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**PHYSICIAN HOSPITAL ARRANGEMENT INFLUENCE ON
NONPROFIT HOSPITAL QUALITY, FINANCIAL PERFORMANCE
AND COMMUNITY BENEFIT EXPENDITURES**

ANDREA CERVIN

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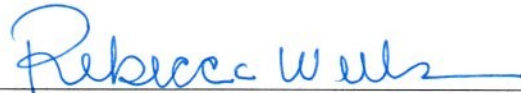
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by

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2020

DEDICATION

To My Family

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by

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Presented to the Faculty of The University of Texas

School of Public Health

in Partial Fulfillment

of the Requirements

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PHYSICIAN HOSPITAL ARRANGEMENT INFLUENCE ON NONPROFIT HOSPITAL QUALITY,
FINANCIAL PERFORMANCE, AND COMMUNITY BENEFIT EXPENDITURES

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Federal policy has encouraged hospitals to provide certain quality outcomes and cost containment. Hospitals have responded by forming physician hospital organizations in attempts to achieve quality outcomes and capture reimbursements. At the same time, federal policy has awarded hospitals with nonprofit status with the requirement to provide community benefits in exchange for the tax exemption they receive. With the formation of physician hospital organizations, there remains the question of whether hospitals are achieving desired quality metrics and whether hospitals are financially viable. There is also public and media interest recently regarding whether nonprofit hospitals fulfill their obligations for community benefit in line with the large tax exemption they receive. This study attempted to understand whether the hospital physician arrangements within nonprofit hospitals influence the hospitals' quality, financial health, and any unintended effects there may be on community benefit expenditures. Data from the American Hospital Association and the tax return 990 schedule H was used to understand the types of hospital physician arrangements and to assess whether there was an association with nonprofit spending on quality, financial health and community benefit expenditures. This study showed that there is

an association with higher Acute Myocardial Infarction 30 day mortality rates and Central Line-Associated Blood Stream Infection scores with physician hospital organizations with high integration; an undesirable outcome. High integration involves more physician and hospital economic, administrative, and group involvement and more shared accountability. This study also showed that there is an association with these physician hospital organizations and lower Acute Myocardial Infarction 30 day readmission rates, higher operating margin, and higher community benefits. No clear direction is apparent for the federal government regarding payer policies causing unintended consequences regarding hospital community benefits spending; however, the formation of physician hospital organizations with high integration may not have the quality metrics desired. The federal government will have to consider its policy effects and downstream consequences and whether they may be counter-productive to community benefit expenditures or whether they even achieve their intended purposes.

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BACKGROUND

Physician Hospital Arrangements

Historically, hospitals served as a workshop for physicians, who were able to work autonomously from hospital administration, where hospitals and physicians had separate governing structures too, one board for medical staff and a separate board for hospital administration (Burns et. al. 2010). This structure provided an autonomous platform for physicians to practice separate from hospital control. Physician practice autonomy was solidified early on in the healthcare industry, even with payment structures, with third party payers paying hospitals and physicians separately (Burns et. al. 2010). However, physician autonomy started eroding in the mid 1900s with legal rulings making hospitals liable for physician behavior that hospitals contracted with for third party payers and also within the hospitals; thus starting an initiative for hospitals demanding a certain level of quality from physicians because of an emerging accountability by hospitals for quality outcomes (Burns et. al. 2010). Later emerged payment structures such as the establishment of Medicare, Medicaid, and later Medicare's Prospective Payment System employing diagnosis-related groups (DRG) (Burns et. al. 2010). The DRG payment structure was first to pay hospitals for a diagnosis related event in total instead of a la carte payments for each hospital service and activity separately (Burns et. al. 2010). Later managed care organizations provided capitated payments for services to hospitals. These payment structures motivated hospitals to improve cost containment and processes within the hospital, which in turn required physician cooperation (Burns et. al. 2010). Current governmental policies and payment structures continue to influence quality standards and cost containment.

In response to quality and financial pressures, hospitals are motivated to enter into physician-hospital arrangements, an alignment between hospitals and physician groups through varying degrees of contracting, employment, and/or hospital privileges. Strategic goals for integration from the nonprofit hospital perspective include capture of the outpatient market, increasing revenue and margins, pricing leverage, and improvement of quality outcomes (Burns and Muller 2008). Hospital motivation to form physician hospital arrangements has changed; however, hospitals continue to have arrangements to integrate with physicians. At the outset of physician integration, managed care organizations encouraged hospital and physician integration through changing payment structures so that hospitals and physicians shared risks with the managed care companies. In response physicians and hospitals formed integrated organizations, such as physician hospital organizations, which still exist today (Morrisey 1996). These organizations are separate entities from hospitals and physician groups formed as a means for integration of hospitals and physicians with physicians. Other reasons for continued hospital integration with physicians includes providing a full continuum of care, increased competition from freestanding care centers (e.g. imaging centers), and requirements to provide continuous quality of care and efficiency (Satiani and Vaccaro 2010, Boone 2000).

In addition to strategic reasons, hospitals formed physician-hospital arrangements in response to managed care and CMS payment strategies (e.g. pay-for-performance) (Burns and Muller 2008, Christianson et. al. 2014, Cuellar and Gertler 2006). Payment policy continues with the recent Centers for Medicare and Medicaid Services (CMS) initiated value based purchasing to provide high-quality of care at lower costs from hospitals (CMS 2012,

2017). The ACA along with other legislative initiatives introduced the Value Based Purchasing program aimed at paying providers based on achieving certain quality outcomes. This program shifts payments away from quantity of services provided to quality of care (CMS 2018). These legislative initiatives started in 2008 with the Medicare Improvements for Patients and Providers Act (CMS 2008). From 2008 to 2013, there were 599 instances of hospitals initially having no physician integration (or physician-hospital arrangements) and then later switched to having some degree of integration with physicians (Short et. al. 2017). There was also 710 transitions to a fully integrated model by hospitals (Short et. al. 2013).

In addition to varying integration of physician hospital arrangements and a trend for increase in physician hospital integration, there is also a current trend for physician arrangements where hospitals employ physicians (high integration); an almost 75% increase in employed physicians from 2000 to 2011 with continued plans to employ more physicians (Kocher and Sahni 2011). Twenty three percent of physicians were employed by practices partially or wholly owned by hospitals (Kane and Emmons 2013). This trend continues with the latest Physician Practice Benchmark study showing that physician owned practice arrangements dropped below 50% for the first time in 2016 meaning physicians are being employed elsewhere or in different arrangements (Kane 2017).

Hospitals can choose to create a physician hospital organization through a variety of different arrangements, which have varying degrees of integration, from little to full integration (Satiani and Vaccaro 2010). Dynan dichotomized physician hospital organizations into two categories: those with high integration and those with low integration (Dynan 1998). Dimensions of integration include levels of physician economic involvement,

administrative involvement, group involvement and shared accountability with hospitals (Dyanan 1998). Hospital integration with physicians was also found to entail clinical integration too (Dyanan 1998). High integration is marked by “strong physician-hospital links, coordinated systems of care, geographic reach, quality management, contractual capabilities, utilization controls, financial strength, organized oversight and economies of scale” (Boone 2000). Essentially, highly integrated models are likely to coordinate with physicians to impact physician behavior to achieve cooperation with process and quality outcomes. Models that include high integration between hospitals and physicians are clinical and foundation models (Satiani and Vaccaro 2010). These models allow employment of physicians through a wholly owned subsidiary of the hospital (Satiani and Vaccaro 2010). These models also allow physicians to have representation in the governance of such organizations, which may include a physician as the CEO (Satiani and Vaccaro 2010).

Those physician-hospital relationships with little to no integration include the independent medical staff and partnership model (Satiani and Vaccaro 2010). In the independent medical staff model, hospitals provide technology and support in order for physicians to provide patient care and procedures at the hospital; the physicians are not required to have their patients only come to a certain hospital but it is the hospital’s hope to build loyalty (Satiani and Vaccaro 2010). In this model, the physicians have little input in hospital operations (Satiani and Vaccaro 2010). In the partner model, a hospital may contract with a physician group or physician to provide medical director services for a fee (Satiani and Vaccaro 2010).

Medium integration arrangements include physician-hospital organizations and managed services organizations (Satiani and Vaccaro 2010). A physician-hospital organization is a conduit for hospitals and physicians to contract with managed care organizations (e.g. an organization created solely for the purposes of hospitals and physicians collectively contracting with insurance companies). Managed services organizations are owned by hospitals to provide physicians with practice management services (administrative services other than providing physician services, e.g. human resources) (Satiani and Vaccaro 2010). However, when looking at dimensions of integration management service organizations are found to be as integrated as foundation models and integrated salary models and are included in physician hospital organizations with high integration (Dyanan 1998, Madison 2004). Closed and Open Physician hospital organizations were categorized as low integration (Madison 2004).

Table 1 below shows the stratification of physician hospital organizations into high or low integration categories used in Madison 2004, based on Dyanan 1998. Table 4 in the Methods section has definitions of each physician hospital organization.

Table 1. Physician Hospital Organizations level of integration (Adapted from Dyanan 1998, Madison 2004)	
High Integration	Group Practice Without Walls, Management Service Organization, Integrated Salary Model, Foundation Model, Equity Model
Low Integration	Independent Practice Association, Open Physician Hospital Organization, Closed Physician Hospital Organization

Forming hospital physician arrangements may not have the intended effects on hospital efficiency (Burns and Muller 2008). Cuellar and Gertler found no improvement in efficiency with integration when looking at fully integrated hospitals compared to non-

integrated hospitals (Cuellar and Gertler 2006). Another study examined whether the trend of physician integration into hospital governance and management increases hospital efficiency (Succi and Alexander 1999). A hypothesis was that the influence of those physicians in governance/management roles can better influence physician staff that is small, diverse and, contains more employed physicians; however the study found that physician involvement led to lower efficiency (Succi and Alexander 1999). Lower efficiency may be due to costs for hospital monitoring of integrated physicians (need for administration), hospital coordination costs between departments, and hospital cooperation cost (Cho 2015). From a societal perspective, integrated delivery networks have higher costs (Goldsmith et. al. 2015). Goldsmith et. al. also found that physician productivity drops and costs increase for hospital employed physicians (Goldsmith et. al. 2015). However, Lelue et. al. found that fully integrated models are more efficient, specifically for profit hospitals (Lelue et. al. 2018).

It was also found that if hospitals are categorized as higher efficiency (admissions and visits per cost) then those hospitals provide more uncompensated care (Hsieh et. al. 2010). With nonprofit hospitals entering into physician hospitals arrangements that are more integrated there may be unintended impacts on hospital efficiency and perhaps also on community benefit spending.

Importance of Nonprofit Hospitals

As seen above, the federal government created payment models encouraging physician hospital organization formation, quality outcome pressures, and cost containment; however, the federal government first established policy for nonprofit hospitals. About 51 percent of hospitals in the U.S. are non-governmental, nonprofit hospitals (NFPs) (American

Hospital Association 2016). NFPs receive their nonprofit status from Section 501(c)(3) of the Internal Revenue Code. The code specifies that for nonprofit designation the organization must operate for a listed exempt purpose and no benefits created by the organization are given to shareholders. Those exempt purposes include religious, charitable, public safety, literary, educational, etc. (26 U.S.C. § 501(c)(3)).

A nonprofit designation is important to organizations because qualifying under section 501(c)(3) exempts an organization from paying federal taxes on income and also may exempt an organization from paying property and state taxes. This designation comes with the condition that nonprofit hospitals provide community benefits. The obligation to provide community benefits has evolved over the years from the requirement to provide charity care to patients unable to afford care to a broader definition of community benefits (Rubin et. al. 2013). The change from the charity care requirement to the broader community benefit requirement came in 1969 after the introduction of Medicare and Medicaid; easing the burden of payment for hospital care, decreasing the need for charity care; and therefore raising the importance of community benefits in exchange for tax exemptions (Rubin et. al. 2013). Hospitals were then and still are required to provide community benefits (Ginn and Moseley 2006). The broader community benefit requirement includes discounted care (charity care), but also includes “other hospital investments and activities promoting community health” (Somerville 2012).

The broad community benefit requirements are clarified through the Internal Revenue Service reporting requirements and Affordable Care Act (ACA). The Internal Revenue Service (IRS) defines community benefits as “activities or programs [that] also seek to

achieve a community benefit objective, including improving access to health services, enhancing public health, advancing increased general knowledge, and relief of a government burden to improve health” (IRS 2017). In 2009, the IRS required a new reporting mechanism of community benefits in the form of a tax return schedule (Rosenbaum 2016). This schedule further clarified that bad debt (write-offs for non-payment of hospital services) is no longer considered a part of charitable care (Rosenbaum 2016).

Nonprofit hospitals receive a large tax exemption; there was an estimated \$24.6 billion tax exemption in 2014 (Rosenbaum et. al. 2015). If nonprofit hospitals receive a large tax exemption then it would be expected that they provide sufficient community benefits; however, there are conflicting reports on levels of provision of community benefits (Rosenbaum et. al. 2015). According to the IRS, in 2011 private tax-exempt hospitals reported over \$62 billion dollars or 9% of total operating expenses were for community benefits (Internal Revenue Service 2015, Rosenbaum et. al. 2015). By comparison, on a local level, California investor owned hospitals provided slightly more uncompensated care at the total level at \$68,600 per hospital while nonprofit hospitals provided about \$62,800 per hospital (Schneider 2007). Generally, investor owned hospitals are not required to provide community benefits. However, United States Congressional Budget Office (CBO) found that nonprofit hospitals on average when compared to for-profit hospitals provided more community benefits, spending seven hundred million dollars more than for-profit hospitals and three billion dollars total, when looking at a small sample of states (Texas, California, Florida, Georgia, Indiana) (CBO 2006).

As seen, nonprofit hospitals may provide more community benefits than for-profit hospitals in some scenarios and not others; however, NFPs receive a large tax benefit and have a requirement to provide these community benefits. Consequently, NFPs received attention on their exemption status and the level of community benefits they provide. Public scrutiny of nonprofit hospitals prompted the CBO in 2006 to produce its report on “Nonprofit Hospitals and the Provision of Community Benefits” (CBO 2006). Later, a Congressional Committee found that the “link between tax-exempt status and the provision of charitable activities for the poor or underserved is weak” to the point where Congress considered revising criteria for tax-exemptions for nonprofit hospitals (U.S. Senate 2007, p1). Senator Grassley even proposed new legislation, which did not pass, to require a minimum standard of nonprofit hospital charity care spending to be more in line with the nonprofit hospital tax benefit (Carreyou and Martinez 2008). Public media also reported on the level of community benefit spending noting NFP spending does not vary much from for-profit spending (Rosenthal 2013, Cohen 2013, KHN 2010). The court system also enforced expectations of community benefit provisions. The City of Pittsburg sued to challenge the University of Pittsburgh Medical Center’s tax-exempt status in 2013 because of its perceived commitment to profits instead of charity (Rosenthal 2013). The University of Pittsburgh Medical Center had an operating revenue of almost \$1 billion and reserves of more than \$3 billion coupled with only about 2% of its spending on charity care, which prompted questioning its behavior as a nonprofit hospital (Rosenthal 2013). In addition to the City of Pittsburgh, The State of New Jersey went further and removed a different NFP’s property tax exemption (Schencker 2015).

For its considerations for tax-exemptions and recent trends scrutinizing community benefits from NFPs, the federal government will want to ensure that community benefits are not being negatively affected by the formation of physician hospital organizations.

Conclusion

Nonprofit hospitals have varying relationships with physicians with differing degrees of integration. Physician hospital integration and formation of physician hospital organizations is in response to changes in provider reimbursement and CMS policies. The shift in payment policies brought on by the Value Based Purchasing program from payer and societal perspective drives for not only for lower costs but also higher quality; while also wanting nonprofit hospitals to remain financially viable for sustainable health care from such institutions. Nonprofit hospitals also have a self-interest to remain financially viable while achieving better costs and qualities. At the same time, within this environment of physician integration, NFPs are expected to produce community benefits as agents of the federal government. However, what is not known is whether physician hospital integration undergone to achieve quality and financial goals has an unintended effect on community benefit spending. This study aimed to understand whether the types of physician-hospital arrangements have an association with quality metrics, financial health, and also community benefit expenses.

Principal Agency Theory Explaining Nonprofit Hospital Behavior

Principal agency theory informs this study. The principal is society represented by the federal government. In principal agency theory (also agency theory), principals tasks agents with certain duties and services through a contractual relationship, resulting in a principal-

agent relationship (Jensen and Meckling 1976). The principal delegates the agent with the authority to make decisions on behalf of the principal; however, the interests of principals and agents are not always aligned (Jensen and Meckling 1976). Agents may be opportunistic and attempt to maximize their own self-interests at the expense of the principal (agency problem), including not performing principal assigned duties without controls in the agency decision process (Fama and Jensen 1983). To align agents with principal goals, principals will provide incentives (traditionally some economic incentive such as money) or monitor the agent's actions (Jensen and Meckling 1976, Shapiro 2005).

In the context of an organization, there are residual claims, that is, excess cash flow. Free cash flow is “discretionary cash flow available to managers in excess of that required to fund all positive net-present-value projects” (Mann and Sichernman 1991, p214). Without clear guidance regarding residuals, the agency problem arises. Principals are concerned about the use of free cash flow because of the divergent interests between principals and agents. In principal agency theory there is an assumption that agents will use residuals in their own self-interests and not the principal's interests. The divergent interests of free cash flow use is more easily seen in a for-profit setting (however, the focus of this study is on non-profit hospitals). In this setting, free-cash flow may be used by managers, who are agents for shareholders, for their own self-interests or distributed to shareholders, the principals, as dividends. One argument is that if shareholders and managers are aligned then efficiency would be maximized in order to increase distributions to shareholders; however, managers are self-interested and are motivated to invest free cash flow in investments that ensure their employment (Mann and Sichernman 1991). One example of a self-interest is a manager

investing in new projects that may not be the core business of the company in order to boost the manager's skill set (e.g. a service corporation acquiring a manufacturer in its supply chain).

The federal government is also a purchaser who is trying to achieve better quality for costs and at the same time the federal government is providing nonprofit hospitals with tax exemptions in return for community benefits. To achieve these goals, the federal government contracts with nonprofit hospitals, who can be viewed as the agent to the federal government. Payment structures and policy has pushed physicians and hospitals toward vertical integration. A part of this integration is for nonprofit hospitals to achieve higher quality and financial health. It is also an interest of society to have sustainable quality healthcare; however, it is not known whether pursuit of higher quality and financial health through physician hospital organizational integration has unintended effects on community benefits. Nonprofit hospital behavior is also explained using principal agency theory. NFPs are expected to provide community benefits in order to receive and maintain their tax exempt status. However, hospitals may not be providing as much community benefit as expected as seen by media and governmental attention described above.

Again, the principal-agent model can explain nonprofit hospitals' behavior regarding their investment of free-cash flow. In this model, NFPs function as agents for the principals, which are the community and government. The principals desire community benefits in exchange for the tax exemptions, an economic incentive in order to align interests. The nonprofit hospitals are agents that are responsible for investing any cash flow into community benefits (the desire of the principal). In the nonprofit setting free cash flow may

be subject to agency divergence under agency theory, meaning NFPs may make self-interested decisions regarding free cash flow use, which may differ from desires of the principal. Recent examples highlighted above with the University of Pittsburg Medical Center and the State of New Jersey's removal of one NFP's property tax exemption, where the interest of the medical center differed enough from principal intent of providing community benefits enough for the government to remove the tax exemption. If NFPs are not providing community benefits, they may be investing in other operating activities, new projects, lines of business, and/or capital expenditures similar to for-profit corporations. Agents (here NFPs) are self-interested and may have different interests than principals; therefore, NFPs may not necessarily invest to the degree desired in community benefits at levels expected by principals.

Nonprofit hospitals are also monitored differently by principals than for-profit hospitals. Nonprofit companies are not subjected to shareholder oversight; however, nonprofit hospitals are not without any oversight. In a nonprofit setting, debt financing through the bond market may subject bond-funded acquisitions to some level of public scrutiny when the nonprofit entity is reviewed for financing. Nonprofit hospitals also receive oversight through their corporate boards. However, the hospital board is also an agent of the government and does may not function as mechanism of public scrutiny to the extent of for-profit corporations with shareholder oversight. Public scrutiny can be seen as principal (governmental, public) monitoring for nonprofit hospitals. This may motivate management, as agents, to use free-cash flow to finance some investments, which is not subject to public scrutiny, as opposed to use debt financing for them where transactions are reviewed by

outside stakeholders. The lack of oversight in the nonprofit setting (such as shareholders for for-profit corporations) may also cause managers to invest in other investments instead of community benefits (Kim et. al. 2009). With lack of direct oversight, principals (government/community) may not directly monitor agent actions as well as stockholders in the for-profit setting. Instead, principals, in this application of principal agency theory to nonprofit hospitals, attempt to incentivize NFPs to invest in community benefits, which is the desire of the principals, by offering a tax exemption.

Additionally, hospitals also have pressure to integrate with physicians. This pressure comes from market competition with free-standing providers and also to provide a “continuous, quality-conscious system” which would include physician services (Satiani and Vaccaro 2010). Integration also stems from federal payment structures for improved quality and the nonprofit hospital’s desire to achieve better federal reimbursement. Nonprofit hospitals are interested in financial stability. Although not completely divergent from the principal’s, the federal government’s, interest, hospitals are interested in quality of care and financial health; however, the federal government is also interested in receiving community benefits. Additionally, integrating physicians is an expensive prospect that requires investment in physician “offices and electronic medical records” and capital purchases (Satiani and Vaccaro 2010). With limited dollars available to fund new projects, NFP management may invest in capital expenditures, a divergent interest from the principal’s interest, instead of the desired to invest in community benefits. This may also be fueled by influence from physicians through differing physician hospital arrangements; physicians are a key stakeholder in the capital expenditure process and may pressure hospitals to invest in

capital expenditures, as an example. This current study attempted to understand whether physician hospital arrangements influence nonprofit hospital quality, financial health and also unintended influence on spending on community benefits.

Public Health Significance

Payment structures and policy have pushed physicians and hospitals toward vertical integration. Nonprofit hospitals are motivated to integrate physicians in order to achieve higher quality and financial health. It is also an interest of society to have sustainable quality healthcare; however, it is not known whether pursuit of higher quality and financial health through physician hospital organizational integration has unintended effects on community benefits. Tax-exemptions for nonprofit hospitals are in effect a subsidy for indigent care at one point in time and now a subsidy for providing community benefits (Schneider 2007). These community benefits are provided by the nonprofit hospitals instead of the federal government itself (CBO 2006). This study contributes to understanding of influences of policy encouraging physician hospital arrangements and quality for lower costs on hospital community benefits expenditures.

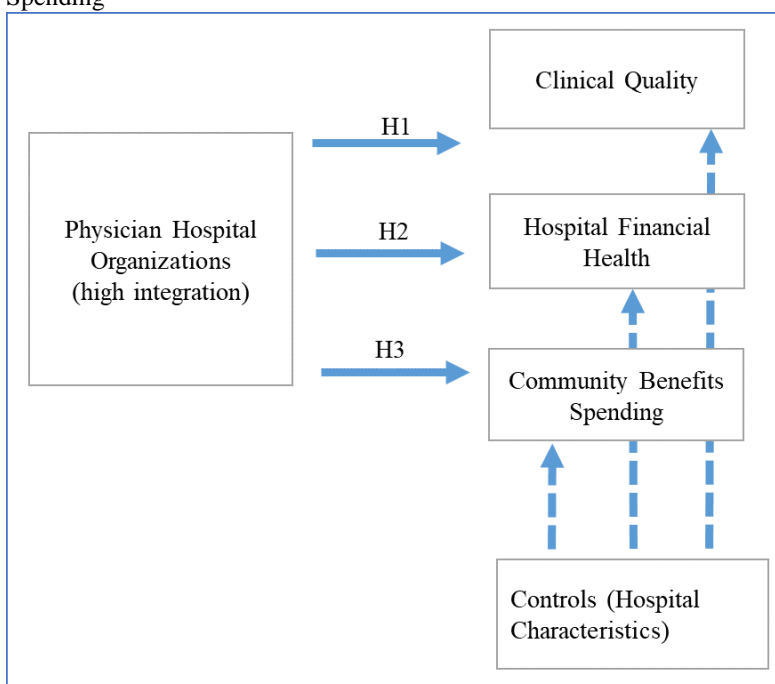
Research Questions and Hypotheses

Study Objective

The overall objective of this study is to understand whether physician hospital arrangements are having the intended associations with quality measures and hospital financial health and also to understand association with community benefit expenditures. This overall objective is then broken down into three research questions.

Figure 1 below shows how physician hospital organizations with high integration may have an association on clinical quality, hospital financial health, and spending on community benefits. Underlying any associations are hospital characteristics that may also have associations with the same measures of quality, financial health, and community benefit spending.

Figure 1. Physician Hospital Organizations Association with Quality, Finances, and Community Benefit Spending



Research Questions

This study aims to determine: Is there an association with participating in physician hospital organizations with higher integration and improved quality metrics, financial health and increased community benefit spending per operating expenses?

Research Question I. Quality Metric Improvement

Previous research on quality measures and associations with physician hospital arrangements found mixed results on improvement. Madison found an association with patients who had higher procedure rates for percutaneous transluminal coronary angioplasty and coronary artery bypass graft if they were patients of hospitals that formed a physician hospital affiliation (Madison 2004). The same study also found lower mortality rates for patients with acute myocardial infarction for patients of hospitals participating in physician hospital affiliations; however, this association was not statistically significant (Madison 2004).

Scott et. al. looked at non-governmental acute care hospitals converting to an employment relationship with physicians between 2003 to 2012 regarding certain quality metrics: risk-adjusted hospital-level mortality rates, 30-day readmission rates, length of stay, patient scores for common medical conditions (Scott 2017). The study found that there was no association with hospitals switching to an employment based model with physicians and improvement in quality metrics (Scott 2017). However, Cuellar and Gertler found fully integrated organizations had improvements in the mortality measures (Cuellar and Gertler 2006). The same study also found that closed and open physician hospital organizations reduced procedure overuse for certain types of patient (Cuellar and Gertler 2006). This study also found that independent practice associations had no improvements in quality metrics and an increase in mortality rates for certain patients (Cuellar and Gertler 2006). In this study, the higher integrated physician hospital organizations (fully integrated model) had improvements in quality metrics. In line with studies that do find improvements in quality metrics with

hospitals that have physician hospital arrangements, the hypothesis for this research question follows.

Hypothesis 1.

Physician hospital organizations with higher integration are associated with improved quality metrics.

Research Question II. Financial Performance Improvement

There has been some research on financial health and different physician hospital arrangements and physician integration strategies. Goes and Zhan looked at operational profitability of California hospitals with differing integrations strategies post Medicare prospective payment system (Goes and Zhan 1995). Types of integration were not formal physician hospital organizations or arrangements but included hospital physician financial integration, physician integration in governance, and physician ownership of hospitals (Goes and Zhan 1995). Goes and Zhan found that financial integration of hospitals and physicians had a significant interaction effect on financial performance (i.e. higher operating margin) (Goes and Zhan 1995).

Burns et. al. looked at hospital integration with physicians (vertical integration) and health plans (Burns et. al. 2005). The study found that hospitals that integrated with physicians, through employment and practice acquisitions (forms of high integration), invested \$40 million to acquire physician practices and also experienced decreasing operating margins (Burns et. al. 2005). This echoes a previous review by Burns and Pauly; hospitals that pursued vertical integration through physician practice acquisitions experienced poorer financial outcomes, suffering financial losses and not enough cash flow

(Burns and Pauly 2002). Different from Burns et. al.'s research, within the context of managed care organizations impact on hospital integration (forward and backward integration), Wang et. al. found that hospitals that had backward integration with physicians to provide outpatient services were associated with better operating margin ratios (Wang et. al. 2001). There are inconsistent associations of integration with hospital financial outcomes such as operating margin. Integration with physicians migrated from more informal integrations like in Goes and Zhan's study to more highly integrated forms seen in Burn et. al.'s and Wang et. al.'s studies. However, Wang et. al. looked at the same financial outcome as this study, operating margin. As such the hypothesis is as follows:

Hypothesis 2.

Physician hospital organizations with higher integration are associated with a higher operating margin.

Research Question III. Increased Community Benefit Spending

There has been previous research on trends of community benefit spending by hospitals over various time periods, all showing an increase in community benefit spending. According to Leider et. al., pre-ACA spending on community benefits (2009 to 2012) was 8% of operating costs in 2009 and increased to between 8.3% to 8.5% in 2012 (Leider et. al. 2017). Over 80% of this community benefit spending was for charity care and the largest hospital systems provided the majority of spending on community benefits (Leider et. al. 2017). Another general trend in community benefit spending close to these time points is the increase in community benefit spending by tax exempt hospitals from an average of 7.6% of operating expenses in 2010 to 8.1% of operating expenses in 2014. (Young et. al. 2018).

Alberti et. al. expanded their research to include points pre- and post- ACA implementation to understand ACA's impact on community benefit spending looking only at teaching hospitals (Alberti et. al. 2018). The study found that teaching hospitals increased spending on community benefits post-ACA by \$2.4 billion dollars, a 15% increase after adjusting for inflation (Alberti et. al. 2018). However, even though an increase in overall community benefit spending by teaching hospitals, there was a decrease of charity care spending between 2012 and 2015 by 16.17% (Alberti et. al. 2018). Shortell et. al. noted in their review of hospital contribution to community health that hospitals that are a part of a system provide more community benefits perhaps due to economies of scale available to a system (Shortell et. al. 2015).

Current Trend in Community Benefit Spending

There appears to be a general trend of slightly more spending on community benefits recently. During this same time there has also been a trend in physician hospital integration as seen above; however, no studies were found regarding the impact of types of physician hospital arrangements on community benefit expenditure. There is a link between increased uncompensated care (a part of community benefits) and hospital efficiency; that is, the more efficient a hospital is then the more such hospital provides uncompensated care (Hsieh et. al. 2010). There is mixed literature regarding physician hospital integration and its desired improvement of hospital efficiency. One study found that more physician involvement in hospital governance and management lead to lower hospital efficiency (Succi and Alexander 1999). Cuellar and Gertler found that higher integrated hospital physician arrangements were shown to have little effect on hospital efficiency (Cuellar and Gertler 2006); however, Leleu

et. al. found that higher integrated physician hospital organizations were more efficient (Lelue et. al. 2018).

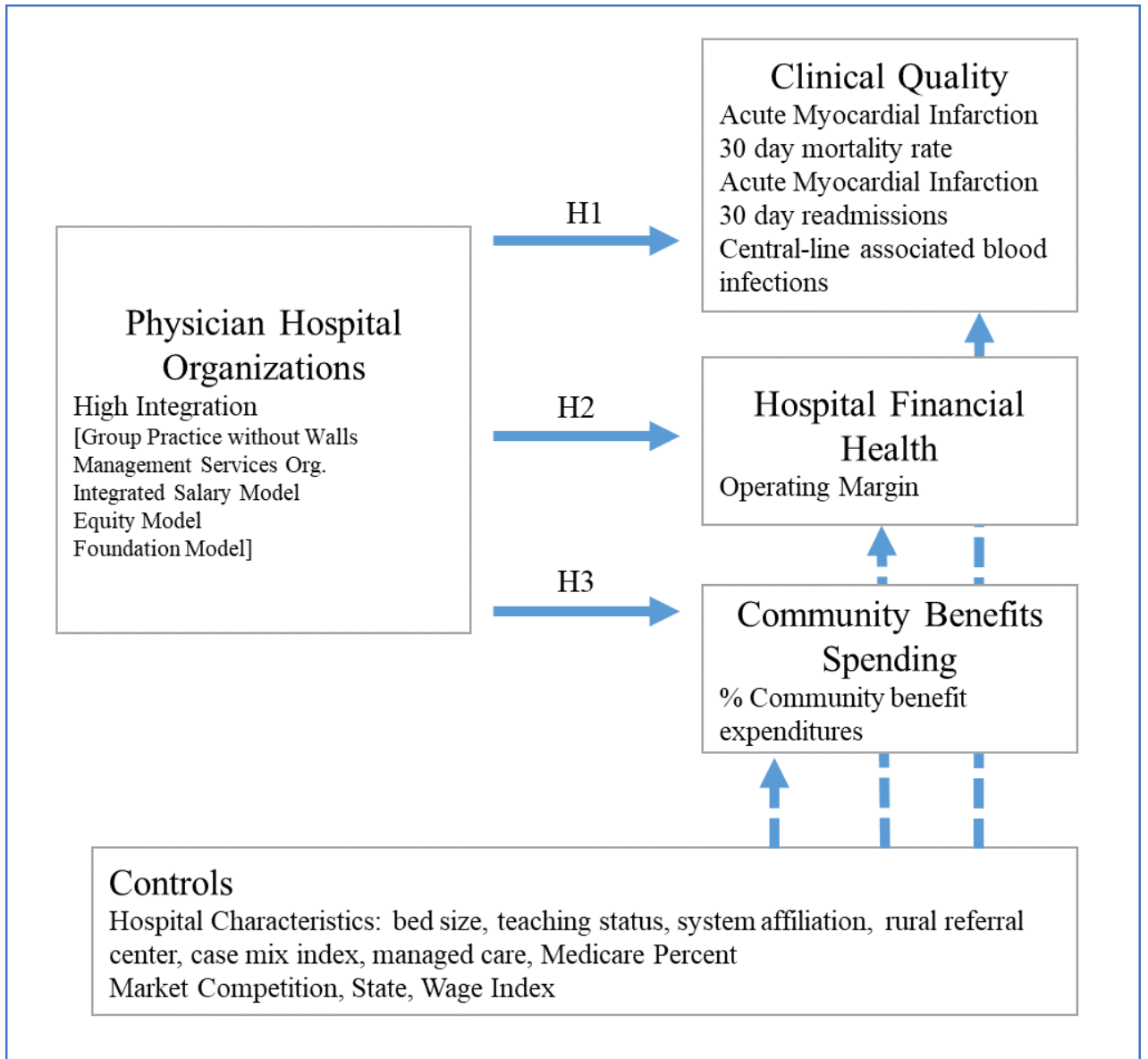
If hospitals were categorized as higher efficiency (admissions and visits per cost) then there was more uncompensated care. Given that there appears to be an overall association of lower efficiency with higher physician hospital integration and that hospitals categorized as higher efficiency provide more uncompensated care then the hypothesis for this research question is as follows:

Hypothesis 3.

Physician hospital organizations with higher integration are associated with lower community benefit expenditures.

Figure 2 below illustrates Hypotheses 1, 2, and 3 independent variables in relation to the outcomes of interest: specified quality metrics, financial health and community benefits. The figure also shows how the control variables for hospital characteristics may also be associated with the dependent variable.

Figure 2. Study Flow Diagram



METHODS

This study was a cross-sectional study of nonprofit hospitals using secondary data from the American Hospital Association (AHA), Guidestar, and Centers for Medicare and Medicaid Services (CMS) Hospital Compare Datasets for the year 2015.

Population

Only nonprofit hospitals were included in the study sample. The study excluded governmentally owned and for-profit hospitals because these entities do not have the requirement to provide community benefits. Additionally, this study also excluded hospitals that are excluded from the Value Based Purchasing program like cancer and children's hospitals (CMS 2012). Additionally, the population excluded hospitals that did not participate in the AHA annual survey for 2015.

Effect Size Calculation based on Sample Size and Power

Table 2. Calculated effect size detectable		
Dependent Variable	Hospitals (n)	Effect size
Acute Myocardial Infarction 30 Day Mortality Rate	1441	0.01
Acute Myocardial Infarction 30 Day Readmission Rate	1342	0.01
Central Line-Associated Blood Stream Infection	1750	0.01
Operating Margin	1757	0.01
Percent Community Benefits	930	0.21

A small effect size for a multiple regression is $R^2=0.02$ (Ellis 2010). With statistical significance (α) set at 0.05 and power ($1-\beta$) set at 0.80 and the sample size used for each dependent variable the effect size that can be detected was calculated using Stata 16. As seen from the calculated possible effect size detected in Table 2 above, the sample size was sufficient for each dependent variable to detect a small effect size.

Data Sources

The main data sources included the American Hospital Association (AHA) annual survey, specifically, information regarding hospital and physician information and the IRS 990s schedule H available at Guidestar (www.guidestar.org) for community benefits data (please see the data table in the appendix specifying the source of the measure). CMS data files were also used to collect case mix index, information on Medicare days, and wage index. CMS Hospital Compare data files will be used to collect the dependent variables of Acute Myocardial Infarction (AMI) 30 day mortality rate, Acute Myocardial Infarction 30 day readmissions, central line-associated blood infections (CLABSI).

The AHA collects data on 6,400 hospitals nationally with a historical response rate of 75% (AHA- Data Collection Methods). The AHA generates estimates for missing data from previous years' information and investigates changes in data from previous years for validation and clarification (AHA- Data Collection Methods). The AHA reviews the data for consistency and makes inquiries for data that does not fit historical trends or does not have other reasons on the survey that explain the change.

Data regarding community benefits came from the IRS 990 Schedule H. These are available through Guidestar, which has the IRS filings for nonprofit hospitals.

Data Collection and Storage

Data Collection

A dataset was purchased from the American Hospital Association. This dataset contained information for hospital-physician arrangement, bed size, teaching status, rurality, state, number of HMO contracts, number of PPO contracts and admission data used to

calculate the Herfindahl-Hirschman Index. Case mix index, percentage of Medicare days was from the CMS IPPS 2015 file. Table 1A below in Appendix A contains further information below regarding the source of data.

Dependent variable information came from AHA and CMS sources. The AHA dataset contained a separate file for the operating margin dependent variable. The AHA datasets (one with control information and the other with dependent operating margin) were combined based on Medicare provider number. Dependent variables for Acute Myocardial Infarction 30 day mortality rate, Acute Myocardial Infarction 30 day readmissions, and Central line-associated blood infections came from CMS Hospital Compare datasets for fiscal year 2015. The CMS Hospital Compare data was added to the dataset based on Medicare provider number. Guidestar was used to collect information for community benefits (total community benefits in dollars) for nonprofit, nongovernmental hospitals. Percent community benefits was calculated by the total community benefits collected from Guidestar divided by the total operating expenses provided in the AHA dataset.

Stata 16 was used to conduct analyses for all specific aims.

Data Storage

Information was kept secure on a password protected external hard drive.

Use of Data in Aims

Table 3 below includes the use of the independent and dependent variables, year, and hospital characteristics used for the research questions.

Table 3. Use of Measures in Research Questions

Research Questions	RQ 1. Association of physician arrangements and quality measures	RQ 2. Association of physician arrangements and financial health	RQ3. Association of physician arrangements and community benefits
Dependent Variables			
Acute Myocardial Infarction 30 day mortality rate	X		
Acute Myocardial Infarction 30 day readmissions	X		
Central line-associated blood infections	X		
Operating Margin		X	
Community Benefits			X
Independent Variables			
High Integrated (Physician Hospital Arrangements; Hospitals may also have a physician hospital organization with low integration present also)	X	X	X
Physician hospitals Organizations with high integration only	X	X	X
Physician hospitals Organizations with low integration only	X	X	X
Hospital and Market Characteristics (Controls for potential confounders)			
Beds	X	X	X
Teaching Affiliation	X	X	X
System Affiliation	X	X	X
Rural Referral Center	X	X	X
Case Mix Index	X	X	X
Managed Care	X	X	X
Medicare Percent	X	X	X
State/Region	X	X	X
Wage Index	X	X	X

Dependent Variables

The first research question assessed whether there is an association between hospital physician arrangements with three quality metrics: Acute Myocardial Infarction 30 day mortality rate (estimated deaths within 30 days of admission), Acute Myocardial Infarction 30 day readmission rate (estimated unplanned readmission measures from hospitalization for acute myocardial infarction), and Central Line-Associated Blood Infections (observed cases of central-line associated blood infections). The numerator for Acute Myocardial Infarction (AMI) 30 day mortality rate is “death from any cause within 30 days from the date of admission for patients discharged from the hospital with a principal diagnosis of AMI” (CMS Measures Inventory Tool: RSMR). The denominator is “admissions for patients discharged from the hospital with a principal discharge diagnosis of AMI and with a complete claims history for the 12 months prior to admission” (CMS Measures Inventory Tool: RSMR) The numerator for AMI 30 day readmission is the 30-day all-cause readmission, where a readmission is “an inpatient admission for any cause, except for certain planned readmissions, within 30 days from the date of discharge from the index AMI admission” (CMS Measures Inventory Tool: AMI Readmission). The denominator for AMI 30 day readmission is as for the AMI 30 day mortality rate (CMS Measures Inventory Tool: AMI Readmission).

These quality metrics were chosen because of their use in previous studies looking at hospital characteristics and quality metrics (Scott et. al. 2017, Silvera 2017). Scott et. al. looked at hospital employment of physicians (a physician hospital organization model with high integration) and associations with mortality rates and readmission rates finding that

there was no improvement in quality metrics after switching to the employment model (Scott et. al. 2017). Scott et. al. looked at composite mortality and readmission rates and individual mortality and readmission rates from acute myocardial infarction, heart failure, and pneumonia. The Acute Myocardial Infarction 30 day mortality and 30 day readmission rates were chosen for this study in line with the Scott article but only looking at one subset of quality measures. Silvera looked at CLABSI in association with hospital size (Silvera 2017). Silvera hypothesized that increase in hospital size leads to looser coupling between hospital administration and providers, specifically physicians (Silvera 2017). Hospital size was also indicative of patterns of control and affiliation (Silvera 2017). If hospitals are larger there is a threat to interdependence and perhaps not following recommended care guidelines (Silvera 2017). Silvera did conclude that larger hospital size was associated with diminished quality (Silvera 2017). Additionally, CLABSI was a specific outcome measured by CMS as a part of its fiscal year 2015 program (CMS HVBP Measures). Because of the finding that hospital and physician coupling and the fact CLABSI was a specific outcome measure for 2015, this study looked at CLABSI as another metric for quality.

The second research question assessed whether there is an association between hospital physician arrangements with hospital financial health. Financial health was measured by operating margin. Operating margin was calculated as net operating income (revenue less expenses) divided by operating revenue.

The third research question assessed whether there is an association between hospital physician arrangements with spending on community benefits. Community benefits was divided by total expenses to get percent community benefits. This study used the total

expenses in USD provided for community benefits listed in Schedule H. Total community benefits includes: financial assistance at cost, Medicaid, costs of other means-tested government programs, total financial and means-tested government programs, community health improvement services and community benefit operations, health professions education, subsidized health services, research, cash and in-kind contributions for community benefit, and total other benefits (from IRS Schedule H of the Form 990). Community benefits in the IRS 990 Schedule H form are self-reported by the organizations. IRS 990s have been shown to be reliable for data entries from balance sheets and income statements; however, other variables such as total contributions, program service revenue, program service expense, and fundraising expense had lower consistency with audited financials (Froelich 2000). One study found that California hospital self-reported community benefits were a valid indicator of charitable activity (Rauscher 2012).

Key Independent Variables

The independent variable for the research questions were hospital physician arrangements. Hospital physician arrangements were classified into high and low integration per Madison 2004, based on Dynan, Bazzoli, and Burns 1998 categorizing on hospital physician arrangements (seen in Table 4 below). Table 4 below has definitions of each physician hospital arrangement as defined by the AHA, which reports whether hospitals participate in the preceding arrangements in its annual survey. A variable, labeled High Integration, was given the value 1 if a hospital had a highly integrated physician hospital organization present and 0 if not present. The same was done for hospital physician arrangements with low integration.

Table 4. Physician Hospital Arrangement Independent Variables AHA Definitions

Physician Hospital Arrangement	AHA Definition
High Integration	
Group practice without walls	Hospital sponsors the formation of, or provides capital to physicians to establish, a "quasi" group to share administrative expenses while remaining independent practitioners.
Management Service Organization	A corporation, owned by the hospital or a physician/hospital joint venture, that provides management services to one or more medical group practices.
Integrated Salary Model	Physicians are salaried by the hospital or another entity of a health system to provide medical services for primary care and specialty care.
Equity Model	Allows established practitioners to become shareholders in a professional corporation in exchange for tangible and intangible assets of their existing practices.
Foundation	A corporation, organized either as a hospital affiliate or subsidiary, which purchases both the tangible and intangible assets of one or more medical group practices. Physicians remain in a separate corporate entity but sign a professional services arrangement with the foundation.
Low Integration	
Independent Practice Association	A legal entity that holds managed care contracts. The IPA then contracts with physicians.
Open Physician-Hospital Organization	A joint venture between the hospital and all members of the medical staff who wish to participate.
Closed Physician-Hospital Organization	A PHO that restricts physician membership to those practitioners who meet criteria for cost effectiveness and/or high quality.

(AHA Annual Survey 2015)

Hospital Characteristics (Controls for potential confounders)

Variables that have the potential to affect community benefits and physician employment were controlled for including bed size, teaching status, and rurality. Studies use bed size as an approximation of hospitals size and use for scale (Cochran & White 1981).

Bed size also used in studies assessing community health and local public spending (Singh 2017). Teaching status and rural setting are also controls used in analysis (Singh 2017). Schneider found that uncompensated care was higher for teaching hospitals, hospitals a part of a multihospital system, disproportionate share hospitals, and large hospitals (Schneider 2007). Case mix index was also be included as a control. Case mix index is based on discharge and based upon average diagnostic group related relative weight per hospital as reported by CMS files and used in other literature (Singh et. al. 2018). Here, the CMS data from the 2015 Inpatient Prospective Payment System (IPPS) Final Rule and Correction Notice was used for the source of CMS data. Managed care was shown to have an association with integration and financial performance (Wang et. al. 2001). Managed care was controlled for by measuring i. the number of HMO contracts (count that a hospital reports) and ii. the number of PPO contracts (count that a hospital reports) as reported in the AHA data (Wang et. al. 2001).

Some hospitals are also a part of a hospital system (an entity comprised of many hospitals). A binary variable of whether a hospital was a part of a system was included to capture whether or not a hospital is a part of system had an influence on the dependent variables. Rurality, whether or not a hospital is designated as a rural hospital, was included as a binary variable. Data came from the AHA data set for the system and rurality control variables.

The percent of Medicare days was measured by finding the Medicare days reported by CMS data files and total inpatient days to understand the proportion of payments that may come from Medicare and also as a way of understanding payor mix for the hospitals (Borah

et. al. 2012). CMS reported percent Medicare days as a part of its IPPS file. Percent Medicare days was seen to be inversely proportional to the mean Value Based Purchasing Score, an average of clinical process of care and patient satisfaction measures (Borah et. al. 2012). For those that did not have a reported percent Medicare days, 0 was assigned.

Market competition for hospitals was measured by calculating the Hirschman-Herfindahl Index of the hospitals based on admitted patients (Singh et. al. 2018). To calculate the Herfindahl-Hirschman Index (HHI), total admissions were used from the AHA data. HHI was calculated at the county level. County information was provided in the demographic file of the hospital compare dataset from CMS. The total admissions and county identification were matched on Medicare provider numbers in from the AHA file to the CMS hospital compare data file. Total market share available was calculated on total number of admissions for the particular county with the total admission data provided by the AHA. Individual hospital market share was calculated divided by hospital's total admissions by the sum of total admission for all hospitals in the same county. The market share was then multiplied by 100. Lastly, the market shares were then squared and summed for the county. For example, a count with three hospitals with admissions a, b, c. The total is calculated $T = a + b + c$. The market shares are then calculated for each hospital: Hospital A market share is $a/T * 100 = A$; Hospital B market share is $b/T * 100 = B$, Hospital C market share is $c/T * 100 = c$. HHI is calculated by $HHI = A^2 + B^2 + C^2$. The HHI for all hospitals in the same will be the same e.g. Hospital A, B and C will have the same HHI.

A variable for each state was created to take into account regulatory differences that may impact independent and dependent variables. For instance, state regulation on

community benefits requirements differ (Singh et. al. 2018) and corporate practice of medicine doctrine may impact hospitals' ability to employ physicians directly. Because state is a categorical variable, interpretation was difficult with over 50 different state categories (including Washington, DC and Puerto Rico). The AHA dataset did provide information regarding US census regions. There were 10 census regions to group states into geographical regions making interpretation easier. States that are in particular regions are listed in Appendix D below.

Wage mix index was also a control. This hospital characteristic is reported by the CMS data files and reflects the cost of labor in the market (Sloan 2011).

Datasets and Missing Data

A sample size of 6251 was provided by the AHA for the year 2015. Of these 6251 hospitals available in the AHA dataset, 3099 of the hospitals in the sample were categorized as nongovernment, not-for-profit by the AHA. Of the 3099 hospitals, 2822 of these were characterized as acute and critical hospitals; they were not characterized as long term acute care hospital, children's hospitals, or psychiatric/behavioral health hospitals. The Medicare Hospital General Information website <https://data.medicare.gov/widgets/xubh-q36u> contains information regarding characterization of the hospital type. Hospitals were looked up by Medicare identification numbers. For those that were missing from the Medicare Hospital General Information website referenced were imputed by Medicare number order. For instance, a hospital may have a Medicare number not on the list but may be between two hospitals on the list that are classified as an Acute Care hospital, therefore, the missing hospital will be given the classification of Acute Care hospital also. For those that are not

able to be classified in this manner were also included on the list but left as blank for its characterization. Of the 2822 hospitals, 2727 hospitals participated in the Value Based Purchasing Program (those that have data from the CMS Hospital Compare datasets). From these 2727 hospitals, the individual datasets were created for each dependent variable.

For system membership, the AHA data provided the value 1 for hospitals that were a part of a system; 0 was put in place for those hospitals that did not have the value 1 and were blank. The number of hospitals that had a 1 for system membership was 1903 hospitals. Hospitals that reported no information for HMO and PPO contracts were given the value 0. If percent Medicare was not reported by CMS, 0 was imputed.

For missing information, list wise deletion was done as explained below for each data set. It was not assumed that data was missing at random nor missing completely at random.

List-wise Deletion Steps

For list wise deletion for each dependent variable, the initial amount of hospitals in the sample was the 2727 hospitals that participated in Value Based Purchasing Program. Hospitals were removed from the sample if there was no information for the dependent variable; that is the information reports was “Not Available” or was blank. Of the remaining hospitals, those that had no information available for physician hospital organizations were deleted. Hospitals were then deleted if they did not have information for the Case Mix Index, Medicare Percentage, and Wage Mix Index. If the hospital did not have an HHI available, it was also deleted. Table 5 contains the final hospital sample size used for each dependent variable dataset.

Table 5. Count of Hospitals in Datasets	
Dependent Variable	Hospitals (n)
Acute Myocardial Infarction 30 Day Mortality Rate	1441
Acute Myocardial Infarction 30 Day Readmission Rate	1342
Dependent Variable	Hospitals (n)
Central Line-Associated Blood Stream Infection	1750
Operating Margin	1757
Percent Community Benefits	930

Data Analysis

As a first step, descriptive information regarding hospital physician organizations and hospital characteristics were tabulated for each dependent variable. Each dependent variable was also checked for normality before analysis (see Appendix B). Each research question was analyzed in a similar manner with dependent variables differing for each research question.

A multiple linear regression was to assess whether physician arrangements (independent variables) have an association with quality outcomes (dependent variable- Research Question 1), financial health (dependent variable- Research Question 2), and community benefit expenditures (dependent variable- Research Question 3). This study looked at hospitals that had a physician hospital organization with high integration first. The same hospitals may have also had a physician hospital organization with low integration present. To see if restricting physician hospital organizations with different levels of integration would have an association with quality, financial performance, and community benefits spending, this study also looked at hospitals with physician hospital organizations with high integration only; that is, the hospitals did not have a physician hospital organization with low integration present also. Lastly, the study looked at hospitals with low

integration physician hospitals, having no physician hospital organizations with high integration present. Each model also included hospital characteristics that may impact independent and dependent variables as described in Table 3 above.

For each dependent variable and each model a multiple regression was run with the untransformed dependent variables. The residuals of this regression were checked for normality and heteroscedasticity. A boxcox test was performed to check to see if the dependent variable should be transformed. If the boxcox test indicated that the dependent variable should be transformed, the dependent variable was transformed and the multiple regression was ran again. Residuals after this regression were checked for normality and heteroscedasticity again. If residuals were found to be non-normal and heteroscedastic, then a robust multiple regression was performed. If residuals were found to be non-normal but homoscedastic for each model, therefore a multiple regression with robust standard errors was performed.

i. Log transformed dependent variables

Y_1 = AMI 30 Day Mortality Rate, AMI 30 Day Readmission Rate, CLABSI

$$\text{Ln}Y_1 = \beta_0 + \beta_1\text{HighIntegration}_1 + \text{Hospital Characteristics}*\gamma_i + \varepsilon_i$$

$$\text{Ln}Y_1 = \beta_0 + \beta_1\text{HighIntegrationOnly}_1 + \text{Hospital Characteristics}*\gamma_i + \varepsilon_i$$

$$\text{Ln}Y_1 = \beta_0 + \beta_1\text{LowIntegrationOnly}_1 + \text{Hospital Characteristics}*\gamma_i + \varepsilon_i$$

ii. Non-transformed dependent variable

Y_1 = Percent Community Benefits, Operating Margin

$$Y_1 = \beta_0 + \beta_1\text{HighIntegration}_1 + \text{Hospital Characteristics}*\gamma_i + \varepsilon_i$$

$$Y_1 = \beta_0 + \beta_1\text{HighIntegrationOnly}_1 + \text{Hospital Characteristics}*\gamma_i + \varepsilon_i$$

$$Y_1 = \beta_0 + \beta_1\text{LowIntegrationOnly}_1 + \text{Hospital Characteristics}*\gamma_i + \varepsilon_i$$

For the CLABSI score dependent variable the equation above represents the second part of the two part model. The first part of the model is a logistic regression when the dependent variable for CLABSI is 0, 1; where 0 is a score of 0 and 1 represents a score greater than 0. The equations for the logistic regression remain the same as ii. above but Y_1 would not be continuous as in the multiple regressions.

In the equations above, High Integration includes hospitals that have a physician hospital organization with high integration present. The same hospitals may also have a physician hospital organization with low integration present at the same time. High Integration Only includes only hospitals with a physician hospital organization with high integration present and no physician hospital organizations with low integration present. Low Integration Only is the opposite of High Integration Only, where there are hospitals with physician hospital organizations with low integration and no hospitals included if they have a physician hospital organization with high integration.

Human Subjects, Animal Subjects, or Safety Considerations

The unit of measure for the specific aims is at the hospital level; therefore, there is no concern for risk of loss of confidentiality of protected health information for individual patients. However, for this study there is need to link the data to each organization. This study also used data from the AHA, a third party, which must be purchased. With the data owned by AHA and the link or data to individual hospitals, there is the concern that the information remain confidential; however, this study was approved by the University of Texas Health Science Center at Houston Institutional Review Board.

RESULTS

Table 6 below contains the descriptive information for the sample population.

Table 6. Descriptive Statistics of Sample						
		Average	Std. Dev.	Min	Max	
Dependent Variable						
Acute Myocardial Infarction 30 Day Mortality Rate (n=1441)		13.95	1.27	9.40	18.70	
Acute Myocardial Infarction 30 Day Readmission Rate (n=1342)		16.81	0.96	13.10	20.60	
Central Line-Associated Blood Stream Infection (n=1750)		6.98	13.35	0	164	
Operating Margin (n=1757)		-0.16	13.82	-157.03	104.58	
Percent Community Benefits (n=930)		0.26	0.27	-5.63	2.69	
Independent (number where present, Percent out of n=1757)		Count	Percent			
High Integration	921	52%				
High Only (no low integration present)	649	37%				
Low Integration	485	28%				
Low Only (no high integration present)	213	12%				
Independent Practice Association (IPA)	180	10%				
Group Practice Without Walls (GPWW)	33	2%				
Open Physician Hospital Organization (OPHO)	279	16%				
Closed Physician Hospital Organization (CPHO)	70	4%				
Management Services Organization (MSO)	108	6%				
Integrated Salary Model (ISM)	763	43%				
Equity Model	25	1%				
Foundation Model	112	6%				
Controls		Count	Average	Std. Dev.	Min	Max
Beds		252	230	3.0	2654	
Teaching Status*	818					
System Affiliation	1323					
Rurality**	105					
Case Mix Index		1.55	0.27	0.67	2.89	
Managed Care HMO Contracts		10.12	13.33	0	145	
Managed Care PPO Contracts		19.96	101.54	0	4140	
Medicare Percent		0.40	0.16	0.00	2.15	
Market Competition (HHI)		5041.4	3377.9	28.8	10,000	
Wage Index		1.00	0.19	0.40	1.72	

Table 6 shows averages and ranges for the dependent variables of interest. Over half of the hospitals had a highly integrated physician hospital organization; 37% of hospitals had a highly integrated physician hospital organization only present. While only 28% of hospitals had a physician hospital organization with low integration present, there were even fewer at 12% having a physician hospital organization with low integration present only. The larger amount of highly integrated physician hospital organizations may be reflective of the trend of hospitals employing more physicians in response to federal payment policy. The table above also has the breakdown of the amounts of the individual hospital physician organizations found in the dataset, and also the averages and ranges of the control variables. For this dataset not all states were present after the list wise deletion of hospitals with missing information; no hospitals from Maryland were included in the dataset. All US census regions were present in the dataset.

Table 7 below has the results of a regression run for each key independent variable (Physicians hospital organizations present with High Integration, those with High integration Only, and those with Low integration Only) as a dependent variable with the hospital control variable as an independent variable to understand if there were any associations between the Key Independent Variables (High Integration, High Only, Low Only) and the hospital controls. The table below shows an association between physician hospital organizations with high integration (including having physicians hospital organization with low integration present) and whether the hospitals are located in Regions 5 (East South Central), 7 (West South Central) and 8 (Mountain), case mix index, wage index, and beds. There is an association between physician hospital organizations with high integration (no physician

hospital organizations with low integration present) and Region 7 (West South Central), HHI, case mix index, and Medicare percent. The table below also shows that there is an association between physician hospital organizations with low integration (no physician hospital organizations with high integration present) and Regions 2 (Mid Atlantic), 3 (South Atlantic), 5 (East South Central), 8 (Mountain), and 9 (Pacific).

Table 7. Association between Key Independent Variables and Control Variables [Coefficient (95% Confidence Interval)]

Variable*	High Integration	High Only	Low Only
Region 2	-0.08 (-0.6, 0.4)	-0.0013 (-0.48, 0.48)	-1.21 (-1.89, -0.53)
Region 3	-0.16 (-0.63, 0.31)	0.37 (-0.1, 0.83)	-1.39 (-2.08, -0.71)
Region 4	-0.44 (-0.89, 0.02)	-0.32 (-0.79, 0.15)	0.04 (-0.52, 0.59)
Region 5	-0.87 (-1.45, -0.29)	-0.48 (-1.09, 0.13)	-1.77 (-2.88, -0.65)
Region 6	-0.03 (-0.55, 0.48)	0.3 (-0.22, 0.81)	-0.39 (-1.05, 0.26)
Region 7	-0.53 (-1.03, -0.03)	-0.57 (-1.1, -0.04)	-0.37 (-1.01, 0.27)
Region 8	-0.64 (-1.2, -0.08)	-0.15 (-0.76, 0.42)	-1.31 (-2.22, -0.40)
Region 9	-0.2 (-0.7, 0.3)	0.08 (-0.42, 0.58)	-1.09 (-1.8, -0.39)
Region 10	dropped	dropped	1.75 (-0.1, 3.6)
HHI**	-0.0002 (-0.003, 0.003)	0.006 (0.003, 0.009)	-0.003 (-0.007, 0.002)
Case Mix Index	0.93 (0.57, 1.3)	0.38 (0.01, 0.74)	-0.028 (-0.57, 0.51)
Medicare Percent	0.36 (-0.23, 0.95)	0.92 (0.31, 1.54)	0.12 (-.76, 1.0)
Wage Index	0.7 (0.2, 1.2)	0.1 (-0.4, 0.6)	0.08 (-0.68, 0.830)
Teaching	-0.26 (-0.45, -0.07)	0.03 (-0.16, 0.23)	-0.21 (-0.5, 0.08)
Rural	0.04 (-0.36, 0.43)	0.3 (-0.1, 0.7)	-0.29 (-0.95, 0.38)
HMO Contracts	0.006 (-0.001, 0.013)	0.0018 (-0.005, 0.009)	0.004 (-0.006, 0.014)
PPO Contracts	-0.0006 (-0.002, 0.001)	-0.001 (-0.005, 0.002)	0.001 (-0.0008, 0.003)
Beds	0.0016 (0.001, 0.002)	0.003 (-0.0002, 0.0007)	-0.0002 (-0.0009, 0.0004)
System Member	0.07 (-0.15, 0.28)	0.15 (-0.07, 0.37)	0.2 (-0.1, 0.5)

*Region 1 is the comparison region for others. The base is set that teaching status is present. The base is set that a hospital is not rural (therefore urban).

** HHI was divided by 100.

Teaching status was looked at in relation to the dependent variables in Table 8 below.

Hospital teaching status was found to be associated with better quality of care and mortality

for AMI (Allison et. al. 2000). Krumholz et. al. also showed that teaching hospitals had a lower risk standardized mortality rate for AMI but a higher risk standardized readmission rate for AMI compared to non-teaching hospitals (Krumholz et. al. 2009). Table 8 below shows that there is an association between teaching status and AMI 30 day mortality rate. The table shows that compared to a teaching hospital, a non-teaching hospital is associated with higher AMI 30 day mortality rates. Table 8 also shows an association between teaching status and CLABSI, a non-teaching hospital is associated with a lower CLABSI score.

Table 8. Association between Teaching Status and Dependent Variables

	AMI 30 Day Mort	AMI 30 Day Readmission	CLABSI	Operating Margin	Percent Community Benefits
Teaching Status*	0.0133 (0.0038, 0.0227)	-0.0044 (-0.0105, 0.0018)	-0.93 (-1.04, -0.81)	0.0002 (-1.3, 1.3)	-0.012 (-.037, 0.013)

*Base set that hospital is a teaching hospital.

Table 9 contains the coefficients, standard error and p value for each dependent variable. Table 9 also contains dependent variable coefficients, standard error and p values.

Regression Results

Table 9. Multiple Regression Results for the Relationship between Physician Hospital Organization and Dependent Variables for Quality, Financial Performance, and Community Benefits, Coefficient (95% Confidence Interval)

Hospital Physician Organization	AMI 30 Day Mortality Rate	AMI 30 Day Readmission Rate**	CLABSI	Operating Margin**	Percent Community Benefits***
High Integration	0.00019 (-0.009, 0.10)	-0.000094 (-0.006, 0.006)	0.017 (-0.067, 0.101)	0.019 (-1.28, 1.32)	0.0021 (-0.021, 0.025)
High Only	0.0025 (-0.007, 0.012)	0.00013 (-0.006, 0.006)	0.018 (-0.069, 0.10)	-0.18 (-1.6, 1.2)	0.016 (-0.01, 0.04)
Low Only	-0.014 (-0.028, 0.0001)	0.0019 (-0.007, 0.011)	-0.16 (-0.28, -0.028)	-0.32 (-2.04, 1.41)	0.014 (-0.014, 0.041)

Dependent Variables	AMI 30 Day Mortality Rate	AMI 30 Day Readmission Rate**	CLABSI	Operating Margin**	Percent Community Benefits***
Region 2	0.0039 (-0.018, 0.026)	0.015 (0.0014, 0.029)	0.21 (-0.001, 0.42)	-0.053 (-2.85, 2.76)	0.021 (-0.025, 0.067)
Region 3	0.019 (-0.006, 0.044)	0.020 (0.004, 0.037)	0.27 (0.036, 0.5)	4.91 (1.78, 8.03)	-0.063 (-0.11, -0.016)
Region 4	0.0023 (-0.022, 0.026)	0.011 (-0.004, 0.026)	-0.024 (-0.24, 0.20)	5.55 (2.55, 8.53)	-0.029 (-0.072, 0.015)
Region 5	0.025 (-0.025, 0.017)	0.030 (0.008, 0.052)	0.26 (-0.049, 0.56)	0.94 (-3.11, 5.00)	0.041 (-0.035, 0.117)
Region 6	0.014 (-0.012, 0.041)	0.0039 (-0.012, 0.021)	-0.070 (-0.32, 0.18)	2.63 (-0.50, 5.77)	-0.046 (-0.093, 0.001)
Region 7	0.036 (0.008, 0.063)	0.012 (-0.005, 0.029)	0.3 (0.04, 0.5)	0.99 (-3.13, 5.11)	-0.06 (-0.11, -0.01)
Region 8	0.0043 (-0.025, 0.033)	-0.017 (-0.035, 0.001)	-0.16 (-0.43, 0.11)	0.37 (-4.13, 4.87)	0.030 (-0.024, 0.084)
Region 9	0.029 (0.005, 0.053)	-0.0076 (-0.024, 0.009)	-0.05 (-0.27, 0.17)	-0.5 (-3.9, 2.9)	0.073 (0.004, 0.14)
Region 10	-0.0082 (-0.11, 0.10)	0.049 (0.013, 0.086)	0.62 (-0.87, 2.1)	-2.27 (-10.03, 5.48)	0.68 (0.08, 1.3)
HHI*	0.00015 (0.00, 0.0003)	-0.00018 (-.0003, -.0001)	-0.0042 (-0.006, -0.003)	0.037 (0.011, 0.063)	-0.000016 (0,0)
Case Mix Index	-0.031 (-0.058, -0.003)	-0.054 (-0.073, -0.036)	1.36 (1.13, 1.59)	8.19 (4.19, 12.19)	-0.12 (-0.19, -0.06)
Medicare Percent	-0.034 (-0.07, 0.001)	0.0025 (-0.018, 0.023)	0.18 (-0.13, 0.49)	-7.21 (-13.56, -0.86)	-0.044 (-0.12, 0.03)
Wage Index	-0.079 (-0.12, -0.04)	0.039 (0.013, 0.065)	0.057 (-0.3, 0.41)	1.6 (-4.1, 7.3)	0.0063 (-0.11, 0.13)
Teaching	-0.0058 (-0.016, 0.005)	-0.0022 (-0.009, 0.005)	-0.17 (-0.27, -0.07)	1.31 (-0.21, 2.83)	-0.013 (-0.043, 0.016)
Rural	-0.0039 (-0.022, 0.015)	0.0022 (-0.013, 0.015)	0.11 (-0.06, 0.28)	-0.08 (-2.28, 2.12)	0.0083 (-0.027, 0.044)
HMO Contracts	-0.00036 (-0.001, 0)	0.00011 (-0.0001, 0.0004)	0.0006 (-0.002, 0.004)	0.032 (-0.012, 0.076)	-0.00016 (-0.001, 0.0007)
PPO Contracts	0.000025 (0, 0.00007)	-5.41 x 10 ⁻⁶ (-0.00001, 0)	0.00023 (-0.0001, 0.0006)	0.0016 (-0.0013, 0.0045)	0.00033 (-0.0002, 0.0009)
Beds	-0.00003 (-0.00006, 0)	0.000033 (0.00002, 0.00005)	0.0024 (0.0022, 0.0026)	-0.0032 (-0.007, 0.0001)	0.00011 (0.0001, 0.00016)
System Member	0.0042 (-0.007, 0.016)	-0.000057 (-0.007, 0.008)	0.036 (-0.068, 0.14)	-4.15 (-5.77, -2.52)	0.018 (-0.008, 0.044)
Constant	2.77 (2.7, 2.8)	2.86 (2.8, 2.9)	-1.4 (-2.0, -0.8)	-14.92 (-23.84, -6.00)	0.44 (0.26, 0.63)

Region 1 is the comparison region for others. The base is set that teaching status is present. The base is set that a hospital is not rural (therefore urban).

* HHI was divided by 100.

** Robust regression ran.

*** Not natural log transformed and robust regression.

Acute Myocardial Infarction 30 Day Mortality Rate

The hypothesis for physician hospital organizations that are highly integrated would be associated with lower AMI 30 day mortality rates. This was not the case, there is not an association with hospitals that have a physician hospital organization that is highly integrated (whether or not a physician hospital organization with low integration is present) and AMI 30 day mortality rate.

Even though there was no association found for hospitals having physician hospital organizations that have high integration, there were certain hospital characteristics for those hospitals that did have an association with AMI 30 day mortality rate. A hospital in Regions 7 (West South Central), 9 (Pacific) and 10 (Associated Areas, e.g. Puerto Rico) (see Appendix C with detailed information regarding Regions), case mix index, wage index, number of HMO contracts, and total number of beds did have a significant association with AMI 30 day mortality rate. Of these hospital characteristics, wage index had the greatest absolute association with AMI 30 day mortality rate; holding all other variables constant, for every one unit increase in wage index, there is a 7.9% decrease in AMI 30 day mortality rate.

Acute Myocardial Infarction 30 Day Readmission Rate

The hypothesis for physician hospital organizations that are highly integrated would also be associated with lower AMI 30 day readmission rates. This was not the case, there is not an association between highly integrated physician hospital organizations (whether or not a physician hospital organization with low integration is present) and AMI 30 day

readmission rate. There is also no association with hospitals that only have physician hospital organizations with low integration.

Again, there were certain hospital characteristics for those hospitals that did have an association with AMI 30 day readmission rate. A hospital in Regions 2 (Mid Atlantic), 3 (South Atlantic), 5 (East South Central), and 9 (Pacific) and 10 (Associated Areas), HHI, case mix index, Medicare percentage, wage index, and total number of beds (very small association with beds) did have a significant association with AMI 30 day readmission rate. The largest association of the hospital characteristics was being located in Region 10 (Associated Areas) (keeping all other variables constant, there if a hospital is located in Region 10 (Associated Areas) compared to Region 1 (New England) there is a 4.9% increase in AMI 30 day readmission rate.

Central Line-Associated Blood Stream Infection

Like the other quality measures AMI 30 day mortality rate and AMI 30 day readmission rate, the original hypothesis for the CLABSI score was that hospitals that had a physician hospital organization with higher integration would be associated with lower CLABSI scores. Hospitals that had a physician hospital organization with high integration, whether or not there was a physician hospital organization with low integration present, there was no association with CLABSI rates either higher or lower. However, if a hospital only had a physician hospital organization characterized as low integration there was an association with lower CLABSI rates. For hospitals that only have a physician hospital organization with low integration, holding all other variables constant, if a low integration physician hospital is present then there is a 16 percent decrease in the CLABSI score.

Other hospital characteristic control variables are associated with the CLABSI score. If a hospital is located in Regions 3 (South Atlantic) and 7 (West South Central), the case mix index, HHI, whether the hospital is a teaching hospital, and the total number of beds also had a significant association with the CLABSI score. Of these hospital characteristics, case mix index had the greatest absolute association with CLABSI score; holding all other variables constant, for every one unit increase in case mix index, there is a 1.36 increase in CLABSI score.

The analysis of CLABSI dependent variable was done with a two part model (See Appendix B below), where a logistic regression was first run because of the large amount of true 0s found in the sample. A regression is then run on the positive values for sample while also taking into account the effects of the entire sample including those with a 0 value for the dependent variable. Table 9 above contains the results from the regression. Table 10 below contains the results from the logistic regression. The logistic regression shows that there is a significant association between the presence of a physician hospital organization with high integration and CLABSI score; holding all other variables constant, if a physician hospital organization with high integration is present then there is a 0.12 decrease in CLABSI score; however, the CLABSI score range was from 6.98 to 164 with an average CLABSI score of 13.35.

Variable	Coefficient	Std. Error	p value
High Integration	-0.12	0.14	0.4
High Only	0.03	0.15	0.8
Low Only	0.02	0.21	0.9

Operating Margin

For the dependent variable operating margin, the hypothesis (Hypothesis 2) was that hospital with physician hospital organizations that were highly integrated would be associated with higher operating margins. The results in Table 7 show that there is no association between highly integrated physician hospital organizations and operating margin. Additionally, there is no association between operating margin and physician hospital organizations with low integration.

Hospital characteristics, controls, that are associated with operating margin are whether the hospitals are located in Regions 3 (South Atlantic) or 4 (East North Central), HHI, case mix index, Medicare percentage, number of HMO contracts, number of PPO contracts, and whether the hospital is not a part of a system of hospitals. Case mix index again was seen having the largest absolute association with operating margin (holding all other variables constant there is a 8.19 unit increase in operating margin for every 1 unit increase in case mix index).

Percent Community Benefits

Hypothesis 3 suggested that there would be an association between hospitals with physician hospital organizations that are highly integrated and lower percent community benefits (community benefit expenditures over total expenditures). The results showed that there is no association between hospitals with physician hospitals organizations characterized as highly integrated and lower percent community benefits. Additionally, there was also no association between hospitals with physician hospitals organizations with only low integration and percent community benefit expenditures.

Again, there are hospital characteristics that are associated with percent community benefit expenditures. A hospital in Regions 3 (South Atlantic), 9 (Pacific), and 10 (Associated Areas), HHI, wage index, case mix index, and total number of beds did have a significant association with percent community benefit expenditures. The largest association of the hospital characteristics was being located in Region 10 (keeping all other variables constant, there if a hospital is located in Region 10 (Associated Areas) compared to Region 1 (New England) there is a 0.68 increase in percent community benefits).

Noticeably, case mix index was significantly associated with all dependent variables. Case mix index had a negative association for AMI 30 day mortality rate and AMI 30 day readmission rate, a desired outcome; however, there was a positive association with the CLABSI score (holding all other variables constant, for every unit change in case mix index, there is a 1.36 unit change in CLABSI score). Case mix index is most likely associated with the quality metrics because the metrics are risk adjusted (CMS “About the Data”). There was a positive association with operating margin, a desired outcome (holding all other variables constant, there is a 8.19 unit increase in operating margin for every 1 unit increase in case mix index). Suggesting that a higher case mix index contributes to better financial performance. Lastly, case mix index was negatively associated with community benefit percent (holding all other variables constant, there is a -0.12 unit change in community benefit percent for every 1 unit increase in case mix index).

DISCUSSION

At the outset the objective of this study was to understand whether physician hospital arrangements were associated with certain quality measures, hospital financial health, and community benefit expenditures.

Quality Metrics

This study aim was to explore whether there was an association between physician hospital organizations and quality metrics. The hypothesis was that physician hospitals organizations with higher integration would be associated with lower quality metrics based on previous limited literature looking at physician hospital associations and quality metric associations. Unlike previous literature, which had mixed findings regarding the association with physician hospital organization and quality metrics (Scott, 2017, Madison 2004, Cuellar and Gertler 2006), this current study found that there was no significant association between quality metrics and higher integrated physician hospital organizations. Contrary to the hypothesis predicting lower quality metrics in the presence of higher integrated physician hospital associations, there was a non-significant association between higher integrated physician hospital associations and higher rates AMI 30 day mortality rate and higher CLABSI scores. These hospitals may have also had a physician hospital organization with low integration but the hospitals had a least one physician hospital organization with high integration present. There was an association of lower AMI 30 day readmission rates with high integration physician hospital organizations hypothesized; however, this again was not significant.

Looking at hospitals that had only a high integration physician hospital organization (no low integration physician hospital organization present), there was no significant association present with the quality metrics; however, the data showed that if only higher integration physician hospital organizations were present then there was an association with higher AMI 30 day mortality rates, AMI 30 day readmission rates, and CLABSI scores. These were not expected results. The expectation was with higher integration and control of physician behavior, then there would be better quality metrics.

Also contrary to the hypothesis, there was a significant association with physician hospital associations with low integration (no high integration physician hospital organizations present) and lower AMI 30 day mortality rate and CLABSI scores. Low integration physician hospital organizations were associated with higher AMI 30 day readmission rates but not significantly. Although not necessarily looking at the degree of integration of physician hospital organizations, previous studies have seen mixed results for quality of care measures after hospital physician vertical integration (Post et. al. 2018). Similarly, previous studies showed marginal and insignificant improvement for mortality rates (Post et. al. 2018). Another recent study showed that physician practices and physician hospital organizations participating in a private payer pay-for-performance model in the State of Michigan had more positive quality indicators for primary care measures than those that did not participate (Lemark et. al. 2015). Physician hospital organizations in this study included independent practice associations, physician hospital organizations, and large multispecialty group practices (no clarification on whether the group practices were clearly an organization with a hospital) (Lemark et. al. 2015).

Hospitals employ varied strategies to achieve quality metrics (Bradley et. al 2012, Bradley, Curry, Horwitz et. al. 2012, DePalo et. al. 2010, Heidenreich et. al. 2009, Kripalani 2014, Marschall et. al. 2008, Peterson et. al. 2006). These practices to achieve quality outcomes are multi-faceted and complex; that is, there are aspects that are controlled at the hospital level (technology, staffing, nursing practices) and some are controlled by physicians. Hospitals have control over staffing levels, large capital and technology expenses, and staff process of care; however, hospitals may not have complete control over physician behavior. These processes do require physician involvement. Direct care providers, like physicians, are responsible to adhering to infection control practices (Marschall 2008) and complying with recommended guidelines. If hospitals are setting out to control physician behavior through higher integration to achieve better quality metrics, this study shows that this is not necessarily the case. When physician hospital organizations with higher integration are present in this study, there are worse performing quality metrics. (The exception being very a slight decrease in AMI 30 day readmission rates). Instead, the study showed that physician hospital organizations with low integration provided better quality metrics. Physicians had have a history of being autonomous and separate from hospitals (Burns et al 2010). Participating with low integration physician hospital organizations with more limited constraints on physician autonomy may be enough to produce better quality metrics similar to the Michigan experiment.

Management may want to consider its motivations for forming physician hospital organizations thoroughly before entering such organizations, and, in particular, what type of physician hospital organization to form. If a goal is to have physician behavior controlled

through high integration to achieve quality metrics, this study suggests that forming a physician hospital organization with high integration may not be the best platform. Management may want to investigate physician hospital organizations with low integration as a means first to accommodate physician autonomy but still have a degree of integration. An added benefit of a physician hospital organization with lower integration would be the added benefit of lower costs to hospitals; that is, the hospitals may not need to incur costs for physician salaries in an employment model. Management will also need to balance performing certain quality metrics with also providing necessary services (e.g. cardiology coverage) if not possible via physician hospital organizations with lower integration, were the only means of such guaranteed coverage is an employment model.

Operating Margin

Hypothesis 2 suggested that there would be an association between higher operating margins and hospitals that had a physician hospital organization with high integration. Goes and Zhan previously showed that more financial integration between hospitals and physicians was associated with higher operating margins; therefore, the higher integration between hospitals and physicians through physician hospital associations with higher integration, the higher the operating margins (Goes and Zhan 1995). However, other studies showed that more integration with physicians were associated with lower operating margins (Burns et. al. 2005, Burns and Pauly 2002).

This current study found inconsistent results regarding an association between hospital operating margin and physician hospital integration. This current study found that highly integrated physician hospital organizations have a positive association with operating

margin; however, if a physician hospital organization with high integration is only present (none present with low integration) then there was a negative association with operating margin. If a physician hospital organization with low integration is only present then there is also a negative association with operating margin. However, none of the associations were significant.

Hospitals and physicians may have a variety of reasons for forming physician hospital organizations. Such reasons may include a relationship with physicians in order to capture more reimbursements and pressure from declining reimbursements, a means to control quality of physician services at the hospital, and perhaps a means of guaranteeing certain services may be offered at the hospitals (Page et. al. 2013). For instance, a hospital may employ a neurosurgeon to ensure that certain neurosurgeries may take place at the hospital. Gapenski found that if a hospital offered more services, there was positive association with profitability (Gapenski et. al. 1993). Another study found that certain services available at hospitals contribute toward contribution margin, one study found, if appropriately staffed, acute care surgery, which includes trauma, surgical critical care, and emergent general surgery have a positive contribution margin. There has been a trend of hospitals employing more hospitalists and specialists; perhaps expanding services and explaining why there is a positive association between the presence of a physician hospital organization with high integration and operating margin.

This current study produced inconsistent results when only a physician hospital organization with high integration is present and only one with low integration is present. This suggests that there may be more explanations associated with operating margin

significantly that may impact operating margin. Gapenski et. al. performed a study to identify determinants of hospital profitability. (Gapenski et. al. 1993). The study discovered teaching status, use of debt financing, labor intensity (full time equivalent per inpatient day), Medicare and Medicaid percentages, had a negative association with profitability that profitability was measured by pre-tax and after-tax operating margins (Gapenski et. al. 1993). Kim also found that a decrease in occupancy, increase in Medicare and Medicaid percentages, increased market competition (HHI), teaching status, led to financial distress of hospitals (Kim 2010). Interestingly, Kim found that an increase in physician supply led to increased hospital financial distress (Kim 2010). Younis et. al. found that being a teaching hospital, being in the South region of the U.S. compared to the Northeast region, occupancy rate above 50%, and bed size below 100 were associated positively with profitability measured by return on assets (net income divided by total assets) (Younis et. al. 2006).

Hospital management may be forming physician hospital organizations in response payment programs from the federal government. That is, hospitals are creating the organizations in order to capture more federal reimbursements encouraging shared quality outcomes for patients with the thought of providing better quality metrics; however, it is not clear whether there is an association with the creation of physician hospital organizations and operating margin. The cross section design of the study does not provide temporality in order to understand whether low operating margins cause hospitals to form a physician hospital organization or a result of forming the organizations instead. Hospital managers will, as they must certainly do, trend its operating margin and other financial indicators as they respond to federal payment structures.

As seen above when discussing quality metrics and possible associations with physician hospital organizations with high integration, these organizations may not have intended quality outcomes. The presence of a physician hospital organization with high integration does not necessarily mean that there are better AMI 30 day mortality rates and CLABSI scores and only are associated with marginal, insignificant improvement in AMI 30 day readmission rates. However, this study shows that physician hospital organizations with higher integration are associated more positively with operating margin. Hospital managers will need to balance forming physician hospital organizations to produce better quality metrics and the actual effect of those physician hospital organizations on operating margin.

Community Benefits

The hypothesis at the start of the study was that community benefit expenditures (as a percent of total expenditures) would be associated with hospitals that have a physician hospital organization with high integration. No study was available in the literature speaking to the impact or association of physician hospital organizations on hospital community benefit spending; however, there was literature finding hospitals with higher efficiency having higher uncompensated care, while hospitals that had higher physician hospital integration led to lower efficiency. This led to the thought that hospitals with physician hospital organizations with higher integration would have lower efficiency and; therefore, lower spending on community benefits.

This study found that contrary to the hypothesis, there was a positive association between community benefit spending and hospital physician organizations. The largest association was present when a hospital only had a hospital physician organization with high

integration (no hospital physician organizations with low integration present). However, again, none of the associations between percent community benefit expenditures and physician hospital organizations were significant.

As stated, overall, there has been a slight increase in spending in community benefits. The ACA did not mandate specific amounts but steered hospitals to contribute to specific community needs through conducting and creating programs based upon community needs assessments. However, charity care remained static for some of the largest healthcare systems (Bannow 2018). After a decline of spending on charity care, charity care spending was at the same level in 2016 as it was the year before in 2015 (Bannow 2018). Chaiyachati et. al. found that for the years 2012 through 2014 there was no change in community benefit spending on health care related activities (Chaiyachti 2018). The same study also found that after adjustment, community benefits were not related to community characteristics and remain a small amount of overall hospital expenditures (Chaiyachti 2018). Although there was a limited response to ACA pushes in community benefit targeted spending, hospitals have responded to policy focused on reimbursement programs. Hospitals have responded to policies by forming physician hospital organizations and participating in the Value-Based Purchasing Program. This study alludes that the formation of physician hospital associations in response to some policy is at least not in conflict and in line with other governmental policies to steer community benefit spending.

Although the presence of physician hospital organization with high integration in this sample did not show a significant association with an increase in community benefit spending. There are also possible other explanations and associations related to community

benefit spending not accounted for in this study. Bai found that in California nonprofit hospitals, a larger board size was associated with greater social performance (captures as community benefits) (Bai 2013). The same study also found that having a physician board members also resulted in a positive association with social performance although not significantly (Bai 2013). Internal and external financial factors also influence community benefit spending. Kim et. al. found free cash flow and long-term debt to capital were negatively associated with charity care spending by California hospitals (Kim et. al. 2009). (Kim et. al. 2009). Chang et. al. found that after state budget cuts to reduce health-related expenses in Texas, there was an increase in the ratio of uncompensated care expenses to gross patient revenue and charity care to total revenue (Chang et. al. 2012). Kim et. al. found that there was a positive association with uncompensated care expenditures in the market with charity care spending by the individual hospital (Kim et. al. 2009). Kim found that nonprofit mission coupled with financial ability (free cash flow) positively associated with charity care expenditures (Kim et. al. 2009).

In other instances, hospitals did respond to changes in policy regarding community benefits. Hospitals in Texas responded to changes in community benefit law requiring a minimum amount 4% of net revenue for community benefit spending (Kennedy et. al. 2010). Hospitals spent more to meet the minimum if they were not previously and those that were above the threshold had a minimal dip in spending (Kennedy et. al. 2010). Federal policy may need to have more direct requirements for community benefits spending instead of the current requirements for a community needs assessment without a mandated contribution minimum. With no stated federal requirement, managers may not be as keyed into providing

a certain level of community benefits unless statutorily required. Hospital managers may not even consider an assessment of community benefit impact when forming physician hospital organizations; perhaps, at most how physician hospital organizations may meet any needs through the community needs assessment. Hospital managers may be more interested in achieving financial and quality goals instead certain community benefits. However, managers should at the same time consider whether the formation physician hospital organizations will negatively impact the hospital's ability to provide community benefits. This study showed that the presence of physician hospital organizations with high integration are at least not having a negative association with community benefits, even if the positive association is marginal and not significant.

As discussed, managers will need to understand the potential impacts of physician hospital organizations with high integration on quality, financial health, and community benefits. The federal government, as a principal, is also interested in the same outcomes for hospitals. The federal government provides tax breaks to hospitals, but is interested in some return for these tax breaks. The federal government structures payment to achieve certain quality goals. As a consequence, hospitals are forming physician hospital organization to achieve certain quality metrics and a trend toward employing more physicians, meaning forming physician hospital organization with higher integration. With this push toward physician hospital organization with higher integration formation, this current study suggests that there may not be intended association desired by the federal government in that the presence of physician hospital organizations with high integration is associated with higher AMI 30 day mortality rates and CLABSI scores, and slight improvement with AMI 30

day readmission rates. The federal government as a principal is interested in ensuring that hospitals remain financially solvent. If hospitals are not financially solvent then hospitals will not remain open and providing services to Medicare and Medicaid patients, another desire of the federal government as a purchaser of services. This study suggests that even with policy pushing hospitals to form physician organizations, operating margin and community benefits are not negatively affected; however, quality metrics may not be as desirable as intended. Community benefits also may not be as greatly positively impacted as desired by policy without an explicit level of community benefit contribution; however, this study does show at least there is no negative association with the presence of physician hospital organizations with high integration.

This study suggests that policies pushing hospitals toward formation of physician hospital organizations with high integration may not be associated with the desired quality metrics but do have a positive association with community benefit spending; which is a desired benefit for public health. However, this association is small and not significant. As far as public health implications go, there may be other programs that can possibly better achieve better public health. This study also does not have clear indications for public health. An objective of public health is, of course, to have a healthier population. The federal government does want to encourage certain quality metrics for hospital to benefit Medicare and Medicaid patients (and all patients more broadly), but the government also provides a large tax break for community benefits. Alternatively to providing this tax break, the federal government through taxes on revenue and to some extent local governments through taxes on

property and sales, could receive the tax income and apply them to programs that directly provide health services to improve public health.

Audience and limitations

Audience

One audience for this dissertation is hospital management, so they may understand empirically how hospital physician organizations are impacting quality and financial measures. Another important audience is policy makers. Policy makers may understand more the downstream implications of hospital payment programs impact on quality and financial metrics and also desired community benefits.

Limitations

This study is a cross-sectional design. As such, a limitation to this design is ambiguous temporal precedence, whether the dependent variables came first or the independent variables (Shadish 2002). This study does not attempt to understand causality, but instead any existing associations between dependent variables and physician hospital associations. Another limitation is the ability to generalize this study to all types of hospitals. This study specifically looks only at nonprofit hospitals because of the governmental requirement to provide community benefits. Other hospitals do provide community benefits, sometimes in the same or more amounts of nonprofit hospitals. This study also only included hospitals participating in the Value-Based-Purchasing Program. The study sample was further limited to hospitals that had data available for this program; that is, the response was not available for quality metrics of interest. This specific sample set limits generalization to all hospitals. Generalization was further limited by list wise for missing variables. This

reduced the sample size for hospitals that had available information, perhaps including hospitals reporting all variables having certain characteristics. In particular, the state of Maryland had not hospitals included in the datasets because of list wise deletion.

There is the possibility also that confounders not included can be influencing dependent variables. To minimize as many confounders as possible, the study collects information on hospital and market characteristics that may possibly influence the dependent and independent variables so that the confounders can be controlled for statistically.

Lastly, the AHA survey is voluntary. This study does not look into whether there is bias due to certain hospitals that self-select to provide AHA information.

CONCLUSION

Federal policy has been to provide tax breaks to non-profit hospitals with the requirement for nonprofit hospitals to provide community benefits. At the same time, the federal government is also a payer for hospital services. As such there are policies layered on top of the initial tax policy and requirement of community benefits to achieve high quality for low costs. These payment policies motivate hospitals to form physician hospital organizations to capture better reimbursements, contemporaneously with a trend of hospitals employing physicians.

It is important for the federal government to understand whether its payment policies can achieve what they set out to without unintended consequences. This study set out to understand if there was an association between physician hospital organizations with high integration forming in response to payment policies and quality, operating margin, and community benefit expenditures. This study showed that there is an association with higher

AMI 30 day mortality rates and CLABSI scores with physician hospital organizations with high integration; an undesirable outcome. This study also showed that there is an association with these physician hospital organizations and lower AMI 30 day readmission rates, higher operating margin, and higher spending on community benefits. None of these associations were significant.

No clear direction is apparent for the federal government regarding payor policies causing unintended consequences regarding hospital community benefits spending; however, the formation of physician hospital organizations with high integration may not have the quality metrics desired. The federal government will have to consider its policy effects and downstream consequences and whether they may be counter-productive to community benefit expenditures or whether they even achieve their intended purposes. The federal government may also want to have more direct policies regarding community benefit spending with explicit amounts mandated to ensure that community benefits spending is adequate enough for the tax breaks nonprofit hospitals receive.

APPENDIX A

DATA CHART AND SOURCE

Table 1A below contains the data sources and data points that will be used for the study and for which research questions. As mentioned above, the data came from Guidestar, AHA and CMS.

Table 1A. Data Chart

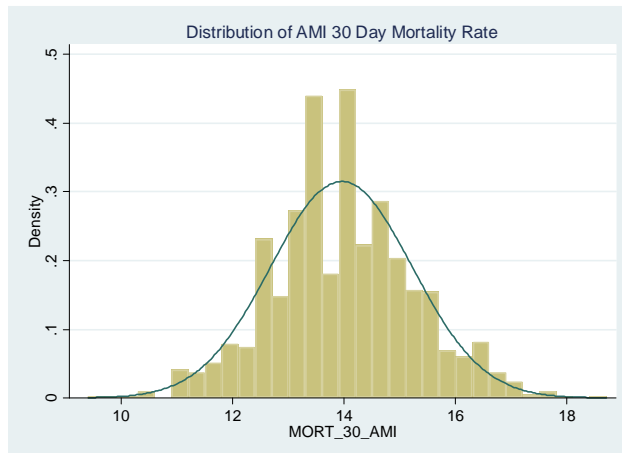
Variable	Question	Definition	Data Source	Literature
Dependent				
Acute Myocardial Infarction 30 day mortality rate	Research Question 1	Estimated deaths within 30 days of admission	CMS Hospital Compare data	Figuro et. al. 2016
Acute Myocardial Infarction 30 day readmission	Research Question 1	Estimate of unplanned readmission measures from hospitalization for AMI	CMS Hospital Compare data	Scott et. al. 2017
Central line-associated blood infections (CLABSI)	Research Question 1	Observed cases of central-line associated blood infections	CMS Hospital Compare data	Silvera 2017
Operating Margin	Research Question 2	Net operating income divided by total operating revenue	AHA financial data	Gapenski 2012
Community Benefits	Research Question 3	% total community benefits divided by total expenditures	AHA financial data (total operating expenditures) IRS 990 Schedule H (Guidestar)	Leider et. al. 2017, Young et. al. 2018
Independent				
High Integration	All	(0/1) if has GPWW, MSO, ISM, Foundation, Equity	AHA data	Madison 2004
Low Integration	All	(0/1) if has IPA, OPHO, CPHO	AHA data	Madison 2004
Controls (Hospital Characteristics, Market Characteristics)				
Beds	All	Number of hospital beds	AHA data	Goes and Zhan 1995, Singh et. al. 2018
Teaching Status	All	Yes/No indication of teaching hospital	AHA data	Morrissey et. al. 1996
System Affiliation	All	Yes/No indication	AHA data	Bai and Anderson 2016
Rurality	All	Yes/No, rural hospital designation	AHA data	Goes and Zhan 1995, Morrissey et. al. 1996

Case Mix Index	All	Case Mix index for discharge, average diagnostic related group relative weight per hospital	CMS files	Singh et. al. 2018
Managed Care	All	i. Number of HMO Contracts ii. Number of PPO Contracts	AHA	Wang et. al. 2001
Medicare Percent	All	Medicare days as percent of total inpatient days	CMS files	Borah et. al. 2012
Market Competition	All	Hirschman-Herfindahl Index based on admitted patients	AHA	Singh et. al. 2018
State	All	Number assigned to separate states	AHA data	Singh et. al. 2018
Wage Index	All	Wage index provided by CMS	CMS files	Wang et. al. 2001, Singh et. al. 2018

APPENDIX B

DEPENDENT VARIABLE ANALYSIS

Figure 1B. Distribution of AMI 30 Day Mortality Rate



The distribution of the dependent variable, AMI 30 Day Mortality Rate, is graphed in Figure 1B. Further testing for normality showed that AMI 30 Day Mortality Rate was not normally distributed. The skewness, kurtosis test has a p-value below 0.05; therefore, the

null hypothesis that the distribution of AMI 30 Day Mortality Rate is rejected and the data distribution is not normal. Table 1B shows the results from the skewness, kurtosis test for the dependent variables.

Figure 2B. Distribution of AMI 30 Day Readmission Rate

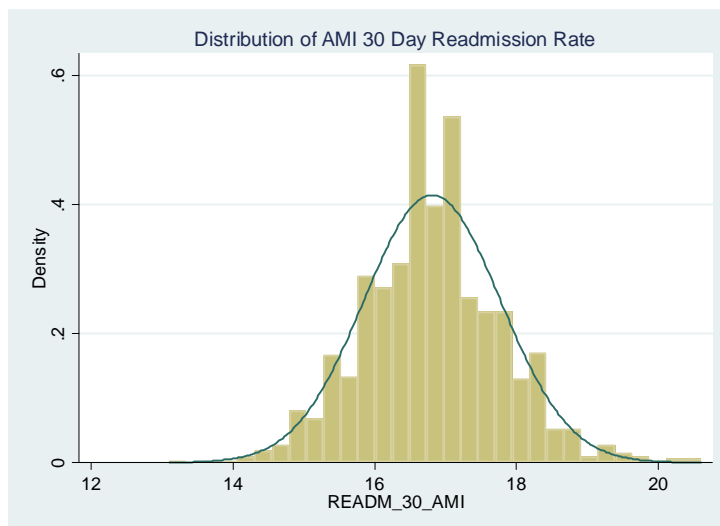


Figure 2B. shows the distribution of the AMI 30 day readmission rate. This distribution was not normal as shown by the tests for skewness and kurtosis in the table below.

Figure 3B. Distribution of CLABSI

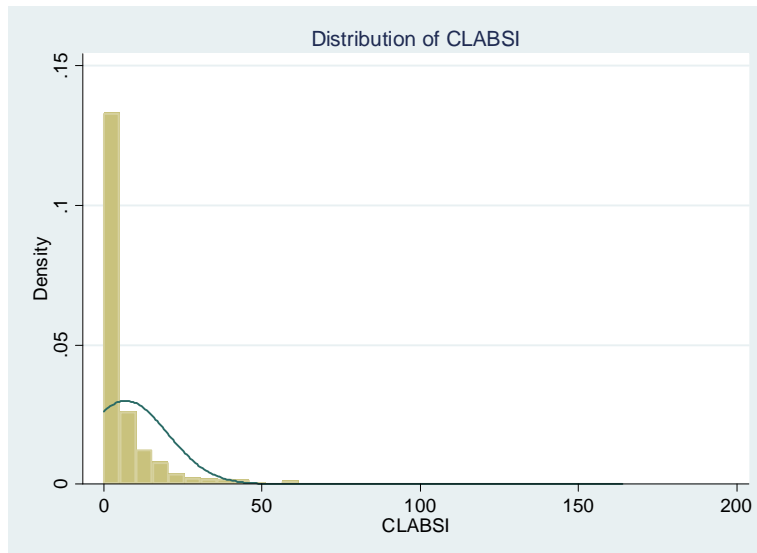


Figure 3B shows the distribution of CLABSI. The figure shows that there is a large amount of 0's for the CLABSI score for the hospitals sample. There were 499 hospitals with a score of 0 out of the 1750 hospitals with

a reported score. The score reflects how often a hospital has a patient with a CLABSI compared to other hospitals. This distribution can be characterized as semicontinuous with the 0's being real (Su et. al. 2009, Neelon et. al. 2016). A two-part model for semicontinuous data with right skewed positive data was the analysis of choice. A Tobit model was not chosen because the data contained true 0's and not 0's due to truncated data. Belotti et. al.'s two part model (twopm) was used to perform the analysis of the CLABSI dependent variable (Belotti et. al. 2015). This model first runs a logistic regression on the binary outcome of the dependent variable being 0 and the dependent variable being greater than 0 (1) (Belotti et. al. 2015). An appropriate regression is fit for the positive dependent variables (Belotti et. al. 2015).

Figure 4B. Distribution of Operating Margin

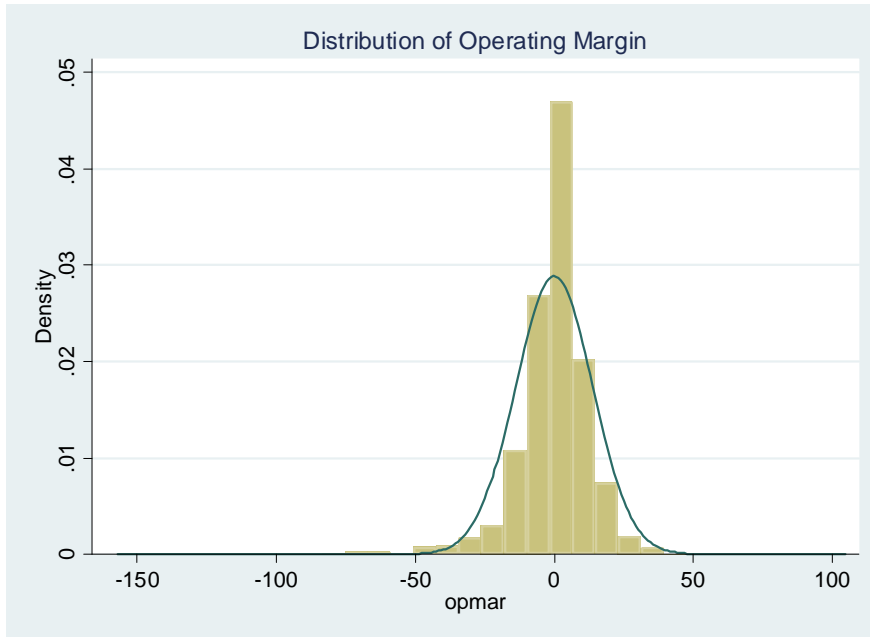


Figure 4B shows the distribution of the dependent variable operating margin. Table 1B below shows that the distribution of operating margin is not normal.

Figure 5B. Distribution of Percent Community Benefits

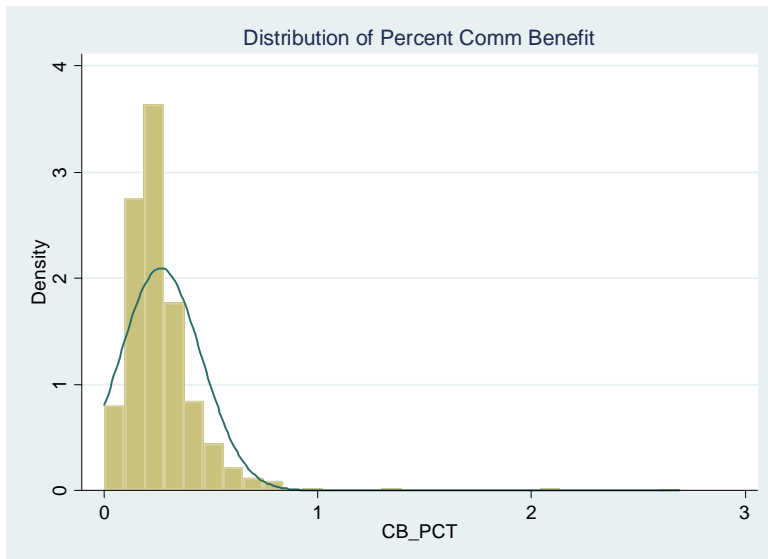


Figure 5B shows the distribution of the Percent Community Benefits with the skewness and kurtosis test below. Both show that the distribution is not normal.

Table 1B below has the outcome for the skewness and kurtosis tests for the dependent variables along with the results for the Shapiro-Francia test for normality (Shapiro and Francia 1972).

Table 1B. Normality tests of dependent variables					
Skewness/Kurtosis Tests for Normality			Joint		
Variable	Obs	Pr(Skewness)	Pr(Kurtosis)	adj ch2(2)	Prob>chi2
AMI 30 Mort	1441	0.056	0.15	6.26	0.043
AMI 30 Readmission	1342	0.011	0	21.85	0
CLABSI	1750	0	0	-	0
Operating Margin	1757	0	0	-	0
Percent Community Benefits	930	0	0	-	0
Shapiro-Francia W' test for normal data					
Variable	Obs	W'	V'	z	Prob>z
AMI 30 Mort	1441	0.997	2.39	2.04	0.021
AMI 30 Readmission	1342	0.993	6.27	4.29	0
CLABSI	1750	0.59	451.8	14.5	0.00001
Operating Margin	1757	0.84	180	12.3	0.00001
Percent Community Benefits	930	0.68	202..31	12.12	0.00001

APPENDIX C
RESIDUAL ANALYSIS

Tables 1C, 2C, and 3C below contain the results for White’s test of the residuals to understand if the residuals were homoscedastic. The CLABSI Score analysis was done using the twopm coding, for a two part analysis to factor in the large amount of 0’s as actual values of the CLABSI Score. After the twopm analysis, Stata would not allow for a White’s test of the residuals (White 1980). Instead, the residuals were calculated and graphed to visually inspect that the residuals were not normal after regression with the log transformed CLABSI Score. The graph of the residuals for the CLABSI score residuals after each regression are in Figures 1C through 3C below.

Table 1C. Homoskedasticity test of residuals for regression of Physician Hospital Organizations with High Integration		
White's test for Ho: homoskedasticity v Ha: unrestricted heteroscedasticity		
Variable	chi2 (172)	Prob>chi2
AMI 30 Mort Residuals	180.67	0.31
AMI 30 Readmission	236.31	0.0007
Operating Margin	372.5	0
Percent Community Benefits	103.06	1.00

Table 2C. Homoskedasticity test of residuals for regression of Physician Hospital Organizations with High Integration Only		
White's test for Ho: homoskedasticity v Ha: unrestricted heteroscedasticity		
Variable	chi2 (172)	Prob>chi2
AMI 30 Mort Residuals	182.2	0.28
AMI 30 Readmission	230.3	0.0017
Operating Margin	392.4	0
Percent Community Benefits	113.7	1.00

Table 3C. Homoskedasticity test of residuals for regression of Physician Hospital Organizations with Low Integration Only		
White's test for Ho: homoskedasticity v Ha: unrestricted heteroscedasticity		
Variable	chi2 (172)	Prob>chi2
AMI 30 Mort Residuals	173.5	0.45
AMI 30 Readmission	218.5	0.0082
Operating Margin	337.8	0
Percent Community Benefits	97.0	1.00

Figure 1C. Distribution of Residuals (CLABSI High Integration)

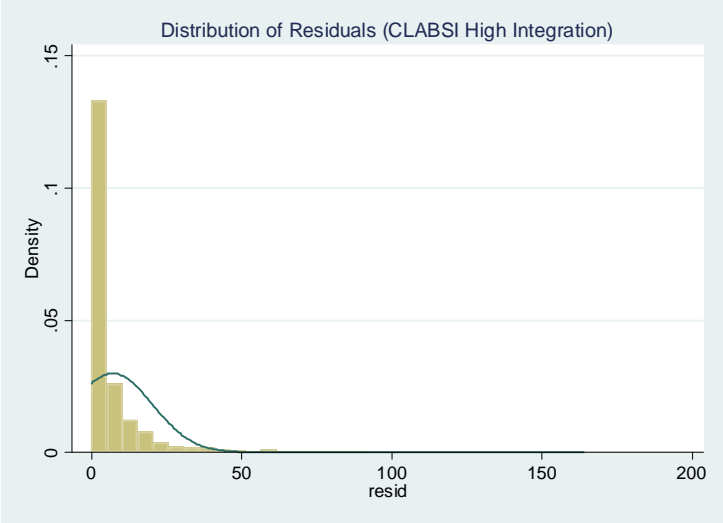


Figure 1C shows the distribution of the residuals of the regression for the CLABSI Score as dependent variable and the independent variable of interest being physician hospital organizations with high integration.

Figure 2C. Distribution of Residuals (CLABSI High Integration Only)

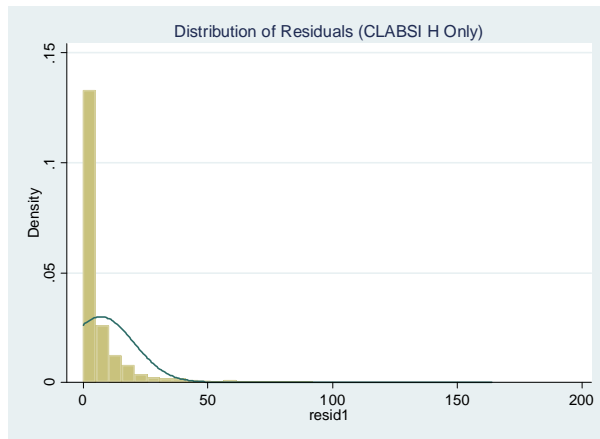


Figure 2C shows the distribution of the residuals of the regression for the CLABSI Score as dependent variable and the independent variable of interest being physician hospital organizations with high integration only and with no presence of physician hospital organizations with low integration.

Figure 3C. Distribution of Residuals (CLABSI Low Integration Only)

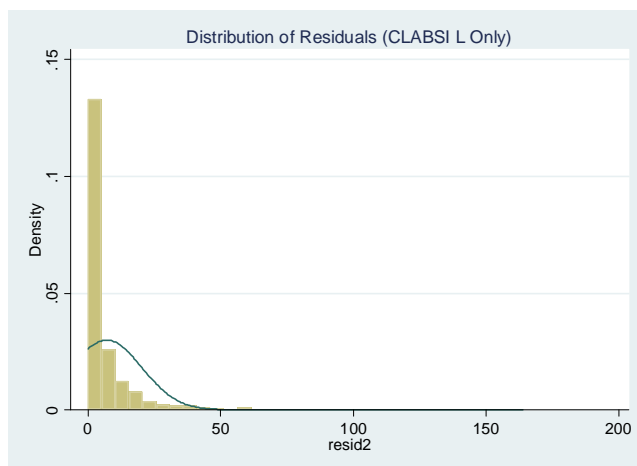


Figure 3C shows the distribution of the residuals of the regression for the CLABSI Score as dependent variable and the independent variable of interest being physician hospital organizations with low integration only and with no presence of physician hospital organizations with high integration.

APPENDIX D

U.S. CENSUS REGIONS

The AHA provided data regarding which state is grouped into which U.S. Census Region.

Below is a table of the regions and the states in each region.

CENSUS DIVISION 1: NEW ENGLAND	CENSUS DIVISION 6: WEST NORTH CENTRAL
Maine	Minnesota
New Hampshire	Iowa
Vermont	Missouri
Massachusetts	North Dakota
Rhode Island	South Dakota
Connecticut	Nebraska
CENSUS DIVISION 2: MID ATLANTIC	Kansas
New York	CENSUS DIVISION 7: WEST SOUTH CENTRAL
New Jersey	Arkansas
Pennsylvania	Louisiana
CENSUS DIVISION 3: SOUTH ATLANTIC	Oklahoma
Delaware	Texas
Maryland	CENSUS DIVISION 8: MOUNTAIN
District of Columbia	Montana
Virginia	Idaho
West Virginia	Wyoming
North Carolina	Colorado
South Carolina	New Mexico
Georgia	Arizona
Florida	Utah
CENSUS DIVISION 4: EAST NORTH CENTRAL	Nevada
Ohio	CENSUS DIVISION 9: PACIFIC
Indiana	Washington
Illinois	Oregon
Michigan	California
Wisconsin	Alaska
CENSUS DIVISION 5: EAST SOUTH CENTRAL	Hawaii
Kentucky	ASSOCIATED AREAS (REGION 10 for this study)
Tennessee	Marshall Islands

Alabama	Puerto Rico
Mississippi	Virgin Islands
	Guam
	American Samoa
	Northern Mariana Islands

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26 U.S.C. § 501(c)(3)