardship of available healthcare resources is a societal issue. Further, in 2017, the gross domestic product for national healthcare expenditures was $19,485 billion and the per capita personal healthcare expenditure was $9,106 (CDC, 2017). Because most people will be impacted by the healthcare system at some point in their life, and because of the high cost of healthcare, work to improve the healthcare system as a whole, but especially hospital-based care, is of vital importance and has significant ability to promote social change. The results of this study may support a preferred model to provide physician care to patients admitted to medical-surgical units in terms of both length of stay and readmission rates, which are two primary markers of hospital efficiency, cost-effectiveness, and quality. Moreover, previous work in critical care (Vincent, 2016) supports that the closed model directly changes human interactions and offers better relationships, which should also translate to medical-surgical units.

Summary and Conclusions

Care of hospitalized patients comprises approximately 31% of total healthcare expenditures (Kara et al., 2015). As such, optimizing both outcomes and efficiency is of supreme importance. Further, hospital length of stay remains a critical marker of productivity, adeptness, and quality of care (Shulan & Gao, 2015). Extended patient admissions cost hospitals in terms of revenue, risks for iatrogenic complications, and can increase readmissions. Similarly, high readmission rates reflect negatively on a hospital's performance and can result in deep financial penalties (Chopra et al., 2016). Given the substantial number of patients admitted each year to medical-surgical units, having a sound understanding of what constitutes the ideal manner to deliver care within these units is vital. Using past research in critical care provides a smart starting point and establishing the potential benefits of a closed model in medical-surgical units could provide the missing link to promote better hospital performance and improved patient outcomes still desired by payers, regulatory bodies, and patients themselves.

This section of the study revealed the underlying problem and provided both a conceptual foundation, as well as highlighted a clear gap within the prevailing medical literature. By illustrating the problem statement, the purpose of the study, and RQs, as well as the nature of the study, assumptions, and scope and delimitations, one can easily understand the opportunity presented within for additional study. In the next section, the research design, data collection, methodology, and threats to validity will be outlined.

Section 2: Research Design and Data Collection

Introduction

Presently, debate exists regarding the optimal medical model used in hospitals to achieve improvements in length of stay and readmission metrics with the concept of a closed unit only studied in critical care. The primary purpose of this quantitative study was to analyze the effects of applying the closed model to medical-surgical units on length of stay. A secondary purpose of the study was to determine if readmission rates are different between open and closed medical-surgical units to be able to potentially refute that a decreased length of stay, if a decrease is seen, in a closed unit raises the risk for short-interval readmission. The study included a four-phase design. The statistical methods used included the Mann Whitney test and the chi-square method, Finally, I used regression models to examine the effect of the closed model on outcome variables, adjusting for confounding variables. This section includes an outline of the research design, study population, and data analysis plan with key emphasis on threats to validity and ethical procedures.

Research Design and Rationale

This study was a retrospective evaluation of the length of stay and readmission rates among patients admitted for the most commonly identified diagnoses to medical-surgical units within a two-hospital system. During the study period, these patients were either admitted to an open medical-surgical unit or a closed unit. Analyses occurred in several phases to explore relationships between the primary variables including length of stay and readmission rates as the dependent variables and the type of medical-surgical unit, open or closed, as the independent variables. Further, key covariates were evaluated in this study, including age, gender, race, and comorbidities. In the first phase, a frequency table was used to identify the top-occurring diagnoses during the study period in both the open and closed medical-surgical units. This exercise yielded the top 11 diagnoses that were included in the study, ensuring adequate sample size and a structure for the sampling. By composing this frequency table, I was also able to control for potential bias stemming from too much variation in the length of stay that naturally occurs between varying admitting diagnoses and is not attributed to the type of unit where the admission occurred. Initially, the frequency table was run in SPSS including all patients admitted to both the open and closed units. However, to ensure the accuracy of this exercise, frequency tables were also run separately on patients admitted to open units and then again for patients admitted to the closed unit to ensure no outlier data were observed. This exercise did not reveal a preponderance of one diagnosis admitted to either the open or closed unit but only a small number of patients with the same diagnosis admitted to the opposite-type unit.

Next, I considered using an independent samples *t* test to compare the means of length of stay for patients admitted to open and closed medical-surgical units. This test is frequently used in studies involving length of stay and is especially appropriate for sample sizes greater than 30 (Chazard et al., 2017). However, the results of this endeavor revealed a violation of the necessary assumptions, so a nonparametric test (Mann-Whitney) was substituted. Chazard et al. reported a known right skewness common to length of stay data. Nonparametric evaluations are often useful because they are not dependent upon assumptions related to the underlying population distribution (Haskins, n.d.). However, nonparametric tests can be less statistically powerful than parametric tests and are often more difficult to analyze (Fagerland, 2012). Fagerland concluded that the *t* test is more appropriate than the Mann-Whitney test for studies with large sample sizes. However, given the significant skewness of the length of stay data, it was prudent to switch to nonparametric testing.

Next, I evaluated readmission prevalence between patients admitted to open versus closed units by using the chi-square method. The contingency tables that are part of the chi-square test of independence illustrated the relationship, or lack thereof, between readmissions and patients, admitted to open or closed medical-surgical units (see Patil, 2018). The chi-square method is commonly used in studies involving hospital readmissions (Lindholm, 2012; Urach, 2016; Wong, 2019).

The final phase of analyses in this study included the use of two regression models to examine the effect of the closed model on the outcome variables, adjusting for confounding variables. The confounders included in this study were age, gender, race, and comorbid conditions. I calculated the Charlson Index score for each patient to obtain a score representing the possible effect of the patient's comorbid conditions. The Charlson Index is widely accepted; it is the most frequently used comorbidity index and has been validated in multiple studies (Setter et al., 2019). I used linear regression to consider the effects of the confounding variables on length of stay, and a multiple logistic regression model to evaluate the confounders' effect on readmissions.

The intention of this study was well supported by this design approach, as it allowed for the determination of whether the mean length of stay for the most frequently occurring diagnoses admitted to medical-surgical units during the study period differed between open and closed units. Further, I was able to extrapolate whether patients were readmitted more frequently when their anchor admission occurred in an open or closed medical-surgical unit. As hospital leaders continue to struggle to understand the optimal medical model that contributes to improved patient length of stay and readmission rates, both in terms of financial gains as well as a marker of quality of care, the design of this study might contribute towards advanced knowledge in the field of hospital operations. There is sufficient evidence that supports the use of the closed model in critical care (Katz, 2017; Ko, 2019; van der Sluis et al., 2017)., warranting a broader study to include medical-surgical units.

Methodology

Population

According to the Healthcare Cost and Utilization Project in 2017, U.S. hospitals experienced 17,095,696 medical admissions and another 7,261,682 surgical admissions (Agency for Healthcare Research and Quality, 2020). Using G*Power 3.1, I obtained a power of 0.95 using a sample size of at least 542 patients admitted to open medical-surgical units during the study period, as well as at least 542 from closed medical-surgical units. Specifically, this calculation was made using an effect size of 0.2, an error probability of 0.05, and a power of 0.95. The study period was 7 months long, spanning from June 2018 through January 2019. The study was comprised of 233 total beds contained within the medical-surgical units that were deemed either open or closed during the study period. Specifically, 88 beds operated under the closed model and 145 beds operated under the open model. Given the number of days contained within the study period and the number of beds available in both the open and closed units, there were sufficient admissions to ensure an adequate sample size.

I used SPSS to generate a frequency table to understand the most prevalent diagnoses admitted to both the open and closed medical-surgical units. First, a frequency table was run in SPSS that included all patients admitted to both the open and closed units. Subsequently, I ran two separate frequency tables, one for patients admitted to the closed units and one for patients admitted to the open unit. This step ensured that potential outliers were identified. Discovering a diagnosis disproportionately contained in one unit type compared to the other would have prompted exclusion from the study to ensure the accuracy of results and conclusions.

Based upon the results obtained from this exercise, I included only patients admitted with these diagnoses in the study, which resulted in enough patients to meet the recommended 542 patients from each type of unit. In doing so, I compared patients with like diagnoses, which lessened a potential error of comparing length of stay and readmission rates of unrelated diagnoses, wherein variation could be attributed to inherent differences central to the diagnosis and not attributable to the medical model the patients were cared for under. This sampling technique ensured that the pre collected data set from the revenue cycle team aligned with the problem being studied, the purpose statement, RQs, and hypotheses.

Sampling and Sampling Procedures Used to Collect Data

I collected data that included admissions to the preidentified open and closed medical-surgical units between June 2018 and January 2019 from a two-hospital system in Naples, Florida. The sample included at least 1,084 total patients, with a minimum of 542 patients admitted to an open medical-surgical unit and 542 admitted to a closed medical-surgical unit. I ensured that all patients included in the study were admitted with the most frequently occurring diagnoses present during the study period. By comparing patients with like diagnoses admitted either to an open unit or a closed unit, I was able to perform specific statistical analyses that aided in evaluating whether the length of stay and readmission rates differed on open medical-surgical units compared to closed medical-surgical units. Future conclusions drawn after completing this study may aid hospital leadership in planning how physician care may be organized and executed on medical-surgical units.

Secondary data sources included patient-specific information including key demographics, admitting diagnosis, unit admitted to, and length of stay. I also obtained data from the revenue cycle department related to patients readmitted within 30 days of the anchor admission to one of the study units within the study time period. Because this study did not include live participants, but rather pre collected information already aggregated by the hospital system, participant consent was not required. However, I was required to present the study design and methodology to the hospital's institutional review board to obtain site approval for use of their pre collected data. Further, I have no independent access to the data during my regular employment duties at the subject hospital system.

Instrumentation and Operationalization of Constructs

As with any research study, it is vital to understand the instrumentation and the operationalization of the constructs. The dependent variables were length of stay and readmissions, a continuous and binary variable, respectively. Length of stay was expressed in numerically, measured in days taken to the 10th place (i.e., 3.2 days). Readmissions were measured as 1 for readmission and 0 if no readmission. The independent variable was the type of medical-surgical unit, either open or closed model, which is a dichotomous variable. This variable was measured as 0 for open and 1 for closed. Four confounding variables were contained within the study, including age (continuous variable), gender (dichotomous), race (categorical), and comorbidities expressed in terms of the calculated Charlson Index.

Age was recorded in years and depicted as a whole number. Gender was recorded as 1 = male and 2 = female. Race was recorded as 1 for White, 2 for Black, 3 for Hispanic, 4 for American Indian, 5 for Asian, and 6 for other. The Charlson Index was expressed in terms of a score, calculated by using an online tool. Table 1 depicts the contents evaluated within the Charlson Index score, which predicts the patient's 10-year mortality risk. I followed Setter et al.'s (2019) approach in calculating the Charlson Index score.

Table 1

Components of the Charlson Index Score

Factor	Point
Age	< 50 years = 0
	50-59 years = 1
	60-69 years = 2
	70-79 years = 3
	>/= 80 years = 4
Myocardial infarction	Yes = 1
CHF	Yes = 1
Peripheral vascular disease	Yes = 1
CVA or TIA	Yes = 1
Dementia	Yes = 1
COPD	Yes = 1
Connective tissue disease	Yes = 1
Peptic ulcer disease	Yes = 1
Liver disease	Mild = 1
Severe = cirrhosis and portal hypertension with variceal bleeding history	Moderate to severe = 3

Factor	Point
Moderate = cirrhosis and portal hypertension but no variceal bleeding history	
Mild = chronic hepatitis or cirrhosis without portal hypertension	
Diabetes mellitus	None or diet-controlled = 0
	Uncomplicated = 1
	End-organ damage = 2
Hemiplegia	Yes = 2
Moderate or severe chronic kidney disease	Yes = 2
Severe = on dialysis, status post	
Moderate = creatinine > 3	
Solid tumor	None = 0
	Localized = 2
	Metastatic = 6
Leukemia	Yes = 2
Lymphoma	Yes = 2
AIDS	Yes = 6

Note. CHF = congestive heart failure; CVA = cerebrovascular accident; TIA = transient ischemic attack; COPD = chronic obstructive pulmonary disease.

For this study, I used no specific instrument. However, it is still important to describe how the different constructs were measured when utilizing the pre collected data provided by the subject hospital system. The primary input was the patient's admitting diagnosis or, more specifically, the DRG assigned to each patient. DRGs are sets that organize patients based upon symptomatology and other information found within physician documentation. DRGs are used to establish reimbursement amounts for hospitals, despite definite costs of providing care to the said patient (Mihailovic et al., 2016). These were preassigned by the hospital system and were not established by the researcher.

According to Healthcare Cost and Utilization Project data, the top 10 most common diagnoses for inpatient hospital stays in 2017 were septicemia, osteoarthritis, heart failure, COPD, acute myocardial infarction, diabetes mellitus, pneumonia, cardiac dysrhythmias, skin infections, and acute renal failure (Agency for Healthcare Research and Quality, 2020). I used frequency tables in SPSS to determine the most frequent diagnoses of patients admitted to both the open and closed units during the study period. The top 11 occurring diagnoses were used such that sufficient numbers of patients were included per the previously conducted power analysis. In doing so, I took steps to eliminate potential bias that may have occurred if attention was not paid to the admitting diagnoses of the patients included in the study. Specifically, it is known that acceptable length of stay can vary by diagnoses (Baek, 2018), as well as potentially the risk for readmission. By limiting the number of diagnoses contained in the study, I took appropriate steps to eliminate this potential concern.

The primary outputs were length of stay and readmissions. According to Amrita (2015), length of stay is measured by the amount of time that elapses between a hospitalized patient's admission and discharge (*Length of stay=date of discharge – date of admission*). According to CMS (2020), readmissions are measured as an unplanned return to the hospital within 30 days of an initial hospital admission regardless of the reason for admission (*Date of readmission – date of anchor discharge </= 30).*

Data Analysis Plan

To prepare the data for analysis and ensure the validity of the data as much as possible, the data was cleaned. Steps used to clean the data included:

1. Identified any patients admitted to units other than the study units and removed them.
2. Identified any patients admitted outside of the study time period and excluded them.
3. Check for any duplicate admissions contained within the data set.

were

RQ1 Quantitative: What is the association between open and closed medical-surgical units and the average length of stay for the most common primary diagnoses in adult patients admitted to a medical-surgical unit in a hospital in Naples, Florida, between the summer of 2018 and January of 2019?

$H_0$1: Open and closed medical-surgical units are not associated with differing average length of stay for the most common primary diagnoses in adult patients admitted to a medical-surgical unit in a hospital in Naples, Florida, between the summer of 2018 and January of 2019.

H_a1: Open and closed medical-surgical units are associated with differing average length of stay for the most common primary diagnoses in adult patients admitted to a medical-surgical unit in a hospital in Naples, Florida, between the summer of 2018 and January of 2019.

RQ2 Quantitative: What is the association between adult patients readmitted to the hospital within 30 days and whether their anchor admission for the most common primary diagnoses occurred in an open or closed medical-surgical unit in a hospital in Naples, Florida, between the summer of 2018 and January of 2019?

H_02: There is no association between adult patients readmitted to the hospital within 30 days and whether their anchor admission for the most common primary diagnoses occurred in an open or closed medical-surgical unit in a hospital in Naples, Florida, between the summer of 2018 and January 2019.

H_a2: There is an association between adult patients readmitted to the hospital within 30 days and whether their anchor admission for the most common primary diagnoses occurred in an open or closed medical-surgical unit in a hospital in Naples, Florida, between the summer of 2018 and January 2019.

Analyses in this study occurred in four phases. Analyses were undertaken by using the Statistical Package for the Social Sciences (SPSS), version 25. The following steps were used during analysis:

1. Uploaded all patients contained within the data set provided by the revenue cycle department and conducted a preliminary analysis using a frequency table
2. Identified sufficient numbers of patients within the most prevalent diagnoses to adhere to sample size requirements
3. Removed all other patients (end of Phase 1)
4. Performed preliminary analyses on included data to evaluate the descriptive statistics of the variables
5. Checked the assumption of normality by examining histograms of the variables.
6. Used a box plot in SPSS to identify and remove any outliers in terms of length of stay and patient age
7. Checked the assumption of homogeneity of variance was met
8. Because the model failed to meet appropriate assumptions, nonparametric tests (Mann-Whitney) was performed
9. Determine the *p* value
10. If the p value < 0.05, significance was determined
11. If the p value > 0.05. no significance was determined (end of Phase 2)
12. Ran a crosstabulation table in SPSS for Pearson chi-square testing
13. Checked the case-processing summary to see if any cases have been excluded due to missing values
14. Examined the contingency table for marginal frequencies

15. Substitute the Fisher's Exact test if necessary
16. Determine the significance of the Pearson chi square
17. If $p < 0.05$, significance was determined
18. If $p > 0.05$, no significance was determined (end of Phase 3)
19. Created dummy variable for unit type and readmission
20. Ran multiple linear regression to examine potential effects of covariates on length of stay
21. Ran multiple logistic regression to examine potential effects of covariates on readmission rates (end of Phase 4)

By following these steps, I was able to adequately address the RQs.

However, a final step included the use of two regression models to rigorously consider the effect of the closed model on each of the outcome variables, adjusting for the common confounding variables, including age, gender, race, and comorbidities. A dummy variable was created in SPSS for the unit type to estimate the effect of the closed model on the outcome. Multiple linear regression was used for length of stay and for readmissions, the latter because it is a categorical variable. I was then able to conclude a closed medical-surgical unit's effect on length of stay and readmission rates for patients admitted with the most prevalent diagnoses during the study period.

The key portion of the analyses of this study was grounded in the multiple regression models. If the results of the initial statistical testing revealed significance in the relationship between the closed medical-surgical unit and length of stay and readmission rates, it was then vital to substantiate that the improvement in the dependent variables was the result of the effects of the closed unit. To do so, I constructed multiple regression models. This allowed for the evaluation of common confounding factors that, in general, can have an unintended influence on healthcare studies. Specifically, I evaluated whether age, gender, race, or co-morbid conditions significantly influenced the results of length of stay and readmission variations that may be seen between open and closed units.

Threats to Validity

Threats to internal validity are described as factors that can represent alternate justifications for an apparent causal relationship between the independent variable and dependent variables (Flannelly et al., 2018). Flannelly et al. described seven likely threats to internal validity common to healthcare-related research, two of which applied to the study described herein. The first is described as history or factors that may affect a patient contained within the study that is outside of the actual experiment. Examples specifically plausible to this study include patients first admitted to a unit outside of the study and then later transferred to a study unit or a patient that experiences an adverse event while hospitalized that has the potential to increase length of stay or likelihood of readmission. The second threat to internal validity can be categorized as selection or the possibility that the attending physicians did not abide by the preset rules for inclusion or admission to the closed unit during the study period. History is considered a universal threat to internal validity because it is always present to some degree within healthcare research studies. The selection threat was addressed as an established assumption, meaning it will be assumed that each physician adhered to the hospital system's rules for admitted patients to the closed unit during the study period. There were system failsafe checks in place including the manager of the bed board and each closed unit's charge nurses and managers who evaluated potential admissions for appropriateness.

Threats to external validity in healthcare-related research center on the ability to generalize causal relationships across other groups, institutions, or times (Steckler & McLeroy, 2008). Because this study was performed from data collected at a two-hospital system in Naples Florida, it is unclear whether benefits of a closed unit used in medical-surgical units would translate to other systems. For example, will the findings apply to for-profit institutions, more or less rural settings, or even larger-sized hospitals? If significance was determined, additional studies would need to be constructed and executed across different geographical settings, differing sized institutions, and it would be interesting to replicate the study in the for-profit environment before deeming the closed model best practice. Because of the difficulty controlling for threats to external validity, Steckler and McLeroy argue researchers must focus on tight control of constructs and threats to internal validity to maximize the impact of their studies.

In addition to threats to external and internal validity, caution must be exercised to ensure statistical validity (Garcia-Perez, 2012). When either improper statistical tests are used, or the results are incorrectly analyzed and reported, threats to statistical validity occur. In this study, the main concern was whether to use parametric or nonparametric testing in Phases 2 and 3. Because of this, careful attention was paid to the homogeneity of variances. Because violations were identified, I switched to nonparametric testing to evaluate length of stay.

Ethical Procedures

I used pre collected data, and no actual human subjects were directly involved in the experiments set forth herein. However, to ensure adequate protections were afforded to the patients that were admitted to the subject hospital system, permission for use of the pre-collected data was obtained from the hospital's institutional review board. Moreover, the university's institutional review board ensured ethical safeguards as well. For example, the pre-collected data was provided de-identified, was not be amended, and was properly stored electronically. The data will be maintained for seven years on a flash drive in a locked, fireproof box. After the seven years', the flash drive will be destroyed.

Summary

The primary purpose of this retrospective quantitative study was to analyze the effects of applying the closed model to medical-surgical units on length of stay. A secondary purpose of the study was to determine if readmission rates were different between open and closed medical-surgical units to be able to potentially refute that a decreased length of stay in a closed unit raised the risk for short-interval readmission. A four-phase model was used to identify the most common diagnoses admitted to medical-surgical units during the study period, compare the length of stay of the included patients admitted to either an open or closed unit, then compared the rates of readmissions for both types of units, and finally evaluated primary confounding variables. This methodology allowed me to conclude whether a closed medical-surgical unit provided benefits in terms of length of stay and readmission rates. This section also described the study's population, sampling procedures, data collection and analysis plans, threats to validity, and ethical assertions. In Section 3, the results of the study will be detailed, and a thorough presentation of the findings will be provided.

Section 3: Presentation of the Results and Findings

Introduction

Immense pressure exists within the U.S. healthcare sector to control costs, gain efficiencies, and improve resource stewardship (Marfill-Garza et al., 2018). More than ever, stakeholders challenge hospitals to operate more efficiently. Within acute care, a key strategy to control costs centers on lowering length of stay (Andriotti et al., 2019) and reducing readmission rates (Upadhyay et al., 2019). An opportunity exists to develop a more efficient model of care for patients admitted to medical-surgical units, given the high proportion of hospitalized patients admitted to these units (Jeffery et al., 2018). Previous research from the field of critical care indicates that a closed unit model may provide the necessary overarching structure and appropriate hospitalist physician resource allocation to sustain length of stay reductions without negatively affecting readmission rates (Katz et al., 2017). In this study, I applied the concept of a closed unit model used in critical care units to medical-surgical units.

The specific purpose of this quantitative study was to explore length of stay and readmission rates among patients admitted to open and closed medical-surgical units at a two-hospital system in Naples, Florida. Sampling for this study included patient admissions from June 2018 to January 2019. The central hypotheses were that the closed unit model would result in a lower length of stay without a concomitant increase in readmissions. In this section, I outline the data collection methods and describe the results of the analysis. Specifically, Section 3 reveals the sampling process, quantitative data that were collected, instrumentation, data analysis, and ethical procedures.

Review of the Research Questions

The study included adult medical-surgical patients admitted with the most frequently occurring diagnoses. The focus of the RQs was on determining the relationship between the type of medical model used in the medical-surgical unit, open or closed, and the length of stay and readmission rates. The RQs and hypotheses were as follows:

RQ1 Quantitative: What is the association between open and closed medical-surgical units and the average length of stay for the most common primary diagnoses in adult patients admitted to a medical-surgical unit in a hospital in Naples, Florida, between the summer of 2018 and January of 2019?

$H_0 1$: Open and closed medical-surgical units are not associated with differing average length of stay for the most common primary diagnoses in adult patients admitted to a medical-surgical unit in a hospital in Naples, Florida, between the summer of 2018 and January of 2019.

$H_a 1$: Open and closed medical-surgical units are associated with differing average length of stay for the most common primary diagnoses in adult patients admitted to a medical-surgical unit in a hospital in Naples, Florida, between the summer of 2018 and January of 2019.

RQ2 Quantitative: What is the association between adult patients readmitted to the hospital within 30 days and whether their anchor admission for the most common primary diagnoses occurred in an open or closed medical-surgical unit in a hospital in Naples, Florida, between the summer of 2018 and January of 2019?

$H_0 2$: There is no association between adult patients readmitted to the hospital within 30 days and whether their anchor admission for the most common primary diagnoses occurred in an open or closed medical-surgical unit in a hospital in Naples, Florida, between the summer of 2018 and January 2019.

$H_a 2$: There is an association between adult patients readmitted to the hospital within 30 days and whether their anchor admission for the most common primary diagnoses occurred in an open or closed medical-surgical unit in a hospital in Naples, Florida, between the summer of 2018 and January 2019.

Data Collection of Secondary Data Set

Data transfer, data translation, scrubbing, coding, and overall data organization were vital components in carrying out the inquiry for this research. In this section, I describe the steps in the data preparation used to guarantee that highly reliable and quality data were used in this study.

Data Transfer

Upon approval from both the healthcare system in Naples, Florida, and the Walden University Institutional Review Board (approval no. 12-18-20-0744692), I obtained the data from the hospital director of revenue cycle. The data set included deidentified patient demographics, admission and discharge dates, final DRGs, length of stay, and 30-day readmission date if any. Specific demographic details included age, gender, and race.

Data Translation and Scrubbing

The initial analysis revealed 8,407 patients admitted to the study units from June 2018 through January 2019. The data were first filtered to show only inpatient admissions to be able to correlate with potential readmissions, given that the hospital's revenue cycle department does not track readmissions of observation patients. The data received from the health system included a column denoted as readmissions, which had a 1 if a patient was readmitted and was blank if no readmission had occurred for patients admitted to an inpatient status. I describe the recoding of this variable in this subsection. Before importing the Microsoft Excel spreadsheet into IBM SPSS Statistics 25 for statistical analysis, the data set was cleaned and organized.

Next, utilizing frequency tables, the most common diagnoses admitted during the study period were identified using the final DRGs contained within the data set. The data set was further filtered to include only the top 11 most commonly occurring final DRGs, which included 1,547 total patients (see Table 1). Subsequently, the coding summary sheets were requested from the Revenue Cycle department, which list all co morbid conditions coded for each patient during the hospital admission that occurred during the study period. The coding summaries were used to calculate the Charlson Index score for each study patient to denote the weight and associated risk of the patient's comorbid conditions during statistical analyses. The Charlson Index score was used as a continuous variable with values from zero to 35. Finally, coding of certain variables allowed for the appropriate use of SPSS functionality. Specifically, for the gender column, male patients were coded as 1 and female patients as 2. Race was coded as 1 for White, 2 for Black, 3 for American Indian/Native Alaskan, 4 for Asian, 5 for other, 6 for Unknown, and 7 for Hawaiian/Pacific Islander.

Variable Coding

The data set contained two dependent variables, including the length of stay, measured in days, and whether the patient incurred a 30-day readmission, which was coded as a 1 when present and a 0 when no readmission occurred. The independent variable was the medical-surgical unit type, which was either open or closed; this was coded as 1 for closed and 0 for open, and a dummy variable was used in SPSS to complete the statistical analyses. The covariates included age, gender, race, and the Charlson Index score. These variables were used in the descriptive analysis and the correlation analysis.

Results

Table 1 denotes the makeup of patients included in the study based on the most commonly occurring final DRGs, used to limit potential bias stemming from natural variation in length of stay between different DRGs. Table 2 includes descriptive statistics presenting the relevant statistical components of the study patients, including age, gender, race, and Charlson Index scores. Table 3 shows the unadjusted multivariable analysis using a linear regression model for length of stay. Finally, Table 4 reveals the unadjusted multivariable analysis using logistic regression for readmissions.

Inferential Statistics for Primary Variables

The following section offers inferences and conclusions about the RQs and study variables. The results presented contain inferential statistics for the dependent variables (length of stay and readmission rates), the independent variables (unit type of open or closed), as well as an examination of key covariates including age, gender, race, and Charlson Index scores and the potential confounding effects on the dependent variables. Key descriptive statistics and RQs follow.

Descriptive Information

The sample size was 1,547 total study patients, of whom 967 were admitted to closed medical-surgical units and 580 to open medical-surgical units. The minimum age was 18 years, and the maximum age was 102 years. The age of the study patients was normally distributed. The mean age of patients admitted to the closed unit was 64.16 years and 70.81 years for the open unit. The gender and race information are depicted in Table 2. The mean Charlson Index score between the open and closed units was 4.62 and 4.12, respectively. The distribution of the Charlson Index was right skewed as expected. The mean length of stay for the open units was 4.44 days and for the closed units, 3.73 days. The length of stay distribution was right-skewed, which is the expected distribution for this data.

Table 2

Most Frequently Occurring DRGs and Patient Counts

Final DRG	DRG Description	Patient Count
4N – Closed Unit		
280	Acute myocardial infarction with MCC	26
392	Esophagitis, gastroenteritis, and misc. digestive disorders	32
378	GI hemorrhage w/ CC	32

Final DRG	DRG Description	Patient Count
683	Renal failure	34
287	Circulatory disorders except AMI	34
310	Cardiac arrhythmia and conduction disorders w/o CC	38
309	Cardiac arrhythmia and conductions disorders w/ CC	40
603	Cellulitis	48
871	Sepsis w/ MCC	53
291	Heart failure	63
897	Alcohol, drug abuse or dependence	143
5N – Open Unit		
603	Cellulitis	29
194	Simple pneumonia	29
872	Sepsis w/o MCC	30
331	Major small and large bowel procedures w/o CC/MCC	31
291	Heart Failure	32
690	Kidney and urinary tract infections	32
330	Major small and large bowel procedures w/ CC	32
392	Esophagitis, gastroenteritis, and misc. GI disorders	37
897	Alcohol, drug abuse or dependence	40
871	Sepsis w/ MCC	41
378	GI hemorrhage w/ CC	45

Final DRG	DRG Description	Patient Count
4E – Closed Unit		
439	Disorders of pancreas except malignancy	18
690	Kidney and urinary tract infections	26
871	Sepsis w/o MCC	31
194	Simple pneumonia	31
603	Cellulitis	34
683	Renal failure w/ CC	35
378	GI hemorrhage w/ CC	35
897	Alcohol, drug abuse or dependence	35
872	Sepsis w/o MCC	51
297	Heart failure	55
392	Esophagitis, gastroenteritis, and misc. digestive disorders	73
5th Floor – Open Unit		
194	Simple pneumonia	10
603	Cellulitis	11
690	Kidney and urinary tract infections	12
871	Sepsis w/ MCC	14
378	GI hemorrhage w/ CC	15
392	Esophagitis, gastroenteritis, and misc. digestive disorders	16
482	Hip and femur procedures w/o CC/MCC	16
872	Sepsis w/o MCC	18
470	Major hip and knee joint replacements	28
481	Hip and femur procedures	28

Final DRG	DRG Description	Patient Count
743	Uterine and adnexa procedures for non-malignancy	34
Grand Total		**1547**

Research Question 1

RQ1 Quantitative: What is the association between open and closed medical-surgical units and the average length of stay for the most common primary diagnoses in adult patients admitted to a medical-surgical unit in a hospital in Naples, Florida, between the summer of 2018 and January of 2019?

$H_0$1: Open and closed medical-surgical units are not associated with differing average length of stay for the most common primary diagnoses in adult patients admitted to a medical-surgical unit in a hospital in Naples, Florida, between the summer of 2018 and January of 2019.

H_a1: Open and closed medical-surgical units are associated with differing average length of stay for the most common primary diagnoses in adult patients admitted to a medical-surgical unit in a hospital in Naples, Florida, between the summer of 2018 and January of 2019.

To determine the variation of length of stay between patients admitted to an open or closed medical-surgical unit, I conducted a comparison of means. Given that the length of stay data were heavily right-skewed, nonparametric testing was performed. A Mann-Whitney U test showed that there was a significant difference (U = 334,469, p = .000) between the length of stay for patients admitted to the closed units compared to those admitted to the open units. The median length of stay for the closed units is 3.00 days compared to 4.00 days for the open units suggesting that the closed model is more effective in efficiently managing patients. However, the effect size is small at 0.16 according to Cohen's classification.

I performed multiple linear regression to predict the length of stay based upon the patient's age, gender, race, Charlson Index score, and unit type. A dummy variable was created so that the closed unit was represented as the reference variable. A significant regression equation was found ($F(5,1541) = 21.421$, $p < .001$), with an R^2 of .065. Participants' predicted length of stay was equal to 2.577 + .252 (Charlson Index score) + .643 (unit type), where the Charlson Index was a calculated value between 0 to 35 and the unit type was coded 1 for closed and 0 for open. Length of stay increased .252 days for each unit increase in the Charlson Index and .643 days if admitted to an open unit. Both the Charlson Index score and unit type were significant predictors of length of stay. The regression model revealed that age, gender, and race were not significant predictors of length of stay.

Research Question 2

RQ2 Quantitative: What is the association between adult patients readmitted to the hospital within 30 days and whether their anchor admission for the most common primary diagnoses occurred in an open or closed medical-surgical unit in a hospital in Naples, Florida, between the summer of 2018 and January of 2019?

$H_0$2: There is no association between adult patients readmitted to the hospital within 30 days and whether their anchor admission for the most common primary diagnoses occurred in an open or closed medical-surgical unit in a hospital in Naples, Florida, between the summer of 2018 and January 2019.

H_a2: There is an association between adult patients readmitted to the hospital within 30 days and whether their anchor admission for the most common primary diagnoses occurred in an open or closed medical-surgical unit in a hospital in Naples, Florida, between the summer of 2018 and January 2019.

To determine the variation among readmission rates for patients admitted to open and closed medical-surgical units, I conducted a chi-square statistical test. The comparison showed that there was no distinct difference in readmission rates between the two-unit types central to this study. ($X^2(1, n = 1547) =.107, p = .895$). A multiple logistic regression analysis was conducted to investigate if unit type, age, gender, race, and the Charlson Index score were factors that affect 30-day readmission rates. The outcome of interest was 30-day readmission. The possible predictor variables were unit type, age, gender, race, and the Charlson Index score. The Hosmer-Lemeshow goodness-of-fit was not significant ($p > .05$), indicating that the model is correctly specified. The model correctly classified 88.1% of cases. Additionally, the 2-log likelihood = 1110.128 and the Nagelkerke R squared = .0.23. The model indicated that the independent variables unit type, age, gender, and race were not significant ($p > .05$); however, the independent variable the Charlson Index score was found to be significant ($p < .05$). Controlling for unit type, age, gender, and race, the predictor variable, the Charlson Index score, in the logistic regression analysis was found to contribute to the model ($B = .113$, $SE = .036$, $Wald = 9.978$, $p = .002$). The estimated odds ratio favored a positive relationship of nearly 11.9% increase (*Exp (B)* = [1.119], 95% CI (1.034,1.191)] for every one unit of increase of the Charlson Index score.

Table 3

Descriptive Statistics for Sample Population

Variables	Open Unit	Closed Unit
Length of Stay		
Mean	4.44	3.73
Standard Deviation	3.10743	2.96353
Age		
Mean	70.81	64.16
Standard Deviation	16.921	19.209
Charlson Index		
Mean	4.82	4.12
Standard Deviation	2.939	3.237
Gender		
Count – Males	235	551
Percent – Males	40.5%	57.0%
Count – Females	345	416
Percent - Females	59.5%	43.0%
Race		
Count – White	537	658
Percent – White	92.30%	91.62%

Variables	Open Unit	Closed Unit
Count – Black	17	31
Percent - Black	2.93%	3.20%
Count – American Indian	1	2
Percent – American Indian	0.02%	0.02%
Count – Asian	0	2
Percent – Asian	0.00%	0.02%
Count – Other	23	42
Percent – Other	3.96%	4.34%
Count – Unknown	3	2
Percent – Unknown	.05%	.02%
Count – Pacific Islander	0	0
Percent – Pacific Islander	0.00%	0.00%
Readmission Rates		
Count	71	113
Percent	12.24%	11.69%
Total Patient Count	**580**	**967**

Table 4

Multivariable Adjusted Linear Regression Model for Length of stay

Predictor	β	SE	*t*	*p*
Unit Type (Closed)	-.643	.159	-4.044	.000
Age	-.008	.006	-1.232	.218
Gender	-.053	.153	-.344	.731

Predictor	β	SE	*t*	*p*
Race	-.046	.080	-.568	.570
Charlson Index Score	.252	.037	6.779	.000

Note. n = 1547
R Square 0.65

Table 5

Multi-Variable Adjusted Logistic Regression for Readmissions

					95% CI for EXP(*B*)	
Predictor	Exp(B)	SE	Wald	*p*	Upper	Lower
Unit Type (Closed)	-.978	.165	.017	.895	.683	1.314
Age	.994	..114	2.917	.400	.983	1.009
Gender	.781	.163	2.296	.130	.567	1.075
Race	.823	.114	.2.917	.088	.659	1.031
Charlson Index Score	1.119	0.36	9.978	.002	1.034	1.191

Note. N = 1547
Nagelkerke R
Square .023

Summary

Based upon the exhaustive literature search conducted during this study, there is an imminent need for a medical model that results in increased efficiency and the delivery of higher quality of care for hospitalists caring for patients admitted to medical-surgical units. The work previously completed in the field of critical care revealed benefits gained from a closed unit model, yet current literature is void of similar studies that apply the concept of a closed unit model to the medical-surgical environment. Chapter 3 addressed the absence of research and provided statistical analyses of adult patients admitted to medical-surgical units in a two-hospital system in Naples, Florida, from June 2018 to June 2019 (n = 1547). The data analysis found that patients admitted to a closed unit had a lower length of stay ($\bar{x}$ = 3.73 days) compared to those admitted to an open unit ($\bar{x}$ = 4.44 days).

The study also showed there was no increased risk for readmission for patients admitted to the closed unit. Patients with a heavy co-morbid burden are at risk for longer hospital stays and have a higher chance for readmission despite which type of unit they are admitted to. Specifically, length of stay increases by .252 days, and the risk of readmission increases by 11.9% as the Charlson Index score or the number and severity of chronic illnesses increases. When comparing the closed model with the open model, the predictors age, gender, and race were not relevant to a patient's length of stay or risk for readmission. As such, utilizing the closed unit model within the scope of medical-surgical patient care presents an opportunity to reduce length of stay without affecting readmission rates.

In Chapter 4, I will expound on the interpretation of the findings. Specifically, Chapter 4 focuses on the study's limitations, as well as recommendations for future research. Finally, I will conclude with how this study might influence both the healthcare sector in terms of hospital operations on medical-surgical units and the utilization of hospitalist physicians, as well as possible implications for social change.

Section 4: Application to Professional Practice and Implications for Social Change

Introduction

Hospitalist physicians typically serve as the primary care providers for adult patients admitted to medical-surgical units. After more than 2 decades in which hospitalists have practiced in most hospitals in the United States, there remains a vital opportunity to refine the way these physicians practice, are assigned patients, and commence with day-to-day operations on the unit to improve efficiency and provide better outcomes for patients (Dalen et al., 2018). Two major markers of a hospital's efficiency and patient outcomes are length of stay and readmission rates, and there remains a paramount opportunity to improve these metrics at virtually every U.S. hospital. Doing so helps to address rapidly increasing healthcare expenditures in the United States (Fox & McCorkle, 2018). Evidence has shown that the closed model improves many outcomes in the critical care sector (El Kersh et al., 2016; Katz, 2017; Ko et al., 2019; Qian et al., 2019), but there is a clear gap in the prevailing literature, as the concept of a closed model has not been studied in medical-surgical departments, according to my review of the literature.

The purpose of this study was to evaluate the closed model in the medical-surgical setting. The closed model allows hospitalists to confine their patients to one unit potentially promoting immediate availability to patients and staff, increased responsiveness to the needs of their patients, and a consistent multidisciplinary approach to caring for the high volumes of patients admitted to medical-surgical units in hospitals (Miller et al., 2021). I sought to answer two RQs regarding the effects of an open or closed unit on length of stay and readmission rates. I hypothesized that the closed model would result in a lower length of stay without negatively influencing readmission rates.

Interpretation of the Findings

With both length of stay (Vinh et al., 2019) and readmissions (Upadhyay et al., 2019) tied to reimbursement and financial outcomes, hospital administrators are constantly seeking means to operate efficiently and provide improved patient outcomes. Moreover, length of stay provides an important gauge of a hospital's overall performance in both efficiency and quality (Abela, 2019; Amrita, 2015; Androtti, 2019; Zolbanin, 2020). Leaders of health systems currently use a myriad of strategies to address length of stay issues including case management initiatives (Joo & Huber, 2019) and targeted quality and patient safety programs to combat existing patient safety concerns known to extend length of stay including medication errors (McCarthy et al., 2017), falls (Gettens, 2015; Lin, 2017; Sade, 2017; Tzeng, 2017), and hospital-acquired conditions (Glied, 2016; Huixue, 2019; Rahmqvist, 2016; Watson, 2019). Despite these efforts, many hospitals continue to struggle to achieve an average length of stay congruent with the GMLOS. Key modifiable risk factors for a prolonged length of stay center on hospital infrastructure and physician practice models (Marfil-Garza et al., 2018). Evidence suggests that improving targeted metrics including length of stay within critical care occurs with a transition to the closed model (Katz, 2017; Ko, 2019), which may translate to medical-surgical units.

Building on previous research and using SPSS v. 25, I conducted several statistical analyses to explore relationships between the dependent variables, length of stay and readmission rates, and the independent variable, unit type of open or closed, while controlling for age, gender, race, and the Charlson Index scores. After multivariate adjustment, the results of this study indicate that the closed unit improved length of stay without negatively increasing readmission rates, making the closed model a viable option to operationalize within medical-surgical units, which could improve efficiency for hospitalist physicians. This study builds upon the evidence from previous critical care studies that addressed organizational structure, hospital operations, and physician practices as key influences with length of stay (Vicendese et al., 2020). The findings from this study are also aligned with current studies that have shifted emphasis away from disease-specific opportunities to a more system-specific focus (Abela, 2019; Maresh, 2017; Scott, 2017, Vicendese, 2020).

Similar to the conclusions of Vicendese et al. (2020) that length of stay is strongly affected by organizational- and unit-specific characteristics including system processes, use of multidisciplinary care teams, and overall patient management practices, this study supports changing the configuration and workflows within a medical-surgical unit, which may provide the overarching structure necessary to sustain improvements in length of stay. Moreover, this study was structured to include only patients with the most commonly occurring diagnoses to avoid bias stemming from clinical factors that influence length of stay. By structuring the study in that manner, clinical variation was decreased, centering the focus on the closed model attributes consistent with current work on length of stay reductions (Abela, 2019; Vicendese, 2020).

This study further demonstrated an increased risk for prolonged length of stay for patients with multiple significant comorbid conditions (high Charlson Index Score). This finding is not new and has been demonstrated in numerous other studies across multiple disease states (Johnson, 2015; Lakomkin, 2017; Marfil-Garza, 2018; Robertson, 2019). However, the finding is noteworthy because studies have shown that between 22% to 99.7% of admitted patients will have more than one comorbid condition with the potential to complicate their hospital stay and increase costs associated with the admission (Robertson et al., 2019). Further, this study revealed the mean Charlson Index score to be 4.31, and 34.7% of patients included in the study had a Charlson Index score above the mean. To understand the closed model's effect on patients with high comorbid burden, further study is needed. However, the signature element of the closed model, the constant presence of the physician to tend to the changing needs of patients, promoted better outcomes for the most acute patients admitted to critical care units (see Multz et al., 1998). Therefore, the closed model may provide enhanced benefit to patients with multiple, complex comorbid conditions admitted to a medical-surgical unit.

Readmissions represent in large part the quality of care rendered by a hospital (Hekkert, 2018; Upadhyay, 2019). Further, under current federal programs, 3% of Medicare reimbursements are at risk for poor performance with certain readmission initiatives. Also, many consumers factor a hospital's readmission performance in their healthcare decision, such as where to seek care (Upadhyay et al., 2019). Moreover, some researchers have expressed concern that reducing length of stay promotes increased risk for readmission to acute care (Oh et al., 2017), which was the predominant reason for including readmission rates as a dependent variable in this study. The study revealed there is no statistically significant increase in readmission risk for patients admitted to the closed model when compared to the open model. Notwithstanding this finding, here again, the Charlson Index score was found to be a significant factor in readmission risk. A 11.9% increase in the risk for readmission was seen for each unit of Charlson Index score increase, again denoting that patients with multiple comorbid conditions require special attention from hospitalists and health systems alike. Possibly, the increased promotion of a multidisciplinary approach to patient care seen in the closed model in critical care (Miller et al., 2021) will translate to the medical-surgical environment and result in better care coordination for these more fragile patients, leading to fewer readmissions in a larger scale study.

Finally, previous work has resulted in conflicting views as to whether the use of hospitalists results in improved metrics such as length of stay and costs, compared to non-hospitalist physicians. Some evidence suggests that patients cared for by hospitalists have a lower length of stay and lower costs (Dynan, 2009; Everett, 2004; Lindenauer, 2007; Rachoin, 2012; White, 2011), while other researchers have found that hospitalists did not improve length of stay (Yousefi et al., 2020). Importantly, Goodwin et al. (2013) found that the practice environment and practice patterns were primary factors responsible for the improvement in length of stay with hospitalist physicians. The results of this study contribute to this body of knowledge in that the hallmark of the closed model centers on the geographic assignment of the hospitalist on one unit and the ability for much greater real-time response to the needs of admitted patients. The findings of this study may signify that the use of hospitalists alone is not sufficient to lower length of stay to desired levels; instead, the overall practice structure of hospitalists is crucial to refining efficiency on medical-surgical units. Hospital administrators may find that limiting a hospitalist physician's assignment to one unit, decreasing physician practice variations, and promoting more immediate availability to both patients and the multidisciplinary team, as seen with the closed model, is the key to success in sustaining lower length of stay, reducing costs, and improving efficiency on medical-surgical units.

Relevance to Donabedian's Triad Theory

Providing a solid framework, Donabedian's structure-process-outcome theory grounded this study. The theory was introduced in 1966 and has been used in countless studies related to quality and process improvement. In acute care, length of stay and readmissions are primary components of process improvement efforts, and both are tied to quality. Both outcomes are rooted in a multitude of complex structures and processes embedded in hospital operations. Fox and McCorkle (2018) indicated that the strength of the outcomes, length of stay and readmissions, is strongly affected by the power of the structure (closed unit) and processes (hospitalists practice model). Further, hospitalists are responsible for an admitted patient's length of stay, and their care decisions may contribute to or prevent readmissions, making hospitalists partially responsible for costs associated with excess days and readmission penalties (Dalen et al., 2018). As such, understanding and operationalizing a care model that supports hospitalists caring for patients admitted to medical-surgical units is an essential opportunity for hospital administration.

To my knowledge, this is the first study to apply Donabedian's theory in examining the effects of changing the hospitalist practice environment inherent in the closed model to improve length of stay and prevent readmissions. Donabedian's triad approach provided not only the framework for this research but also provides the ideal foundation for improvement efforts for both length of stay and readmissions given the intricacies known to both (Chelluri, 2008). Chelluri understood that Donabedian's framework includes the notion that decreasing variation in structure and processes produces solid outcomes and enhances the quality of care. The closed unit decreases variation for hospitalists in that the model centers the physician on one unit, with only one set of ancillary staff caring for their patients, as seen in the field of critical care (Miller et al., 2021). In this regard, variation is diminished in communication, practice patterns, and the geographical location of the physician's assigned patient (van de Vijsel et al., 2015). van de Vijsel et al. indicated reducing practice variation among hospitalist physicians is of paramount importance during efforts to reduce length of stay.

The findings of my study suggest that the closed model resulted in a lower length of stay without an untoward increase in 30-day readmissions. If the purpose of Donabedian's theory for process improvement is to refine structure and processes such that it results in an improved outcome (Donabedian, 1966), my findings support the potential for the closed model to result in lower length of stay without causing an increased short-interval return to acute care. For example, based upon previous work in the field of critical care (Miller et al., 2021), it is known that the closed model would change the structure of the medical-surgical unit and how hospitalist physicians' practice and process changes center around communication, collaboration, and more immediate availability of the attending physician to patients. These differences in the closed model compared to the open version contribute to the improved patient throughput on a medical-surgical unit seen in this study. Improved length of stay on a medical-surgical unit would likely result in decreased costs for hospitals, especially given the high numbers of admissions to this unit type (Jeffrey et al., 2018). Specifically, Vinh et al. (2019) found that a hospital with an average daily census of 200 patients could experience a $13.3 million cost savings by reducing the average length of stay by just 0.08 days. This study showed a decrease in the average length of stay of 0.77 days for patients admitted to the closed model compared to the open model, which represents a decrease that is more than nine times larger than that cited in Vinh et al.'s study. Likewise, the closed model may improve the quality of care such that discharged patients may have a decreased risk for readmission, even though the results of this study showed no statistically significant difference in readmission rates between the two model types.

Limitations of the Study

Potential for Bias

One limitation of my study was the potential for bias related to the natural variation of expected length of stay between different diagnoses (van de Vijsel et al., 2015). Specifically, because the GMLOS is different for each patient, based upon their diagnosis and the weight of certain comorbid conditions, the argument can be made that differences in the mean and median length of stay could be attributed to those variations instead of the unit model. van de Vijsel et al. established the actuality of length of stay variation between differing DRGs and the potential effect on research; the researchers suggested adjusting for it by building models that factor in specific covariates. In my study, I felt it was best to restrict the number of DRGs included in the sample to limit this bias given that the most frequent DRGs were virtually the same across all four units contained within the study (see Table 1).

Trustworthiness

Another limitation in my study is the attribution of the burden of sample patients' comorbid conditions. I used the Charlson Index score to standardize this process. Coding summaries were used to obtain information regarding patient's comorbid conditions from one standardized source. There may be errors made by the coders or variations in the coding process across different coders that may result in inaccurate coding summaries and subsequent inaccurate attribution of certain comorbid conditions to sample patients. Despite this, reliability is not problematic, as the scores are reproducible. However, previous research has established the Charlson Index score as a common means to address covariate analysis; however, it is important to acknowledge limitations in the score's ability to realistically represent the effects of certain comorbid conditions using a score represented as a single value (Scheneeweiss & Maclure, 2000). Given the frequency in which the Charlson Index score is used in quantitative research, I felt it was the best option to capture this portion of the covariate analysis. However, reporting the score's limitations is crucial because adjustment for comorbidity burden is a multifaceted matter (van de Vijsel et al., 2015). Further, the Charlson Index score was found to be a significant predictor of both length of stay and readmissions.

The study also faced potential issues with tracking patient readmissions. It is not uncommon for hospitals to lack the means to track patients admitted to other facilities making readmission data in a research study incomplete (Joynt et al., 2014). Further, Joynt et al. understood that there are always significant, individualized patient factors that contribute to readmissions. As such, solely attributing readmission risk, or lack thereof, to the unit type or practice model for the hospitalist physician during the anchor admission may be somewhat misleading.

Generalizability

Yet another limitation to the study is the relative inability to generalize. Although the purpose of the study was to focus on a two-hospital system in South Florida, the study focus does not allow for generalizability of the results nationwide due to specific variations in the region where the data were collected. Examples of region-specific variations that may fail to translate to other systems include a nonprofit status, patient demographic variation such as the high percentage of White patients (> 91%), staffing and practice patterns, employed versus non employed hospitalists, and disparities in social determinants compared to other regions. Last, it is unclear if the results of this study would generalize across other unit types such as cardiac, pediatric, or oncology units, and further research is required.

Recommendations

Current literature showed limited information on the closed model outside of the critical care environment. Results of this study showed that the closed model resulted in a lower length of stay for adult patients admitted to a medical-surgical unit, offering insight for hospital administrators on a more efficient practice model for hospitalist physicians. However, further research is needed to statistically examine the closed model in other settings such as for-profit hospitals, more urban settings, tertiary care settings, or larger-scale academic medical centers. Next, it was outside the scope of this study to apply cost reductions, if any, to the decreased length of stay achieved within the closed unit. Although it is understood that decreasing length of stay results in cost savings, it is not understood what the cost would be of applying the closed model to a medical-surgical unit. A full economic study would be useful in determining if the closed model is in fact cost-effective and would result in actual cost savings as hypothesized herein. Finally, a qualitative study would provide an exploration into both physician and patient perceptions of the closed model in the medical-surgical environment, both of which are key to sustaining a change as proposed in this study. Both physician and patient satisfaction metrics are of paramount importance to hospitals presently. Expounding on this research with the additional inquiries suggested would provide a more robust evaluation of feasibility, reproducibility, and the cost of utilizing the closed model outside of critical care.

Implications for Professional Practice and Social Change

Recommendations for Practice

Since the advent of hospital medicine, born out of a need to provide more efficient care to hospitalized patients, there have been some incongruences in what constitutes the ideal practice model for these physicians. In an era of cost containment in the healthcare sector, both length of stay and readmissions have been identified as leading opportunities for hospitals to reduce costs and improve patient outcomes. However, there is a lack of evidence regarding the optimal practice model for hospitalists in the medical-surgical environment to reduce length of stay without negatively influencing readmission rates. The results of this study may empower hospital administrators to use their hospitalist physician workforce differently and more similarly to how critical care intensivists are staffed, assigned patients, and how the physicians themselves manage admitted patients. By cohorting a hospitalist's patients all on one unit, efficiencies are gained. Moreover, multidisciplinary collaboration is enhanced, which is necessary to achieve the expected length of stay, as well as the care coordination necessary to mitigate readmissions.

Given the highest volumes of patients are admitted to medical-surgical units, hospital administrators can use the closed model to drive their system's quest to lower length of stay and control costs. By using the closed model, there will be an easier means to track and trend data and outcomes by physicians. Further, by stationing one or more hospitalists on a unit and providing continuity of care for those patients admitted to each hospitalist, and allowing them to follow the patient through to discharge, it may lead to a reduction in the overall total admissions and discharges completed by each hospitalist each shift. Admissions and discharges are the timeliest processes for physicians during a patient's stay. By reducing these events per physician overall, physicians have more time to focus on the current patients on their roster, likely providing the efficiencies necessary that resulted in the reduced length of stay seen in this study.

Additionally, there currently exists a difficulty in attributing length of stay by physician, which is key to data analysis necessary to drive change within an organization. The way length of stay data is currently managed most often if a hospitalist picks up a patient who has already been in the hospital for 10 days and discharges them the next day, that physician inherits a 10-day length of stay. This method skews results of data analysis by each hospitalist. If administrators opt to use the closed model for their medical-surgical units, there would be an opportunity to improve continuity of care among hospitalists, thereby resulting in improved physician attribution to length of stay data. Improved data quality would strengthen organizational process improvement efforts.

Finally, the results of this study revealed that the Charlson Index score or the burden of a patient's comorbid conditions was a significant predictor of both length of stay and risk for readmission. While this is not necessarily new knowledge, physicians, hospital administrators, nurses, and community leaders should use the results of this study as corroboration of the imperative need to ensure care coordination across the continuum. Further, policymakers must prioritize resources toward the management of chronic conditions, as they significantly contribute to the overall cost of healthcare in the United States. Specifically, it is reported that 86% of the cost of healthcare is ascribed to patients' chronic, not acute conditions (Holman, 2020). Because of this, hospital administrators should consider adopting the closed model for their medical-surgical units, given the model's ability to reduce fragmentation of care that can contribute to increased hospital days and the risk for readmission related to poor management of chronic conditions.

Social Change

The notion that the healthcare sector in the United States is changing is a ubiquitous fact. There is a global demand to lower the costs associated with health expenditures that are arguably the most necessary in the United States. As such, it is clear this project supports social change. Specifically, the closed model resulted in a statistically significant lower length of stay for patients admitted to medical-surgical units. Hospitals are facing unrelenting pressure from payers to shorten length of stay and regulatory bodies are scrutinizing hospital readmissions. As such, both are woven into the fabric of a hospital's overall financial performance. Notwithstanding this, patients as healthcare consumers are also savvier than ever, demanding improved outcomes coupled with lower costs. Therefore, identifying a model that results in a lower length of stay for the high volumes of patients admitted annually to medical-surgical units is a key win for these objectives, multiple stakeholders, and therefore, wrought with implications for social change. If the closed model is supported in future research on a larger scale, the closed model may be used more widely, therefore propagating social change in the United States.

Superfluously protracted hospital stays are bad for patients ("NHS", 2018). Further, longer length of stay and readmissions are associated with higher costs and possibly lower revenue for hospitals (Vinh et al., 2018). Therefore, improving length of stay without increasing readmission rates benefits society from a personal and economic standpoint. The results of this study provide evidence that the closed model can address suboptimal length of stay in medical-surgical units and do not sacrifice readmission rates. The perceived societal benefits impact all citizens who have the potential to be hospitalized at some point, care for a family member, or be financially responsible for someone hospitalized.

Conclusion

An emphasis on lowering costs while increasing quality and providing better patient outcomes has become a primary objective of all health systems. Hospital administrators are constantly tasked with vital decisions such as resource allocation, labor decisions, and compliance with regulatory requirements to ensure profitability, quality, and sustained operations. Two key components of these efforts are often length of stay and readmissions. Most health systems use hospitalists to care for patients admitted to medical-surgical units, constituting the highest patient population within a hospital. However, the opportunity exists to refine the medical model that underpins hospitalists' practice on these units. Years of evidence revealed benefits of the closed model, including length of stay improvements, in critical care. To the best of my knowledge, this study was the first study that examines the effects of using the closed model on a medical-surgical unit. The statistical results of this study revealed patients admitted to medical-surgical units experience a lower length of stay when the closed model is practiced. The presented information and data offered awareness of a possible strategic solution to optimize hospitalist physician practice in hospitals, resulting in an opportunity to reduce costs, improve collaboration, and lessen the risk for untoward patient events stemming from prolonged hospitalization.

During length of stay improvement projects, it is imperative to keep a watchful eye on readmission rates, as there is an opportunity to cause increased readmissions inadvertently when patients leave acute care quicker. Because readmission rates are tied to hospital revenue, as well as a clear marker for overall patient quality, it is essential that the improved length of stay experienced on the closed unit does not result in higher readmission rates. Physicians and hospital administrators can be assured from this study that the closed model preserved readmission rates. However, the importance of careful consideration towards the burden of a patient's chronic conditions was highlighted, emphasizing the importance of co-managing the patient's comorbid as well as acute conditions while hospitalized.

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