2019

The Association Between Leapfrog's Healthcare Organizational Grades and 30-Day Mortality Rates

Steven Michael Armstrong
Walden University

Walden University

College of Health Sciences

This is to certify that the doctoral study by

Steven Armstrong

has been found to be complete and satisfactory in all respects,
and that any and all revisions required by
the review committee have been made.

Review Committee
Dr. James Rohrer, Committee Chairperson, Health Sciences Faculty
Dr. Rabeh Hijazi, Committee Member, Health Sciences Faculty
Dr. Ronald Hudak, University Reviewer, Health Sciences Faculty

Chief Academic Officer
Eric Riedel, Ph.D.

Walden University
2019

Abstract

The Association Between Leapfrog's Healthcare Organizational Grades and 30-Day Mortality Rates

by

Steven M. Armstrong

MSHA, Virginia Commonwealth University, 2011

BS, Jacksonville State University, 1992

Doctoral Study Submitted in Partial Fulfillment

of the Requirements for the Degree of

Doctor of Healthcare Administration

Walden University

August 2019

Abstract

U.S. healthcare consumers have access to various provider ratings from several organizations that are meant to assist in selecting their healthcare providers. Leapfrog Hospital Safety Grades is one such rating system that professes to allow consumers the ability to select the best hospital for their care. However, since consumers ranking mortality risk as their most important concern, it is essential to determine if Leapfrog grades align with consumer expectations. Andersen's Phase-4 behavioral model of healthcare utilization was used as the foundation for understanding healthcare consumer preferences. This study was designed to determine if Leapfrog grades are predictive of CMS 30-day mortality rates for pneumonia, chronic heart failure, and acute myocardial infarction data, while also adjusting for selected organizational descriptors: state of residency, Medicare expansion, safety-net status, ownership type, teaching classification, and number of licensed beds. Linear regression demonstrated that Leapfrog grades are not reliable predictors of the 3 inpatient mortality rates analyzed. The study demonstrated that ownership type was a significant predictor for 2 of the 3 dependent variables. Furthermore, most of the covariates also provided some predictive value for at least 1 of the included outcomes; however, in most cases, the effect (β) was small. This study can help provide positive social change by elucidating that Leapfrog grades are not reliable predictors of patient outcomes for consumers, while also demonstrating that efforts to reduce 30-day mortality rates, especially for pneumonia, can be targeted by selected states, ownership type, and teaching status.

The Association Between Leapfrog's Healthcare Organizational Grades and 30-Day Mortality Rates

by

Steven M. Armstrong

MSHA, Virginia Commonwealth University, 2011

BS, Jacksonville State University, 1992

Doctoral Study Submitted in Partial Fulfillment

of the Requirements for the Degree of

Doctor of Healthcare Administration

Walden University

August 2019

Dedication

This study is dedicated to my family and friends who provided me encouragement and the time to complete my doctorate. Specifically, I would like to thank Sylvianne Montanez who first encouraged me to pursue my dreams. My sons, Brian and Brandan, for their support. My mother, Angela Coughlin, whose belief in my abilities propelled me forward during the difficult times. I also must thank Kristen Gartland and her wonderful daughters Emma, Erica, and Leah Johnson for their love and unwavering understanding. Finally, all my friends and colleagues who demonstrated they all could genuinely be relied upon whenever needed. The completion of my doctoral research is a testament to the love, support, understanding, and encouragement from all those in my life.

Acknowledgments

I wanted to acknowledge my committee chair, Dr. James Rohrer, for his rapid review and invaluable feedback that pushed me to complete my research. My committee members, Dr. Rabeh Hijazi and Dr. Ronald Hudak, for their feedback and support.

Table of Contents

List of Tables

List of Figures

Section 1: Foundation of the Study and Literature Review

Introduction

Consumer available provider comparative quality information has been increasing in availability since the passage of the Affordable Care Act (Scanlon, Shi, Bhandari, & Christianson, 2015). Such quality comparative data is currently available from many sources, ranging from private to public entities that may or may not charge for participating. My goal with this study was to determine if the publicly available hospital Leapfrog Hospital Safety Grades (Leapfrog grades) provide consumers with information that is predictive of Centers for Medicare and Medicaid Services (CMS) 30-day mortality rates for three diagnoses (pneumonia, congestive heart failure [CHF], and acute myocardial infarctions [AMI]).

Problem Statement

U.S. healthcare is so complex that the seemingly simple act of comparing health outcome data, hospital safety information, and organization descriptors among healthcare enterprises has proven difficult. Several rating organizations, using their proprietary rating systems, have attempted to compare hospitals. The problem with these rating systems is that they measure different operational aspects and do not correlate with each other (Rothberg, Morsi, Benjamin, Pekow, & Lindenauer, 2008). The lack of correlation only adds to the confusion that healthcare consumers are already experiencing when selecting a hospital in which to receive their care. Austin et al. (2015) demonstrated how not a single hospital is designated as a high performer among all four rating systems (The

Leapfrog Group, U.S News, Hospital Compare, and Consumer Reports) they analyzed. The authors stated that only 10% of the hospitals that appeared in any single rating system as a high performer was rated as a high performer by any other rater (Austin et al., 2015). With so much disparity among the various survey findings, one begins to question if the rating systems are valid as a resource to consumers for selecting their healthcare providers.

Consumer-oriented scores/grades from each rating organization's unique evidence-based quality indicator framework are meant to guide healthcare consumers in selecting their healthcare providers based on a proprietary score/grade of excellence (Austin et al., 2015). Hence, this research addressed the gap that exists in determining if the Leapfrog consumer rating system is a good predictor of patient outcomes.

Purpose of the Study

The primary purpose of this study was to determine if Leapfrog hospital grades are predictive of patient mortality rates for pneumonia, AMI, and CHF using CMS datasets from all hospitals that have sufficient data elements from eight states (GA, MD, OH, NC, PA, TN, VA, and WV), similar to other Leapfrog-focused studies (Pakyz, Wang, Ozcan, Edmond, & Vogus, 2017). While other studies have looked at the relationship between an organization's financial performance and CHF, AMI, and pneumonia mortality rates (Nguyen, Halm, & Makam, 2016), this study was unique in that it looked at the information available to consumers on which they base their healthcare purchasing decisions. Secondarily, a comparison of the linear regressions derived from each organization's grade was used to determine if the hospital grade was predictive of the 30-day mortality data. Since the most significant measure of a healthcare organization's quality is patient outcomes (e.g., mortality rates), by performing a retrospective analysis one can compare if the rating organization's provided healthcare grades are correlated with hospitals that have better patient outcomes. Additional stratifications using covariates of hospital-level quality data and descriptors (e.g., ownership type) were used to look for relationships, using regression analysis, and biases that existed between the grades and other independent variables.

Research Questions and Hypotheses

RQ1: Does an organization's Leapfrog grade demonstrate a statistically significant correlation with the CMS pneumonia mortality rate data adjusting for each covariate: licensed beds, ownership type, state of residency, safety net hospital status, state Medicaid expansion status, and organization's teaching status?

$H_1$1: The available consumer available health organization's Leapfrog grade is predictive of patient pneumonia mortality rate data adjusting for each covariate: licensed beds, ownership type, state of residency, safety net hospital status, state Medicaid expansion status, and organization's teaching status.

$H_0$1: There is no correlation between Leapfrog grades and patient health mortality rates based on pneumonia data adjusting for each covariate: licensed beds, ownership type, state of residency, safety net hospital status, state Medicaid expansion status, and organization's teaching status.

RQ2: Does an organization's Leapfrog grade demonstrate a statistically significant correlation with CMS congestive heart failure (CHF) patient mortality rate data adjusting for each covariate: licensed beds, ownership type, state of residency, safety net hospital status, state Medicaid expansion status, and organization's teaching status?

$H_1$2: The available consumer available health organization's Leapfrog grade is predictive of patient chronic heart failure (CHF) mortality rate data adjusting for each covariate: licensed beds, ownership type, state of residency, safety net hospital status, state Medicaid expansion status, and organization's teaching status.

$H_0$2: There is no correlation between Leapfrog grades and patient mortality rates based on CHF data adjusting for each covariate: licensed beds, ownership type, state of residency, safety net hospital status, state Medicaid expansion status, and organization's teaching status.

RQ3: Does an organization's Leapfrog grade demonstrate a statistically significant correlation with CMS acute myocardial infarctions (AMI) patient mortality rate data adjusting for each covariate: licensed beds, ownership type, state of residency, safety net hospital status, state Medicaid expansion status, and organization's teaching status?

$H_1$3: The available consumer available health organization's Leapfrog grade is predictive of patient pneumonia mortality rate data adjusting for each covariate: licensed beds, ownership type, state of residency, safety net hospital status, state Medicaid expansion status, and organization's teaching status.

$H_0$3: There is no correlation between Leapfrog grades and patient health mortality rates based on pneumonia data adjusting for each covariate: licensed beds, ownership type, state of residency, safety net hospital status, state Medicaid expansion status, and organization's teaching status.

Theoretical Foundation of the Study

I used Andersen's behavioral model of healthcare utilization (Andersen, 1995). This approach was appropriate for ascertaining if the quantitative data were predictive for determining if an association existed between the independent variables (grades and descriptive characteristics) and the dependent variables (30-day mortality rates). Specifically, the three dependent variables used for this study consisted of pneumonia, CHF, and AMI 30-day mortality rates derived from publicly available CMS data. Andersen described in his Phase-4 model that consumers' preference and satisfaction play an essential part in the selection of healthcare services (Andersen, 1995). This comparison included both the independent and dependent variables that are publicly available to healthcare consumers and are meant to influence patient preference and provider selection.

Nature of the Study

The study was a quantitative study using a secondary dataset obtained from the Centers for Medicare and Medicaid Services (CMS), The Leapfrog Group, and the American Hospital Association (AHA). The study was conducted to determine if the Leapfrog's publicly available organization health grades are reliable predictors of 30-day mortality rates (pneumonia, CHF, AMI) that are derived from the CMS database. Further analysis was performed assessing whether the outcome data demonstrated bias by also correlating with the descriptor elements (covariates) with the same health outcome data.

The study was built upon similar studies that also looked to correlate the predictability of publicly available health scores/grades and quality indicators. One similar study looked to determine a relationship between Leapfrog scores and hospital-acquired infections (Pakyz et al., 2017) and provides an approach that was used for this research study.

Literature Search Strategies

The Walden University and the Virginia Commonwealth University (VCU) online libraries and Google Scholar were searched using various keywords and phrases (e.g., *consumer healthcare data, Leapfrog, HQA, patient mortality rates, Anderson's behavioral model,* and *Hospital Compare*). The various searches were refined to primarily display articles that were published within the immediate past 5 years (2014 – 2018). Articles primarily from ProQuest Central, MEDLINE, PubMed, SAGE Journals, CINAHL Plus, and from peer-reviewed sources were used.

Additional sources of relevant articles were found within the various journal articles being reviewed. This process led to chaining of related papers that was initiated by the original keyword search approach but allowed for the finding specific articles of interest in either the Walden University or Virginia Commonwealth University databases. This approach was found to be an excellent source of additional articles; however, this approach often led to articles that were outside of the 5-year primary search period.

The main subjects of the literature searches pertained to the main sections and themes of this paper. The significance of each article used in this paper is described within the areas they are referenced.

Literature Review

Introduction

The U.S. healthcare system has been on a journey towards improving the quality of patient care based on current best practices, expanding access, and decreasing costs. The healthcare industry has relied upon the use of quality benchmarking for measuring improvements to differentiate organizational quality. However, to date, the improvement of healthcare quality initiatives has produced limited improvement using current quality indicators (Burstin, Leatherman, & Goldmann, 2016). As quality benchmarking continues to help determine organizational reimbursement through quality reimbursement modeling, it has been demonstrated that this approach may lead to organizations becoming less likely to improve the organization's quality of care measures due to the loss of revenue (Manary, Staelin, Boulding, & Glickman, 2015). Quality improvement is becoming more critical as healthcare reimbursement is partially determined using quality measures, including patient survey data.

The fact that quality outcome data surveys are now part of the reimbursement level calculations, some hospitals may be negatively impacted by the nature of the data collected and presented to the public as hospital quality indicators. Figueroa, Wang, and Jha (2016) demonstrated that reimbursement penalties adversely impact the problems associated with comparing hospitals using the pay-for-performance (P4P) models. These issues associated with these reimbursement models have also demonstrated that large, major teaching, and safety-net hospitals are notably more negatively impacted more than other hospital types (Figueroa et al., 2016; Manary et al., 2015). This data would imply that major academic medical centers, which tend to be large major teaching safety-net hospitals, would be the most impacted of all hospital types. However, large, major teaching, and safety-net hospitals are not the only organizational characteristics that are predictive of profitability, and as discussed above, impact quality indicators.

Patient acuity, based on case mix index, demonstrates a statistical difference among organizations with diverse ownership types, university affiliations, teaching status, and as expected, trauma center level designations (Mendez, Harrington, Christenson, & Spellberg, 2014). Furthermore, using both private and government payer data, some patterns begin to emerge that can predict profitability among system types and locations (Bai & Anderson, 2016) that could be based on acuity differences.

The use of the 30-day mortality rate has been used to provide consumers with a quality indicator needed to help determine hospital quality (Shahian, Wolf, Iezzoni, Kirle, & Normand, 2010). Hu et al., (2017) determined that Hospital Compare's overall scores, which are derived from the various quality indicators, did not demonstrate a correlation that would allow for consumers to make informed healthcare decisions. However, the authors did not specifically attempt to correlate 30-day mortality rates for pneumonia, CHF, and AMI with the Hospital Compare scores, or any of the other available scores/grades (e.g., Leapfrog), and instead analyzed at all the quality indicators to determine consistency among the scores and all quality indicators used in calculating each organization's score (Hu et al., 2017). Therefore, with the advent of multiple publicly available scores/grades, the question then becomes which, if any, of the quality indicators, correlate with the scores/grades that assigned to each hospital.

Leapfrog Group Organization Grades

Organizational Overview

The Leapfrog Group produces letter safety grades for acute care hospitals (A, B, C, D, or F) to provide consumers with information to select safe hospitals from which to receive their care. Leapfrog describes themselves as

> The Leapfrog Group is a nonprofit watchdog organization that serves as a voice for health care purchasers, using their collective influence to foster positive change in U.S. health care. Leapfrog is the nation's premier advocate of hospital transparency—collecting, analyzing and disseminating hospital data to inform value-based purchasing. (The Leapfrog Group, n.d.)

The Leapfrog grades are made available to the public on the organization's website. Consumers can search for various hospitals and compare safety grades to guide provider selection.

Scoring Methodology

For the Fall 2018 grades, Leapfrog's grade for each organization is determined through the weighting of 28 national performance measures derived from CMS data, Leapfrog's organization survey, and other secondary data sources such as the American

Hospital Association's Annual Survey and IT Supplement (The Leapfrog Group, 2018, p.4). The grade is calculated by converting the various performance measures into a *z-score* and then, using Leapfrog's proprietary weighting, used to produce value, that if higher than the mean, is considered better performance, and lower than the mean, is considered worse. (Austin et al., 2014).

Usefulness of Consumer Available Health Scores/Grades

As healthcare moves towards a consumer-driven marketplace, hospital reimbursement levels will be impacted by consumers. The Hospital Value-Based Purchasing Program implemented by CMS calculates hospital reimbursement levels on patient outcomes, consumer satisfaction, quality indicators, and efficiency scores (Manary et al., & Glickman, 2015). Currently, CMS satisfaction scores account for 1.5% of hospital reimbursement (Tefera, Lehrman, & Conway, 2016). It can be expected that reimbursement will continue to be increasingly dependent on hospital performance and patient satisfaction.

The various formulations by Leapfrog, Hospital Compare, and Consumer Reports, and others consider, through a proprietary combination of hospital performance, safety, and patient satisfaction, to produce a score/grade that helps consumers determine where to receive their care (Austin et al., 2015). Therefore, the availability of consumer scores/grades has the potential to influence which hospitals consumers select to receive their care (Sandmeyer, & Fraser, 2016). However, the authors stipulated that consumers as a whole have yet to begin to use these available scores/grades to make their healthcare decisions (Sandmeyer, & Fraser, 2016). Regardless, it is important to determine if the scores/grades are providing consumers with information that correlates with performance (e.g., 30-day mortality rates) and not merely stylistic (e.g., hotel-like lobbies) approaches that pander to consumerism.

For example, The Malcolm Baldrige National Quality Award uses quality, leadership, business, and satisfaction data indicators to select the award winners (Evans & Mai, 2014). While the Baldrige Award is a coveted and respected award, hospitals that win the award have not demonstrated a difference from other organizations when comparing CMS patient outcomes or satisfaction scores (Schulingkamp & Latham, 2015).

Hospitals are in the business to treat and care for the sick and injured. Organizations continue to pursue higher patient satisfaction scores to improve both their patient care, reimbursement levels, and to have higher ratings than their competitors for marketing purposes (Smith, Reichert, Ameling, & Meddings, 2017). The question must be asked if Leapfrog grades reliably predict 30-day mortality rates for pneumonia, AMI, and CHF. With the new emphasis on aesthetics and concierge services, it cannot be forgotten that patients' outcomes are at the core of hospitals existence; and reduced mortality rates remain patients' primary concern (Mühlbacher & Bethge, 2015).

30-day Mortality Rates (Dependent Variables)

The usefulness of using the CMS derived data must be demonstrated to perform an analysis using available Leapfrog grades for predicting hospital-level patient 30-day mortality rates. First, it had to be determined if dependent variables are useful in demonstrating correlations among hospitals. Dy et al. (2016) were able to demonstrate that 30-day mortality rates for CHF among 895 U.S. hospitals were correlated with patient satisfaction scores (HCAHPS) and readmission rates. However, the authors found that heart failure mitigation quality process indicators (e.g., ACE inhibitors) did not demonstrate any statistical correlation (Dy et al., 2016). The same correlations between readmission rates and all three 30-day mortality rates have also been demonstrated (Hu et al., 2017). Other studies using CHF, AMI, and pneumonia 30-day mortality data and were able to demonstrate that the only CHF mortality rates, and not AMI and pneumonia rates, were correlated with quality measure data (Ryan, Nallamothu, & Dimick, 2012). Therefore, the usefulness of the three selected dependent variables, and the fact they are independent of each other, has been demonstrated.

The rates for the 30-day mortality rates are recorded as a percentage of deaths ≤ 30 days from the date of admission. The CMS 30-day mortality rates are risk adjusted for age, medical history, and comorbidities (CMS.gov, 2016).

Independent Variables

Leapfrog

Leapfrog Group developed a hospital safety grade (A, B, C, D, or F) based on both survey results and other publicly available data. The hospital score is made available to the public on the organization's website to provide consumers with the ability to compare hospitals across the United States. The unique aspect of the Leapfrog grade is the focus on patient safety and not direct patient outcomes (e.g., 30-day mortality rates) or satisfaction survey data (e.g., HCAHPS). Again, making the argument that patient outcomes (i.e., the prevention of patient death) are the ultimate goal for hospitals, then one must ask if the Leapfrog grades, based on patient safety indicators, correlate with outcome data.

Austin et al. (2014), did determine that Leapfrog grades demonstrate statistically significant negative bias based on region, number of beds, and ownership type. However, one of the significant issues with the Leapfrog grade is that participants who complete the proprietary survey get to use their data. For organizations that do not wish to pay and complete the Leapfrog survey, the Leapfrog Group uses a combination of publicly available safety data and a process of exclusion and recalibration of the data (Austin et al., 2014). This self-reporting of results allows for organizations to produce values based on their own criteria and not necessarily the same as the CMS reporting methodology. This inconstancy has demonstrated that self-reporting produced better values than those reported to CMS (Smith et al., 2017). Furthermore, this could potentially cause those hospitals that self-report to have more favorable grades than those hospitals that do not self-report. Smith et al. (2017) did demonstrate that self-reporting of results did produce improved scores over those organizations that did not self-report and whose CMS data was used. Additionally, the authors also found that the self-reported values had little association with the mandatorily reported CMS data (Smith et al., 2017).

Covariates and 30-day Mortality Rates

Safety-net status. Safety-net hospitals do not have a single definition. For this study, the definition used by Gilman et al., (2015) will be used. Gilman et al. defined safety-net hospitals as those organizations that are in the top quartile for receiving the highest percentage of disproportionate-share hospital (DSH) payments for providing uncompensated care. In this study, I analyzed each state separately, and the top quartile of hospitals in each state was designated as safety-net facilities to divide the hospitals for this covariate analysis.

The purpose of including safety-net status as a covariate is due to differences in hospital profitability. Hospitals that provide increased amounts of uninsured patient care are less profitable (Bai & Anderson, 2016). It is easy to understand that if an organization is less profitable, there could potentially be decreased investments in capital and infrastructure that might directly or indirectly impact patient outcome data. Contrary to what might be expected, safety-net hospitals, organizations that have increased Medicaid patients and an increasingly disproportionate amount of uncompensated care (Gilman et al., 2014), have been shown to have no statistical difference between patient outcomes when compared to nonsafety-net hospitals (Gilman et al., 2015). Therefore, it would be expected that an organization's safety-net designation should not influence the designated Leapfrog grade. While the various analyses performed used direct correlations between safety-net designation and 30-day mortality rates, I used safety-net status as a covariate to see if the scores/grades demonstrate any statistically significant correlations.

Ownership type. Ownership type has been used to differentiate hospital performance to determine if the philosophical and mission differences make a difference in patient outcomes (Zhao, Haley, Spaulding, & Balogh, 2015). Ownership type for this study was divided into three groups: for-profit, not-for-profit, and public. When AMI, CHF, and pneumonia hospital readmissions were previously analyzed using hospital ownership as a variable, it was determined to have limited effect on the variability demonstrated among hospitals (Herrin et al., 2015). However, the authors looked at readmission rates and not mortality rates for the same three outcomes. Furthermore, Herrin et al., (2015) also used geographic location as the primary variable which accounted for 58% of hospital variability for the above readmission rates. Therefore, the slight increase in hospital variability that may have been attributable to hospital ownership could still be significant, just less than location.

When other studies, at least in Chile, there were differences demonstrated among hospitals with different ownership types for total mortality rates (Cid Pedraza, Herrera, Prieto Toledo, & Oyarzún, 2015). While the Chilean authors looked at total mortality rates, this study will include a more focused 30-day mortality rate for only three patient outcomes (i.e., CHF, AMI, and pneumonia) using CMS data for the included eight states.

Teaching status. An organization's teaching status has been shown to demonstrate outcome differences regarding patient outcomes. Burke, Frakt, Khullar, Orav, and Jha (2017) were able to demonstrate that teaching hospitals did demonstrate statistically lower mortality rates for CHF, AMI, and pneumonia outcomes when compared to nonteaching hospitals. Furthermore, the authors were also able to demonstrate a gradient for these three outcomes among hospitals that were defined as *major teaching, minor teaching,* and *nonteaching* (Burke et al., 2017). The gradient demonstrated increased mortality rates as the status went from major to minor to nonteaching hospitals (Burke et al., 2017). However, other studies demonstrated no differences for other mortality rates (open versus endovascular aortic aneurysm repairs) between teaching and nonteaching hospitals (Hicks et al., 2016).

This study used the teaching status, using the AHA annual survey hospital responses to identify hospitals teaching status. While this study compared teaching status and the 30-day outcomes for CHF, AMI, and pneumonia, the status served as a covariate helping to demonstrate if the indirect variables demonstrate variability among hospitals of the various teaching statuses.

AHA survey data delineated among the three teaching statuses: major being members of both the Accreditation Council for Graduate Medical Education (ACGME) and Association of American Medical Colleges (AAMC) Council of Teaching Hospitals (COTH); minor is defined as those accredited by ACGME, but are not COTH members; nonteaching are all hospitals without either ACGME or COTH membership (Rivard, Christiansen, Zhao, Elixhauser, & Rosen, 2008).

Licensed beds (size). Hospital size is customarily defined by the number of licensed beds that the facility has available to provide patient care. The correlation is often believed that larger size facilities offer more diverse and sophisticated care. The use of hospital size as a covariate is not meant to determine why any difference that may be demonstrated for 30-day mortality rates among facilities. Nor is the study meant to speculate and why these differences, if any, exist; but rather to demonstrate if hospital size is correlated, positively or negatively, when compared to the hospital Leapfrog grades. While bed size is not to indicate a direct causal factor and purely a predictor variable, differences among hospitals based on size have been demonstrated. Sheetz, Dimick, and Ghaferi (2016) were able to demonstrate that hospital size was a predictor of patient outcomes (e.g., failure to rescue) with smaller hospitals (< 200 beds) performing statistically worse than larger hospitals (> 200 beds). For this study, beds were separated into four groups (< 100 beds, 100 – 199 beds, 200 – 499 beds, and ≥500 beds) to determine if differences were demonstrated among the various hospital size groupings.

State of residency. Because of differences in state health policies, the study will also look to determine if the state in which the hospital is located provides any statistically significant bias regarding Leapfrog grades. To help mitigate geographic differences among patients from each state, the states used for this study are also relatively clustered together with each state sharing a border with at least two other states, and with six of the eight sharing a border with at least three study states (Figure 1).

Health disparities among various states and U.S. geographic regions have been noted, including mortality rates. Roth et al., (2017) was able to describe significant differences among various U.S. geographical regions when comparing mortality rates for heart disease and stroke. Because some of these differences have been attributed to socioeconomic differences (Singh, Siahpush, Azuine, & Williams, 2015), it only adds to the necessity to reduce geographic variability by keeping the study states in the same general region (see Figure 1).

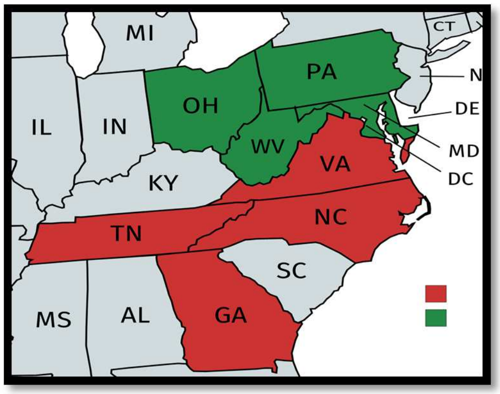

Figure 1: States used for the study

Medicaid expanded versus nonexpanded states. There have been mixed results from studies regarding health disparities between states that expanded Medicaid and those that did not expand Medicaid under the Affordable Care Act (ACA; Bhatt & Beck-Sagué, 2018; Anderson et al., 2016). In states that expanded Medicaid, infant mortality was found to be lower (Bhatt & Beck-Sagué, 2018). However, other studies have not shown any difference when comparing states that did and did not expand Medicaid for in length of stay and other mortality rates (Anderson et al., 2016).

The inclusion of Medicaid expansion is not meant to determine if there is a direct causal effect with Leapfrog grades, but rather to see if hospitals in states with Medicaid expansion are statistically significantly different from those that did not expand Medicaid. Table 1 lists the states included (four that expanded and four did not expand Medicaid) and their Medicaid status as of December 31, 2018 (Kaiser Family Foundation, 2018).

Table 1

Study Inclusion States and their Medicaid Expansion Status

State	Medicaid Expansion (as of 12/31/2018)	Comments
Maryland	Yes	
Ohio	Yes	
Pennsylvania	Yes	
West Virginia	Yes	
Georgia	No	
North Carolina	No	
Tennessee	No	
Virginia	No	Medicaid Expanded on January 1, 2019

Definitions

30-day Mortality rate: The rate of death within 30 days of entering the hospital with a given condition (Medicare.gov, n.d.).

Acute Myocardial Infarction (AMI): A sudden onset heart attack "when there is evidence of myocardial necrosis in a clinical setting consistent with acute myocardial ischemia" (Thygesen et al., 2012, p. 1584).

Affordable Care Act (ACA): The U.S. healthcare law enacted in March of 2010 (HealthCare.gov, n.d.).

Center for Medicare and Medicaid Services (CMS): The federal agency designated to administer the U.S. Medicare program and assist states with the Medicaid program (CMS.gov, 2006).

Chronic Heart Failure (CHF): A condition that is present when a patient exhibits symptoms of heart failure over a period of time (Ponikowski et al., 2016).

Hospital Compare: Hospital Compare "is a consumer-oriented website that provides information on how well hospitals provide recommended care to their patients" (CMS.gov, 2016, p. 1).

Leapfrog Group (Leapfrog): A nonprofit organization that provides hospital data for the purpose of informing the public to help facilitate value-based purchasing using hospital grades (The Leapfrog Group, n.d.)

Licensed beds (size): The number of patient beds that a hospital is allowed to operate (Agency for Healthcare Research and Quality, 2005). The larger the number of beds is a good approximation of relative hospital size.

Medicaid: A healthcare program to help with medical costs for individuals with low and limited income that is comanaged by states and the federal (CMS.gov, 2006).

Medicaid expansion: A designation for states that have selected to provide Medicaid coverage to citizens that are within 138% of the federal poverty level as allowed by the ACA (Kaiser Family Foundation, 2018).

Ownership type: A designation that indicates if a hospital is a for-profit, not-for-profit, government (nonfederal), or federal organization (Zhao, Haley, Spaulding, & Balogh, 2015). Federally managed hospitals are excluded from this study.

Pneumonia: An infection of the lungs that causes the lung sacs, alveoli, to fill with fluid and inhibit the normal gas exchange process leading to difficulty in breathing (Prina, Ranzani, & Torres, 2015).

Safety-net hospital: A designation for hospitals that provide a disproportionate share of healthcare to low-income individuals (Gilman et al., 2014).

State of Residency: The state in which the physical hospital is located.

Teaching Status: "A hospital is considered a teaching hospital if it has one or more Accreditation Council for Graduate Medical Education (ACGME) approved residency program, is a member of the Council of Teaching Hospitals (COTH) or has a ratio of full-time equivalent interns and residents to beds of .25 or higher" (Healthcare Cost and Utilization Project, 2008, p. 1).

Assumptions

It is assumed that the 30-day mortality rates used in this study, as collected by CMS and presented in their hospital compare data, are accurate. Furthermore, it is assumed that the CMS data, which are derived from only Medicare patients 65 years old and older (Medicare.gov, n.d.), is an accurate predictor of population health outcomes for those that fall below the eligibility age. However, the CMS dataset is the only consistently reported hospital performance information available for comparing US hospitals.

It is also assumed that the variables are independent of each other. This includes the method, as described above, in which the Leapfrog grade is calculated from the hospital safety data. It is important for the statistical analysis that all variables are independent.

Limitations

Since the 30-day mortality rates are derived from Medicare patient data, it is a known limitation of this data that the data is only predictive of patients that are 65 years or older (Burke et al., 2017).

The Leapfrog grades are derived from both self-reported questionnaires for participating hospitals and from CMS data for those that do not choose to participate (Austin et al., 2014).

The analysis was limited to only those organizations that had adequate data elements. Organizations that did not complete an AHA survey, have a Leapfrog grade, and at least one dependent variable, were eliminated from the study.

The results of this research only apply to the eight states studied and may not be conveyable to other U.S. states.

Scope and Delimitations

The scope of this study was limited to the use of comparing the Leapfrog grades presented on The Leapfrog Group website for each hospital, AHA hospital data, and Hospital Compare. All secondary data was extracted from publicly available datasets and analyzed as presented from the various organization without manipulation or interpretation.

Significance of Study

This study explored the linkage between publically available Leapfrog grades and patient outcomes. I was able to demonstrate an inconsistent association between leapfrog's consumer-accessible Hospital Safety Grades and included 30-day mortality rates. Therefore, Leapfrog grades were demonstrated to be an unreliable indicator from which consumers can use to select their healthcare provider on the basis of the analyzed outcomes. The study was also able to provide information on how the included covariates were associated with each outcome.

Significance to Practice

Medicine is the art of healing and preventing illness. However, the vast majority of quality measures are not outcome based. Of the nearly 2,000 quality indicators in the National Quality Measures Clearinghouse, only 7% (139) are based on patient outcomes (Porter, Larsson, & Lee, 2016). However, improved patient outcomes, specifically decreases in mortality rates, are the ultimate end goal of medicine. While the authors discussed that mortality is rare and may not be a good differentiator among hospitals as a performance indicator, mortality is an important, and arguably the most important, outcome measure (Porter, Larsson, & Lee, 2016). The CMS data does exist to allow for determining significant differences among hospital data, regardless if mortality is a rare event among all hospitals.

Researching the linkage between Leapfrog grades and CMS available outcome measures for pneumonia, CHF, and AMI may help determine if correlations exists.

Significance to Social Change

This study provided healthcare consumers with the information needed to determine the usefulness of available Leapfrog grades for reliably predicting individual hospital patient outcomes for pneumonia, CHF, and AMI. Furthermore, healthcare organizations will be able to use the data to understand how their organizational attributes (e.g., ownership type) may impact patient outcomes and begin to make enhancements to increase their levels of care.

Summary and Conclusion

The U.S. healthcare system has been undergoing a change in which consumers demand safe quality care that provides a positive customer experience. As the U.S. healthcare system becomes more consumer-focused and driven, it is essential that consumers have the information necessary to make informed health decisions. These decisions are not only about which type of treatments and medications they wish to partake but also which organization in which they wish to receive their care. Leapfrog, using a proprietary safety grade calculation, is designed to give hospitals an A, B, C, D, or F grade (to match traditional school grades) to easily convey to consumers the safety and quality of care provided for a given hospital. While this is admirable, the grades given to each hospital have the potential to impact the financial health of each organization. Therefore, it is imperative that the grades be truly indicative of the care provided and devoid of biases towards a particular subset of hospitals. This study was designed to ascertain if there is a correlation between Leapfrog scores and 30-day mortality rates. Furthermore, using the described covariates, the analysis was completed to determine if organizational descriptors demonstrate a grading bias.

Section 2: Research Design and Data Collection

Introduction

Section 1 provided the rationality and historical validity for determining if a correlation is evident between the publicly available Leapfrog grades (independent variables) and the 30-day mortality rates for CHF, AMI, and pneumonia (dependent variables) data extracted from the CMS dataset. It was demonstrated that further stratifying the data across the covariates is also supported by the literature. The use of the covariates provides a foundation for determining if the Leapfrog grades demonstrate bias at a level that is statistically significant ($p < 0.05$). Section 2 provides the research design, data collection, and analyses of the variables and covariates.

Purpose of the Study

The primary purpose of this study was to determine if Leapfrog hospital grades are predictive of patient mortality rates for pneumonia, AMI, and CHF using CMS data from hospitals with other elements from eight states (GA, MD, OH, NC, PA, TN, VA, and WV) similar to Leapfrog focused studies (Pakyz et al., 2017). While other studies have looked at the relationship between an organization's financial performance and CHF, AMI, and pneumonia mortality rates (Nguyen et al., 2016), this study is unique in that I examined the information available to consumers on which they base their healthcare purchasing decisions. Secondarily, a comparison of the linear regressions derived from each organization's grade was used to determine if the hospital safetey grade is predictive of the 30-day mortality data. Since the most significant measure of a healthcare organization's quality is patient outcomes (e.g., mortality rates), by performing a retrospective analysis one can compare if the rating organization's provided healthcare grades are correlated with hospitals that have better patient outcomes. Additional stratifications using covariates of hospital-level quality data and descriptors (e.g., ownership type) were used to look for relationships, using regression analysis, and biases that may exist between the grades and other independent variables.

Research Design and Rationale

This study used an inductive relational correlation theoretical approach that is described by Eisenhardt, Graebner, and Sonenshein (2016) to analyze the data. This approach is appropriate for determining if the data are predictive in determining if an association exists between the independent variables (Leapfrog grades and descriptive characteristics) and the dependent variables (30-day mortality rates). Specifically, the three dependent variables used for determining correlations will consist of pneumonia, CHF, and AMI 30-day mortality rates derived from publicly available CMS data.

The study was built upon similar studies that also looked to correlate the predictability of publicly available health scores/grades and quality indicators. One similar study sought to determine a relationship between Leapfrog scores and hospital-acquired infections (Pakyz et al., 2017) and provide an approach that was used for this study.

Research Questions and Hypotheses

RQ1: Does an organization's Leapfrog grade demonstrate a statistically significant correlation with the CMS pneumonia mortality rate data adjusting for each covariate: licensed beds, ownership type, state of residency, safety net hospital status, state Medicaid expansion status, and organization's teaching status?

$H_1 1$: The available consumer available health organization's Leapfrog grade is predictive of patient pneumonia mortality rate data adjusting for each covariate: licensed beds, ownership type, state of residency, safety net hospital status, state Medicaid expansion status, and organization's teaching status.

$H_0 1$: There is no correlation between Leapfrog grades and patient health mortality rates based on pneumonia data adjusting for each covariate: licensed beds, ownership type, state of residency, safety net hospital status, state Medicaid expansion status, and organization's teaching status.

RQ2: Does an organization's Leapfrog grade demonstrate a statistically significant correlation with CMS congestive heart failure (CHF) patient mortality rate data adjusting for each covariate: licensed beds, ownership type, state of residency, safety net hospital status, state Medicaid expansion status, and organization's teaching status?

$H_1 2$: The available consumer available health organization's Leapfrog grade is predictive of patient chronic heart failure (CHF) mortality rate data adjusting for each covariate: licensed beds, ownership type, state of residency, safety net hospital status, state Medicaid expansion status, and organization's teaching status.

$H_0$2: There is no correlation between Leapfrog grades and patient mortality rates based on CHF data adjusting for each covariate: licensed beds, ownership type, state of residency, safety net hospital status, state Medicaid expansion status, and organization's teaching status.

RQ3: Does an organization's Leapfrog grade demonstrate a statistically significant correlation with CMS acute myocardial infarctions (AMI) patient mortality rate data adjusting for each covariate: licensed beds, ownership type, state of residency, safety net hospital status, state Medicaid expansion status, and organization's teaching status?

$H_1$3: The available consumer available health organization's Leapfrog grade is predictive of patient pneumonia mortality rate data adjusting for each covariate: licensed beds, ownership type, state of residency, safety net hospital status, state Medicaid expansion status, and organization's teaching status.

$H_0$3: There is no correlation between Leapfrog grades and patient health mortality rates based on pneumonia data adjusting for each covariate: licensed beds, ownership type, state of residency, safety net hospital status, state Medicaid expansion status, and organization's teaching status.

Study Population Estimates

Acute care hospitals from eight states (GA, MD, NC, OH, PA, TN, VA, and WV) that contain required data elements (Table 2) were included. To be included, each hospital had to have the following minimum data elements: Fall 2018 Leapfrog grade, at least one of the three 30-day mortality rates, determined safety-net status, and all AHA survey elements.

Table 2

Required Data Elements for Study Inclusion

Data Element	Source
Independent Variables	
Leapfrog grades	2018 Leapfrog Hospital Safety Grades
Dependent Variables	
Pneumonia 30-day mortality rate	CMS.gov
CHF 30-day mortality rate	CMS.gov
AMI 30-day mortality rate	CMS.gov
Covariates	
Safety-net status	CMS.gov (DSH payments)
Ownership Type	2017 AHA Survey (ahadataview.com)
Teaching status	2017 AHA Survey (ahadataview.com)
Licensed beds (size)	2017 AHA Survey (ahadataview.com)
State of residency	2017 AHA Survey (ahadataview.com)
Medicaid expansion	Kaiser Family Foundation (KFF.org)

Estimated Sample Size

Table 3 provides the number of acute hospitals that in each state that received grades by the Leapfrog Group using the Fall 2018 dataset. The total number of available hospitals was 590. However, the numbers were reduced when additional data elements were found to be missing from the various datasets.

Table 3

Number of Acute Care Hospitals Available for Study (per State)

State	Medicaid Expansion (as of 12/31/2018)	Number of graded hospitals
Maryland	Yes	40
Ohio	Yes	110
Pennsylvania	Yes	132
West Virginia	Yes	24
Georgia	No	74
North Carolina	No	79
Tennessee	No	65
Virginia	No	66

Power Analysis

An a priori power analysis was performed using G*Power (Version 3.1.9.2) to determine if the number of hospitals included in the study would be sufficient to detect a significant difference at a small effect size ($f^2 = .02$). With an $\alpha = 0.05$ and at 80% predictive power, the minimum number of hospitals was 395 (Table 4). The small effect size was selected due to the expected small difference among facilities and mortality rates. The 80% predictive power was selected to give a minimum lower level. However, based on the final sample sizes, all levels were > 85%. There were 468 hospitals included for AMI mortality rates. Pneumonia and CHF mortality rates each had 522 hospitals analyzed. The study exceeded the a priori minimum power to detect any differences that exist.

Table 4

A Priori Predicted Study Size Calculation

Inputs:	Tail(s)	2
	Effect size (f^2)	0.02
	α value	0.05
	Power	0.80
	Number of predictors	8
Outputs:	Sample size	395
	Actual power	0.8006

Secondary Data Types and Sources of Information

The data for each hospital was obtained from the Hospital Compare website at CMS.gov, the AHA Annual survey data obtained from the AHA website, and the Leapfrog website. Table 2 details which elements are derived from which source.

Data Collection and Management

All data for this study was obtained from publicly available datasets. No patient or other protected information was utilized. All data were downloaded directly from the various sources and kept on both my personal computer and backed-up using cloud storage.

Study Analytical Strategies

This study used linear regression analysis modeling to determine if statistically significant correlations exist between the three dependent variables patient outcomes (pneumonia, CHF, and AMI) and the independent variables while adjusting for each covariate (licensed beds, ownership type, state of residency, safety-net hospital status, state Medicaid expansion status, organization's safety net designation, and organization's teaching status).

All data were analyzed using SPSS (version 25) with the data tables imported from Microsoft® Excel®. A Means analysis for each independent-dependent combination was performed using the Compare Means tool. Multiple regressions were run using the Regression tool.

Initial Significance Modeling: Means Analysis

Each independent was analyzed using the Means test to check for statistical significance that may exist with each dependent variable before inclusion in the multiple regression analysis for each dependent variable. The a priori acceptable level of significance was set at $p \leq .05$. Eta Square (η^2) value was used to demonstrate the strength of the association between each independent–dependent variable Means analysis. For all categorical data elements (Table 5), dummy variables were utilized to allow for regression analysis. Each independent was analyzed using the Means test to check for statistical significance that may exist with each dependent variable before including the independent variables in the multiple regression analysis.

Table 5

Data Type for Each Study Variable

Data Element	Data Type
Independent Variables	
Leapfrog grades	Categorical: A, B, C, D, or F
Dependent Variables	
Pneumonia 30-day mortality rate	Continuous
CHF 30-day mortality rate	Continuous
AMI 30-day mortality rate	Continuous
Covariates	
Safety-net status	Categorical (dichotomous): Yes or No
Ownership Type	Categorical: for-profit, not-for-profit, or public
Teaching status	Categorical: Major, Minor, or non-teaching
Licensed beds (size)	Continuous
State of residency	Categorical: GA, MD, NC, OH, PA, TN, VA, and WV
Medicaid expansion	Categorical (dichotomous): Yes or No

Multiple Regression Analysis

Three multiple regression analyses were performed, one for each dependent variable. An a priori $p \leq .05$ was used to determine if the model exhibited statistical significance. The unstandardized β was analyzed to determine the effect size of each included independent variable. The adjusted R^2 was utilized to determine the strength of the model. VIF score of ≥ 5 was utilized for determining collinearity among the independent and covariate variables. Any data element that demonstrated multicollinearity, using VIF or tolerance, was removed from the final regression.

Threats to Validity

Leapfrog grades are calculated by using either hospital supplied data or captured from Medicare publicly available data. The validity of the data provided to Leapfrog from each participating organization is not able to be checked to ensure the values are valid during this study.

Ethical Considerations

I will not have contact with any organization the compiled and supplied the publicly available datasets (e.g., Leapfrog). There was no primary data collected for this study. The Walden University institutional review board was consulted and approval granted before any research was conducted.

Summary

In Section 2, I provided the proposed study design and data collection methods used for determining a correlation between Leapfrog grades and 30-day mortality rates.

Additional analysis was performed to determine if any of the indicated covariates demonstrate any statistically significant correlations. Furthermore, data collecting, handling, and analysis have also been provided to help ensure all results derived from this study are valid. Lastly, possible data threats and ethical concerns were addressed.

Section 3: Presentation of the Results and Findings

Introduction

The primary purpose of this study was to determine if Leapfrog hospital grades are predictive of patient mortality rates for pneumonia, AMI, and CHF using CMS data from hospitals with other elements from eight states (GA, MD, OH, NC, PA, TN, VA, and WV) similar to Leapfrog focused studies (Pakyz et al., 2017). In this section, the data collection methods, data selection criteria, data analysis methodologies, and a summary of the statistical results are presented. The final number of hospitals that were included in the study was 524 with no individual dependent variable having more than 522 hospitals. To be included, each hospital had to have the following minimum data: Leapfrog grade, at least one of the three 30-day mortality rates, determined safety-net status, and all AHA survey elements.

Secondary Data Element Collection

Leapfrog Hospital Safety Grades

The Fall 2018 Leapfrog Hospital Safety Grades were the most currently available when the data was collected from the Leapfrog Group's website in December 2018. For each state included in the study (GA, MD, OH, NC, PA, TN, VA, and WV), the selection was made for search by state and the state was entered. This process allowed for the propagation of a listing of all hospitals within each state. The list consisted of the hospital's name, the hospital's address, and their corresponding safety grade. Each hospital name and corresponding grade was entered into an Excel® spreadsheet. There were 590 individual hospital entries (see Table 3 for distribution by state).

30-Day Mortality Rates (AMI, CHF, and Pneumonia)

The CMS 30-day mortality rate data was recovered from the CMS.gov website. The dataset was downloaded as an Excel® file to allow for appropriate sorting. The data were sorted by state and placed in alphabetical order. All data elements that did not pertain to the 30-day mortality rate information were eliminated, along with the states not included in this study. Each Leapfrog hospital had its results manually entered for AMI, CHF, and pneumonia 30-day mortality rates. Hospitals were matched by facility name and address. However, when the hospital names did not match, the address of the facility was used to ensure the facilities were indeed the same. Of the 590 hospitals with Leapfrog grades, 30-day mortality rates were available for 79.3% (n=468) for AMI, 88.5% (n=522) for CHF, and 88.5% (n=522) for pneumonia.

Table 6 presents the mortality rates for each dependent variable. It is important to note, and will be used later, the spread of the values among the hospitals for each dependent variable (AMI=8.6, CHF=10.3, and pneumonia=12.2). The greater the variability of each mortality rates among the hospitals increases the possibility of discovering statistical differences among hospitals.

AHA Data Elements (Teaching Status, Number of Beds, and Ownership Type)

Each hospital with a Leapfrog grade had their AHA survey data accessed through the Health Forum website (ahadataviewer.com) in December 2018 – January 2019. Health Forum is an affiliate of the AHA and provides access to AHA survey data. An attempt was made to find the AHA survey data for each of the 590 Leapfrog hospitals. An information sheet for each hospital was printed using the "Free Hospital Look-Up" feature. AHA survey data was found for 90.3% (*n*=533) of the Leapfrog hospitals. The 57 hospitals without verifiable AHA data were eliminated from the study. All relevant data elements were manually entered into the data collection spreadsheet.

Safety-Net Status

Safety-net status was derived from the "CMS DSH Payment Percentages" found on CMS.gov on January 4, 2019. The percentage of DSH payments, as reported by each hospital, varied between November 2015 and September 2017. Each state's percentages were sorted from highest to lowest. The top quartile from each state was designated as a safety-net hospital regardless of whether the hospitals were included as part of the study. The sorting of all hospitals allowed for an accurate ranking of the state's safety-net hospitals. When there was a tie among hospitals for the final quartile position, all hospitals with that DSH payment percentage were included as a safety-net hospital. Each hospital's safety-net designation manually loaded into the spreadsheet as a dichotomously coded variable (1 =Yes, 0 =No). Because a disproportionate share of safety-net hospitals had Leapfrog scores, at least one CMS mortality rate, and AHA survey data (*n*=533), 43.4% (n=232) of hospital included in the study were designated as safety-net, and 56.6% (*n*=302) were not safety-net.

Medicaid Expansion

Each of the study's eight state's Medicaid expansion status was through December 31, 2018. The status of each state was derived from the Kaiser Family

Foundation's website (KFF.org). Each hospital's Medicaid expansion designation manually loaded into the spreadsheet as a dichotomously coded variable (1 =Yes, 0 =No).

State

Each hospitals state was loaded into the dataset as extracted from the Leapfrog database and confirmed using both the CMS and AHA datasets. There were no discrepancies found within the dataset when determining the state in which each hospital is physically located.

Descriptive Statistics

The descriptive statistics for each dependent variable are listed in Table 6. The scores for AMI mortality rates: n=468, $\bar{x}$=13.20, SD=1.15, minimum=10.1, and maximum=18.7; CHF mortality rates: n=522, $\bar{x}$=11.57, SD=1.64, minimum=6.7, and maximum=17.0; pneumonia mortality rates: n=522, $\bar{x}$=16.07, SD=2.00, minimum=11.3, and maximum=23.5. Figures 2-4 demonstrate that each dependent variable is normally distributed around the mean.

Table 6

Descriptive Statistics for Dependent Variables

Variable	*n*	Min	Max	Mean	SD
AMI 30-Day Mortality Rate	468	10.1	18.7	13.20	1.15
CHF 30-Day Mortality Rate	522	6.7	17.0	11.57	1.64
Pneumonia 30-Day Mortality Rate	522	11.3	23.5	16.07	2.00

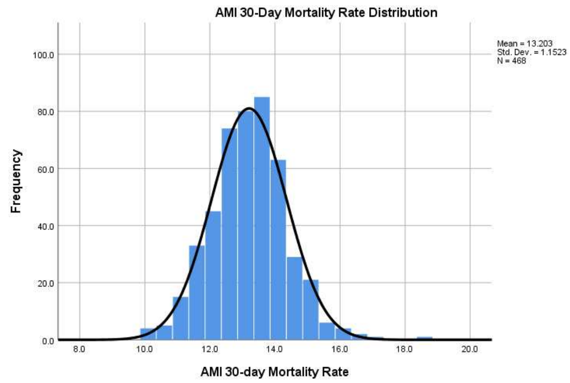

Figure 2: AMI 30-day mortality rate distribution

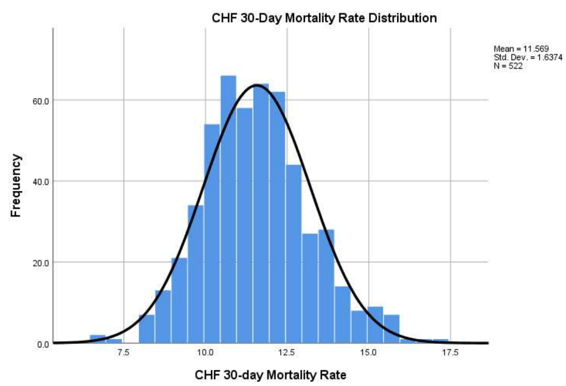

Figure 3: CHF 30-day mortality rate distribution

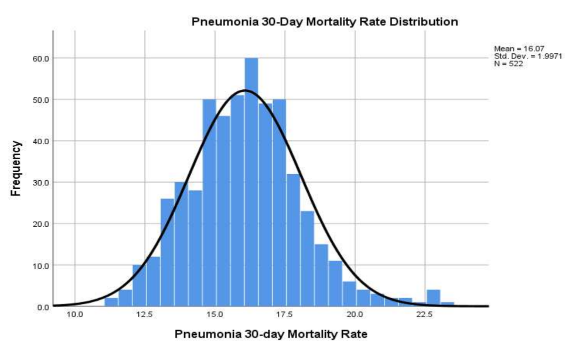

Figure 4: Pneumonia 30-day mortality rate distribution

The descriptive statistics for each independent variable are listed in Table 7. It is notable that for the Leapfrog grades, that none of the 524 included hospitals received an "F" for the Fall 2018 grades. The Leapfrog grades were distributed as such: 37.2% received an "A" (*n*=195), 24.4% received a "B" (*n*=128), 33.0% received a "C" (*n*=173), and only 5.3% received a "D" (*n*=28). With the absence of any "F" grades, the distribution of Leapfrog grades is skewed heavily to the left and does not demonstrate a normal distribution.

Safety-net hospital status ("Yes" =43.7%, "No" =56.37%) and Medicaid expansion ("Yes" =51.9%, "No" =48.1%) were nearly equally distributed. The distribution of teaching status (Major =10.7%, Minor =50.4%, Nonteaching =38.9%) and ownership type (Not-For-Profit =78.2%, For-Profit =12.4%, Public =9.4%) were not equally distributed and demonstrated that a strong propensity towards minor teaching status and not-for-profit status. The distribution of hospitals among the eight states (PA =21.4%, OH =18.7%, NC =13.7%, GA =13.0%, VA =11.6%, TN=9.7%, MD =7.4%, WV =4.4%) demonstrate a distribution that very closely resembled each states population.

Table 7

Descriptive Statistics for Independent Variables

Variable	*n*	%
Leapfrog Grades		
A	195	37.2%
B	128	24.4%
C	173	33.0%
D	28	5.3%
F	0	0.0%
Safety-Net Hospital		
Yes	229	43.7%
No	295	56.3%
Medicaid Expansion		
Yes	272	51.9%
No	252	48.1%
State		
GA	68	13.0%
MD	39	7.4%
NC	72	13.7%
OH	98	18.7%
PA	112	21.4%
TN	51	9.7%
VA	61	11.6%
WV	23	4.4%
Teaching Status		
Major	56	10.7%
Minor	264	50.4%
Non-Teaching	204	38.9%
Ownership Type		
Not-For-Profit	410	78.2%
For-Profit	65	12.4%
Public	49	9.4%
Licensed Bed Groupings		
<100	111	21.2%
100 – 199	151	28.8%
200 – 499	189	36.1%
≥500	73	13.9%

Study Results

After completing the collection, collating, and description of the data elements for each hospital, the SPSS Means comparison test was performed with each independent variable to test significance with each dependent variable. The Means test was done to ensure that only independent variables that demonstrated significance ($p < .05$) were included in the multiple regression analyses.

The multiple regression modeling for each dependent variable was performed using indicator, or dummy, variables for the noncontinuous independent variables (Leapfrog grade, state, teaching status, ownership type, and groupings of bed size). For dichotomous independent variables (safety-net and Medicaid expansion) the data was entered using binary coding (yes = 1 and no = 0). The reference value for each set of indicator variables used for the multiple regression analysis was: Leapfrog grade – "A," state – Virginia, teaching status – major, ownership type – not-for-profit, and groupings of bed size – small (< 100 beds).

Research Question #1: Pneumonia Data

RQ1. Does an organization's Leapfrog grade demonstrate a statistically significant correlation with the CMS pneumonia mortality rate data adjusting for each covariate: licensed beds, ownership type, state of residency, safety net hospital status, state Medicaid expansion status, and organization's teaching status?

Means comparison testing. Using the ANOVA results from the Means comparison test, Table 8 depicts that Leapfrog grades (p=.042), Medicaid expansion (p<.001), state (p<.001), teaching status (p<.001), and ownership type (p<.001) all demonstrated statistical significance with 30-day pneumonia mortality rates. However, safety-net hospital status (p=.964) and number of beds (p=.360) failed to demonstrate statistical significance and were not included in the multiple regression analyses.

Table 8

Means Comparison of Independent Variables and Pneumonia 30-Day Mortality Rates

Variable	*n*	Mean	SD	*p*
Leapfrog Grades				.042
A	194	15.8	2.0	
B	127	16.3	2.0	
C	173	16.3	2.0	
D	28	15.9	1.4	
Safety-Net Hospital				.964
Yes	228	16.1	2.0	
No	294	16.1	2.0	
Medicaid Expansion				<.001
Yes	271	15.5	1.8	
No	251	16.6	2.0	
State				<.001
GA	68	16.4	2.1	
MD	39	16.1	1.6	
NC	72	17.3	1.8	
OH	98	15.1	1.8	
PA	111	15.7	1.8	
TN	51	16.7	2.1	
VA	60	16.1	1.9	
WV	23	15.7	2.2	
Teaching Status				<.001
Major	55	15.4	1.8	
Minor	264	15.9	1.9	
Non-Teaching	203	16.5	2.1	
Ownership Type				<.001
Not-For-Profit	409	15.9	2.0	
For-Profit	64	16.8	2.0	
Public	49	16.8	2.0	
Licensed Bed Groupings				.360
<100	111	16.3	1.9	
100 - 199	150	16.0	2.1	
200 - 499	189	16.1	2.0	
≥500	72	15.7	2.0	

Multiple regression analysis. The multiple regression analysis did not demonstrate multicollinearity, except for Pennsylvania, as all VIF values were < 3.50 and tolerance values were > .28. Pennsylvania was excluded from the SPSS multiple regression analysis as the tolerance value (.000) demonstrated multicollinearity. There was no indication of autocorrelation as the Durbin-Watson score was 1.96. The model was statistically significant ($p < .001$) with an adjusted $R^2 = .132$.

Table 9 demonstrates that among the Leapfrog grades, all hospital grades demonstrated a deterioration (positive unstandardized β indicates an increase in the percentage of pneumonia deaths) compared those for "A" rated hospitals. Only hospitals with a "C" grade (β = 0.513, $p = .010$) was statistically significantly different from the reference category ("B" = β = 0.358, $p = .096$; "D" = β = 0.250, $p = .519$). However, the actual effect size, as a percentage of the range of pneumonia values (range = 12.2), demonstrated the effect was small and the actual differences among the grades were minimal (B = 2.9%, C = 4.2%, and D = 2.0%).

Medicaid expansion did not demonstrate a statistically significant difference ($p = .276$) for 30-day pneumonia mortality rates between hospitals that reside in states that have or have not expanded Medicaid.

Using Virginia as the reference category, only North Carolina (β = 1.156, $p = .001$) and Ohio (β = -0.524, $p = .044$) were significantly different for pneumonia mortality. North Carolina's effect size demonstrated a 9.5% increase and Ohio's effect size indicated a 4.3% decrease in mortality rates. Pennsylvania was eliminated from the multiple regression analysis using SPSS due to the state demonstrating multicollinearity (tolerance = .000).

Teaching status, using major teaching status as the reference category, non-teaching status ($\beta = 0.734$, $p = .012$) demonstrated 6.0% worse outcomes and minor teaching status ($\beta = 0.463$, $p = .098$) just failed to exhibit statistical significance.

There was a significant difference demonstrated among not-for-profit (reference category) and for-profit hospitals ($\beta = 0.678$, $p = .011$), but not for public hospitals ($\beta = 0.159$, $p = .610$). The effect size for the for-profit hospitals revealed a 5.6% increase in mortality rates.

Table 9

Multiple Regression Analysis for Pneumonia 30-Day Mortality Rates (N=522)

Variable	Unstandardized β	*P*	VIF	Tolerance
Leapfrog Grades (A = reference category)				
B	.358	.096	1.280	.781
C	.513	.010	1.328	.753
D	.250	.519	1.147	.872
Medicaid Expansion	-.331	.276	3.467	.288
State				
(VA = reference category)				
GA	.244	.469	1.934	.517
MD	.397	.258	1.283	.780
NC	1.156	.001	2.100	.476
OH	-.524	.044	1.554	.644
TN	.312	.391	1.751	.571
WV	-.193	.656	1.189	.841
PA – excluded variable				.000
Teaching Status				
(Major = reference category)				
Minor	.463	.098	2.940	.340
Non-Teaching	.734	.012	3.002	.333
Ownership Type				
(Not-For-Profit = reference category)				
For-Profit	.678	.011	1.141	.876
Public	.159	.610	1.237	.809

Research Question #2: CHF

RQ 2. Does an organization's Leapfrog grade demonstrate a statistically significant correlation with CMS congestive heart failure (CHF) patient mortality rate data adjusting for each covariate: licensed beds, ownership type, state of residency, safety net hospital status, state Medicaid expansion status, and organization's teaching status?

Means comparison testing. Using the ANOVA results from the Means comparison test, Table 10 depicts that Medicaid expansion (p = .003), state (p = .001), teaching status (p = .003), ownership type (p = .001), and number of beds (p = .033) all demonstrated statistical significance with 30-day CHF mortality rates. However, Leapfrog grades (p = .115) and safety-net hospital status (p = .159) failed to demonstrate statistical significance and were not included in the multiple regression analyses.

Table 10

Means Comparison of Independent Variables and CHF 30-Day Mortality Rates

Variable	*n*	Mean	SD	*p*
Leapfrog Grades				.115
A	194	11.5	1.6	
B	127	11.6	1.6	
C	173	11.8	1.7	
D	28	11.0	1.5	
Safety-Net Hospital				.159
Yes	229	11.5	1.6	
No	293	11.7	1.6	
Medicaid Expansion				.003
Yes	270	11.4	1.7	
No	252	11.8	1.5	
State				.001
GA	68	11.6	1.6	
MD	39	10.9	1.8	
NC	72	12.1	1.3	
OH	97	11.3	1.8	
PA	111	11.5	1.5	
TN	51	12.2	1.6	
VA	61	11.3	1.5	
WV	23	11.6	1.8	
Teaching Status				.003
Major	55	11.1	1.8	
Minor	263	11.4	1.7	
Non-Teaching	204	11.8	1.5	
Ownership Type				.001
Not-For-Profit	409	11.4	1.6	
For-Profit	65	11.9	1.5	
Public	48	12.3	1.7	
Licensed Bed Groupings				.033
<100	110	11.9	1.5	
100 - 199	151	11.6	1.6	
200 - 499	189	11.4	1.7	
≥500	72	11.3	1.6	

Multiple regression analysis. The multiple regression analysis, as seen in Table 11, did not demonstrate multicollinearity for the tested variables, except for Medicaid expansion, as all VIF values were < 4.722 and tolerance values were > .211. Medicaid expansion was removed from the SPSS analysis due to the demonstration of multicollinearity (tolerance = .000). There was no indication of autocorrelation as the Durbin-Watson score was 2.085. The model was statistically significant ($p < .001$) with the adjusted $R^2 = .049$ revealing the model has a very weak relationship among the independent variables and CHF mortality rates.

Using Virginia as the reference category, only North Carolina (β = 0.686, *p* = .020) and Tennessee (β = 0.761, *p* = .014) were significantly different for CHF mortality. Both states demonstrated increased CHF mortality rates (North Carolina = 6.7%, Tennessee = 7.4%) when compared to Virginia.

When comparing teaching statuses, using major teaching status as the reference category, minor teaching status (β = 0.222, *p* = .431) nor non-teaching status (β = 0.358, *p* = .251) demonstrated statistical significance for CHF.

There was a significant difference demonstrated among not-for-profit (reference category) and public hospitals (β = 0.543, *p* = .044); however, for-profit hospitals (β = 0.253, *p* = .266) failed to exhibit statistical significance for CHF. The β for public hospitals suggests a 5.3% increase in CHF mortality than the reference category.

There was no statistically significant difference among hospitals with differences in the number of licensed beds using small, < 100 beds, as the reference category.

Medium, 100 – 199, (β = -0.338, *p* = .099), large, 200 – 499, (β = -0.339, *p*=.099), and very large, 500+, (β = -0.523, *p* = .079).

Table 11

Multiple Regression Analysis for CHF 30-Day Mortality Rates (N=522)

Variable	Unstandardized β	*P*	VIF	Tolerance
Medicaid Expansion –*excluded variable*				.000
State				
(VA = reference category)				
GA	.302	.292	1.901	.526
MD	-2.33	.485	1.577	.634
NC	.686	.020	2.101	.476
OH	.139	.601	2.177	.459
PA	.306	.236	2.279	.439
TN	.761	.014	1.727	.579
WV	.300	.445	1.326	.754
Teaching Status				
(Major = reference category)				
Minor	.222	.431	4.065	.246
Non-Teaching	.358	.251	4.721	.212
Ownership Type				
(Not-For-Profit = indicator variable)				
For-Profit	.253	.266	1.152	.868
Public	.543	.044	1.233	.811
Licensed Bed Groupings				
(<100 = reference category)				
100 - 199	-.338	.099	1.756	.569
200 - 499	-.339	.099	1.991	.502
500+	-.523	.079	2.152	.465

Research Question #3: AMI

RQ 3. Does an organization's Leapfrog grade demonstrate a statistically significant correlation with CMS acute myocardial infarctions (AMI) patient mortality rate data adjusting for each covariate: licensed beds, ownership type, state of residency, safety net hospital status, state Medicaid expansion status, and organization's teaching status?

Means comparison testing. Using the ANOVA results from the Means comparison test, Table 12 depicts that Medicaid expansion ($p < .001$), state ($p < .001$), teaching status ($p < .001$), and ownership type ($p < .001$), all demonstrated statistical significance with 30-day AMI mortality rates. However, Leapfrog grades ($p = .345$), safety-net hospital status ($p = .395$), and number of beds ($p = .365$) failed to demonstrate statistical significance and were not included in the multiple regression analyses.

Table 12

Means Comparison of Independent Variables and AMI 30-Day Mortality Rates

Variable	*n*	Mean	SD	*p*
Leapfrog Grades				.345
A	172	13.1	1.2	
B	114	13.2	1.3	
C	157	13.3	1.1	
D	25	13.1	1.1	
Safety-Net Hospital				.395
Yes	212	13.3	1.2	
No	256	13.2	1.1	
Medicaid Expansion				<.001
Yes	239	12.9	1.1	
No	229	13.5	1.1	
State				<.001
GA	60	13.5	1.2	
MD	35	13.0	1.0	
NC	69	13.5	1.1	
OH	81	12.7	1.1	
PA	100	12.9	1.1	
TN	42	13.7	1.3	
VA	58	13.4	0.9	
WV	23	13.3	1.1	
Teaching Status				<.001
Major	55	13.2	1.5	
Minor	245	13.0	1.1	
Non-Teaching	168	13.5	1.1	
Ownership Type				<.001
Not-For-Profit	371	13.1	1.1	
For-Profit	56	13.7	1.1	
Public	41	13.7	1.3	
Licensed Bed Groupings				.360
<100	70	13.3	0.8	
100 - 199	139	13.2	1.1	
200 - 499	188	13.2	1.2	
≥500	71	13.0	1.4	

Multiple regression analysis. The multiple regression analysis, as seen in Table 13, did not demonstrate multicollinearity, except for Pennsylvania, as all VIF values were < 3.27 and tolerance values were > .30. Pennsylvania was excluded from the SPSS multiple regression analysis as the tolerance value (.000) demonstrated multicollinearity. There was no indication of autocorrelation as the Durbin-Watson score was 1.98. The model was statistically significant ($p < .001$) with a weak adjusted $R^2 = .101$.

Medicaid expansion demonstrated that for hospitals in states that did not expand Medicaid, there was a 4.6% improvement ($\beta = -0.396$, $p = .031$) in AMI mortality rates when compared with those that did expand Medicaid.

Using Virginia as the reference category, none of the states were significantly different for AMI mortality rates [GA ($\beta = 0.114$, $p = .574$), MD ($\beta = 0.152$, $p = .481$), NC ($\beta = -0.004$, $p = .985$), OH ($\beta = -0.122$, $p = .458$), TN ($\beta = 0.182$, $p = .420$), WV ($\beta = 0.320$, $p = .209$)]. Pennsylvania was excluded from the SPSS multiple regression analysis as the tolerance value (.000) demonstrated multicollinearity.

When comparing teaching statuses, using major teaching status as the reference category, minor teaching status ($\beta = -0.238$, $p = .150$) nor non-teaching status ($\beta = 0.116$, $p = .505$) demonstrated statistical significance for AMI.

There was a significant difference demonstrated among not-for-profit (reference category) and for-profit hospitals ($\beta = 0.392$, $p = .019$), but not for public hospitals ($\beta = 0.384$, $p = .052$). The for-profit β indicated a 4.6% increase in AMI mortality rates.

Table 13

Multiple Regression Analysis for AMI 30-Day Mortality Rates (N=468)

Variable	Unstandardized β	*P*	VIF	Tolerance
Medicaid Expansion	-.396	.031	3.261	.307
State				
(VA = reference category)				
GA	.114	.574	1.815	.551
MD	.152	.481	1.256	.796
NC	-.004	.985	2.093	.478
OH	-.122	.458	1.514	.661
TN	.182	.420	1.619	.618
WV	.320	.209	1.184	.845
PA – excluded variable				.000
Teaching Status				
(Major = reference category)				
Minor	-.238	.150	2.666	.375
Non-Teaching	.116	.505	2.737	.365
Ownership Type				
(Not-For-Profit = reference category)				
For-Profit	.392	.019	1.149	.870
Public	.384	.052	1.220	.820

Summary

Above, the data analysis was presented for both the performed Means comparisons testing and multiple regression analysis for each dependent variable. Leapfrog Hospital Safety Grades do not reliably predict patient outcomes for 30-day patient mortality rates. The regression modeling demonstrated weak relationships for each dependent variable; however, the pneumonia model was the best at demonstrating predictable differences among the various independent variables. Additional findings are that Medicaid expansion correlates with better outcomes for AMI (β = -0.396, p = .031, decrease of 4.6%), North Carolina has worse outcomes for both pneumonia (β = 1.156, p

= .001, increase of 9.5%) and CHF (β = 0.686, *p* = .020, increase of 6.7%), Ohio has improved pneumonia outcomes (β = -0.524, *p* = .044, decrease of 4.3%), Tennessee has worse CHF outcomes (β = 0.761, *p* = .014, increase of 7.4%), non-teaching hospitals have poorer pneumonia outcomes (β = 0.734, *p* = .012, increase of 6.0%), For-Profit hospitals have worse outcomes for both pneumonia (β = 0.678, *p* = .011, increase of 5.6%) and AMI (β = 0.392, *p* = .019, increase of 4.6%), while publicly owned facilities have worse outcomes for CHF (β = 0.543, *p* = .044, increase of 5.3%), when adjusting for other included covariates. Overall, ownership type and selected states (e.g., North Carolina) was a significant predictor for two of the three dependent variables. While most of the covariates provided some predictive value for at least one of the included outcomes, in most cases, the effect (β) was small.

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

Introduction

The purpose of this research study was to determine if publicly available Leapfrog Hospital Safety Grades could be used by healthcare consumers to select hospitals with an expectation of improved 30-day mortality rates for pneumonia, CHF, and AMI. The data was also analyzed to determine if specified covariates were correlated with these same patient outcomes to further assist consumers with their healthcare choices. It is important that publically available healthcare ratings and information provided to healthcare consumers are accurate indications of the care provided.

Interpretation of Results

RQ1: Analysis

Leapfrog grades and pneumonia. Leapfrog grades are correlated with 30-day mortality rates for pneumonia (p = 0.42). Therefore, the $H_0 1$ is rejected, and $H_1 1$ is accepted. The Leapfrog grade does allow consumers to predict 30-day mortality outcomes for pneumonia, but with a very low level of association (η^2 = .016) may lead to inaccurate predictions despite the acceptable level of statistical significance. However, only between “A” and “C” grades were differences exhibited among the grades themselves (p = .010) and pneumonia mortality rates in the multiple regression model. The model itself exhibited a weak relationship (adjusted R^2 = .132) between the included variables and dependent variable.

Covariates and pneumonia. When looking at the effect of the various covariates have on pneumonia mortality rates, there was a significant difference demonstrated for Medicaid expansion ($p < .001$), among the states ($p < .001$), teaching status ($p < .001$), and ownership type ($p < .001$), when analyzed as groups.

When analyzing pneumonia mortality rates for Medicaid expansion, there is statistically no difference between states that have expanded Medicaid and those that have not ($p = .276$) when all significant covariates are analyzed as part of the multiple regression.

The differences between Virginia (reference value) and North Carolina ($\beta = 1.156$, $p = .001$) was statistically significant and demonstrated that North Carolina has a significantly higher mortality rate from pneumonia. There was also a statistical difference demonstrated between Virginia and Ohio ($\beta = -0.524$, $p = .044$). However, in this case, Ohio has lower mortality rates than Virginia. The remaining did not demonstrate any statistical difference when compared to Virginia. Therefore, there are statistically significant differences among states for pneumonia 30-day mortality rates.

Teaching status did demonstrate a statistical difference between major teaching (reference category) and hospitals that are non-teaching ($\beta = 0.734$, $p = .012$). These results demonstrate that non-teaching hospitals worse 30-day mortality rates for patients with pneumonia than those patients treated at major teaching hospitals. There was no difference, at the a priori $p < .05$ level, between major teaching and minor teaching ($\beta = 0.463$, $p = .098$). However, the differences are such that major teaching hospitals may do a better job of treating pneumonia, thus reducing the mortality rates, at least when compared to non-teaching hospitals. It is important to note that 84% of major teaching hospitals in this study are not-for-profit organizations. Therefore, the linkage between major teaching status and ownership type might explain a lot of the effect being demonstrated in both categories.

Ownership type demonstrated a significant difference among not-for-profit (reference category) and for-profit hospitals ($\beta = 0.678$, $p = .011$), but not for public hospitals ($\beta = 0.159$, $p = .610$). The data demonstrated that not-for-profit hospitals do have a 5.6% decrease in pneumonia mortality than for-profit hospitals.

RQ2: Analysis

Leapfrog grades and CHF. Leapfrog grades were found not to be correlated with 30-day mortality rates for CHF ($p = .115$). Leapfrog grades had a very weak association ($\eta^2 = .011$) with CHF mortality rates. Therefore, the $H_0 2$ cannot be rejected, and must be is accepted. The Leapfrog grades are not a reliable tool for consumers to predict 30-day mortality outcomes for CHF. The lack of correlation between a hospital's Leapfrog grade and patient CHF outcomes is a significant finding and will be discussed further.

Covariates and CHF. When looking at the effect of the various covariates have on CHF mortality rates, there was significant difference demonstrated for Medicaid expansion ($p = .003$), state ($p = .001$), teaching status ($p = .003$), ownership type ($p = .001$), and number of beds ($p = .033$). The only covariate that failed to demonstrate statistical significance for 30-day CHF mortality rates was safety-net hospital status ($p = .159$). It is important to note that the model demonstrates a weak relationship (adjusted

R^2 = .050) as almost none of the variance in the dependent variable is explained by the independent variables.

Medicaid expansion, while being correlated with CHF outcomes, was unable to be used as part of the multiple regression analysis due to multiple collinearity (tolerance = .000), and was excluded from the analysis by SPSS. However, it is still notable that Medicaid expansion is correlated with CHF outcomes, and can be used a predictor.

When compared individually to Virginia, North Carolina (β = 0.686, *p* = .020) and Tennessee (β = 0.761, *p* = .014) both demonstrated worse 30-day outcomes for patients with CHF. While none of the other states demonstrated a statistically significance when compared to Virginia, the analysis demonstrates that there are significant differences among states and CHF outcomes.

Teaching status failed to demonstrate any difference among hospitals for patient outcomes for CHF using major teaching status as the reference category. The individual comparison between major teaching and both minor teaching (β = 0.222, *p* = .431) and non-teaching (β = .358, *p* = .251) hospitals did not have either value even approach significance.

Ownership type, using not-for-profit as the reference category, demonstrated a significant difference with public hospitals (β = 0.543, *p* = .044); however, for-profit hospitals (β = .253, *p* = .266) did not demonstrate any such difference. Therefore, not-for-profit hospitals do demonstrate significantly better outcomes for CHF than public hospitals.

All hospitals sizes [Medium, 100 – 199, (β = -0.338, p = .099), large, 200 – 499, (β = -0.339, p = .099), and very large, 500+, (β = -0.523, p = .079)] demonstrated improved CHF mortality rates when compared to small hospitals at the $p < 0.1$ level. However, the a priori significance level for this study was established at $p < .05$; therefore, none of the numbers are considered to be statistically significant for this study.

RQ3: Analysis

Leapfrog grades and AMI. Leapfrog grades were found not to be correlated with 30-day mortality rates for AMI (p = .345). Leapfrog grades had an extremely weak association (η^2 = .007) with AMI mortality rates. Therefore, the $H_0 3$ cannot be rejected, and must be is accepted. The Leapfrog grades are not a reliable tool for consumers to predict 30-day mortality outcomes for AMI. The lack of correlation between a hospital's Leapfrog grade and patient AMI outcomes is a significant finding and will be discussed further.

Covariates and AMI. When analyzing the effect of the various covariates, using Means comparison, on AMI mortality rates, there was significant difference demonstrated for Medicaid expansion ($p < .001$), state ($p < .001$), teaching status ($p < .001$), and ownership type ($p < .001$). Safety-net status (p = .395) and number of beds (p = .360) failed to demonstrate statistical significance for 30-day AMI mortality rates. In addition, the model demonstrated a weak relationship (adjusted R^2 = .101) as most of the variance in the dependent variable is not explained by the independent variables.

Medicaid expansion results demonstrated that patients in states without Medicaid expansion (β = 0.396, p = .031) had worse 30-day mortality rates for AMI than those states that did expand Medicaid. The reasons for improved patient outcomes for patients in states with Medicaid expansion are outside the scope of this study but may warrant further study.

State comparisons with Virginia demonstrated that the various states did not demonstrate any statistical differences for AMI mortality rates. While there was a correlation for the states, when taken as a whole, and AMI outcomes, there was no difference when the states were compared to Virginia. However, this does not mean, if a different state was used as a reference category, that some differences in AMI results would not be demonstrated.

When comparing teaching statuses, using major teaching status as the reference category, minor teaching status ($\beta = -0.238$, $p = .150$) nor nonteaching status ($\beta = 0.116$, $p = .505$) demonstrated statistical significance for AMI. Therefore, while teaching status can be correlated with AMI mortality rates, when the results are compared to major teaching status, there are no statistical differences observed. There might be differences seen if a different reference category was utilized.

There was a significant difference demonstrated among not-for-profit (reference category) and for-profit hospitals ($\beta = 0.392$, $p = .019$). However, public hospitals ($\beta = 0.384$, $p = .052$) just failed to exhibit statistical significance when compared to the study's a prior *p*-value of $< .05$. In each case, both for-profit and public had worse patient outcomes for AMI mortality rates. Future studies that include all 50 states might be able to further elucidate the strength of the relationship between ownership type and AMI mortality rates.

Limitations of the Study

Since the 30-day mortality rates are derived from Medicare patient data, it is a known limitation of this data that the data is only predictive of patients that are 65 years or older (Burke, Frakt, Khullar, Orav, & Jha, 2017). In addition, Leapfrog grades are derived from both self-reported questionnaires for participating hospitals and from CMS data for those that do not choose to participate (Austin et al., 2014). The analysis was limited to only those organizations that had adequate data elements. Organizations that did not complete an AHA survey, have a Leapfrog grade, and at least one dependent variable, were eliminated from the study. Finally, the results of this research only apply to the eight states studied and may not be conveyable to other US states.

Recommendation

The study demonstrated, within the stated limitations, that Leapfrog Hospital Safety Grades are not particularly useful for consumers to utilize if selecting a care provider expecting different mortality rates for the hospitals included. Therefore, Leapfrog Hospital Safety Grades should not be used to differentiate hospitals for patient outcomes. The data did demonstrate that some hospital characteristics could be utilized as predictors of potential patient outcomes, especially with pneumonia 30-day mortality rates, within the eight US states that were included. It is recommended that this study is expanded to include all 50 US States to ensure a regional bias is not being demonstrated. Furthermore, the expansion to all 50 States would help account for variabilities that may exist among regions and populations.

Implications for Professional Practice and Social Change

The study was able to demonstrate that healthcare consumers cannot rely upon Leapfrog grades to predict differences among hospitals for 30-day mortality rates for pneumonia, CHF, and AMI. The demonstration of the lack of linkage should cause healthcare consumers to look for other possible indicators for predicting outcomes. The study also provided a connection between various hospital descriptors (selected states, ownership type, and teaching status) that demonstrated that efforts to reduce 30-day mortality rates, especially for pneumonia, can be targeted for improvement.

Professional Practice

Healthcare continues to become more customer focused, and the amount of available quality information is also expanding to provide consumers with the information to select their healthcare providers (Scanlon, Shi, Bhandari, & Christianson, 2015). It is essential that the provider quality information is meaningful and indicative of the care provided. Studies, such as this one, are essential to analyze consumer available scores and grades to determine if correlations exist between the various ratings and patient care. Healthcare providers, like healthcare consumers, must be aware of how their care is represented within each rating system. Knowing how each rating system represents care allows healthcare providers and organizations to know which areas to focus their process improvement activities while benchmarking themselves against similar organizations.

Positive Social Change

The one facet of healthcare that can never be lost among the current wave of patient satisfaction initiatives is the importance of understanding that patient outcomes, specifically reduced mortality risks, are still the most critical aspect of care to healthcare consumers (Mühlbacher & Bethge, 2015). Therefore, determining if there is an alignment between publicly available healthcare provider ratings and patient outcome data, allows healthcare consumers to make more informed decisions where to receive their care. Studies, like this one, continue to demonstrate the strengths and weaknesses of the various rating systems and ensure they align with consumer expectations. While this study helped elucidate that Leapfrog grades are not reliable predictors of patient outcomes, it also demonstrated that efforts to reduce 30-day mortality rates, especially for pneumonia, can be targeted by selected states, ownership type, and teaching status.

Conclusion

Leapfrog Hospital Safety Grades demonstrated a statistically significant correlation for pneumonia 30-day mortality rates. However, Leapfrog grades are poorly correlated with patient 30-day mortality outcomes for CHF and AMI. The study also demonstrated, except for ownership type, the independent variables could not be used as a reliable predictor of patient outcomes across all three dependent variables. However, except for safety-net status, all the covariates did provide some predictive value of for at least one of the analyzed outcomes. Organizational ownership type did provide predictive value for all three depended variables. However, in most cases, the effect (β) was small.

The lack of a consistent correlation between Leapfrog grades and patient outcomes is a significant finding. Since mortality risk is still the most critical factor for patients (Mühlbacher & Bethge, 2015), demonstrating how publicly available grades align, or fail to align, with outcomes is of importance to healthcare consumers. This study demonstrates that there is a gap, at least between Leapfrog grades and the CHF and AMI outcomes, which need to be addressed to ensure that rating systems are consistently ranking per what is vital to consumers.

References

Agency for Healthcare Research and Quality (2005). AHRQ releases standardized hospital bed definitions. Retrieved from https://archive.ahrq.gov/research/havbed/definitions.htm

Anderson, M. E., Glasheen, J. J., Anoff, D., Pierce, R., Lane, M., & Jones, C. D. (2016). Impact of state medicaid expansion status on length of stay and in‐hospital mortality for general medicine patients at U.S. academic medical centers. *Journal of Hospital Medicine, 11*(12), 847-852. doi:10.1002/jhm.2649

Andersen, R. M. (1995). Revisiting the behavioral model and access to medical care: does it matter?. *Journal of Health and Social Behavior, 36*(1), 1-10. Retrieved from http://www.jstor.org/stable/2137284

Austin, J. M., D'Andrea, G., Birkmeyer, J. D., Leape, L. L., Milstein, A., Pronovost, P. J., ... & Wachter, R. M. (2014). Safety in numbers: the development of Leapfrog's composite patient safety score for US hospitals. *Journal of Patient Safety, 10*(1), 64-71. doi:10.1097/PTS.0b013e3182952644

Austin, J. M., Jha, A. K., Romano, P. S., Singer, S. J., Vogus, T. J., Wachter, R. M., & Pronovost, P. J. (2015). National hospital rating systems share few common scores and may generate confusion instead of clarity. *Health Affairs, 34*(3), 423-430. doi:10.1377/hlthaff.2014.0201

Bai, G., & Anderson, G. F. (2016). A more detailed understanding of factors associated with hospital profitability. *Health Affairs*, 35(5), 889-897. doi:10.1377/hlthaff.2015.1193

Bhatt, C. B., & Beck-Sagué, C. M. (2018). Medicaid Expansion and Infant Mortality in the United States. *American Journal of Public Health, 108*(4), 565–567. doi:10.2105/AJPH.2017.304218

Burke, L. G., Frakt, A. B., Khullar, D., Orav, E. J., & Jha, A. K. (2017). Association between teaching status and mortality in US hospitals. *Journal of the American Medical Association, 317*(20), 2105-2113. doi:10.1001/jama.2017.5702

Burstin, H., Leatherman, S., & Goldmann, D. (2016). The evolution of healthcare quality measurementin the United States. *Journal of Internal Medicine, 279*(2), 154-159. doi:10.1111/joim.12471

Cid Pedraza, C., Herrera, C. A., Prieto Toledo, L., & Oyarzún, F. (2015). Mortality outcomes in hospitals with public, private not-for-profit and private for-profit ownership in Chile 2001–2010. *Health policy and planning, 30*(suppl_1), i75-i81. doi:10.1093/heapol/czu143

CMS.gov. (2006). Glossary. Retrieved from https://www.cms.gov/apps/glossary/default.asp?Letter=C&Language=English

CMS.gov. (2016). Hospital Compare. Retrieved from https://www.cms.gov/medicare/quality-initiatives-patient-assessment-instruments/hospitalqualityinits/hospitalcompare.html

Dy, S. M., Chan, K. S., Chang, H. Y., Zhang, A., Zhu, J., & Mylod, D. (2016). Patient perspectives of care and process and outcome quality measures for heart failure admissions in US hospitals: how are they related in the era of public reporting? *International Journal for Quality in Health Care, 28*(4), 522-528. doi:10.1093/intqhc/mzw063

Eisenhardt, K. M., Graebner, M. E., & Sonenshein, S. (2016). Grand Challenges and Inductive Methods: Rigor without Rigor Mortis. Academy of Management Journal, 59(4), 1113-1123. doi:10.5465/amj.2016.4004

Evans, J. R., & Mai, F. (2014). Insights from the Baldrige Award item-level blinded applicant scoring data. *Quality Management Journal, 21*(2), 45-64. doi:10.1080/10686967.2014.11918384

Figueroa, J. F., Wang, D. E., & Jha, A. K. (2016). Characteristics of hospitals receiving the largest penalties by U.S. pay-for-performance programs. *British Medical Journal of Quality and Safety, 25*, 898-900. doi:10.1136/bmjqs-2015-005040

Gilman, M., Adams, E. K., Hockenberry, J. M., Wilson, I. B., Milstein, A. S., & Becker, E. R. (2014). California safety-net hospitals likely to be penalized by ACA value, readmission, and meaningful-use programs. *Health Affairs, 33*(8), 1314-1322. doi:10.1377/hlthaff.2014.0138

Gilman, M., Adams, E. K., Hockenberry, J. M., Milstein, A. S., Wilson, I. B., & Becker, E. R. (2015). Safety-net hospitals more likely than other hospitals to fare poorly under Medicare's value-based purchasing. *Health Affairs, 34*(3), 398-405. doi:10.1377/hlthaff.2014.1059

Healthcare.gov. (n.d.). Affordable Care Act (ACA). Retrieved from https://www.healthcare.gov/glossary/affordable-care-act/

Healthcare Cost and Utilization Project (HCUP). (2008). HCUP NIS Description of Data Elements. Retrieved from https://www.hcupus.ahrq.gov/db/vars/ hosp_teach/nisnote.jsp

Herrin, J., St. Andre, J., Kenward, K., Joshi, M. S., Audet, A. M. J., & Hines, S. C. (2015). Community factors and hospital readmission rates. *Health Services Research, 50*(1), 20-39. doi:10.1111/1475-6773.12177

Hicks, C. W., Canner, J. K., Arhuidese, I., Obeid, T., Black, J. H., & Malas, M. B. (2016). Comprehensive assessment of factors associated with in-hospital mortality after elective abdominal aortic aneurysm repair. *Journal of American Medical Association - Surgery, 151*(9), 838-845. doi:10.1001/jamasurg.2016.0782

Hu, J., Jordan, J., Rubinfeld, I., Schreiber, M., Waterman, B., & Nerenz, D. (2017). Correlations among hospital quality measures: What “Hospital Compare” data tell us. *American Journal of Medical Quality, 32*(6), 605–610. doi:10.1177/1062860616684012

Kaiser Family Foundation. (2018). Status of State Action on the Medicaid Expansion Decision. Retrieved from https://www.kff.org/health-reform/state-indicator/state-activity-around-expanding-medicaid-under-the-affordable-care-act/?currentTimeframe=0&sortModel=%7B%22colId%22:%22Location%22,%22sort%22:%22asc%22%7D

Manary, M., Staelin, R., Boulding, W., & Glickman, S. W. (2015). Payer mix & financial health drive hospital quality: Implications for value-based reimbursement policies. *Behavioral Science & Policy, 1*(1), 77-84. doi:10.1353/bsp.2015.0007

Medicare.gov. (n.d.). Hospital Compare: 30-day death (mortality) rates. Retrieved from https://www.medicare.gov/hospitalcompare/Data/Death-rates.html

Mendez, C. M., Harrington, D. W., Christenson, P., & Spellberg, B. (2014). Impact of Hospital Variables on Case Mix Index as a Marker of Disease Severity. *Population Health Management, 17*(1), 28-34. doi:10.1089/pop.2013.0002

Mühlbacher, A. C., & Bethge, S. (2015). Reduce mortality risk above all else: a discrete-choice experiment in acute coronary syndrome patients. Pharmacoeconomics, 33(1), 71-81. doi:10.1007/s40273-014-0223-1

Nguyen, O. K., Halm, E. A., & Makam, A. N. (2016). Relationship between hospital financial performance and publicly reported outcomes. *Journal of Hospital Medicine, 11*(7), 481-488. doi:10.1002/jhm.2570

Pakyz, A. L., Wang, H., Ozcan, Y. A., Edmond, M. B., & Vogus, T. J. (2017). Leapfrog Hospital Safety Score, Magnet Designation, and Healthcare-Associated Infections in United States Hospitals. *Journal of Patient Safety*. doi:10.1097/PTS.0000000000000378

Ponikowski, P., Voors, A. A., Anker, S. D., Bueno, H., Cleland, J. G. F., Coats, A. J. S., … van der Meer, P. (2016). 2016 ESC Guidelines for the diagnosis and treatment of acute and chronic heart failure. *European Journal of Heart Failure, 18*, 891-975. doi: 10.1002/ejhf.592

Porter, M. E., Larsson, S., & Lee, T. H. (2016). Standardizing Patient Outcomes Measurement. *New England Journal of Medicine, 374*(6), 504-506. doi:10.1056/NEJMp1511701

Prina, E., Ranzani, O. T., & Torres, A. (2015). Community-acquired pneumonia. The Lancet, 386(9998), 1097-1108. doi:10.1016/S0140-6736(15)60733-4

Rivard, P. E., Christiansen, C. L., Zhao, S., Elixhauser, A. & Rosen, A. K. (2008). Is there an association between patient safety indicators and hospital teaching status?. In Henriksen K., Battles J. B., Keyes M.A., & Grady M. L. (Ed.), *Source Advances in Patient Safety: New Directions and Alternative Approaches (Vol. 2: Culture and Redesign)* (1-10). Rockville (MD): Agency for Healthcare Research and Quality (US). Retrieved from https://www.ncbi.nlm.nih.gov/books/NBK43711/?report=reader

Roth, G. A., Dwyer-Lindgren, L., Bertozzi-Villa, A., Stubbs, R. W., Morozoff, C., Naghavi, M., ... & Murray, C. J. (2017). Trends and patterns of geographic variation in cardiovascular mortality among US counties, 1980-2014. *Journal of the American Medical Association, 317*(19), 1976-1992. doi:10.1001/jama.2017.4150

Rothberg, M. B., Morsi, E., Benjamin, E. M., Pekow, P. S., & Lindenauer, P. K. (2008). Choosing the best hospital: The limitations of public quality reporting. *Health Affairs, 27*(6), 1680-1687. doi:10.1377/hlthaff.27.6.1680

Ryan, A. M., Nallamothu, B. K., & Dimick, J. B. (2012). Medicare's public reporting initiative on hospital quality had modest or no impact on mortality from three key conditions. *Health Affairs, 31*(3), 585-592. doi:10.1377/hlthaff.2011.0719

Sandmeyer, B., & Fraser, I. (2016). New evidence on what works in effective public reporting. *Health Services Research, 51*(3), 1159-1166. doi:10.1111/1475-6773.12502

Scanlon, D. P., Shi, Y., Bhandari, N., Christianson, J. B. (2015). Are healthcare quality "report cards" reaching consumers? Awareness in the chronically ill population. *American Journal of American Journal of Managed Care, 21*(3), 236-244. Retrieved from https://www.ajmc.com/journals/issue/2015/2015-vol21-n3/are-healthcare-quality-report-cards-reaching-consumers-awareness-in-the-chronically-ill-population?p=1

Schulingkamp, R. C., & Latham, J. R. (2015). Healthcare performance excellence: A comparison of baldrige award recipients and competitors. *The Quality Management Journal, 22*(3), 6-22. Retrieved from https://secure.asq.org/perl/msg.pl?prvurl=http://asq.org/quality-management/2015/07/baldrige-program/healthcare-performance-excellence-a-comparison-of-baldrige-award-recipients-and-competitors.pdf

Shahian, D. M., Wolf, R. E., Iezzoni, L. I., Kirle, L., & Normand, S. L. T. (2010). Variability in the measurement of hospital-wide mortality rates. *New England Journal of Medicine, 363*(26), 2530-2539. doi:10.1056/NEJMsa1006396

Sheetz, K. H., Dimick, J. B., & Ghaferi, A. A. (2016). Impact of hospital characteristics on failure to rescue following major surgery. *Annals of surgery, 263*(4), 692-697. doi:10.1097/SLA.0000000000001414

Singh, G. K., Siahpush, M., Azuine, R. E., & Williams, S. D. (2015). Widening socioeconomic and racial disparities in cardiovascular disease mortality in the United States, 1969-2013. *International Journal of MCH and AIDS, 3*(2), 106–118. Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5005986/

Smith, S. N., Reichert, H., Ameling, J., & Meddings, J. (2017). Dissecting Leapfrog: How well do Leapfrog Safe Practices Scores correlate with Hospital Compare ratings and penalties, and how much do they matter?. *Medical care, 55*(6), 606 – 614. doi:10.1097/MLR.0000000000000716

Tefera, L., Lehrman, W. G., & Conway, P. (2016). Measurement of the patient experience: clarifying facts, myths, and approaches. *Journal of American Medical Association, 315*(20), 2167-2168. doi:10.1001/jama.2016.1652

The Leapfrog Group. (n.d.). About the Leapfrog Group. Retrieved from http://www.Leapfroggroup.org/

The Leapfrog Group. (2018). Leapfrog hospital safety grade: Scoring methodology. Retrieved from https://www.hospitalsafetygrade.org/media/file/HospitalSafetyGrade_ScoringMethodology_Fall2018_Final2.pdf

Thygesen, K., Alpert, J. S., Jaffe, A. S., Simoons, M. L., Chaitman, B. R., & White, H. D. (2012). Third universal definition of myocardial infarction. *Journal of the American College of Cardiology, 60*(16), 1581-98. doi:10.1016/j.jacc.2012.08.001

Zhao, M., Haley, D. R., Spaulding, A., & Balogh, H. A. (2015). Value-based purchasing, efficiency, and hospital performance. *The Health Care Manager*, 34(1), 4-13. doi:10.1097/HCM.0000000000000048