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EXTERNAL ENVIRONMENTAL DIMENSIONS AND FINANCIAL PERFORMANCE OF MAJOR TEACHING HOSPITALS IN THE U.S

KARIMA LALANI

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by

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DEDICATION

To Sarah, Iqbal and Zahid

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OF MAJOR TEACHING HOSPITALS IN THE U.S.

by

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of the Requirements

for the Degree of

DOCTOR OF PHILOSOPHY

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PREFACE

Pursuit of higher education has been a driving force in my family for generations, and that pursuit has led me to conduct research for this dissertation, and to seek the Ph.D. degree.

ACKNOWLEDGEMENTS

This dissertation would not have been possible without the mentoring of my Academic Advisor, Chair, and Dissertation Supervisor, Dr. James Langabeer, II; Dr. Lee Revere, Committee Member for Health Policy Minor; and, Dr. Wenyaw Chan, Committee Member for Research Methods breadth. Additionally, I would not have been able to reach this stage in my life without the unflinching support of my family!

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The University of Texas
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ABSTRACT

Background: Teaching hospitals have a unique mission to not only deliver graduate medical education, but to also provide both inpatient and ambulatory care, and to conduct clinical and medical research; therefore, they are under constant financial pressure, and it is important to find out what types of external environmental components affect their financial performance. No recent studies have been comprehensively conducted for all major teaching hospitals in the U.S. to examine if there is an association between the external environmental dimensions based upon Resource Dependence Theory (Munificence, Uncertainty, Complexity) and the short-term financial performance, measured by days cash on hand all sources, and long-term financial performance, measured by return on assets.

Methods: This study analyzed data for 226 major teaching hospitals, spanning 46 states.

The dependent variable for short-term financial performance was days cash on hand all sources, which was an average of the most recently available 4-year data (2014-2017). The dependent variable for long-term financial performance was return on assets, which was an average of the most recently available 4-year data (2014-2017). Descriptive statistics were

used to assess each variable, including means and standard deviations for normally distributed data, and medians and interquartile range for non-normal data. Differences among independent variables were explored using ANOVA and Chi-square analysis. Linear regression model was used for both aims of the study, using factors with significant univariate results.

Results: For the short-term financial performance of major teaching hospitals, results showed significance between outpatient revenue and days cash on hand (p -value 0.039). For the long-term financial performance of major teaching hospitals, the study showed significant relationship between the population of the metropolitan statistical area (p -value 0.041), unemployment rate of the metropolitan statistical area (p -value 0.001) and the teaching hospital's return on assets. Additionally, system membership (p -value 0.009), type of ownership/control (p -value 0.033), and teaching intensity (p -value 0.047) also showed significant association with return on assets.

Conclusions: This study examined if there is an association between the short-term and long-term financial performance of major teaching hospitals in the United States, and the external environmental dimensions, as measured by the Resource Dependence Theory. The results of the study showed significant associations between the long-term financial performance of teaching hospitals and the external environmental dimensions, and additional significant association between system membership, type of ownership/control, and teaching intensity with long-term financial performance.

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BACKGROUND

Introduction

Health care spending continues to be higher in the U.S., as compared to other developed nations, and the total health care spending as a percentage of U.S. Gross Domestic Product (GDP) has steadily increased since 1970 (Appendix A). In 2016, U.S. spent almost 18% of its GDP on health care (Papanicolas et al., 2018), and the total national health spending on hospital care reached almost 6% of GDP in 2015 (Appendix B). Given the unsustainable rise in health care costs, hospitals continue to face various pressures to maximize their efficiency.

Teaching hospitals, also known as academic hospitals, are complex healthcare entities, whose three-pronged mission is to deliver graduate medical education; to conduct medical and clinical research; and, to provide both inpatient and ambulatory care (Ginzberg, 1985). All hospitals in the U.S. continue to face pressures, both financial and non-financial, to improve their quality and efficiency, but teaching hospitals in particular have to juggle not only these pressures, but also their mission to provide care, conduct research and deliver graduate medical education.

Reduced research budgets, increased patient demands, as well as higher expectations from healthcare consumers, as well as growing emphasis on value in healthcare (Porter, 2010) have put administrators on notice to seek new ways to optimize revenue and protect the unique mission of teaching hospitals. Furthermore, the U.S. Supreme Court's upholding of the Affordable Care Act (ACA) of 2010 affects teaching hospitals because the states that

chose not to expand Medicaid programs, will have more uninsured residents, which will increase the number of uninsured patients that come to teaching hospitals for treatment (Valletta et al., 2013). At the time of writing, 37 states and the District of Columbia have expanded their Medicaid programs (Kaiser, 2019). Despite the challenges, these healthcare entities have continued to weather financial turbulence over the years and continue to do so today.

Results from a study done on a sample of 50 major teaching hospitals in 2004 found that nearly one out of six major teaching hospital in the sample was near immediate bankruptcy (Langabeer, 2006). Teaching hospitals are under constant financial pressure, and it is important to find out how their financial performance is being affected by their external environment and what types of strategies should they employ to ensure their long-term financial performance and survival.

No recent studies have been comprehensively conducted for all major teaching hospitals in the United States, and according to the American Association of Medical Colleges, there are close to 300 major teaching hospitals in the U.S. (AAMC, 2019). Only a few studies have examined the impact of a teaching hospital's strategy and operations on its financial performance, and these studies were conducted decades ago (Foley et al., 1986; Langabeer, 1998).

This research study asked the following two questions and set out to understand if there is an association between the external environmental dimensions and the short-term and long-term financial performance of all major teaching hospitals in the United States:

Question 1: Using the Resource Dependence Theory framework, is there an association between the external environment and the short-

term liquidity of all major teaching hospitals in the U.S.?

Question 2: Using the Resource Dependence Theory framework, is there an association between the external environment and the long-term profitability of all major teaching hospitals in the U.S.?

Public Health Significance

From a public health perspective, one should note that teaching hospitals are also an integral part of the healthcare ecosystem of their respective communities; not only do they provide graduate medical education, but they also treat the sickest patients due to the fact that they conduct clinical and medical research, and they treat the neediest of patients as well (Vanselow, 1990). Additionally, teaching hospitals account for 21% of all hospital beds in the U.S. (Chen et al., 2018); plus, they carry a large burden of charity care for the neediest of patients by caring for almost 40% of the uninsured, and they account for almost 33% of national health-related funds for research (Smitherman et al., 2019).

Teaching hospitals also produce approximately 22,000 medical school graduates Annually, since they are the dominant providers of graduate medical education (GME) (Smitherman et al., 2019). Additionally, they also graduate about 15,000 nurses and 6,000 public health professionals (Smitherman et al., 2019). Furthermore, teaching hospitals contributed approximately \$380 billion in value to the U.S. economy and supported over 6 million jobs in 2017 (AAMC, 2019).

From the perspective of healthcare transformation and achieving Triple Aim (Appendix C), teaching hospitals are poised to play pivotal roles for the advancement of population health, and some have begun to promote population health across their three

major domains of medical education, research and patient care (Gourevitch et al., 2019).

Due to their unique triple-pronged mission, teaching hospitals are well-positioned to identify and facilitate understanding of population health needs and challenges, and can also innovate and implement strategies and solutions to meet the population health needs (Smitherman et al., 2019). Teaching hospitals are also positioned to play a pivotal role in addressing the social determinants of health (Appendix D), by collaborating with non-healthcare community organizations and stakeholders to address the social needs of the communities they serve (Smitherman et al., 2019).

For public health leaders and researchers, the financial performance of teaching hospitals, both short-term and long-term, should be of paramount importance so that these integral institutions of the community can continue to deliver upon their educational mission, as well as their treatment of the underserved members of the community.

Literature Review

Historical Perspective

In 2001, the Institute of Medicine's study about academic health centers resulted in an expansive look at the evolving and growing role of an academic health center (Institute of Medicine, 2004). The report explicated that the clinical enterprise of an academic health center is represented by the teaching hospital (Institute of Medicine, 2004). From a historical viewpoint, the Flexner Report of 1910 spurred reform of medical education in the U.S. to include curriculum of clinical teaching and basic sciences, emphasizing more problem solving and limited learning by memorization (Regan-Smith, 1998). After World War II, the

federal government funding was expanded for research at these institutions, and with the passage of Medicare and Medicaid in 1965, support for graduate medical education became solidified (Korn, 1996).

As the clinical enterprise of an academic health center, teaching hospitals have a unique three-pronged mission to deliver not only graduate medical education, but also to provide both inpatient and ambulatory care, and conduct clinical and medical research (Ginzberg, 1985). In order to conduct graduate medical education, the training of medical school graduates is organized around the day-to-day operations of a teaching hospital (Iglehart, 1993). The resident physicians treat patients under the supervision of faculty physicians; thus, both the patient care and the medical education takes place simultaneously in a teaching hospital.

Clinical and Medical Research at Teaching Hospitals

Additionally, teaching hospitals conduct a wide range of clinical and medical research. They are the primary centers of research, and over the last several decades, new approaches to diagnosis and prevention, as well as medical breakthroughs and innovations have been pioneered at teaching hospitals (AAMC, 2019). Consequently, these unique missions of teaching hospitals also increase the cost of patient care at these facilities, and as a result, payers and health policy makers continue to raise an issue about the value of teaching hospitals (Khullar et al., 2019).

In a recent study, more than 21 million Medicare fee-for-service hospitalizations for common medical and surgical conditions were evaluated, and overall, the patients treated at

major teaching hospitals had significantly lower 30-day adjusted mortality than those treated at non-teaching hospitals (Burke et al., 2017). Major teaching hospitals were those that were members of Council of Teaching Hospitals (COTH), and these major teaching hospitals had lower mortality rates for 11 out of 15 common medical conditions, and lower rates for 2 out of 6 common surgical conditions (Burke et al., 2017).

In another study, more than 11 million hospitalizations from 2012 to 2014 were examined for Medicare beneficiaries, and researchers found that the high-severity patients had 7 percent lower odds; the medium-severity patients had 13 percent lower odds; and, the low-severity patients had 17 percent lower odds of 30-day mortality when treated at a teaching hospital for common medical conditions, compared to similar patients that were treated at a non-teaching hospital (Burke et al., 2018).

Given the fact that the teaching hospitals are fulfilling their unique missions, advancing clinical and medical research, and maintaining lower mortality rates, it is important to examine which factors and aspects are affecting the teaching hospitals' financial performance, and what types of strategies ought to be examined and implemented by the teaching hospitals' administration and leadership.

Empirical Studies on Hospital Financial Performance since the 1980s

Several empirical studies have been conducted over the last few decades about hospitals and their financial performance; however, studies that have focused solely on teaching hospitals' financial performance have been conducted with less frequency. A study of 64 teaching hospitals in the 1980s analyzed the impact of state-level environment on

hospital's financial performance (Choi, 1985). A study about teaching hospitals from 1986 concluded that although all teaching hospitals face constant financial pressures, those teaching hospitals that are under government control are in a more precarious financial position, as compared to the non-municipal teaching hospitals (Schwartz, 1986).

In the 1990s, it was noted by the Council on Graduate Medical Education that the financial situation of major teaching hospitals in the U.S. had deteriorated, and the major teaching hospitals had lowest margins in the hospital industry (Whitcomb et al., 1993). A study in 2000 utilized activity-based cost analysis at a teaching hospital to enhance the financial performance of a clinical department (Cohen et al., 2000). Another study from early 2000s analyzed cost inefficiencies in 211 major teaching hospitals (Rosko, 2004).

A study from 2011 examined data for only 103 teaching hospitals and concluded that the hospitals with low cash flow also tend to have higher operating losses and low financial performance (McCue et al., 2011). A study conducted in 2013 analyzed data from 117 teaching hospitals and concluded that large teaching hospitals located in urban areas were more likely to have higher fixed costs and lower variable costs (Younis, 2013).

A study conducted in 2015 looked at all nonfederal acute care public hospitals in the U.S. and concluded that the teaching hospitals should undergo either privatization, complete restructuring or other strategic changes to overcome their financial challenges (Ramamonjiarivelo et al., 2015). A study conducted in 2017 looked at the major teaching hospitals in only the 20 largest U.S. cities, and found that the economic status of the surrounding community, the hospital's size, and teaching intensity were more important than operational efficiency (Langabeer et al., 2018). A qualitative study on a sample of 20 major teaching hospitals found that the leadership of high-performing major teaching hospitals

foster a vision and mission for their teaching hospital to deliver consistent, high quality of care to their patients and communities (Chatfield et al., 2017).

Teaching hospitals have also been of interest to healthcare management researchers in Germany. A group of researchers analyzed data from 24 German teaching hospitals in 2007, and concluded that a teaching hospital's emphasis on research may increase the hospital's overall efficiency (Schreyögg et al., 2008). Several empirical studies about hospitals have been conducted over decades, but no study has looked at how specific external environmental dimensions of Resource Dependence Theory affect both the short-term and the long-term financial performance of all the major teaching hospitals nationwide. The Resource Dependence Theory uses the dimensions of Munificence, Uncertainty and Complexity to operationalize the external environmental components affecting an organization (Pfeffer and Salancik, 1978), and is explained in the next section.

Theoretical Framework and Conceptual Model

Since the publication of Pfeffer and Salancik's seminal work on Resource Dependence Theory (RDT) in 1978, the RDT has become an influential theory in the realm of strategic management. Resource Dependence Theory recognizes the influence of external factors on organizational behavior, and posits how managers can act to reduce dependence and environmental uncertainty. Resource Dependence Theory has been used in healthcare management literature; however, no study has used the Resource Dependence Theory framework to identify the external environmental factors affecting the short-term and long-term financial performance of all major teaching hospitals in the U.S.

Assumptions and Rationale of Resource Dependence Theory

Resource Dependence Theory is an organizational theory that argues that organizations employ various inter-organizational linkages to manage and control their resource dependence on other actors in the environment. Resource Dependence Theory assumes that the goal of an organization is to minimize its dependence on other organizations for the supply of scarce resources in its environment, and to find ways of influencing other organizations to make resources available (Pfeffer and Salancik, 1978). The rationale of this theory is that organizations are open systems whose survival and development are constrained by external influences (Pfeffer and Salancik, 1978). Some resources are scarce and controlled by other organizations in the environment. Scarce resources motivate managers to act in ways that will secure those resources and reduce uncertainty (Kreiser et al., 2002).

An organization's environment consists of other entities from which it procures resources and to which it sells products and services. Because an organization's possession and control of key resources imply power, organizations must adopt various strategies to acquire and control these resources to reduce their dependence and increase their power. Mergers and acquisitions, vertical or horizontal integrations, strategic alliances, joint ventures, and diversifications are among the various strategic moves that organizations adopt to reduce dependence on and increase control over resources (Pfeffer & Salancik, 1978), and empirical studies of resource dependence theory focus on testing propositions developed from this perspective. The size and composition of boards of directors, inter-industry merger patterns, and inter-organizational linkages are organizational responses commonly used to reduce interdependence and control the resources. This theory builds upon the context of

external environment having three major dimensions, namely Munificence, Uncertainty, and Complexity, and empirical studies have used these three constructs to operationalize the RDT perspective (Pfeffer and Salancik, 1978; Kreiser et al., 2002).

According to Pfeffer and Salancik, the munificence of the environment is based upon the availability of resources that are necessary to the organization (1978). In the healthcare context, an example of munificent environment would be of a hospital in an urban location, and with favorable access to financial resources. The constructs of uncertainty and complexity relate to the level of uncertainty of information in the environment. Something that constantly changes will be dynamic, and the more fluctuations in the environment, the more information uncertainty will increase for the organization's decision-makers (Yeager et al., 2014).

Empirical Studies in Healthcare Settings

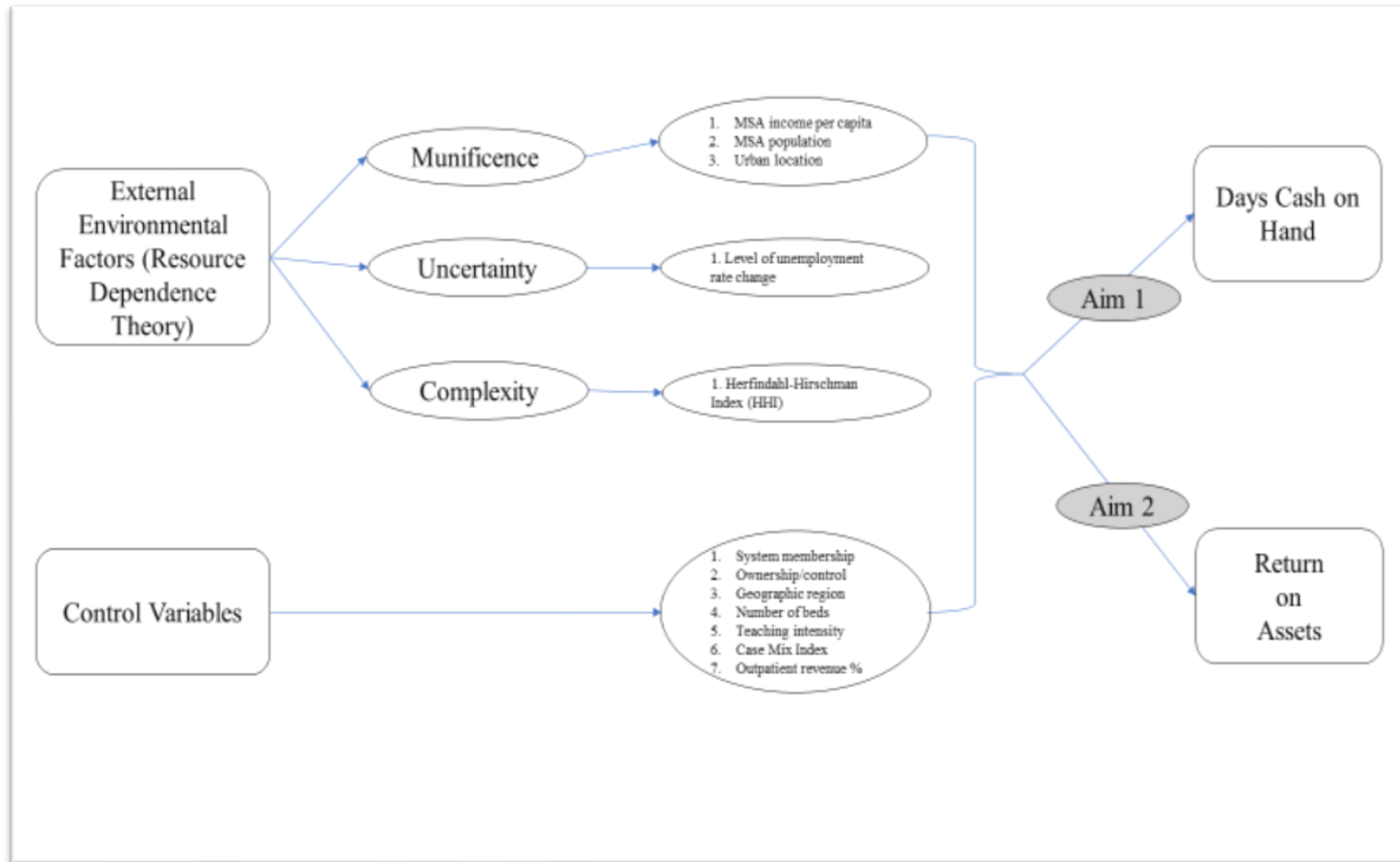
Resource Dependence Theory has been applied to various healthcare settings also. Researchers have used RDT to examine the impact of market and organizational characteristics on organizational innovation for nursing care setting (Banaszak-Holl et al., 1996). The RDT framework has been used to study whether managed care has effects on the administrative burden in outpatient substance abuse treatment facilities (Alexander et al., 1997). This framework has been utilized in healthcare settings to find palliative care programs as a strategy to secure and maintain resources (Chisholm et al., 2015). RDT has also been used to examine participation in Medicare Accountable Care Organizations (ACOs) as a strategy to reduce financial risk (Yeager et al., 2015).

More recently, the Resource Dependence Theory framework has also been used to

analyze strategies for increasing market share in areas where hospitals operate freestanding emergency departments (Patidar et al., 2017). Another study that analyzed 2014 data from more than 2600 hospitals in the U.S. by using the Resource Dependence Theory framework found that the external environmental forces do have an impact on hospitals' performance in the Hospital Value-Based Purchasing program (Spaulding et al., 2018).

Since Resource Dependence Theory builds upon the context of external environment having three major dimensions, namely munificence, uncertainty, and complexity, empirical studies have used these three constructs to operationalize the RDT perspective (Pfeffer and Salancik, 1978; Kreiser et al., 2002). Figure 1 illustrates the conceptual model for this study, based upon the external environmental dimensions of the Resource Dependence Theory.

Figure 1: Conceptual Model



Hypothesis, Research Question, Specific Aims and Objectives

This study explored whether there was an association between the external environmental dimensions based upon Resource Dependence Theory (Munificence, Uncertainty, Complexity) and the short-term and long-term financial performance of all major teaching hospitals in the United States. This study's first aim was to explore if there is an association between the external environmental dimensions and the short-term financial measure "Days Cash on Hand" for all major teaching hospitals in the United States. This study's second aim was to explore if there is an association between the external environmental dimensions and the long-term financial measure "Return on Assets" for all major teaching hospitals in the United States. The hypotheses associated with the specific aims of this study are as explained below, and also illustrated in Figure 2 and in Figure 3, respectively.

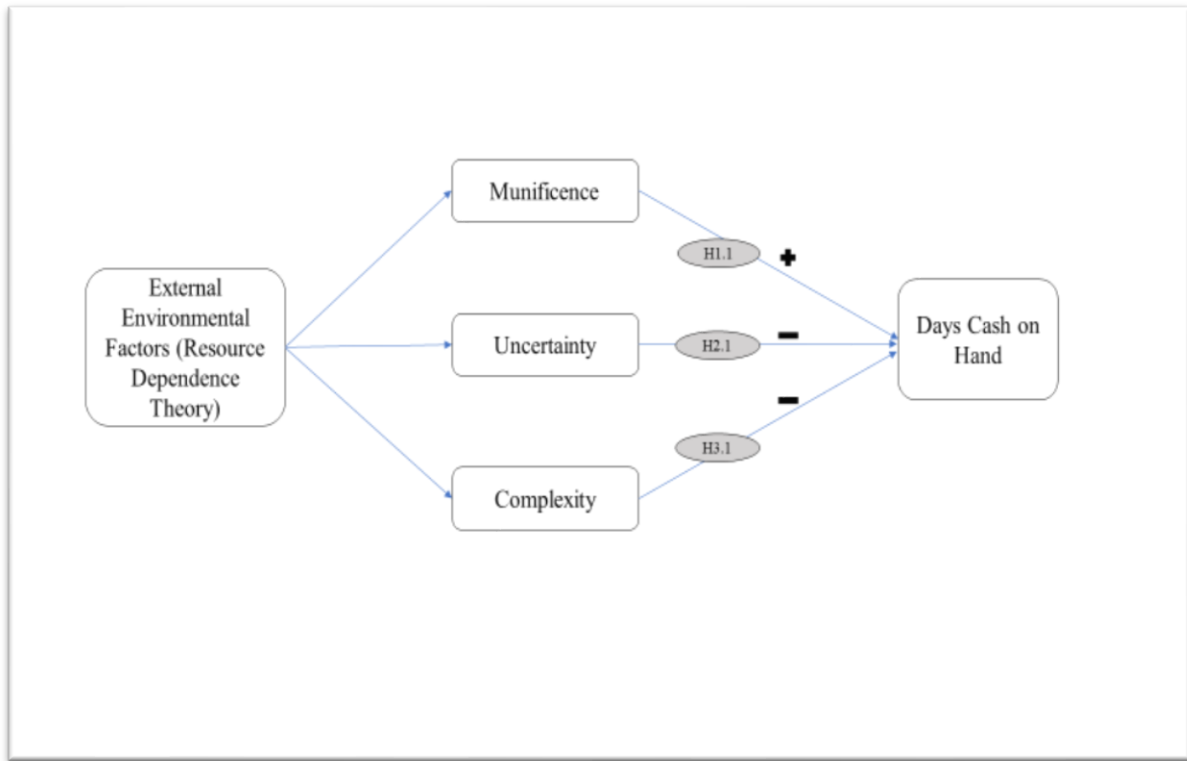
Study Aim 1

This study explored if there is an association between the external environmental factors and the short-term financial measure "Days Cash on Hand" for all major teaching hospitals in the United States, and the related hypotheses are noted below.

- 1) **Hypothesis 1 (H1.1)**: Munificence of the external environment will have positive impact on days cash on hand of major teaching hospitals.
- 2) **Hypothesis 2 (H2.1)**: Uncertainty of the external environment will have negative impact on days cash on hand of major teaching hospitals.
- 3) **Hypothesis 3 (H3.1)**: Complexity of the external environment will have negative

impact on days cash on hand of major teaching hospitals.

Figure 2: Hypotheses of Study Aim 1



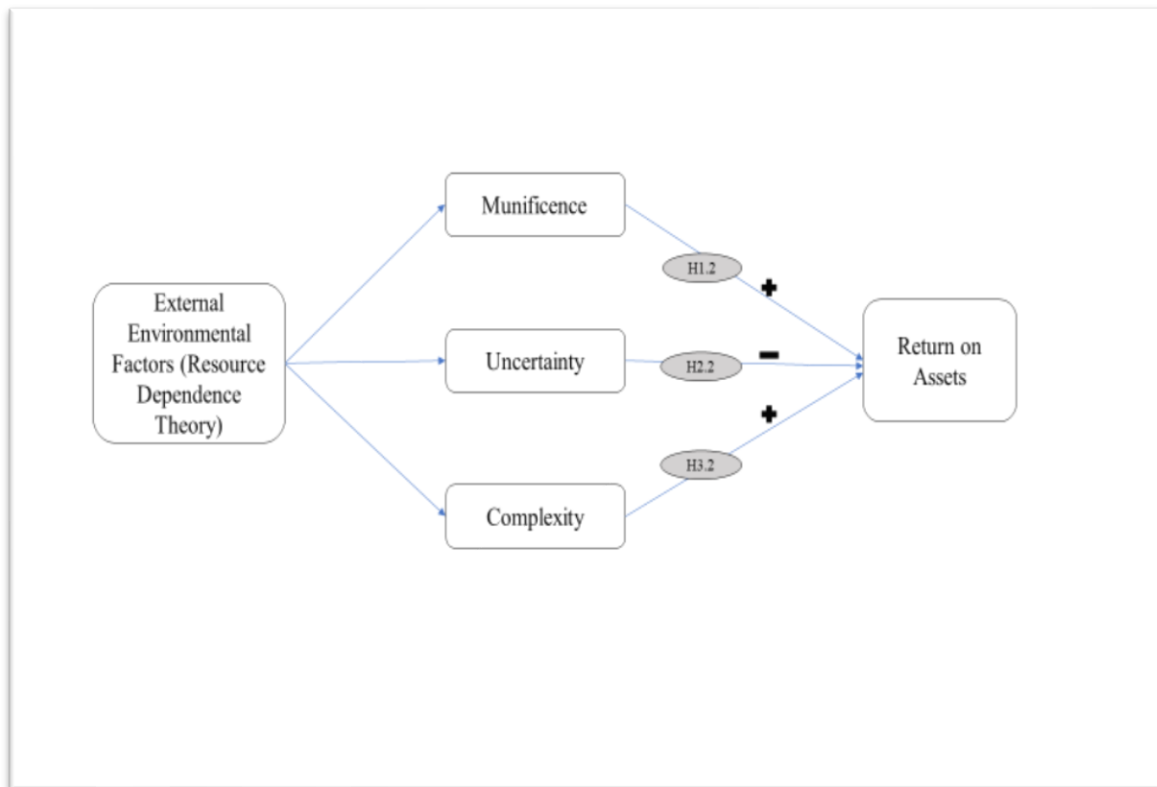
Study Aim 2

This study also explored if there is an association between the external environmental dimensions and the long-term financial measure “Return on Assets” for all major teaching hospitals in the United States, and the related hypotheses are noted below.

- 1) **Hypothesis 1 (H1.2):** Munificence of the external environment will have positive impact on return on assets of major teaching hospitals.
- 2) **Hypothesis 2 (H2.2):** Uncertainty of the external environment will have negative impact on return on assets of major teaching hospitals.

- 3) **Hypothesis 3 (H3.2):** Complexity of the external environment will have positive impact on return on assets of major teaching hospitals.

Figure 3: Hypotheses of Study Aim 2



As noted earlier, this study was designed to understand if there is an association between the external environment, based upon the Resource Dependence Theory perspective, and the short-term and long-term financial performance of all major teaching hospitals nationwide. This study's results will fill some gaps in healthcare management literature about teaching hospitals' finances, as well as the applicability of Resource Dependence Theory in the context of teaching hospitals.

METHODS

Study Design

This study was conducted to understand if there is an association between the external environmental dimensions based upon Resource Dependence Theory (Munificence, Uncertainty, Complexity) and the short-term and long-term financial performance of all major teaching hospitals in the United States. This study was a retrospective, cross-sectional, observational study, using publicly available secondary data from 2014 to 2017. This study was approved in February 2019, and was determined to be exempt by The University of Texas Health Science Center at Houston (UTHealth) Committee for the Protection of Human Subjects, and the study's data was collected for analysis in March 2019 and in April 2019.

Data Management

This study utilized a personal computer, with UTHealth VPN and UTHealth firewall to conduct data cleaning, computation of new variables and any needed statistical analysis. Files were password-protected, and data were analyzed using STATA, version 14 (StataCorp, College Station, Texas). No human subjects were used or considered for this study, and no protected health information or personal information was used.

Study Sample

This study's population included all short-term, acute care hospitals in U.S., using the Association of American Medical Colleges' Council of Teaching Hospitals and Health Systems (COTH) criteria for major teaching hospitals (AAMC, 2019). Membership to the

Council of Teaching Hospitals and Health Systems (COTH) is for those teaching hospitals that meet the following criteria:

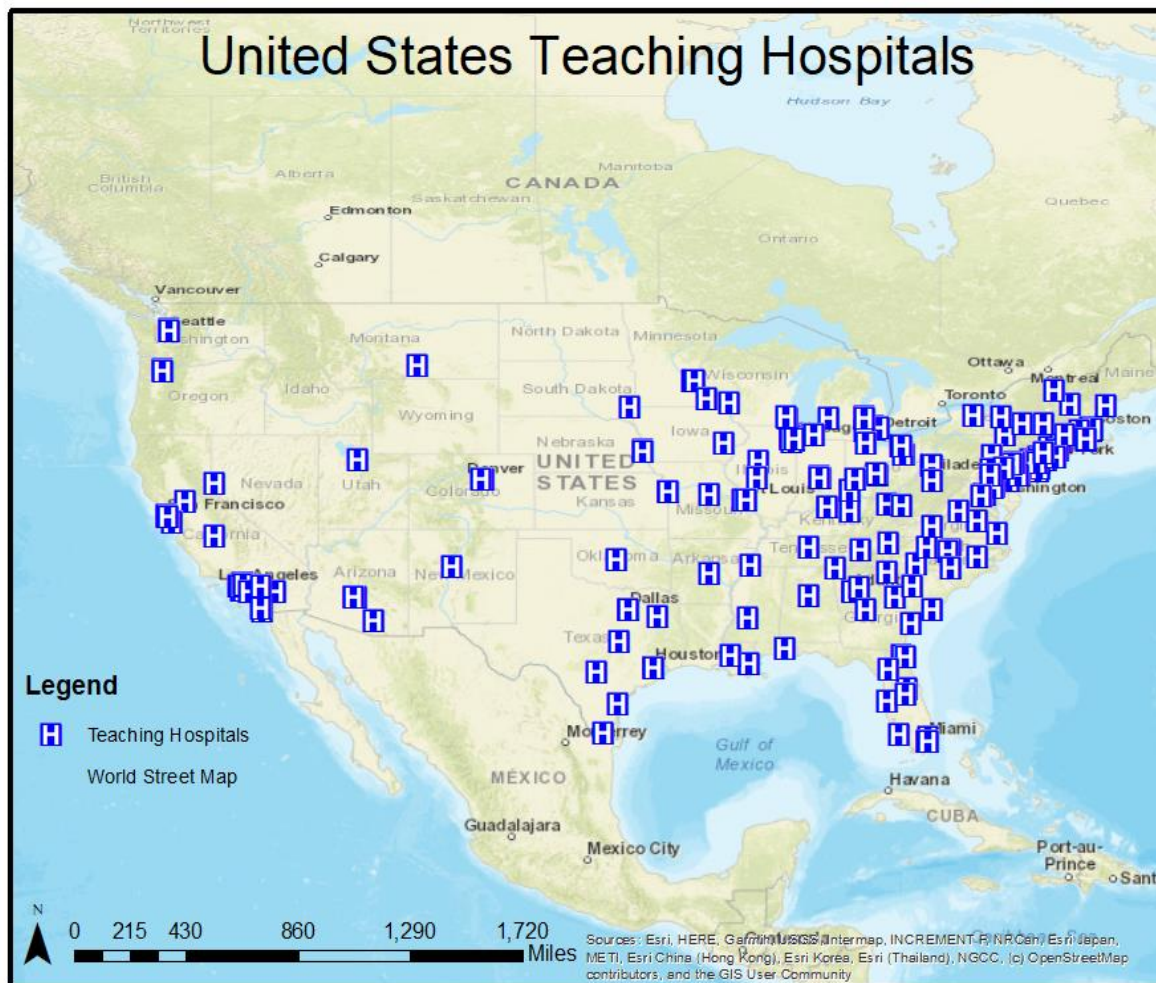
- a) Have a documented affiliation agreement with an accredited US medical school;
- b) Have minimum of four approved, active residency programs, including at least two approved residency programs in medicine, surgery, pediatrics, family practice, psychiatry or obstetrics/gynecology (AAMC, 2019).

Empirically, the findings of a study on teaching hospitals conducted in early 1990s suggested that major academic hospitals should be studied as a group separately from other non-major teaching and non-teaching hospitals, when measuring the hospital's performance (Custer et al., 1991). The study by Langabeer et al. (2018) also studied major teaching hospitals as a group, in order to better control the results.

This study's population, based upon the AAMC data, consisted of 226 hospitals in 46 states, representing 80% of all major teaching hospitals in the U.S. Total COTH members as of March 2019 were 282 teaching hospitals. This study excluded 6 specialty hospitals, 17 children's hospitals, and 33 Veterans Administration (VA) hospitals. The VA hospitals are under the purview and financing of Veterans Health Administration, under U.S. Department of Veterans Affairs (VA, 2019), and these hospitals were excluded from this study to better control the study results. Specialty hospitals do not have comparative patient populations as other general, short-term acute care hospitals, and treat less complex and more profitable cases (Guterman, 2006); thus, these hospitals were also excluded from this study for better control of the study results.

The states where these major teaching hospitals are located are 46 states, plus the District of Columbia. Four states, Alaska, Hawaii, Idaho and Wyoming, did not have a COTH member hospital, as of March 2019. Figure 3 pictorially depicts the states where this study’s sample hospitals are located, and Appendix B provides a breakdown, per state, of the number of major teaching hospitals.

Figure 3: Map of U.S. and study’s sample population



Statistical Analysis

The sample size of the study was 226 hospitals, out of a total of 282, with exclusions noted earlier for 6 specialty hospitals, 17 children's hospitals, and 33 Veterans Administration (VA) hospitals to better control the study results. Descriptive statistics were used to assess each variable, including means and standard deviations for normally distributed data, and differences among independent variables were explored using ANOVA and Chi-square analysis. Linear Regression Model was used for both aims of the study, using factors with significant univariate results.

Nonlinearities in regression analysis are incorporated by transforming the dependent variable in logarithmic form (Wooldridge, 2013). All the variables were graphically inspected for normality before beginning the regression analysis, by incorporating analysis of histograms, kernel density plots, normal quantile plots, and normal probability plots in STATA-14. The two dependent variables, Days Cash on Hand and Return on Assets, did not meet the criteria of normality, after examination of their respective plots; hence, the `ladder` command in STATA-14 was utilized to assist in the transformation of the two dependent variables, and the logarithmic transformation of the two dependent variables was used for this study. The independent variables in this study did not warrant logarithmic transformations, and thus, were not transformed.

Once the regression models were run for both aims of this study, additional regression diagnostics were analyzed to assess the goodness of fit of the regression models. The `predict` command in STATA-14 was utilized to create residuals and then kernel density plots, quantile normal plots and normal probability plots were used to check the normality of the

residuals. Additionally, since STATA assumes homoskedastic standard errors by default, the two models were adjusted to account for heteroskedasticity, by using the option of robust in STATA-14 (Stock, 2011).

STATA-14 commands were also used to detect any multicollinearity in the two models. When multicollinearity is present, the standard errors in the regression model may be inflated (Stock, 2011); therefore, the command VIF (variance inflation factor) was used to detect multicollinearity, since any value variable that has VIF value of greater than 10 would require further investigation (Regression with STATA, 2019). None of the variables in both regression models for this study had any VIF value of 10 or greater.

Regression model specification tests were also conducted in STATA-14 for both regression models of this study. The two model specification tests were the linktest and the omitted variable test in STATA-14. The linktest for both models generated p -values of the squared prediction variable, $_hatsq$, to be greater than 0.98, and the omitted variable test was not significant and confirmed that no variables were omitted in both regression models.

Operationalization of Study Variables

Operationalization of Dependent Variables

For the study's first aim, the dependent measure was the financial measure of liquidity called days cash on hand. In financial literature, this measure of liquidity is calculated in two different ways:

$$\text{*Days Cash on Hand} = \frac{(\text{Cash} + \text{Market Securities})}{(\text{Total operating expenses} - \text{Depreciation}) / 365}$$

$$\text{*Days Cash on Hand (all sources)} = \frac{(\text{Cash} + \text{Mkt Securities} + \text{Short-term Investments})}{(\text{Total operating expenses} - \text{Depreciation}) / 365}$$

This financial measure illustrates the number of days that an organization can continue to pay its cash obligations, if no new cash resources became available. High positive values of days cash on hand imply that an organization has high liquidity and the organization can then be viewed favorably by creditors (Gapenski, 2012; Nowicki, 2015). For the purposes of this study, the calculation of “Days Cash on Hand – All Sources” (Appendix G) has been used, and will be referred as “Days Cash on Hand” throughout this study.

For the study’s second aim, the dependent measure was the financial measure of profitability called “Return on Assets” (ROA). In financial literature, this measure of profitability is calculated as:

$$\text{Return on Assets} = \frac{\text{Net Income} \times 100}{\text{Total Assets}}$$

This financial measure of profitability illustrates how an organization can use its assets to generate income; for example, if an organization has a return on assets of 12%, then it means that each dollar invested in total assets produces 12-cents in profits. A high ROA denotes that the organization’s assets are financially productive (Gapenski, 2012; Nowicki 2015). In the healthcare context, a hospital’s Return on Assets is considered a key indicator that can reflect the hospital’s ability to fulfill its current operational funding, as well as its ability to take care of funding any future increases in assets (Burkhardt, 2013). One item to note is that in the return on assets calculation, this measure includes aspects of both operating revenue and nonoperating revenue (Gapenski, 2012), which means that an organization could be operating at a loss, but if its nonoperating income was large, then the organization would show a positive return on its assets.

Operationalization of Independent Variables

Operationalizing RDT dimension of Munificence

Empirical studies in the healthcare management realm have posited how the RDT dimension of Munificence can be operationalized. The independent variables of the income per capita, population per capita, as well as the hospital's urban location have been empirically used to operationalize this RDT dimension (Yeager et al., 2015; Patidar et al., 2017).

Operationalizing RDT dimension of Uncertainty

Empirical studies in healthcare management realm have posited that the RDT dimension of Uncertainty can be operationalized through the independent variable of unemployment rate change of the metropolitan statistical area (Yeager et al., 2015; Patidar et al., 2017). High rates of unemployment in an area produce uncertainty for the population.

Operationalizing RDT dimension of Complexity

Empirical studies in the healthcare management arena have shown that the RDT dimension of Complexity can be operationalized through the independent variable called the Herfindahl–Hirschman Index (HHI), which is a commonly accepted measure of market competition (Yeager et al., 2015; Patidar et al., 2017). HHI measures the amount of competition among firms in a particular market and is the sum of all facilities' squared market share (Balotsky, 2005). HHI in this study was calculated based upon the metropolitan statistical area (MSA) where the major teaching hospital is located, instead of at the county level since major teaching hospitals serve a broader community in a MSA (Balotsky, 2005). The U.S. Department of Justice considers markets in which the HHI is between 1,500 and

2,500 points to be moderately concentrated, and markets in which HHI is higher than 2,500 points to be highly concentrated (HHI, 2019).

Operationalizing Control Variables

Research studies in the healthcare management literature have utilized several different control variables. For the purposes of this study, seven control variables were used, namely system membership, type of ownership or control of hospital; geographic region; number of beds; teaching intensity, measured by number of medical residents; case mix index, and percentage of outpatient revenue. All the study measures, their data sources and definitions are summarized in Table 1.

Table 1: Study Measures

Variables	Type of Variable	Related Aim / Hypothesis	Unit of Analysis	Data Source	Definition	Literature Reference
Dependent Variables						
Days Cash on Hand	Continuous	Aim 1	Hospital	Medicare Cost Report	A measure of company's liquidity, whether it can meet its payments when they are due.	Gapenski, 2012
Return on Assets	Continuous	Aim 2	Hospital	Medicare Cost Report	A ratio of net income to total assets; it tells managers if their assets are being used productively or not; measures a company's ability to control expenses, and measures its ability to use its assets to generate revenue.	Gapenski, 2012
Independent Variables						
Resource Dependence Theory Dimension of Munificence						
MSA Income per capita	Continuous	Aim 1, H1 Aim 2, H1	MSA	US Dept of Commerce, Bureau of Economic Analysis	Per capita income of the metropolitan statistical area (MSA) where teaching hospital is located.	Ginn, 1992; Zinn, 1997
MSA Population	Continuous	Aim 1, H1 Aim 2, H1	MSA	U.S. Census Bureau	Population of the metropolitan statistical area (MSA) where teaching hospital is located.	Balotsky, 2005

Urban location	Yes = 1 No = 0	Aim 1, H1 Aim 2, H1	Hospital	Medicare Cost Report	Designation of 1 if the hospital is in an urban area; otherwise, designation of 0.	Zinn, 1997
<i>Resource Dependence Theory Dimension of Uncertainty</i>						
Level of unemployment rate change	Continuous	Aim 1, H2 Aim 2, H2	MSA	US Dept of Labor, Bureau of Labor Statistics	Level of unemployment rate change at the metropolitan statistical area (MSA) level.	Kazley, 2007
<i>Resource Dependence Theory Dimension of Complexity</i>						
Herfindahl-Hirshman Index (HHI)	Continuous	Aim 1, H3 Aim 2, H3	MSA	Medicare Cost Report	A measure of market concentration; the amount of competition among firms in a particular market; sum of all facilities' squared market share.	Balotsky, 2005
<i>Control Variables</i>						
System membership	Yes = 1 No = 0	Aim 1 Aim 2	Hospital	Hospital Characteristics data	Denotes a hospital's membership in a health system.	Langabeer, 2018
Ownership/control	Categorical (Voluntary Nonprofit; Government ; Church; Proprietary)	Aim 1 Aim 2	Hospital	Medicare Cost Report	Type of ownership or control of the hospital.	Langabeer, 2018
Geographic region	Categorical 1=Region 1 2 =Region 2 3 =Region 3 4 =Region 4	Aim 1 Aim 2	Hospital	U.S. Census Bureau	Hospital's location in one of four U.S. geographic regions.	Horwitz, 2015

Number of beds	Continuous	Aim 1 Aim 2	Hospital	Medicare Cost Report	Number of beds in a hospital.	Langabeer, 2018
Teaching intensity	Continuous	Aim 1 Aim 2	Hospital	Medicare Cost Report	Number of medical residents in a teaching hospital.	Langabeer, 2018
Case Mix Index	Continuous	Aim 1 Aim 2	Hospital	Medicare Case Mix Index data	Reflects the clinical complexity and resources needs of all patients in a hospital; more complex case loads are indicated by high case mix index.	Langabeer, 2018
Outpatient revenue %	Continuous	Aim 1 Aim 2	Hospital	Calculated using Medicare Cost Report data	Percentage of hospital's total revenue attributed to outpatient services.	Langabeer, 2018

Aligning Operationalized Variables into Regression Analysis

The operationalization of all the study variables assisted in aligning and formulating the regression equations for both of the study's aims. The section below further explains the regression analysis, data sources, outcome, predictors, covariates and regression equations:

- **Study Aim 1:** This study's first aim explored if there was an association between the external environmental dimensions and the short-term financial measure "Days Cash on Hand" for all major teaching hospitals in the United States.

- **Hypothesis 1 (H1.1)**: Munificence of the external environment will have positive impact on days cash on hand of major teaching hospitals.
- **Analysis**: This study used linear regression analysis, using factors with significant univariate results. ANOVA and Chi-square analysis were used to explore differences among independent variables.
- **Data**: Data sources for the study years 2014 to 2017 were data from the U.S. Department of Commerce, Bureau of Economic Analysis; the U.S. Census Bureau; and, Medicare Cost Report data accessed from American Hospital Directory database.
- **Primary Outcome**: Primary outcome was days cash on hand, which is a measure of company's liquidity, whether the teaching hospital can meet its payments when they are due.
- **Primary Predictors**: Primary predictor variables were income per capita of the metropolitan statistical area where the teaching hospital is located; the population of the metropolitan statistical area where the teaching hospital is located, and whether the teaching hospital's location is urban or rural.
- **Control Variables**: The control variables of the study were system membership of the hospital; type of ownership or control of the hospital; U.S. geographic region of the hospital; number of beds; teaching intensity, denoted by the number of medical residents; case mix index; and, the hospital's outpatient revenue percentage.
- **Regression Equation for Hypothesis 1.1:**

$$\ln(y)_{DCOH} = a + \beta X_{MSAincome} + \beta X_{MSApop} + \beta X_{urban} + \text{control variables} + \text{error}$$

where $\ln(y)_{\text{DCOH}}$ represents natural logarithmic transformation of dependent variable, days cash on hand, and $X_{\text{MSAincome}}$ represents the MSA income per capita; X_{MSApop} represents the population of the MSA, and X_{urban} represents the urban location.

- **Study Aim 1:** This study's first aim explored if there was an association between the external environmental dimensions and the short-term financial measure "Days Cash on Hand" for all major teaching hospitals in the United States.
 - **Hypothesis 2 (H2.1):** Uncertainty of the external environment will have negative impact on days cash on hand of major teaching hospitals.
 - **Analysis:** This study used linear regression analysis, using factors with significant univariate results. ANOVA and Chi-square analysis were used to explore differences among independent variables.
 - **Data:** The data for the study years 2014 to 2017 came from publicly available data provided by the U.S. Dept of Labor, Bureau of Labor Statistics.
 - **Primary Outcome:** Primary outcome was days cash on hand, which is a measure of company's liquidity, whether the teaching hospital can meet its payments when they are due.
 - **Primary Predictors:** Primary predictor variable was the level of unemployment rate change.
 - **Control Variables:** The control variables of the study were system membership of the hospital; type of ownership or control of the hospital; U.S. geographic region of the hospital; number of beds; teaching intensity, denoted

by the number of medical residents; case mix index; and, the hospital's outpatient revenue percentage.

○ **Regression Equation for Hypothesis 2.1:**

$$\ln(y)_{DCOH} = a + \beta X_{unemplratechange} + \text{control variables} + \text{error}$$

where $\ln(y)_{DCOH}$ represents natural logarithmic transformation of dependent variable, days cash on hand, and $X_{unemplratechange}$ represents the level of unemployment rate change.

- **Study Aim 1:** This study's first aim explored if there was an association between the external environmental dimensions and the short-term financial measure "Days Cash on Hand" for all major teaching hospitals in the United States.
 - **Hypothesis 3.1 (H3.1):** Complexity of the external environment will have negative impact on days cash on hand of major teaching hospitals.
 - **Analysis:** This study used linear regression analysis, using factors with significant univariate results. ANOVA and Chi-square analysis were used to explore differences among independent variables.
 - **Data:** The data for the study years to compute the HHI came Medicare Cost Report data accessed from American Hospital Directory.
 - **Primary Outcome:** Primary outcome was days cash on hand, which is a measure of company's liquidity, whether the teaching hospital can meet its payments when they are due.
 - **Primary Predictors:** Primary predictor variable was the Herfindahl-Hirshman Index (HHI), which is a measure of market concentration or the

amount of competition among firms in a particular market, and is the sum of all facilities' squared market share.

- **Control Variables:** The control variables of the study were system membership of the hospital; type of ownership or control of the hospital; U.S. geographic region of the hospital; number of beds; teaching intensity, denoted by the number of medical residents; case mix index; and, the hospital's outpatient revenue percentage.

- **Regression Equation for Hypothesis 3.1:**

$$\ln(y)_{DCOH} = a + \beta X_{HHI} + \text{control variables} + \text{error}$$

where $\ln(y)_{DCOH}$ represents natural logarithmic transformation of dependent variable, days cash on hand, and X_{HHI} represents the Herfindahl-Hirshman Index (HHI) of the metropolitan statistical area where the teaching hospital is located.

- **Study Aim 2:** This study's second aim explored if there was an association between the external environmental dimensions and the long-term financial measure "Return on Assets" for all major teaching hospitals in the United States.
 - **Hypothesis 1.2 (H1.2):** Munificence of the external environment will have positive impact on return on assets of major teaching hospitals.
 - **Analysis:** This study used linear regression analysis, using factors with significant univariate results. ANOVA and Chi-square analysis were used to explore differences among independent variables.
 - **Data:** Data sources for the study years 2014 to 2017 were data from the U.S.

Department of Commerce, Bureau of Economic Analysis; the U.S. Census Bureau; and, Medicare Cost Report data accessed from American Hospital Directory database portal.

- **Primary Outcome:** Primary outcome was Return on Assets (ROA), which is a ratio of net income to total assets; it tells managers if their assets are being used productively or not; it measures a company's ability to control expenses and measures its ability to use its assets to generate revenue.
- **Primary Predictors:** Primary predictor variables were income per capita of the metropolitan statistical area where the teaching hospital is located; the population of the metropolitan statistical area where the teaching hospital is located, and whether the teaching hospital's location is urban or rural.
- **Control Variables:** The control variables of the study were system membership of the hospital; type of ownership or control of the hospital; U.S. geographic region of the hospital; number of beds; teaching intensity, denoted by the number of medical residents; case mix index; and, the hospital's outpatient revenue percentage.
- **Regression Equation for Hypothesis 1.2:**
$$\ln(y)_{ROA} = a + \beta X_{MSAincome} + \beta X_{MSApop} + \beta X_{urban} + control\ variables + error$$
where $\ln(y)_{ROA}$ represents natural logarithmic transformation of dependent variable, Return on Assets, and $X_{MSAincome}$ represents the MSA income per capita; X_{MSApop} represents the population of the MSA, and X_{urban} represents the urban location.

- **Study Aim 2:** This study’s second aim explored if there was an association between the external environmental dimensions and the long-term financial measure “Return on Assets” for all major teaching hospitals in the United States.
 - **Hypothesis 2.2 (H2.2):** Uncertainty of the external environment will have negative impact on return on assets of major teaching hospitals.
 - **Analysis:** This study used linear regression analysis, using factors with significant univariate results. ANOVA and Chi-square analysis were used to explore differences among independent variables.
 - **Data:** The data for the study years 2014 to 2017 came from publicly available data provided by the U.S. Dept of Labor, Bureau of Labor Statistics.
 - **Primary Outcome:** Primary outcome was Return on Assets (ROA), which is a ratio of net income to total assets; it tells managers if their assets are being used productively or not; it measures a company’s ability to control expenses and measures its ability to use its assets to generate revenue.
 - **Primary Predictors:** Primary predictor variable was the level of unemployment rate change.
 - **Control Variables:** The control variables of the study were system membership of the hospital; type of ownership or control of the hospital; U.S. geographic region of the hospital; number of beds; teaching intensity, denoted by the number of medical residents; case mix index; and, the hospital’s outpatient revenue percentage.

- **Regression Equation for Hypothesis 2.2:**

$$\ln(y)_{ROA} = a + \beta X_{unemplratechange} + \text{control variables} + \text{error}$$

where $\ln(y)_{ROA}$ represents natural logarithmic transformation of dependent variable, Return on Assets, and $X_{unemplratechange}$ represents the level of unemployment rate change.

- **Study Aim 2:** This study's second aim explored if there was an association between the external environmental dimensions and the long-term financial measure "Return on Assets" for all major teaching hospitals in the United States.
 - **Hypothesis 3.2 (H3.2):** Complexity of the external environment will have positive impact on return on assets of major teaching hospitals.
 - **Analysis:** This study used linear regression analysis, using factors with significant univariate results. ANOVA and Chi-square analysis were used to explore differences among independent variables.
 - **Data:** The data for the study years to compute the HHI came Medicare Cost Report data accessed from American Hospital Directory.
 - **Primary Outcome:** Primary outcome was Return on Assets (ROA), which is a ratio of net income to total assets; it tells managers if their assets are being used productively or not; it measures a company's ability to control expenses and measures its ability to use its assets to generate revenue.
 - **Primary Predictors:** Primary predictor variable was the Herfindahl-Hirshman Index (HHI), which is a measure of market concentration or the amount of competition among firms in a particular market, and is the sum of

all facilities' squared market share.

- **Control Variables:** The control variables of the study were system membership of the hospital; type of ownership or control of the hospital; U.S. geographic region of the hospital; number of beds; teaching intensity, denoted by the number of medical residents; case mix index; and, the hospital's outpatient revenue percentage.

- **Regression Equation for Hypothesis 3.2:**

$$\ln(y)_{ROA} = a + \beta X_{HHI} + \text{control variables} + \text{error}$$

where $\ln(y)_{ROA}$ represents natural logarithmic transformation of dependent variable, Return on Assets, and X_{HHI} represents the Herfindahl-Hirshman Index (HHI) of the metropolitan statistical area where the teaching hospital is located.

Table 2: Summary of Regression Equations

<i>Regression Equations for Study Aim 1</i>		
Hypothesis 1.1	Munificence of the external environment and Days Cash on Hand	$\ln(y)_{DCOH} = a + \beta X_{MSAincome} + \beta X_{MSApop} + \beta X_{urban} + \text{control variables} + \text{error}$
Hypothesis 2.1	Uncertainty of the external environment and Days Cash on Hand	$\ln(y)_{DCOH} = a + \beta X_{unemplratechange} + \text{control variables} + \text{error}$
Hypothesis 3.1	Complexity of the external environment and Days Cash on Hand	$\ln(y)_{DCOH} = a + \beta X_{HHI} + \text{control variables} + \text{error}$
<i>Regression Equations for Study Aim 2</i>		
Hypothesis 1.2	Munificence of the external environment and Return on Assets	$\ln(y)_{ROA} = a + \beta X_{MSAincome} + \beta X_{MSApop} + \beta X_{urban} + \text{control variables} + \text{error}$
Hypothesis 2.2	Uncertainty of the external environment and Return on Assets	$\ln(y)_{ROA} = a + \beta X_{unemplratechange} + \text{control variables} + \text{error}$
Hypothesis 3.2	Complexity of the external environment and Return on Assets	$\ln(y)_{ROA} = a + \beta X_{HHI} + \text{control variables} + \text{error}$

Reliability and Validity of Data

The database maintained by American Hospital Directory aggregates data points from all the CMS Medicare cost reports, submitted by hospitals. The information about the COTH teaching hospital members was taken directly from the American Association of Medical Colleges' publicly available data about teaching hospitals. As noted in the measurement matrix, the data from Bureau of Economic Analysis, and the U.S. Census Bureau have been used specifically in healthcare management literature.

RESULTS

Data from 226 major teaching hospitals were included in the analysis. Table 3 provides the descriptive statistics for all variables used in this study. The overall results for these major teaching hospitals were remarkable. For the short-term financial performance of major teaching hospitals, results of the regression model showed an increase in outpatient revenue to be significantly associated with Days Cash on Hand. For the long-term financial performance of major teaching hospitals, the study showed significant relationships between the munificence and uncertainty dimensions of the teaching hospital's external environment and its Return on Assets. Additionally, system membership, type of ownership/control and teaching intensity also showed significant associations with long-term financial performance.

Table 3: Descriptive Statistics and Hospital Characteristics

Variable	Total
Hospitals, n	226
Days Cash on Hand, mean (SD)	141 (257)
Return on Assets as %, mean (SD)	6.58% (0.1398)
MSA per capita income (\$ per 10,000), mean (SD)	5.36 (1.24)
MSA population (in 1,000,000s), mean (SD)	5.05 (6.17)
MSA Unemployment Rate Change as %, mean (SD)	-0.90% (0.026)
MSA Herfindahl-Hirschman Index (HHI), mean (SD)	1990 (1919)
Number of Beds, mean (SD)	678 (455)
Teaching intensity, mean (SD)	314 (233)
Case Mix Index, mean (SD)	1.937 (0.262)
Outpatient revenue %, mean (SD)	44.65% (0.1045)
Location	
Urban, n (%)	180 (79.65%)
Rural, n (%)	46 (20.35%)
System membership	
Yes, n (%)	193 (85.40%)
No, n (%)	33 (14.60%)
Type of ownership / control	
Voluntary non-profit, n (%)	141 (62.39%)
Church, n (%)	19 (8.41%)
Government, n (%)	54 (23.89%)
Proprietary, n (%)	12 (5.31%)
Geographic Region	
Northeast, n (%)	67 (29.65%)
Midwest, n (%)	54 (23.89%)
South, n (%)	73 (32.30%)
West, n (%)	32 (14.16%)

Regression Results for Study Aim 1

Regression results for Aim 1 of the study showed no significant relationship between the short-term financial performance, measured by days cash on hand all sources, and the Resource Dependence Theory's dimensions of munificence, uncertainty or complexity of the teaching hospital's external environment; however, there was significance between short-

term financial performance and outpatient revenue, showing that a one percent increase in outpatient revenue will increase days cash on hand by 12.61% (p -value 0.039). The dependent variable, days cash on hand, was logarithmically transformed because nonlinearities in regression analysis are incorporated by transforming the dependent variable in logarithmic form (Wooldridge, 2013); thus, the coefficients were transformed to enable correct interpretation with a logarithmically transformed dependent variable.

This study used linear regression analysis, using factors with significant univariate results. ANOVA and Chi-square analysis were used to explore differences among independent variables. The dependent variable of days cash on hand was logarithmically transformed. While analyzing variables that had significant univariate results with days cash on hand, the following variables showed univariate significance, which were then included in the Regression Model for Study Aim 1: per capita income of MSA (p -value 0.010); population of MSA (p -value 0.008); unemployment rate change (p -value 0.031); HHI of MSA (p -value 0.089); number of beds (p -value 0.068); teaching intensity (p -value 0.075); and, percentage of outpatient revenue (p -value 0.121).

After multivariate controls, the final regression model for days cash on hand showed significance with only one independent variable: outpatient revenue percentage ($\beta = 2.53$; p -value = 0.039). Once the regression model was run for this study aim, additional regression diagnostics were analyzed to assess the goodness of fit of the regression model. The predict command in STATA-14 was utilized to create residuals and then kernel density plots, quantile normal plots and normal probability plots were used to check the normality of the residuals. Additionally, since STATA assumes homoskedastic standard errors by default, the model was adjusted to account for heteroskedasticity, by using the option of *robust* in

STATA-14 (Stock, 2011), after the Breusch-Pagan/Cook-Weisberg test for heteroskedasticity detected heteroskedasticity, and generated p -value of 0.001.

STATA-14 commands were also used to detect any multicollinearity in the regression model. When multicollinearity is present, the standard errors in the regression model may be inflated (Stock, 2011); therefore, the command VIF (variance inflation factor) was used to detect multicollinearity, since any value variable that has VIF value of greater than 10 would require further investigation (Regression with STATA, 2019). None of the variables in this regression model had any VIF value of 10 or greater.

Regression model specification tests were also conducted in STATA-14 for this regression model. The two model specification tests were the linktest and the omitted variable test in STATA-14. The omitted variable test was not significant, with p -value 0.797, and confirmed that no variables were omitted in this regression model. The linktest for this model generated p -value of the squared prediction variable, $_hatsq$, to be 0.983; therefore, the linktest in STATA-14 failed to reject the assumption that the model is specified correctly, and thus, there was no specification error in this model. The regression model results for days cash on hand are provided in Table 4.

Table 4: Regression Model Results for Study Aim 1, Days Cash on Hand (Dependent Variable)

Variable	Coefficient	p -value	95% C.I.
<i>Resource Dependence Theory Dimension of Munificence</i>			
MSA per capita income (\$ per 10,000)	0.074	0.321	(-0.073, 0.223)
MSA population (in 1,000,000s)	0.019	0.349	(-0.021, 0.060)
Urban location	-0.170	0.537	(-0.713, 0.372)
<i>Resource Dependence Theory Dimension of Uncertainty</i>			
Unemployment Rate Change	-2.111	0.089	(-4.544, 0.321)

<i>Resource Dependence Theory Dimension of Complexity</i>			
MSA HHI	0.0001	0.100	(-0.00001, 0.0002)
<i>Control Variables</i>			
System membership	-0.170	0.405	(-0.573, 0.232)
Ownership/control	-0.133	0.756	(-0.973, 0.707)
Geographic Region	-0.308	0.385	(-1.004, 0.389)
Number of Beds	.0008	0.058	(-0.00003, 0.0017)
Teaching intensity	-.0002	0.774	(-0.0016, 0.0012)
Case Mix Index	0.367	0.477	(-0.648, 1.383)
Outpatient revenue %	2.534	0.039	(0.127, 4.943)
Constant	2.044	0.188	

R² = 0.050

The R^2 value of 0.050 for the regression model results for aim 1 indicates that there are other explanatory variables that may explain the relationship with the dependent variable of days cash on hand in this model. In social sciences research, low values of R^2 are not uncommon (Wooldridge, 2013).

Regression Results for Study Aim 2

Regression results for Aim 2 of the study show significant relationship between the long-term financial performance, measured by return on assets, and the Resource Dependence Theory's dimensions of munificence and uncertainty of the teaching hospital's external environment. The dependent variable, return on assets, was logarithmically transformed because nonlinearities in regression analysis are incorporated by transforming the dependent variable in logarithmic form (Wooldridge, 2013); thus, the interpretation of the statistically significant results are as follows: for every 1,000,000 unit increment in the population of the metropolitan statistical area (MSA), the return on assets will decrease by 0.974% (p -value 0.041); every one percent increment in the unemployment rate of the MSA will decrease the return on assets by 0.0098% (p -value 0.000). There was no significant

relationship between long-term financial performance and the complexity of the external environment, measured by the HHI.

Additionally, system-affiliated teaching hospitals have 2.05% higher ROA, as compared to non-system affiliated teaching hospitals (p -value 0.009). This study's sample had 193 hospitals that were system-affiliated, and 33 hospitals that were not system-affiliated. Teaching hospitals under proprietary control have almost 2.51% higher ROA, as compared to teaching hospitals under non-profit control (p -value 0.033). Also, for every 1 unit increase in teaching intensity (number of residents), the ROA will decrease by 0.99% (p -value 0.047).

This study used linear regression analysis, using factors with significant univariate results. ANOVA and Chi-square analysis were used to explore differences among independent variables. While analyzing variables that had significant univariate results with return on assets, the following variables showed significance, which were then included in the Regression Model for Study Aim 2: per capita income of MSA (p -value 0.057); population of MSA (p -value 0.037); unemployment rate change (p -value 0.090); case mix index (p -value 0.068); HHI of MSA (p -value 0.073); number of beds (p -value 0.026); teaching intensity (p -value 0.117); and, outpatient revenue % (p -value 0.021).

After multivariate controls, the regression analysis for return on assets showed significance with the following independent variables: population of MSA ($\beta = -0.026$; p -value < 0.041); unemployment rate change ($\beta = -4.626$; p -value < 0.001); system membership ($\beta = 0.719$; p -value < 0.009); proprietary control ($\beta = 0.920$; p -value < 0.033); and, teaching intensity ($\beta = -0.000764$; p -value < 0.047). The coefficients were transformed to enable correct interpretation with a logarithmically transformed dependent variable.

Once the regression model was run for this study aim, additional regression diagnostics were analyzed to assess the goodness of fit of the regression model. The `predict` command in STATA-14 was utilized to create residuals and then kernel density plots, quantile normal plots and normal probability plots were used to check the normality of the residuals. Additionally, since STATA assumes homoskedastic standard errors by default, the model was adjusted to account for heteroskedasticity, by using the option of *robust* in STATA-14 (Stock, 2011), after the Breusch-Pagan/Cook-Weisberg test for heteroskedasticity detected heteroskedasticity, and resulted in p -value of 0.030.

STATA-14 commands were also used to detect any multicollinearity in the regression model. When multicollinearity is present, the standard errors in the regression model may be inflated (Stock, 2011); therefore, the command VIF (variance inflation factor) was used to detect multicollinearity, since any value variable that has VIF value of greater than 10 would require further investigation (Regression with STATA, 2019). None of the variables in this regression model had any VIF value of 10 or greater.

Regression model specification tests were also conducted in STATA-14 for this regression model. The two model specification tests were the `linktest` and the omitted variable test in STATA-14. The omitted variable test was not significant, with p -value 0.462, and confirmed that no variables were omitted in this regression model. The `linktest` for this model generated p -value of the squared prediction variable, `_hatsq`, to be 0.989; therefore, the `linktest` in STATA-14 failed to reject the assumption that the model is specified correctly, and thus, there was no specification error in this model. The regression model results for Return on Assets are provided in Table 5.

Table 5: Regression Model Results for Study Aim 2: Return on Assets (Dependent Variable)

Variable	Coefficient	p-value	95% C.I.
<i>Resource Dependence Theory Dimension of Munificence</i>			
MSA per capita income (\$ per 10,000)	-0.010	0.891	(-0.160, 0.139)
MSA population (in 1,000,000s)	-0.026	0.041	(-0.051, -0.001)
Urban location	0.087	0.612	(-0.252, 0.427)
<i>Resource Dependence Theory Dimension of Uncertainty</i>			
Unemployment Rate Change	-4.626	0.001	(-6.021, -3.230)
<i>Resource Dependence Theory Dimension of Complexity</i>			
MSA HHI	-0.00000179	0.963	(-0.00000786, 0.000075)
<i>Control Variables</i>			
System membership	0.719	0.009	(0.181, 1.258)
Proprietary control	0.920	0.033	(0.076, 1.764)
Number of Beds	0.000153	0.216	(-0.0000908, 0.0003984)
Teaching intensity	-0.000764	0.047	(-0.0015, -0.00899)
Case Mix Index	0.482	0.183	(-.2297, 1.1941)
Outpatient revenue %	-0.610	0.399	(-2.035, 0.815)
Constant	-4.044	0.0001	

R² = 0.192

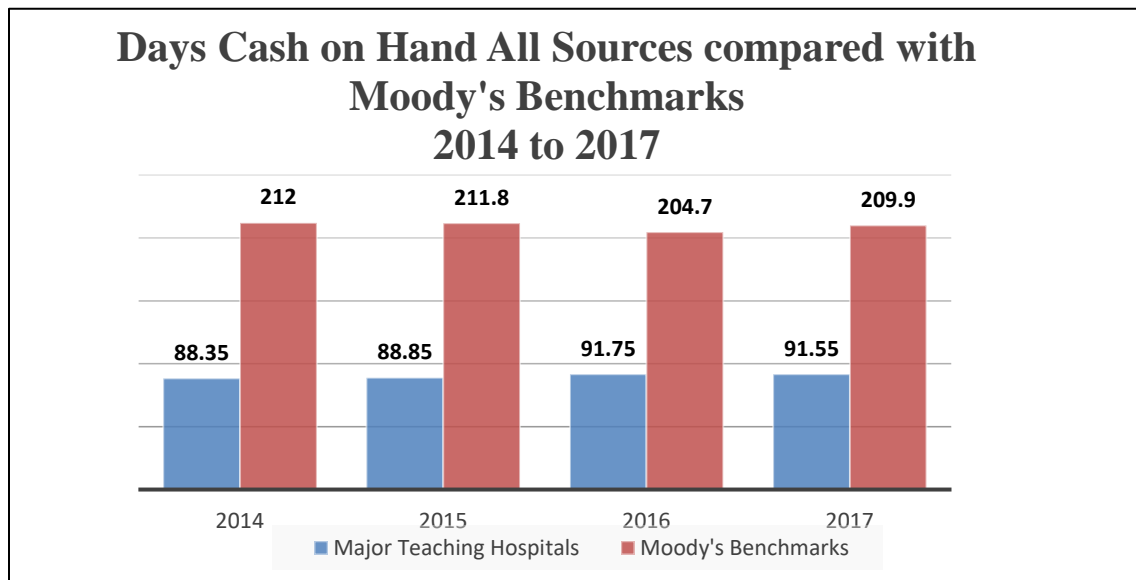
The R^2 value of 0.192 for the regression model results for aim 2 indicates that there are other explanatory variables that may explain the relationship with the dependent variable of return on assets in this model. In social sciences research, low values of R^2 are not uncommon (Wooldridge, 2013).

Additional Insights about Days Cash on Hand

In addition to the regression results for this study, additional insights were also gleaned from the study's data for the years 2014 through 2017. These additional insights are not statistically tested, and thus, significance cannot be determined; however, the analyses

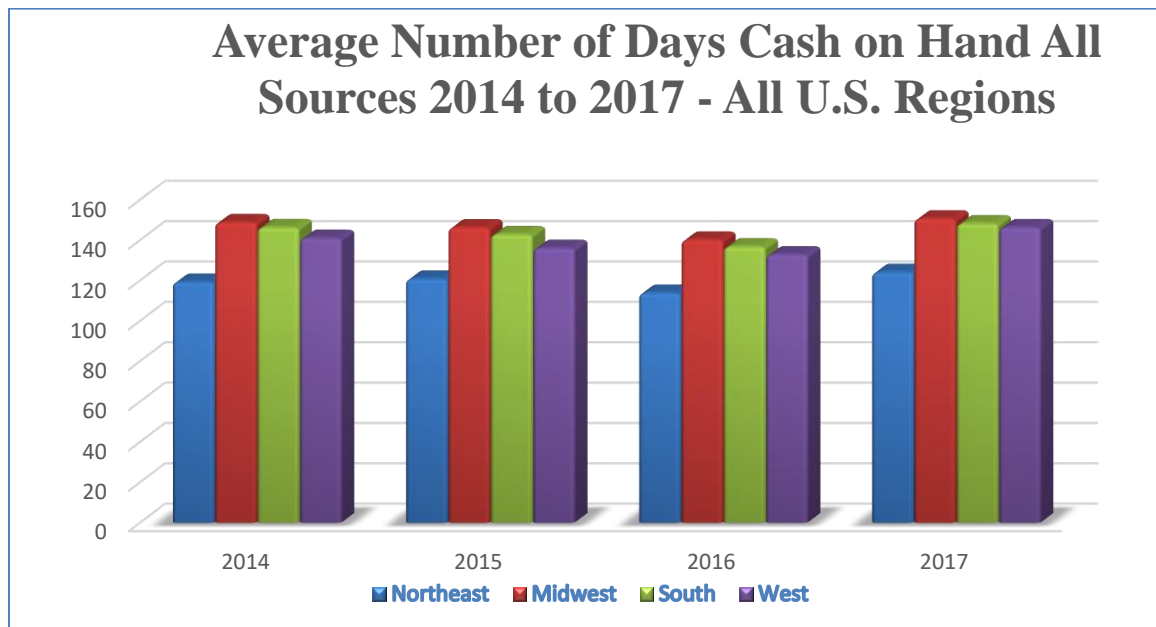
shed additional light about days cash on hand at major teaching hospitals. One of the insights was that the major teaching hospitals are in a liquidity crunch, and are well below the benchmark median days cash on hand, as released by Moody's Investor Service (Becker's Hospital Review, 2017). Figure 4 depicts how the major teaching hospitals' median days cash on hand from all sources for each year compared to the median benchmarks from Moody's Investor Service.

Figure 4: Comparison of Days Cash on Hand with Moody's Benchmarks



The regression analysis did not show any significance between the geographic regions and mean days cash on hand, but additional insights showed that the Northeast region consistently maintained a lower number of days cash on hand from all sources, which may mean that the Northeast region perhaps had more challenges related to cash liquidity, as compared to the Midwest, South and West regions, shown in Figure 5.

Figure 5: Average Number of Days Cash on Hand for U.S. Regions

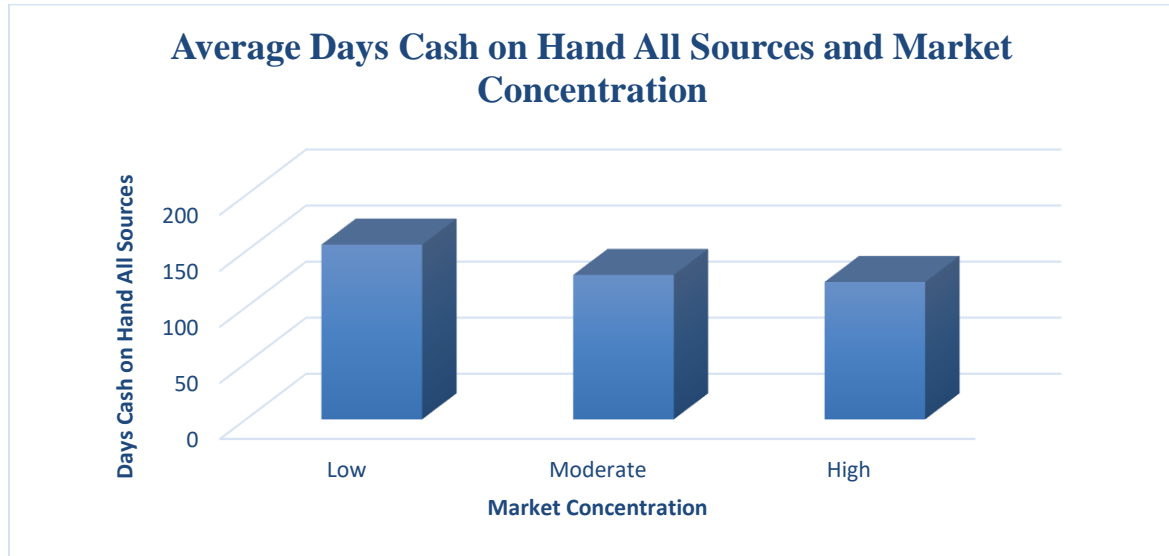


The level of market concentration, operationalized as Herfindahl-Hirschman Index (HHI) in this study, did not show statistically significant association with days cash on hand in the regression analysis for this study's first aim about short-term financial performance; however, additional non-statistical insight from the data collected for this study shows, in Figure 6, that the average number of days cash on hand from all sources were higher in major teaching hospitals located in metropolitan statistical areas that had low market concentration; i.e., high market competition, as compared to days cash on hand for major teaching hospitals located in metropolitan statistical areas with moderate to high market concentration; i.e., moderate to low competition.

The Department of Justice classifies those markets that have HHI up to 1500 points to be markets with low concentration (high competition). Those markets that have HHI between 1500 to 2500 points are considered to be moderately concentrated, and those

markets that have HHI higher than 2500 points are considered to be highly concentrated, and with low competition (HHI, 2019).

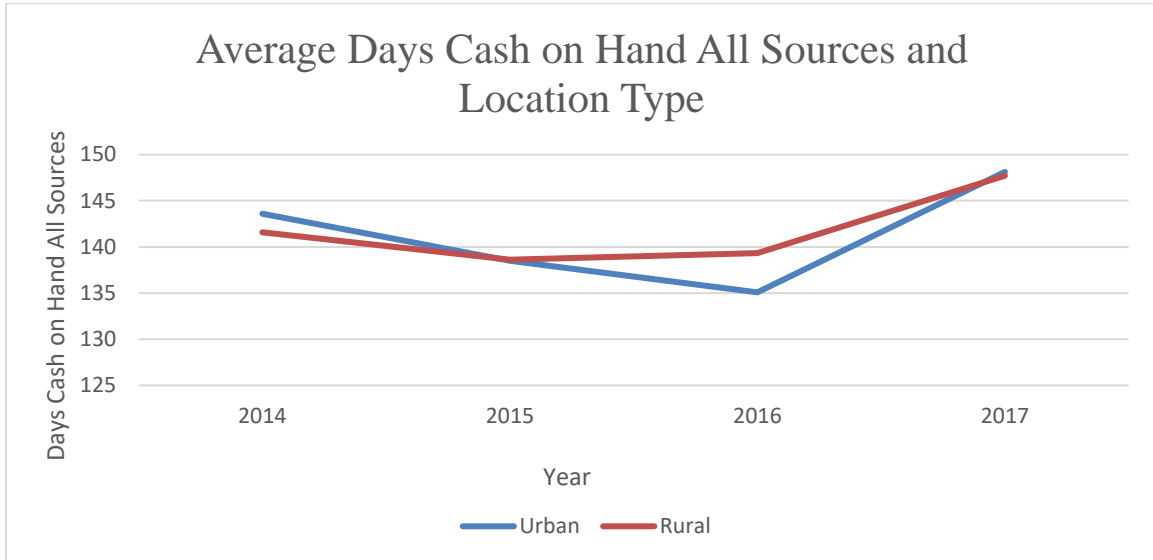
Figure 6: Average Number of Days Cash on Hand and Market Concentration



Another interesting finding was about the average number of days cash on hand and the location type of the major teaching hospital, whether it is designated as urban or rural. The regression analysis did not find any statistical significance between the location type and days cash on hand, but additional non-statistical insight depicted in Figure 7 shows that major teaching hospitals located in urban areas had two additional days of cash on hand in 2014, as compared to their rural counterparts (143 days vs. 141 days). The major teaching hospitals located in urban areas had same number of days cash on hand in 2015 (139 days), as compared to their rural counterparts, and same number of days cash on hand in 2017 (148 days), as compared to their rural counterparts.

Figure 7: Average Number of Days Cash on Hand and Location Type of Teaching

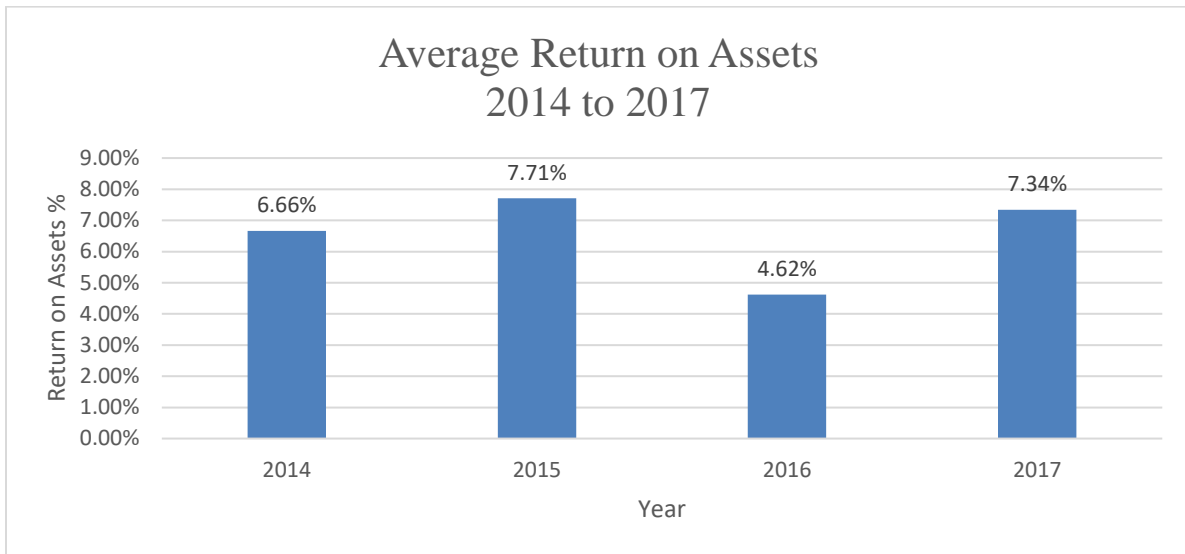
Hospitals



Additional Insights about Return on Assets

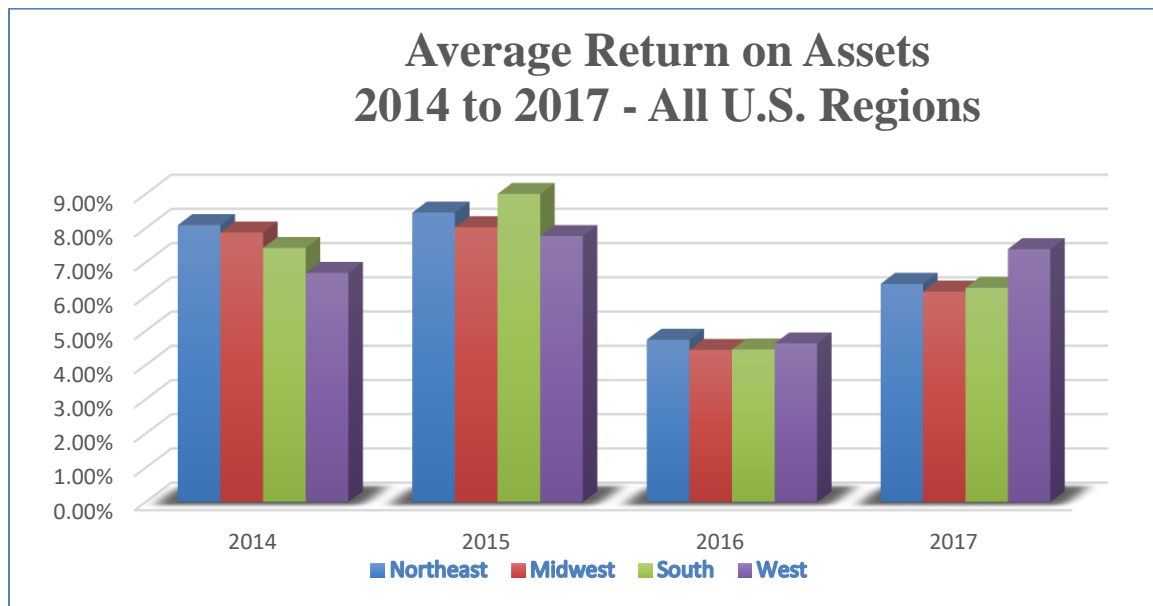
Another insight gleaned from this study was the trend in the average return on assets for all major teaching hospitals for the years 2014 through 2017. These insights are not statistically tested, but shed additional light about return on assets at major teaching hospitals. Figure 8 depicts the range of average return on assets, from 4.62% to 7.71%, with 2016 marking the lowest average return on assets for all major U.S. teaching hospitals.

Figure 8: Average Return on Assets, 2014 to 2017



For the dependent variable of return on assets (ROA), a financial measure of profitability, even though the regression analysis did not show any significance between the geographic regions and the ROA, additional non-statistical analysis showed that the Northeast region consistently maintained slightly higher ROA, as compared to the other three geographic regions. The average ROA from 2014 to 2017 for the Northeast region was at 6.91%, slightly above 6.78% for Southern U.S., and above 6.62% for both Midwest and Western U.S., as illustrated in Figure 9.

Figure 9: Average Return on Assets, 2014 to 2017 for all U.S. Regions

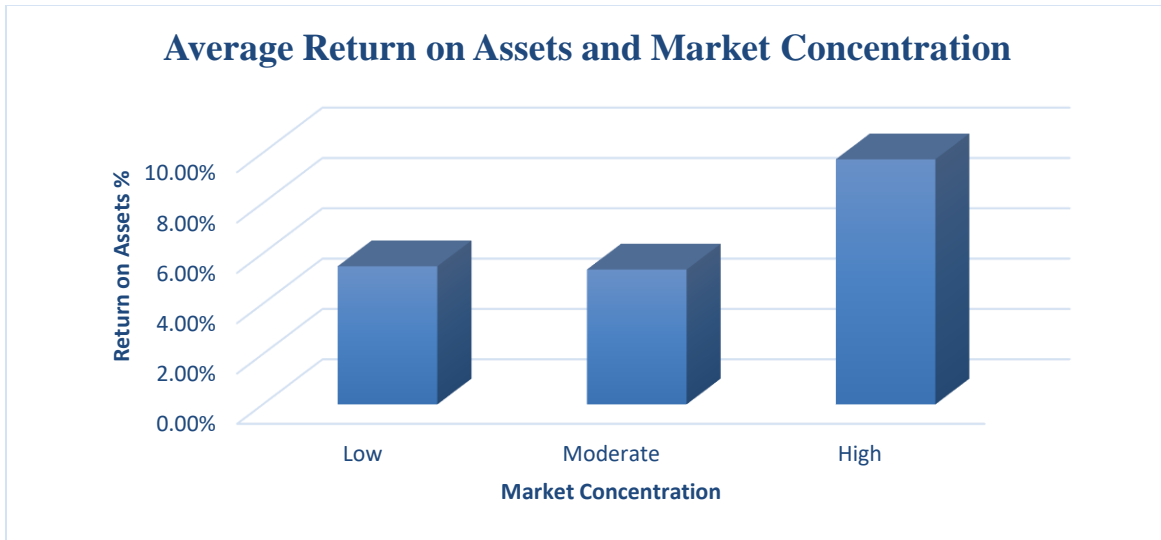


The level of market concentration, operationalized as Herfindahl-Hirschman Index (HHI) in this study, did not show statistically significant association with return on assets in the regression analysis for this study’s second aim, also; however, additional non-statistical analysis of the data collected for this study shows, in Figure 10, that the average return on assets, a financial metric of profitability, was higher in major teaching hospitals located in metropolitan statistical areas that had high market concentration; i.e., low market competition, as compared to return on assets for major teaching hospitals located in metropolitan statistical areas with low to moderate market concentration; i.e., low to moderate competition.

The Department of Justice classifies those markets that have HHI up to 1500 points to be markets with high competition. Markets that have HHI between 1500 to 2500 points are considered to be moderately concentrated, and those markets that have HHI higher than 2500

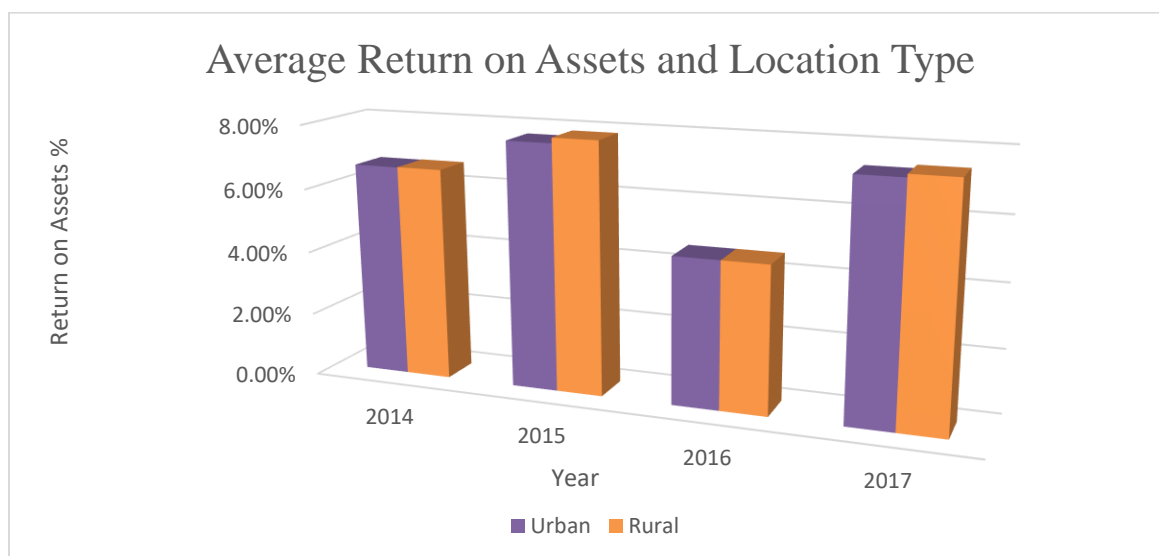
points are considered to be highly concentrated, and with low competition (HHI, 2019).

Figure 10: Average Return on Assets and Market Concentration



For the average return on assets and the type of location of the major teaching hospital, the rural hospitals seemed to fare better than the urban hospitals in the years 2015 and 2017, as depicted in Figure 11.

Figure 11: Average Return on Assets and Location Type



Additionally, the study's results also found that hospital market concentration is low, i.e. competition is high for teaching hospitals, in the following ten metropolitan areas:

Table 6: Metropolitan areas with competitive hospital markets

<u>Metropolitan statistical areas with teaching hospitals in low concentration markets (2014 to 2017)</u>	
1)	Los Angeles-Long Beach-Anaheim
2)	New York-Newark-Jersey City
3)	Houston-The Woodlands-Sugar Land
4)	Dallas-Fort Worth-Arlington
5)	Chicago-Naperville-Elgin
6)	Miami-Fort Lauderdale-West Palm Beach
7)	Phoenix-Mesa-Scottsdale
8)	Philadelphia-Camden-Wilmington
9)	Seattle-Tacoma-Bellevue
10)	Portland-Vancouver-Hillsboro

Also, the study's results found that hospital market concentration is high, i.e.

competition is low for teaching hospitals, in the following ten metropolitan areas:

Table 7: Metropolitan areas with highly concentrated hospital markets

<u>Metropolitan statistical areas with teaching hospitals in high concentration markets (2014 to 2017)</u>	
1)	Greenville (North Carolina)
2)	Ann Arbor
3)	Fayetteville (North Carolina)
4)	Burlington-South Burlington
5)	Charleston (West Virginia)
6)	Charlottesville
7)	Springfield (Massachusetts)
8)	Morgantown
9)	Rochester (Minnesota)
10)	New Haven-Milford

DISCUSSION

Hospitals around the country, specifically the teaching hospitals, are facing financial challenges and pressures, and will continue to do so as the momentum in the U.S. moves towards providing more value-based health services that will keep populations healthy. This study explored if there is an association between the short-term and long-term financial performance of major teaching hospitals, and the external environmental dimensions based upon the Resource Dependence Theory framework. Based upon the literature review, this study is the first of its kind to comprehensively study all major teaching hospitals in the U.S., and their short-term financial performance based upon the financial measure of liquidity called days cash on hand, and their long-term financial performance based upon the financial measure of profitability called return on assets, from the perspective of Resource Dependence Theory.

Results of this study have shed light on the precarious cash liquidity situation for the major teaching hospitals (Figure 4), whose medians for days cash on hand continue to be well below Moody's Investor Service benchmarks. Additionally, the regression analysis of this study found a significant positive association between this measure of liquidity and outpatient revenue of the teaching hospital. This study confirms the finding that increasing percentage of outpatient revenue will result in reducing financial difficulty, or financial distress, of the hospital (Langabeer et al., 2018). Financial distress is the term that is used in financial management literature to refer to those organizations that have difficulties in paying their creditors, employees and investors (Sun et al., 2013).

This study also found that the financial liquidity was higher in major teaching

hospitals located in cities that had high market competition, as compared to those major teaching hospitals located in metropolitan areas with moderate to low competition (Figure 6). Empirical studies in healthcare management literature have operationalized the dimensions of the Resource Dependence Theory with the variables of per capita income of the MSA; population of the MSA; and, the teaching hospital's location to study Munificence of the external environment; the unemployment rate change of the MSA to study Uncertainty of the external environment; and, the Herfindahl-Hirschman Index (HHI) to study the Complexity of the external environment. This study's statistical analysis did not find significance between these specific external environmental components and the liquidity measure chosen for this study.

For the study's second aim about teaching hospitals' long-term financial performance, the Resource Dependence Theory based operationalized variables showed significance with the dimensions of Munificence and Uncertainty of the external environment. The regression results confirm prior findings about significant relationship between hospital's performance and population of the metropolitan statistical area (Balotsky, 2005); the level of unemployment rate change (Kazley et al., 2007); system affiliation (Langabeer et al., 2018); and, teaching intensity (Langabeer et al., 2018).

Despite the regression results showing negative relationship between the teaching intensity and return on assets, this study is not suggesting that a teaching hospital should reduce their number of residents to achieve long-term profitability. Employing higher number of graduate medical students will increase labor costs, but it will increase the human resource capacity in the hospital, and will allow for greater efficiencies to treat higher volume of patients (Langabeer et al., 2018).

Additionally, this study's non-statistical results have also shed light on differences in levels of profitability by geographic region (Figure 9); and, higher level of return on assets for major teaching hospitals located in metropolitan areas with low market competition (Figure 10). Another remarkable non-statistical finding from this study was that the average profitability was higher for rural hospitals, as compared with urban teaching hospitals (Figure 11), which contradicts prior healthcare management studies that have found rural hospitals to be in a more financially vulnerable position (Pink et al., 2009); therefore, the metric of return on assets will need to be studied further, specifically for rural hospitals. These additional findings are not statistical analyses, nor statistically significant; however, potential future studies may explore the statistical significance for these specific areas.

Policy Implications

Despite the challenging healthcare landscape in the U.S., major teaching hospitals have continued to maintain and fulfill their clinical, academic, and research missions. This study's findings can help the administrators and decision-makers at these institutions to formulate and implement strategies that can increase both their short-term and long-term financial performance. This research suggests that increasing percentage of outpatient revenue can be an important element to consider for the major teaching hospitals to increase their cash liquidity, as component of their approach towards increasing the organization's liquidity.

Hospital administrators can analyze their respective service lines and revenue mix to offer more outpatient services to their patients and surrounding community. Furthermore, administrators and managers at major teaching hospitals can explore novel ways of

delivering care, by utilizing telehealth and other technological innovations. Administrators of teaching hospitals can also consider developing efficiencies in their accounts receivables system to better manage their cash flow and liquidity.

Another area for administrators of major teaching hospitals to consider is the population of their metropolitan area. This study's findings showed a negative significant relationship between the level of profitability and an increase in the population of the surrounding metropolitan statistical area. Hospital administrators can analyze their respective metropolitan area's population growth patterns based upon specific age groups, to ensure that the optimal mix and types of services are being offered and rendered that can continue to ensure the desired level of long-term profitability of the teaching hospital.

Smitherman et al. have proposed that rather than the traditional three-pronged mission of teaching hospitals, addressing the social determinants of health should allow teaching hospitals to have a "quadripartite mission" to address social accountability (2019). A number of social science and public health researchers have also concluded that socioeconomic components, as well as living conditions, now account for over 60% of all chronic disability and premature deaths in the U.S. (Smitherman et al., 2019). Teaching hospitals are in a unique position to take a leadership role in their communities to partner with pertinent stakeholders to improve the health of their local population.

Another one of this study's findings was that system-affiliated hospitals have 2.05% higher return on assets, assuming all other variables remain constant, as compared to non-system affiliated teaching hospitals. This finding is consistent with the assumptions and rationale of Resource Dependence Theory because strategic alliances is one of the ways organizations adopt to increase their control over resources (Pfeffer & Salancik, 1978).

Administrators at non-system affiliated hospitals may want to consider evaluating the feasibility of a health system alliance in the turbulent financial environment, either centralized, moderately centralized or decentralized health system (Rosko et al., 2007), and how it will impact both short-term liquidity and long-term profitability. Another approach towards affiliation can be strengthening the teaching hospital's access within a geographic region, and mergers, acquisitions, as well as strategic geographic partnerships can also help teaching hospitals to broaden their area of service (Valletta et al., 2013).

Regarding the type of ownership and control, this study's regression results found that teaching hospitals under proprietary control have almost 2.51% higher return on assets, as compared to teaching hospitals that are under non-profit control, assuming all other variables remain constant. Type of ownership an organization maintains to reduce its dependence over resources and increase control over the resources in the environment are consistent with the rationale of Resource Dependence Theory (Pfeffer & Salancik, 1978). A proprietary, for-profit control of an organization denotes answering to external shareholders and creditors about the organization's income, profits or losses, as well as operational and leadership trajectories, and hospital administrators will need to assess the long-term organizational strategy before considering changing their ownership type and control.

Teaching hospitals are also primary centers of research, and over several decades, novel approaches to diagnosis and prevention, as well as medical innovations have been pioneered at these hospitals (AAMC, 2019). Translating academic clinical research into patient care improvement and innovative breakthroughs is not an easy task, and in the current turbulent market of shrinking research budgets and financial constraints, a gap exists between

this type of clinical research and commercializing it; thus, health care innovation centers have filled this gap recently (Siefert et al., 2019). Health care innovation centers tend to be partnerships between academic and medical institutions, and provide education, mentoring, advising, as well as funding to innovators who want to solve real-world healthcare problems, and teaching hospitals are again positioned to partner with relevant stakeholders to commercialize promising clinical research, to improve patient care and invent medical breakthroughs (Siefert et al., 2019).

Additionally, teaching hospitals can also maximize their investments in health data analytics, and enabling broader sharing of the population clinical data, so additional research and development around enhancing patient care and treatments can take place at these facilities.

Strengths and Limitations

One of the strengths of this study is that it has analyzed all the major teaching hospitals in the U.S., and their cash liquidity and long-term profitability for the years 2014 to 2017. This study provides an observational, cross-sectional analysis of how the major teaching hospitals are faring in the current era of rising healthcare expenditures and financial turbulence. Another strength of this study is that the external environmental dimensions based upon the Resource Dependence Theory have been operationalized in this research to explore an association between those external environmental components and both the short-term and long-term financial performance of major teaching hospitals.

The third strength of this study is that this research has also sought to fill gaps in healthcare management literature about the applicability of Resource Dependence Theory in

the specific context of major teaching hospitals. Although Pfeffer and Salancik's work on Resource Dependence Theory has been studied in healthcare settings, such as hospitals, nursing homes and medical practices, this study adds to the growing corpus of healthcare studies, but with specific focus on major teaching hospitals, and the external environment's impact on their financial performance.

As with all research studies, this study also has limitations. One of the limitations is that this study analyzed data for major teaching hospitals; i.e. those teaching hospitals that are members of the Council of Teaching Hospitals and Health Systems (COTH); thus, results of this study may not be generalizable to teaching and non-teaching hospitals that are not members of COTH and maybe located in smaller communities and metropolitan areas.

Another limitation of this study is that the data used are derived not from primary sources, but from secondary sources; however, publicly available national sources of data were used for this study, in order to mitigate the effect of this specific limitation. An additional limitation of this study is that hospitals have different fiscal reporting cycles, and hence, the averages for their reported financial data were taken for this study.

Also, there are other types of financial measures that could have been used for this study (Appendix G). The liquidity measure of days cash on hand was chosen for this study to shed light on how many days can major teaching hospitals operate with, if no new sources of cash became available to them. Also, the long-term financial measure of return on assets was used in this study because this measure is more comprehensive since it takes into account both the net income and total assets, compared to other long-term profitability measures, like operating margin or growth rate in equity (Gapenski, 2012).

Finally, this study was a retrospective, cross-sectional study, providing a snapshot

into the liquidity and profitability of major teaching hospitals for a certain point in time, namely from 2014 to 2017. The findings of this research, therefore, may vary for different periods of time.

Future Research

This research study can be used as a foundation for multiple future research studies. One area of future research can be expansion of this study's design, based upon the operationalization of Resource Dependence Theory and extending it to all teaching hospitals in the U.S., not just the major teaching hospitals. A second area of future research can be to expand this study's theoretical framework for all hospitals nationwide, not just the teaching hospitals. A third area of future research can explore combining multiple organizational management theories, like transaction cost economics and institutional theory, with Resource Dependence Theory and operationalizing them to study financial performance of various types of healthcare facilities. All healthcare settings are operating with varying degrees of uncertainty and complexity in their respective external environments, and future research can shed light upon any interrelationships amongst the strategies used to reduce external environmental dependencies.

Future research can also explore the association between short-term and long-term financial performance of teaching hospitals by using different measures of liquidity, like the current ratio and quick ratio, and different measures of profitability, like growth rate in equity, operating margin and total margin (Gapenski, 2012). Another future study can study the effect of Medicaid expansion on the short-term and long-term financial performance of teaching hospitals. Another future research study can examine the impact of specific

healthcare technologies, like telehealth and diagnostic imaging, on both the short-term and long-term performance of teaching hospitals.

The data from this study also showed differences in levels of profitability by geographic region (Figure 9), which can also be used for future research to analyze geographical differences and hospital profitability. Also, Figure 10 illustrated that the return on assets was higher in major teaching hospitals located in metropolitan statistical areas that had high market concentration; i.e., those areas with low market competition. A September 2019 report from Health Care Cost Institute (HCCI) found that those metropolitan areas that had higher hospital market concentration were also likely to see increase in their inpatient prices (HCCI, 2019); thus, this study's framework and findings can also assist future research studies to further analyze the hospital market concentration nationwide.

Quantitative studies are not the only options for future research. This study's findings can also be utilized for qualitative studies that can look for themes that may emerge from observations and evaluations of certain contexts. Semi-structured or structured interviews (Jacobsen, 2012) of various decision makers and members of leadership team at teaching hospitals can be conducted to ascertain more complete understanding of strategies they are using, and plan to use in the future, to navigate the challenging financial terrain. Additionally, mixed-methods studies can also be conducted based upon this study's findings, incorporating both quantitative and qualitative research methodologies.

CONCLUSION

This study set out to understand if there is an association between the external environmental dimensions and the short-term and long-term financial performance of all major teaching hospitals in the United States, and sought to answer the following questions:

Question 1: Using the Resource Dependence Theory framework, is there an association between the external environment and the short-term liquidity of all major teaching hospitals in the U.S.?

Question 2: Using the Resource Dependence Theory framework, is there an association between the external environment and the long-term profitability of all major teaching hospitals in the U.S.?

Findings for the first research question of this study have shed light on the precarious cash liquidity situation for all the major teaching hospitals nationwide, and this study found a significant positive association between the number of days cash on hand and the outpatient revenue of the teaching hospital. Although not part of the regression model and not statistically evaluated, this study also found that the financial liquidity was higher in major teaching hospitals located in cities that had high market competition, as compared to those major teaching hospitals located in cities with moderate to low competition.

Answers to the second research question of this study confirmed prior findings about significant relationship between hospital's performance and population of the metropolitan statistical area; the level of unemployment rate change in the metropolitan area; system affiliation; and, teaching intensity. This study's results have also shed light on differences in levels of profitability by geographic region, and higher level of profitability for teaching

hospitals located in metropolitan areas with low market competition. Another remarkable finding from this study was that the average profitability was higher for rural hospitals, as compared with urban teaching hospitals, for the years 2014 to 2017, although not statistically significant, and not part of the study's regression model.

Currently, the U.S. healthcare environment is operating in a state of flux and uncertainty, and with the high level of attention focused on national health expenditures and healthcare organizations, the application of Resource Dependence Theory perspective in research studies of healthcare organizations has become more critical and relevant than ever before. Resource Dependence Theory assumes that organizations will minimize their dependence on other organizations in the environment for the supply of resources, and the organization's survival will be threatened if it is unable to secure the needed resources.

Managers and decision-makers need to continually engage with strategies and innovative organizational alliances and linkages to ensure the organization's survival, growth, and reduced dependence on resources. In an effort to minimize dependence on other organizations, hospitals must be careful not to engage in unethical behavior and trade practices to reduce dependencies, since that may potentially be an unintended consequence when managers are faced with uncertainty within the external environment and may try to utilize any means necessary to secure resources.

No recent studies have been comprehensively conducted for all major teaching hospitals in the United States, and this study fills the gaps in the healthcare management body of knowledge about the financial performance of major teaching hospitals nationwide. Results from this study can be used by teaching hospital administrators to further optimize their revenue streams proactively, and to continue to be engaged with their local communities

to work towards population health improvements.

Despite the tough financial environment, teaching hospitals have an opportunity to enhance and balance their unique mission, with exploring novel revenue streams and aligning their breakthrough medical research work with business strategy. Creating a health care innovation center can assist the teaching hospitals to commercialize and commoditize their innovative clinical research, but success of translational research also requires open channels of communication between the basic scientists and clinical researchers (Siefert et al., 2019). Becoming leaders in interprofessional education is another area for teaching hospital administrators to consider, to break the silos and enhance patient care and experience, and to demonstrate their added value proposition in the healthcare industry.

From the perspective of healthcare transformation and achieving Triple Aim, teaching hospitals are poised to play pivotal roles to advance health of the population, and some teaching hospitals have begun to promote population health across their three major domains of medical education, research and patient care (Gourevitch et al., 2019). Due to their unique triple-pronged mission, teaching hospitals are well-positioned to identify and facilitate understanding of population health needs and challenges, and can also innovate and implement strategies that meet the population health needs (Smitherman et al., 2019).

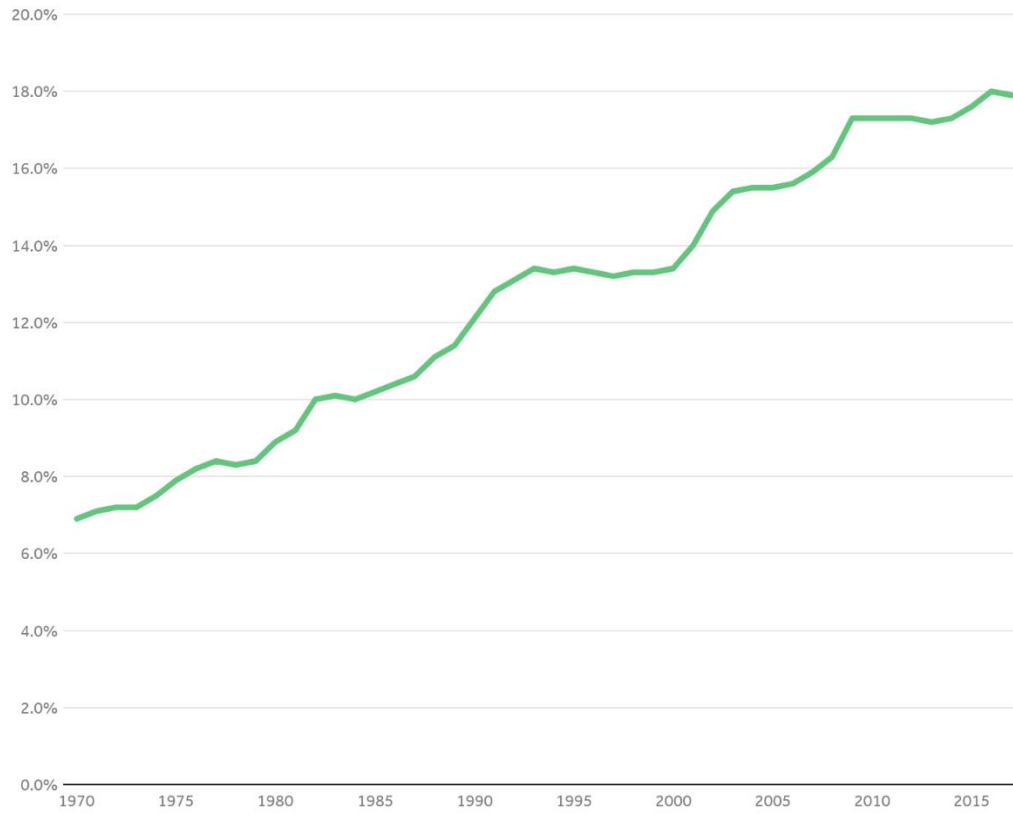
The unique mission of clinical research, medical education and patient care are foundations of the exceptional institutions called teaching hospitals. As the confluence of financial, operating, regulatory, and technological changes continue to shape the U.S. healthcare industry, findings and suggestions from this study may help the administrators and leadership of teaching hospitals to analyze and evaluate their existing strategies, and align the

suggestions towards enhancing their unique mission, while ensuring successful short-term and long-term financial performance of their hospitals.

APPENDICES

Appendix A: U.S. Health Expenditures as % of GDP

Total national health expenditures as a percent of Gross Domestic Product, 1970-2017



Source: KFF analysis of National Health Expenditure (NHE) data • [Get the data](#) • PNG

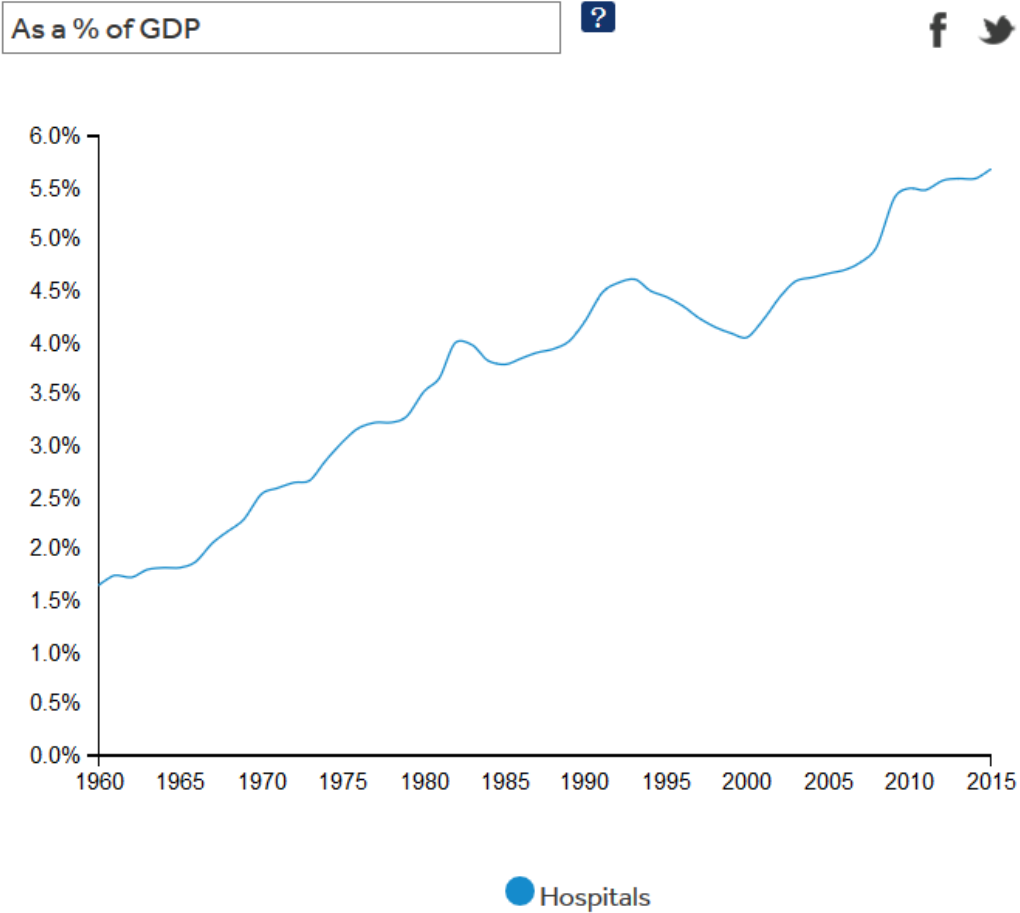
Peterson-Kaiser
Health System Tracker

Source: Peterson-Kaiser Health System Tracker

Appendix B: U.S. Health Expenditures on Hospitals, as % of GDP

U.S. HEALTH EXPENDITURES 1960 - 2015

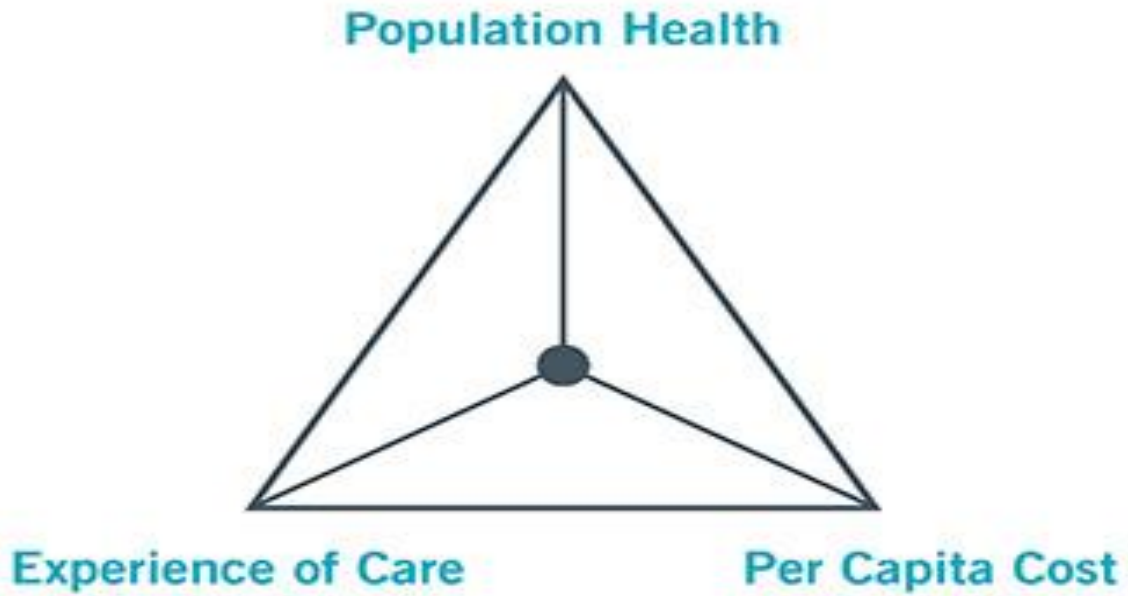
On Hospitals by All Sources of Funds (As a % of GDP)



Source: Peterson-Kaiser Health System Tracker

Appendix C: Triple Aim

The IHI Triple Aim



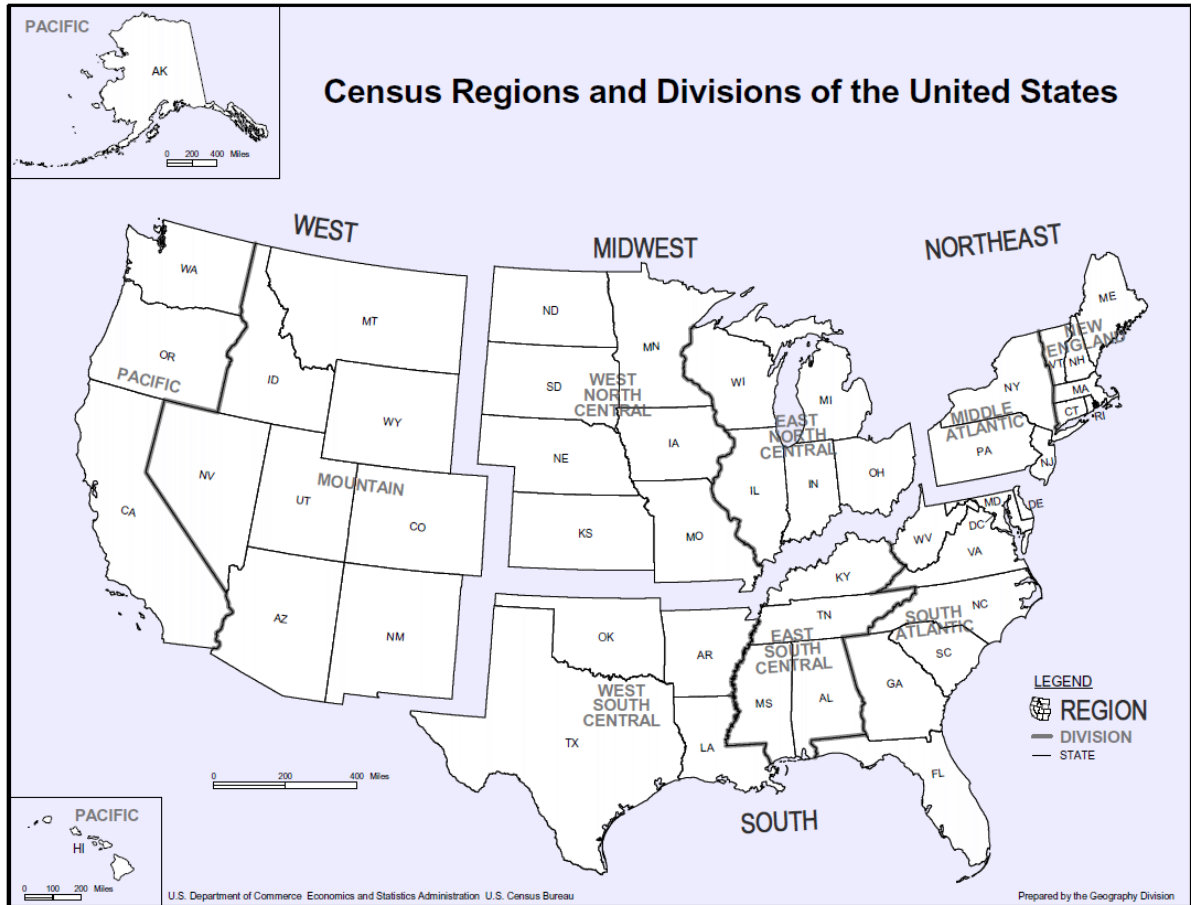
Source: Institute for Healthcare Improvement (IHI)

Appendix D: Social Determinants of Health



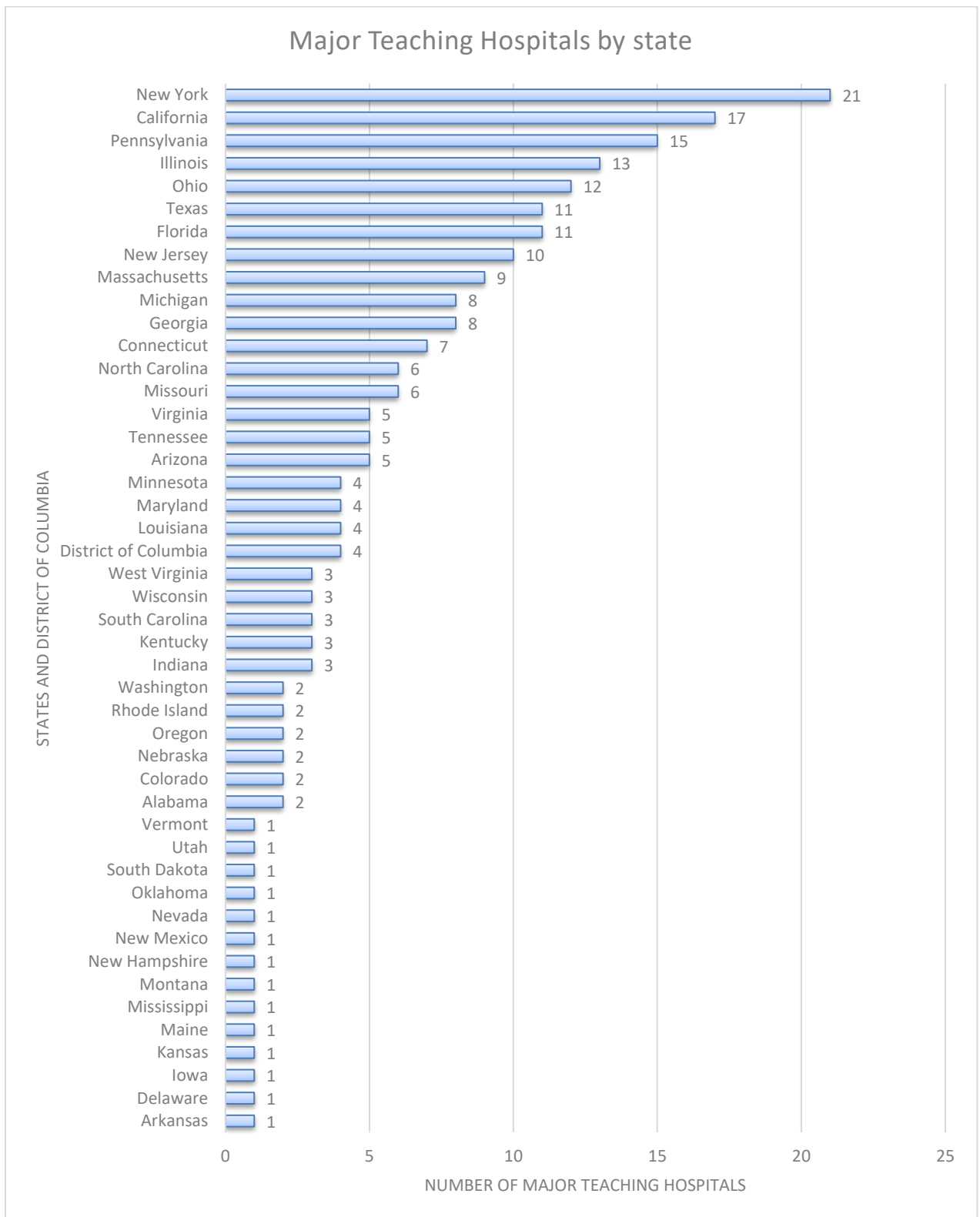
Source: HealthyPeople.gov

Appendix E: Census Regions and Divisions of the United States



Source: U.S. Census Bureau

Appendix F: Major Teaching Hospitals In This Study, By State



Appendix G: Financial ratios referenced in this study

$$\text{Days Cash on Hand (all sources)} = \frac{(\text{Cash} + \text{Marketable Securities} + \text{Short-term Investments})}{(\text{Total operating expenses} - \text{Depreciation}) / 365}$$

$$\text{Return on Assets} = \frac{\text{Net Income}}{\text{Total assets}} \times 100$$

$$\text{Current Ratio} = \frac{\text{Current assets}}{\text{Current liabilities}}$$

$$\text{Quick Ratio} = \frac{\text{Current assets} - \text{Inventories}}{\text{Current liabilities}}$$

$$\text{Total margin} = \frac{\text{Net income}}{\text{Total revenues}} \times 100$$

$$\text{Operating margin} = \frac{\text{Net operating income}}{\text{Operating revenue}} \times 100$$

$$\text{Growth rate in equity} = \frac{\text{End of year equity} - \text{Beginning of year equity}}{\text{Beginning of year equity}} \times 100$$

$$\text{Days in patient accounts receivable} = \frac{\text{Net patient accounts receivable}}{\text{Net patient service revenue}/365}$$

Source: Gapenski, L. 2012. *Fundamentals of healthcare finance*. Chicago, IL: Health Administration Press.

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