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Managing Risk: Evaluating Hospital Strategies for Value-based Payment Reform

By

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Doctor of Philosophy

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Managing Risk: Evaluating Hospital Strategies for Value-based Payment Reform

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B.A., Rice University, 2013

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An abstract of
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Abstract

Managing Risk: Evaluating Hospital Strategies for Value-based Payment Reform

By Sanjula Jain

A key factor underlying high health care spending in the United States is the structure of fee-for-service payment. In response, payers have begun to shift risk toward care providers through value-based payment models (Chapter 1). Among hospitals participating in these models, certain hospital characteristics (e.g., teaching status) have been associated with stronger performance. Further evidence suggests these characteristics explain some, but not all, of the variation in performance. This unexplained variation serves as the basis for this dissertation, which examines organizational strategies that facilitate the delivery of high-value care.

In Chapter 2, I evaluate whether hospital implementation of care management practices, such as data sharing and care coordination, affect performance. I find early indications that care management practices can improve performance outcomes, but the magnitude of effects largely depends on internal organizational dynamics. Moreover, hospitals are more likely to invest in innovations such as care management if financial risk is involved. In Chapter 3, I assess trends in risk assumption and then determine which risk-related contracting arrangements contribute to more revenue at risk. I find that hospitals haven't substantially changed their level of risk assumption in response to recent reforms, and yet are increasingly participating in risk-related contracting. Contracting through medical homes and physician employment are key drivers of risk assumption. This suggests that hospitals need to develop their internal capacity and infrastructure for value-based care delivery before assuming risk. Then, in Chapter 4, I conduct a case study of Emory Healthcare to evaluate the effectiveness of clinical and operational standardization strategies. Using a mixed-methods approach, I study whether implementation of sepsis standardization practices have an influence on clinical and financial outcomes. I find that adoption of such practices improves most clinical outcomes and results in cost savings. To further contextualize these findings, I interviewed hospital leaders to identify factors such as shared governance that underlie successful practice implementation.

Together, this research conveys the importance of organizational strategies in understanding the variation in hospital performance under new payment schemes (Chapter 5). These findings not only have implications for providers participating in value-based models, but for policymakers designing future incentive structures.

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Chapter 1

Introduction

The rapid growth of health care spending in the United States is unsustainable. Public insurance programs – primarily Medicare and Medicaid – pay for the largest shares of the nation's total $3.2 trillion health care expenditures (Howell & Davis, 2017). Moreover, hospital care, physician and clinical services account for 52% of total spending. High spending for provider services is largely attributed to the structure of fee-for-service (FFS) payment (Cubanski & Neuman, 2016). The FFS mechanism drives overutilization and lack of coordination among providers, creating much of the inefficiency underlying high spending (Schroeder & Frist, 2013).

Value-based payment can be used as a strategy to curb spending among providers by rewarding the quality of care provided over the quantity of services delivered. The new payment model is designed to harness the volume incentives of FFS and hold providers accountable for the full continuum of patient care (Burwell, 2015). Value-based payment tracks quality performance related to measures such as patient experience, while requiring providers to assume some financial risk for low quality or failure to control costs ("Better Care. Smarter Spending. Healthier People: Paying Providers for Value, Not Volume," 2015; Porter, 2010).

Current policy priorities reflect the growing recognition that paying for health care with consideration for quality-based performance is necessary to improve care quality and manage costs (Burwell, 2015). Several provisions within the 2010 Affordable Care Act established federal programs such as Value-Based Purchasing (VBP) and alternative payment models (APMs) to incentivize providers to shift from volume to value payments ("Better Care. Smarter Spending. Healthier People: Paying Providers for Value, Not Volume," 2015). The initial success, in terms of both cost savings and quality outcomes, of such payment initiatives has led Medicare to push for widespread adoption of value-based

models (Damberg et al., 2014). As part of this broader strategy, The Center for Medicare and Medicaid Services (CMS) intends to tie 90% of traditional Medicare FFS payments to quality or value by the end of 2018 ("Better Care. Smarter Spending. Healthier People: Paying Providers for Value, Not Volume," 2015). The 2015 Medicare Access and CHIP Reauthorization Act further incentives participation in value-based APMs by placing an increasing amount of revenue at risk for physicians who continue to practice predominantly in FFS models ("Medicare Program; Merit-Based Incentive Payment System (MIPS) and the Alternative Payment Model Incentive under the Physician Fee Schedule, and Criteria for Physician-Focused Payment Models ", 2016).

A growing body of literature evaluating hospital participation in value-based payment programs has shown performance is at best, mixed (Damberg et al., 2014; Lee, Maciejewski, Raju, Shrank & Choudhry, 2013; Kocot & White, 2016; Miller et al., 2011). General hospital characteristics– larger, urban, teaching status – have been associated with improved quality performance (Epstein et al., 2014; Centers for Medicaid and Medicaid Services [CDC], 2014; Kivlahan et al., 2016). However, analysis over time suggests that these hospital characteristics explain some, but not all, of the variation in performance (Damberg et al., 2014; Kivlahan et al., 2016; Spaulding, Edwardson, & Zhao, 2018). This unexplained gap between high and low performing hospitals serves as the basis for this dissertation research, which will evaluate organizational strategies with the the potential to promote success under value-based payment.

Chapter 2

The Effect of Implementing Care Management Practices on Hospital Performance under Value-based Payment

Introduction

In an attempt to reduce healthcare costs, public and private payers have increasingly shifted financial risk toward providers of care ("Better Care. Smarter Spending. Healthier People: Paying Providers for Value, Not Volume," 2015; Burwell, 2015). One approach to doing this is value-based payment, which is designed to reduce the volume-increasing incentives of FFS medicine by rewarding the quality of care provided over the quantity of services delivered. Value-based payment aims to both rein in the costs associated with FFS and offer an incentive to improve care quality by implicitly making providers accountable for outcomes across the full continuum of care. To facilitate this transition, providers can leverage new alternative payment models (APMs) such as accountable care organizations (ACOs) and medical homes to become familiar with value-based care delivery.

A growing body of literature evaluating hospital participation in value-based programs has shown that performance is, at best, mixed (Damberg et al., 2014; Lee, Maciejewski, Raju, Shrank & Choudhry, 2013; Kocot & White, 2016; Miller et al., 2011). General organizational characteristics, such as larger, urban, teaching status, have typically been associated with improved value-based performance (Epstein et al., 2014; Centers for Medicaid and Medicaid Services [CDC], 2014; Kivlahan et al., 2016). However, these characteristics explain only a small proportion of the variation in performance (Damberg et al., 2014; Kivlahan et al., 2016; Spaulding et al., 2018). This suggests that financial incentives alone may not meaningfully improve quality or lower costs (Daaleman, Hay, Prentice, & Gwynne, 2014; "Medicare ACOs: Incremental Progress, but Performance Varies ", 2016). Rather, hospital success under value-based payment depends on the extent to which organizations adjust their overarching patient management

approach and rearrange their internal resources to align with this strategy (Alexander, 2001; G. J. Bazzoli, Dynan, L., Burns, L.R. and Lindrooth, R., 2000; Burgelman, 1991; Spaulding et al., 2018).

Under value-based payment, high performers tend to be hospitals with strategies for improving their care management capabilities (Hsu et al., 2017; Mechanic & Zinner, 2016). Similarly, challenges in the delivery of value-based care have been attributed in part, to the underuse of care management practices (Audet, Kenward, Patel, & Joshi, 2012; Conrad, Vaughn, Grembowski, & Marcus-Smith, 2016). Care management processes (CMPs) are evidence-based, practice innovations that are effective, individually and collectively, at improving the quality of care delivered (Bodenheimer et al., 2004; "Care Management Definition and Framework ", 2007; "Care Management Implications for Medical Practice, Health Policy, and Health Services Research ", 2015; L. Casalino et al., 2003). These strategies include processes to improve data systems and more efficiently manage chronically ill, high-cost patients (Mechanic & Zinner, 2016).

Even though Medicare programs have found that certain quality outcomes can be modified through CMPs (McWilliams, Landon, Chernew, & Zaslavsky, 2014; Tsai, Orav, & Jha, 2015), little is known about whether hospitals are adopting such processes. This information is valuable because systematic processes for managing patients post-discharge, for example, are associated with reduced rates of readmissions, an indicator of strong hospital performance (Tsai, Orav, & Jha, 2015). To address this gap, I examine the extent to which hospitals are adopting care management practices in response to value-based payment, and whether this impacts hospital performance as it relates to efficiency and care quality.

As federal policies increasingly incentivize payment tied to value, it is necessary to consider the role of care management practices in facilitating better quality at lower cost. Although many providers have embraced payment reforms, those newer to risk contracting are hesitant to participate in new payment models until they have developed a stronger capacity for care management (Mechanic & Zinner,

2016). This study reveals specific organizational strategies for care delivery by which hospitals can improve performance. This insight has the potential to accelerate the transition from volume- to value-based care delivery among providers.

Theoretical Framework

To examine the focal relationship between CMPs and hospital performance, I leverage Donabedian's Model for Evaluating Health Care Quality (Donabedian, 1966). I also draw upon Diffusion of Innovation and resource based-view (RBV) theories to adapt Donabedian's traditional "Structure-Process-Outcome" model to develop a conceptual framework (Exhibit 1) for this study.

Structural factors affecting care quality can include organizational attributes and fiscal organization (Donabedian, 1988; Hadley, Zuckerman, & Iezzoni, 1996). Value-based payment programs provide financial incentives to systematically change how hospitals operate. Accordingly, the new practices and values pursued in response to the new payment structure can be considered to be a source of uncertainty for providers (Rogers, 2003). Diffusion of innovation and RBV posits that such uncertainty will be embraced by organizations with the creation and implementation of processes representative of its core strategy and internal resources (Barney, Wright, & Ketchen Jr, 2001; Rogers, 2003). Hence, we can expect hospitals to implement CMPs to improve quality (Conrad et al., 2016; Ryan et al., 2017). Value-based quality, a measure of hospital performance, is intended to reflect changes in efficiency, patient experience, and likelihood of achieving desired health outcomes (Damberg et al., 2014).

Participation in APMs have also been associated with increased used of care management process innovations (Daaleman et al., 2014; Larson et al., 2010; Rittenhouse et al., 2010). I expect that hospitals with greater participation in value-based models such as those for APMs, will by the nature of the financial arrangement, be more likely to change how health care services are delivered. To account for this potential effect, I will include control indicators for participation in select APMs.

Lastly, I recognize hospital leadership constructs that are unobservable in the context of this study, but may confound the focal relationship between implementation of CMPs and hospital performance (Frølich, Talavera, Broadhead, & Dudley, 2007; VanLare, Blum, & Conway, 2012). Organizational learning and leadership support can influence provider capacity to manage financial risk (Reiter, Nahra, Alexander, & Wheeler, 2006) Physician engagement within the organization and receptiveness to hospital leadership are also likely to be positively tied to performance outcomes. While the following conceptual framework includes variables that cannot all be measured, this adapted Donabedian model presents an initial approach to evaluating the organizational dynamics underlying implementation of value-based payment.

Hypotheses

Participation in programs or payer arrangements that incentivize quality improvement are associated with greater use of care management processes (Rittenhouse et al., 2010). Hospitals that initiate processes to eliminate unnecessary variation in clinical practice can substantially improve quality (Laffel & Blumenthal, 1989). Moreover, there is a strong positive relationship between implementation of quality management practices and the performance advantage achieved (Douglas & Judge, 2001). Therefore, hospitals that implement more care management processes should achieve gains in quality and efficiency. It should be noted that the magnitude of performance gains will depend on the extent to which implementation is supported and facilitated by hospital leadership in both administrative and clinical functions. Since these factors are unobservable in the present study, I make the following hypothesis independent of leadership quality.

H1: *After controlling for confounders, hospitals with more care management processes are associated with improved hospital performance as determined by value-based performance criteria.*

Data and Methods

I examine care management practices that have been effective in reducing inefficiencies in care delivery and achieving value-based performance benchmarks (Daaleman et al., 2014; McClellan, McKethan, Lewis, Roski, & Fisher, 2010). Specifically, I consider the following care management domains: data monitoring and sharing, transitional care, co-location of services, care coordination, and chronic care management. Data monitoring and sharing refers to the technical means used to effectively manage and leverage patient data to enhance care delivery ("Health Information Technology Integration," 2015). Transitional care entails processes to minimize the poor execution of patient movement between care settings that increase the risk of adverse events ("Care Management Implications for Medical Practice, Health Policy, and Health Services Research ", 2015). Co-location of services is defined as the hospital's ability to provide integrated primary, acute, and post-acute health services (Clarke et al., 2015). Care coordination is the organization and synchronization of patient care processes across care settings, and includes processes such as medication reconciliation (("Care Coordination," 2016). And, chronic care management focuses on managing and supporting patients with multiple chronic diseases through interventions focused on self-management, addressing barriers, and facilitating access to community services.("Care Management Implications for Medical Practice, Health Policy, and Health Services Research ", 2015; "Designing and Implementing Medicaid Disease and Care Management Programs," 2014)

Data Sources

This study primarily draws upon data from two hospital-level datasets for years 2013 and 2014. The explanatory variables, CMPs, and hospital characteristics, are measured using *American Hospital Association* (AHA) data. The dependent variables, hospital value-based performance measures, are from the Center for Medicare & Medicaid Services' *Hospital Compare* data.

The AHA is an annually updated, nationally representative, dataset derived from the *AHA Annual Survey of Hospitals* and one of its supplements, the *AHA Survey of Care Systems & Payment.* The *Annual Survey* provides information noting structural characteristics of the hospital and utilization trends across the facility (e.g., teaching status, total discharges), which we use to capture our confounder variables. To assess hospital implementation of CMPs, I used the *Care Systems & Payment* survey, which captures newly established measures of hospital participation in alternative payment and delivery models (e.g., bundled payments, medical home) and care management strategies (e.g., use of EHR, provision of post-acute and acute health services). Whereas the *Annual Survey* represents nearly all operating US hospitals (nearly 6,500 hospitals), the optional *Care Systems & Payment* survey receives responses from approximately 1,200 hospitals (Mehrotra, Epstein, & Rosenthal, 2006).

To calculate value-based performance for hospitals in our sample, I used *Hospital Compare,* a publicly available database reporting quality scores for more than 4,000 Medicare-certified hospitals across the country. I included data from hospitals reporting Medicare Spending per Beneficiary (MSPB), Hospital Readmissions, Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS), and Value-based Purchasing (VBP) Program scores. The HCAHPS captures patients' perceptions of their hospital experience. The VBP Program provides hospitals with incentive payments based upon several quality and efficiency measures across four domains. For this study, I was primarily interested in the total performance score for the VBP Program.

Measures

Explanatory Variables

I measured *use of CMPs* as a vector of the five key care management domains. First, each hospital received a composite score representing its overall use of CMPs. Composite scores were calculated by dividing the total number of processes used by the hospital across all domains by the total number of processes specified on the survey. A total of 29 CMPs were considered across all five domains

(See Appendix Table 1). Next, I considered evidence from David and colleague's examination of patient-centered medical homes, which suggests different practices across different care domain yield differences in outcomes (David, Saynisch, & Smith-McLallen, 2016). Accordingly, I calculated individual domain scores based upon the degree of utilization to further differentiate hospital-level care management strategies. I adapted Berwolitz et al.'s (2003) methodology for quality improvement implementation to score degree of CMP implementation. Correspondingly, a hospital would receive a score for an individual CMP ranging from 0-4 depending on the degree of use as indicated on the *Care Systems & Payment* survey: 0 for "Not used at all", 1 for "Used minimally", 2 for "Used moderately", 3 for "Used widely", and 4 for "Used hospital-wide". The scoring scale was validated for internal consistency using Cronbach's alpha (Bland & Altman, 1997). Then, I used individual CMP implementation scores to calculate factor scores (DiStefano, Zhu, & Mindrila, 2009; Moseley & Klett, 1964) for each individual CMP domain. For both hospital composite and domain factor scores, higher score values indicate greater use of care management practices.

Dependent Variables

I evaluated hospital value-based performance using MSPB, HCAPHS, Hospital Readmission Rates, VBP, and Clinical Care Outcomes scores reported by *Hospital Compare*. MSPB and Hospital Readmissions are reported as ratios relative to 1. Ratios greater than 1 indicate excess readmissions or spending. More specifically, a MSPB value of 1.1 indicates that the hospital has average risk-adjusted spending levels 10 % higher than the median MSPB episode. HCAPHS, VBP, and clinical care outcome scores are reported as a numeric value ranging from 0 to 100 where greater scores indicate greater performance. I consider total performance score for the VBP program and the unweighted VBP sub-scores for the clinical care outcomes domain.

Confounders to the Focal Relationship

While value-based payment is a mechanism for quality improvement, a hospital's response to corresponding financial incentives may vary by individual hospital characteristics and resources (Reiter, Nahra, Alexander, & Wheeler, 2006). RBV suggests that hospital characteristics such as increased market concentration and urban location positively influence organizational access to and use of resources (Yeager, Zhang, & Diana, 2015) Hospitals with greater or superior resources may be more likely to have well-developed care processes. Thus, I control for confounders representing aspects of a hospital's resources that may positively influence care management practices and clinical performance. These confounding variables include market concentration, teaching status ("Hospital Value-Based Purchasing (VBP) Program: Trend Analysis," 2014) network affiliation (G. J. Bazzoli, Chan, Shortell, & D'Aunno, 2000), metropolitan location, small bed size (<200 beds) (Lehrman et al., 2010), and ownership (not-for-profit) (Fisher et al., 2003). Indicator variables were included for participation in any type of ACO and bundled payment contract (Daaleman et al., 2014; Larson et al., 2010; Rittenhouse et al., 2010). Market concentration was determined using the Herfindhl-Hirschman index (HHI), where high concentration (HHI>1800) was controlled for. Teaching status was determined by the ratio of full-time residents to the number of hospital beds, where a ratio greater than or equal to 0.25 denoted a teaching hospital.

Statistical Analyses

The analytic sample (depicted in Exhibit 2) was limited to hospitals that completed the *Care Systems & Payment* survey in 2013 and 2014. Ordinary least squares (OLS) regression was used to evaluate the relationship between hospital use of CMPs and value-based performance. OLS models were of the following general form:

$$\mathbf{y} = \beta_0 + \beta_1 \mathbf{x}_{\boldsymbol{CMP}} + \beta_2 \mathbf{x}_{\boldsymbol{C}} + \varepsilon \quad \textbf{(Model 1)}$$

where **y** represents the vector of performance outcomes, $\mathbf{X_{CMP}}$ represents the (i) CMP composite score and (ii) vector of CMP domain factor scores; and $\mathbf{X_C}$ represents the vector of confounders. Standard errors were clustered at the hospital level. Next, to evaluate whether changes in hospital use of CMPs enables

changes in performance, I conducted first-difference estimation using the two-period panel data, which is equivalent to a hospital fixed effects model (Wooldridge, 2010). This approach controls for time invariant heterogeneity. In effect, in the first difference models we are estimating the effects of care processes based on the variation of hospitals that made changes in these processes between the two survey periods. The specific first-difference models I estimated were of following general form:

$$\Delta \mathbf{y} = \beta_0 + \beta_1 \, \Delta \mathbf{x}_{\boldsymbol{CMP}} + \beta_2 \, \Delta \mathbf{x}_{\boldsymbol{C}} + \Delta \varepsilon \quad \textbf{(Model 2)}$$

where Δ denoted the change from years 2013 to 2014.OLS and first difference models were specified for both composite and domain CMP scores for each of the five performance outcomes.

I assumed that hospitals that completed the *Care Systems & Payment* survey for only a single year – either 2013 or 2014 - experienced no change in CMP use in the other year. For hospitals in this category, I imputed the data assuming no change from one year to the next and conducted sensitivity analyses to assess the likely effect of such imputation. This assumption is based upon previous evidence suggesting hospital adoption of quality improvement innovations such as the EHR, occurs over the course of years (Silow-Carroll, Edwards, & Rodin, 2012). The results of the sensitivity analyses (see Appendix Tables 2 & 3) were consistent with the primary results. All regression models were specified for each of the five hospital performance measures. All analyses were conducted using STATA Version 12.

Results

Descriptive Statistics

Exhibit 3 summarizes characteristics of hospitals included in the analytic sample by level of CMP utilization. The analytic sample is left-skewed (not shown) with hospitals reporting composite CMP scores ranging from 0 to 29, with a mean of 22 and standard deviation of 5.5. Hospitals with high use of CMPs, defined as reporting implementation of more than 20 CMPs, tend to be teaching organizations (13.5%), network affiliates (55.1%), and not-for-profit (75.2%). High users are also more likely to be

located in more concentrated (14.2%), metropolitan markets (72.4%), and more likely to participate in value-based risk contracts such as ACOs (43.5%) and bundled payments (26.2%).

Average performance as reported by *Hospital Compare* for MSPB and Clinical Care Outcomes is stronger among high CMP users. The rate of hospital readmissions is relatively consistent between both levels of CMP use with marginal difference of 0.001 in rates. Conversely, hospitals with reported low use of CMPs have higher patient satisfaction and VBP performance scores. The most notable difference in mean performance is the 4.11 HCAHPS point difference between low and high CMP users.

Changes in CMP use across all domains are statistically significant. Degree of CMP use, represented by mean factor scores, increased in four of the five care management domains between 2013 and 2014 (Exhibit 4). Hospitals experienced the greatest change in the use of chronic care management and care coordination processes with factor score increases of 0.19 and 0.13, respectively. While, factor scores for data monitoring and sharing and transitional care processes increased on average by 0.03 and 0.04, respectively. Transitional care is the only care management domain in which hospitals decreased process use by a margin of 0.04.

Regression Results

Standardized coefficients from the multivariable OLS (Model 1) and first-difference (Model 2) regressions of hospital performance measures on CMP composite and individual domain scores appear in Exhibits 5 and 6, respectively. Analysis of composite care management scores (Exhibit 5) reveal a one standard deviation increase in use of CMPs results in a 0.061 standard deviation, or 1.1 HCAHPS point, increase in patient satisfaction. Although non-significant, there also appears to be a positive relationship between CMP utilization and clinical care outcomes. Increased CMP use is also associated with decreases in MSPB. After controlling for time invariant heterogeneity in Model 2, I find a one standard deviation

increase in composite CMP scores results in 0.083 standard deviation increase in spending per beneficiary.

Analysis of care management strategies by CMP domain (Exhibit 6) reveals more variation than at the composite level. I find significant associations between co-location of services, care coordination, and chronic care management processes and hospital performance. While a standard deviation increase in co-location of services results in decreased spending (0.092 standard deviations), it is also associated with a decrease in patient satisfaction and increased rate of readmissions. Care coordination processes are associated with increases in patient satisfaction (1.4 HCAHPS points), VBP scores (1.3 points) and clinical care outcomes (2.1 points). In contrast, chronic care management processes are associated with decreases in clinical care outcomes (1.4 points). The first differences model suggests a significant negative relationship between change in use of transitional care processes and VBP performance. I also observe a significant increase in VBP scores (1.2 points) for a standard deviation change in data sharing and monitoring processes. Although non-significant, there is a consistent positive relationship between change in the use of processes within each care management domain and MSPB, where co-location of services and care coordination account for the greatest spending increases.

Discussion

A hospital's ability to perform well under value-based payment may have more to do with internal organizational processes and strategies than with its structural characteristics (e.g., size, teaching status). This study examined whether care management strategies explain any variation in hospital performance on core quality and efficiency measures. I find that hospitals are increasingly adopting care management practices, the use of which affects hospital performance.

Both linear and first difference regression models reveal statistically significant, but modest, changes in performance outcomes. I found that CMP use is associated with both increases and decreases in measures of hospital performance. Even in instances where hospitals are able to improve performance, these quality gains come at a cost. Study findings show that hospitals that increase implementation of CMPs spend significantly more per Medicare beneficiary. The positive relationship between implementation of care management practices and spending is consistent with previous literature suggesting that quality improvement initiatives initially result in more costs than savings, particularly when it involves process innovations and organizational changes (Reed, Lemak, & Montgomery, 1996). Taken together, these findings are consistent with the emerging literature on the relatively modest performance of changes in care organization and financing attributed to value-based models such as ACOs (Hsu et al., 2017; J M McWilliams, 2014; McWilliams, Chernew, & Landon, 2017; McWilliams, Hatfield, Chernew, Landon, & Schwartz, 2016).

It is important to note however, that even though the estimates of the direct impact of implementing more CMPs on corresponding changes in hospital performance generally reveal decreases in performance outcomes, there are still positive associations between specific care management strategies and quality scores. For example, care coordination and data monitoring processes are associated with increases in patient satisfaction, VBP scores and clinical care outcomes, and decreases in the rate of readmissions. Furthermore, these programs are relatively new, and the long-term effects of these changes in care delivery may differ from the short-term effects.

While the largely negative relationship between CMP use and hospital performance outcomes is seemingly counterintuitive, study results should be viewed with caution. Although quality improvement strategies such as care management have evidentiary support for improving quality of care, hospitals often struggle with its implementation (Shortell, Bennett, & Byck, 1998). First, the effectiveness of care management strategies depends on the external environment in which the hospital is operating (Reed et

al., 1996). This is important because organizations operating in low uncertainty environments create more efficiencies than those in high uncertainty environments. Given that the introduction of value-based payment, in contrast to FFS, is a source of source of uncertainty for providers (Conrad et al., 2016), we can expect the value gained from implementing CMPs to increase over time as providers become more familiar with the tenets of value-based care. Additionally, hospitals must make significant investments in time, resources, and strategic thinking to diffuse new care management practices throughout the organization (Hunter, Robin, & Flowers, 2017). Accordingly, implementation of CMPs may result in an initial loss of value due to the amount of time it takes for the hospital to promote awareness of the new practices and for its clinicians to adjust to the changes in workflow.

Performance gains are also affected by interpersonal and organizational dynamics (Conrad et al., 2016; Hilligoss & Vogus, 2015). Quality improvements are driven by hospital leaders and their ability to engage frontline clinicians in such endeavors (Dickson, Anguelov, Vetterick, Eller, & Singh, 2009). However, clinicians may be reluctant to participate in care management practices due to factors such as distrust of hospital motives, lack of time with patients, and fear that such processes will prompt over-standardization and compromise their ability to vary care to address individual patient need (Ganguli & Ferris, 2017; Weiner et al., 2006). Thus, the level of internal alignment between hospital leadership and clinical providers plays a key role in resource allocation and the extent to which CMPs can reduce inappropriate variation in care delivery.

Management Implications

Hospital leaders should consider leveraging the incentive structure of patient-centered medical home, CPC+ and Track 1 ACO models to improve care management capabilities by facilitating collaboration across the care continuum and aligning resources to meet the clinical care and care coordination needs of patient populations. Hospitals should use the support of these resources (e.g. care

teams) to begin tracking "care management impact scores" (Pierce-Wrobel & Micklos, 2018) to evaluate the effectiveness of different care management practices in real-time. Leadership should also consider catering individual care management practices to individual clinical settings. To the extent that the hospital can provide context-specific support to provide clinicians with sufficient guidance to adapt specific processes to their clinical area, diffusion of CMPs will be more widespread. For example, communicating the differences in priorities when following up with patients discharged from the emergency department versus the ICU with case managers is likely to increase efficiencies.

Finally, hospitals should continually involve clinicians in quality improvement decision-making and regularly seek input in developing and adapting new care management practices. Using clinician dashboards and providing clinical teams with real-time data is essential to demonstrate the need for improvement, as well as to track progress in achieving value-based performance benchmarks. Although value-based payment provides some financial incentives to encourage care management practices, the hospital should strive to reorient internal compensation structures to reward clinicians for their commitment to delivering value-based care. Increased alignment between hospitals and clinicians - with regard to both culture of care and financial incentives - will result in more synchronized implementation of new practices will be. Above all, hospitals must embrace the learning curve associated with implementing new care processes and that performance improvements will occur incrementally as providers grow accustomed to this new way of clinical practice.

Policy Implications

To date, value-based APMs have shown limited improvements in quality and cost reduction. This study provides evidence indicating that strong performance under value-based payment depends on more than just organizational characteristics such as teaching status and size. Rather, success is largely a product of the hospital's internal strategies for implementing these new payment models and quality

improvement initiatives. Even though APMs are associated with increased implementation of care management strategies, which can enhance care quality and efficiency, the current incentive structure for reimbursing providers remains insufficient. Stronger incentives can facilitate continuous quality improvement amongst provider organizations, which is critical to achieving and sustaining high performance under value-based payment.

Policymakers should consider establishing additional incentives and programs to help providers build up their care management capacity and infrastructure. In designing such structures, consideration should be given to evaluating providers using a "care management impact" (Pierce-Wrobel & Micklos, 2018) scoring methodology. These incentives could be catered to the individual clinician, as well as the broader provider organization. Rather than prioritizing performance measures on outcomes, there may be value in promoting processes that promote certain care management practices such as telephonic outreach post-discharge. In addition to considering new incentive structures, policymakers should continue to leverage existing APMs and consider ways exploit synergies in care management capabilities for providers participating in different contracts concurrently. While initial reform efforts have succeeded in giving providers an initial push towards value-based care delivery, future policy efforts must continue to emphasize the transition away from FFS to drive new investments in care delivery innovations.

Future Directions

The results of this study provide early indications that care management strategies influence hospital value-based performance**.** The ongoing debate as to whether current value-based performance measures are meaningful to patients, and whether these measures correlate with clinically significant outcomes, suggests that future research should evaluate the effect of CMPs on additional, intermediate-level quality metrics. This is especially true for outcomes such as patient satisfaction that are often independent of hospital observance of processes that influence the clinical aspects of care delivery (Jha, Orav, Zheng, & Epstein, 2008; Lyu, Wick, Housman, Freischlag, & Makary, 2013). In other words, hospital performance

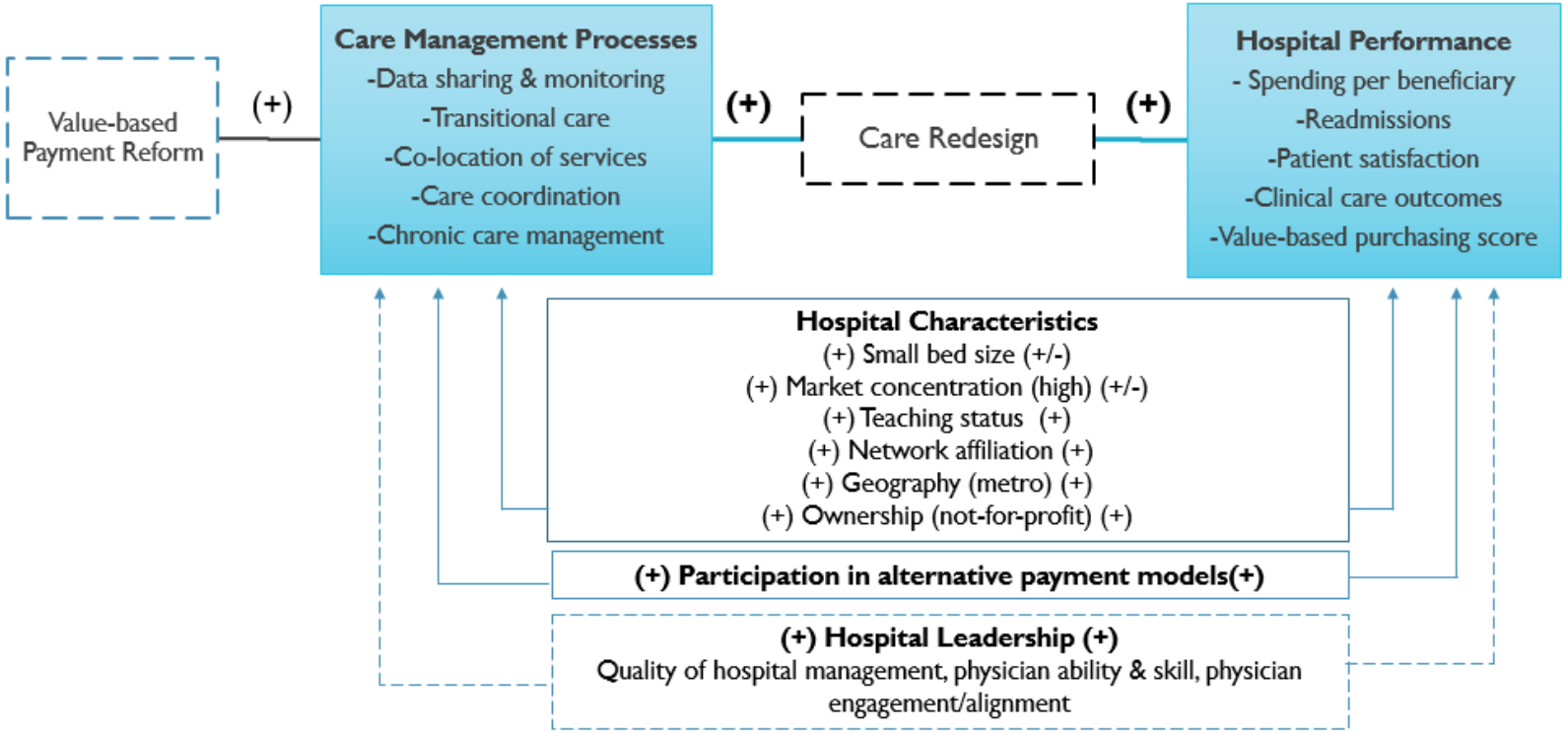
on patient satisfaction metrics may have more to do with the "bells and whistles" of the hospital facility that promote an appealing patient experience. This phenomenon may explain why CMPs can reduce patient satisfaction scores, since they don't necessarily enhance the more tangible aspects of a patient's hospital stay.

Additional research may consider differentiating effects of care management practices by condition (e.g. chronic condition vs. surgical) and differentiating by specific care settings (e.g., ambulatory vs. inpatient). Additional data is needed to gain more specificity around the technical components and organizational features supporting implementation of care management practices. For example, rather than evaluating whether the hospital has a chronic care management program, rigorous evaluations of specific interventions (e.g., diet regimens) within these programs should be considered. Further examination of human capital factors (e.g., physician characteristics) and organizational factors supporting implementation of CMPs will be essential to facilitating effective adoption of value-based payment programs.

Conclusion

This study examines the relationship between care management strategies and hospital performance. The evidence suggest that hospitals are increasing their implementation of CMPs, which has led to changes in quality and efficiency. Although implementation of care management practices increases spending, the evidence suggests that true value will depend on how these processes are integrated and deployed throughout the organization over time. Regardless of where an organization stands in its transition to value-based payment, there are opportunities to better prepare for the rapidly changing healthcare system. Success under the new payment structure will require hospitals to implement and evaluate tailored care delivery innovations, such as CMPs, to deliver high quality, efficient patient care.

Exhibit 1. Conceptual Framework



Note. This framework evaluates the focal relationship between hospital implementation of care management processes (CMPs) and hospital performance. Dashed lines denote unobservable constructs. +/- denote the hypothesized directionality of impact on the related construct.

Exhibit 2. Analytic Sample

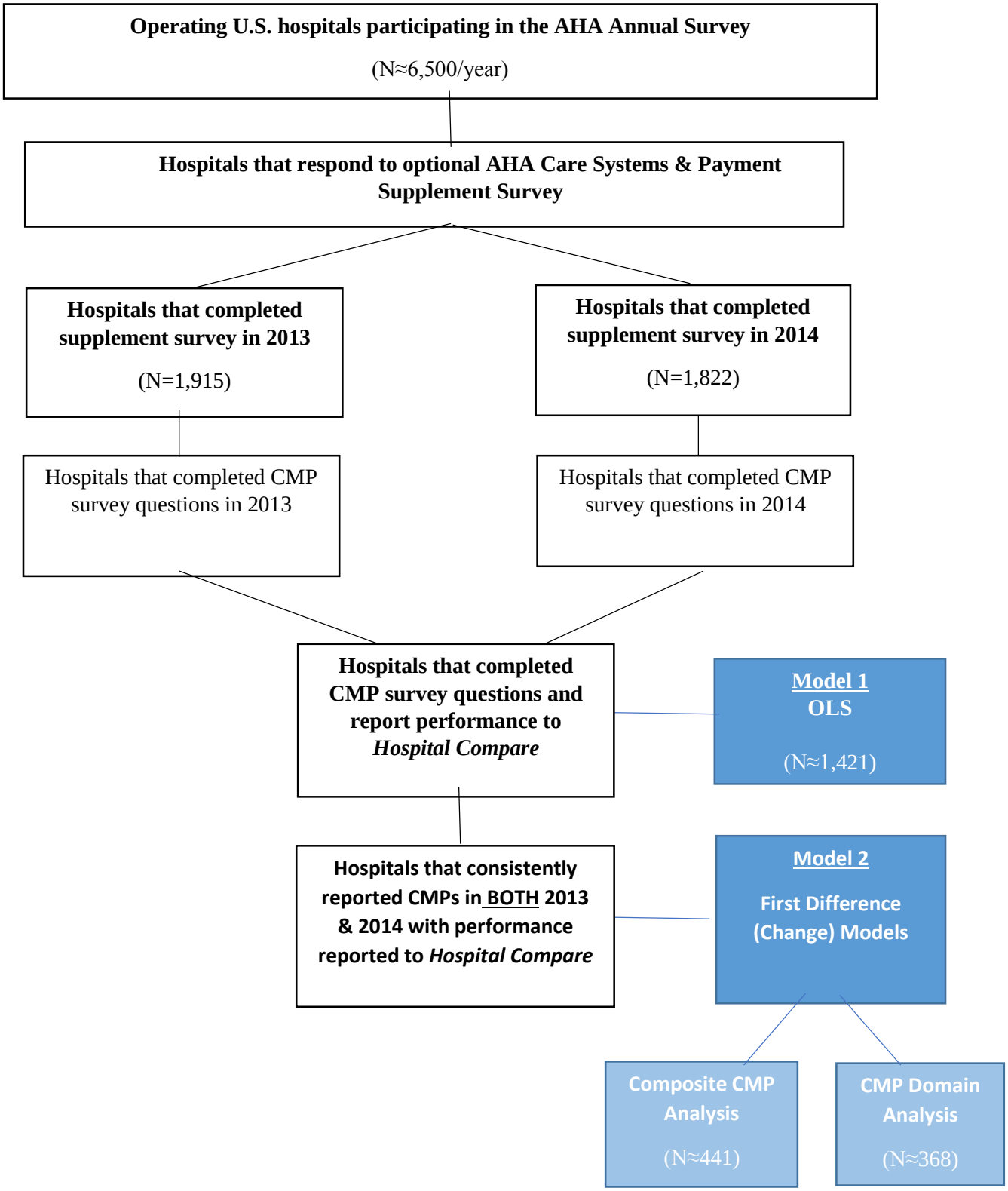


Exhibit 3. Hospital Characteristics by Level of Care Management Use

	Low (%) ***≤15 CMPs***	**High (%)** ***16-29 CMPs***
N	1,313	1,282
Teaching Status	9.82	11.5
Network Affiliation	47.5	49.3
Hospital Ownership		
Government	24.2	20.6
For-profit	10.8	9.28
Not-for-profit	65.0	70.1
Location		
Metro	61.2	64.3
Concentrated market (low competition)	9.03	14.2
Risk Contracts		
Accountable Care Organization(ACO)	8.21	30.0
Bundled Payment	10.6	26.2
Value-Based Performance		
Medicare Spending per Beneficiary (MSPB)	0.978	0.983
Patient Satisfaction (HCAHPS)	45.4	41.29
Readmission Reduction	0.996	0.997
Value-based Purchasing (VBP)	55.3	54.1
Clinical Care Outcomes	59.49	59.54

Notes: (1) CMPs refer to Care Management Processes; hospitals receive individual composite scores representing use of care management practices on a scale of 0-29. (2) MSPB and Hospital Readmission Performance Scores are reported as ratios relative to 1 where values ≤1 are ideal; HCAHPS, VBP and Clinical Care Outcome scores are reported as numeric values between 0-100 where higher values indicate better performance. (3) High and low users were determined according to the cutoff of a composite CMP score of 15, which was also the median of the score distribution.

Exhibit 4. Mean Change in Care Management Factor Scores, 2013-2014

	Mean Implementation Factor Score [95% Confidence Interval]		*T-test of Significance*
CARE MANAGEMENT DOMAIN	**2013**	**2014**	**P-value**
Data Monitoring & Performance Sharing	1.53 [1.49, 1.56] N=1,411	1.58 [1.54,1.62] N=1,083	0.029**
Transitional Care	1.3 [1.26,1.34] N=1,395	1.26 [1.23,1.28] N=953	0.038**
Care Coordination	2.09 [2.05, 2.14] N=1,420	2.22 [2.17, 2.27] N=1,104	0.0001***
Chronic Care Management	1.68 [1.62, 1.73] N=1,416	1.87 [1.80, 1.93] N=1,099	0.0000***
Co-location of Services	0.78 [0.77, 0.80] N=1,431	0.82 [0.80, 0.83] N=1,111	0.0002***

Notes: (1) T-tests of significance were performed to evaluate differences in mean implementation scores between 2013-2014, *p<0.1, **p<0.05, ***p<0.01. (2) Factor scores reflect the degree of care management process (CMP) utilization where higher values indicate greater level of implementation.

Exhibit 5. Standardized Regression Coefficients in Models Regressing Hospital Performance on Composite CMP Scores

	Medicare Spending per Beneficiary (MSPB)		*Patient Satisfaction (HCAHPS)*		*Readmission Reduction*		*Value-based Purchasing (VBP)*		*Clinical Care Outcomes*	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
N	1,430	445	1,384	429	1,464	454	1,387	429	1,379	426
Dependent Variables										
Mean	0.985		41.6		0.997		47.4		57.6	
(Standard Deviation)	(0.067)		(18.1)		(0.004)		(13.5)		(17.5)	
Explanatory Variable										
Composite CMP	-0.029	0.083*	0.061**	-0.030	-0.002	-0.047	0.041	-0.075	0.031	-0.028
Control Variables										
Network Affiliation	0.022	-----	0.007	-----	-0.008	-----	0.016	-----	0.024	-----
Metro Location	0.263***	-----	-0.093***	-----	0.014	-----	-0.028	-----	0.078**	-----
Teaching Status	-0.019	-----	-0.124***	-----	-0.184***	-----	-0.077***	-----	-0.056*	-----
Bed Size (<200 beds)	0.125**	-----	0.211***	-----	0.042	-----	0.095***	-----	-0.000	-----
Strong Market Concentration (HHI>1800)	-0.038	-----	0.075***	-----	0.104***	-----	-0.003	-----	-0.022	-----
Not-for-profit	-0.063**	-----	0.060**	-----	0.029	-----	0.053**	-----	0.007	-----
ACO	0.037	0.035	0.012	-0.048	0.031	-0.014	0.037	0.049	0.048	0.005
Bundled Payment Contract	0.009	-0.010	-0.012	-0.061	0.019	0.109**	-0.010	0.099***	0.018	0.016
Year Dummy (2014)	0.047	-----	-0.005	-----	0.051	-----	-0.475***	-----	-0.118***	-----

Note: (1) All coefficients are standardized; **p<0.1, **p<0.05, ***p<0.01*. A one standard deviation in composite CMP scores is 5.5 *(2)* CMPs refer to Care Management Processes; hospitals receive individual composite scores representing use of care management practices on a scale of 0-29. (3) Model 1 refers to OLS; Model 2 refers to First Difference estimation. (4) MSPB and Readmission Reduction performance are reported as ratios relative to 1 where values ≤1 are ideal; HCAHPS, VBP and Clinical Care Outcome scores are reported as numeric values between 0-100 where higher values indicate better performance.

Exhibit 6. Standardized Regression Coefficients in Models Regressing Hospital Performance on CMP Scores by Domain

	Medicare Spending per Beneficiary (MSPB)		*Patient Satisfaction (HCAHPS)*		*Readmission Reduction*		*Value-based Purchasing (VBP)*		*Clinical Care Outcomes*	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
N	1,430	370	1,384	360	1,464	379	1,387	360	1,379	357
Dependent Variables										
Mean	0.985		41.6		0.997		47.4		57.6	
(Standard Deviation)	(0.067)		(18.1)		(0.004)		(13.5)		(17.5)	
Explanatory Variables										
Data Sharing & Monitoring	0.022	0.039	0.010	0.006	0.004	-0.004	0.024	0.089*	0.009	0.018
Co-location of Services	-0.092***	0.056	-0.054*	0.007	0.072**	0.065	-0.019	-0.013	-0.041	-0.012
Transitional Care	-0.032	0.034	-0.005	-0.081	0.018	-0.067	-0.023	-0.136**	-0.019	-0.055
Care Coordination	0.046	0.047	0.079**	-0.003	-0.028	-0.002	0.093***	-0.055	0.122***	-0.012
Chronic Care Management	-0.041	0.022	0.007	-0.075	-0.015	-0.044	-0.045	-0.059	-0.079**	0.018
Control Variables										
Network Affiliation	0.027	-----	0.011	-----	-0.014	-----	0.016	-----	0.026	-----
Metro Location	0.265***	-----	-0.092***	-----	0.013	-----	-0.025	-----	0.081***	-----
Teaching Status	-0.015	-----	-0.121***	-----	-0.188***	-----	-0.076**	-----	-0.052*	-----
Bed Size (<200 beds)	-0.140***	-----	0.200***	-----	0.053*	-----	0.088***	-----	-0.012	-----
Strong Market Concentration (HHI>1800)	-0.033	-----	0.079***	-----	0.101**	-----	0.000	-----	-0.018	-----
Not-for-profit	-0.049*	-----	0.070***	-----	0.018	-----	0.059**	-----	0.016	-----
ACO	0.048*	0.032	0.019	-0.072	0.025	-0.011	0.040	0.065	0.056*	0.003
Bundled Payment Contract	0.018	-0.045	-0.005	-0.084	0.012	0.146***	-0.004	-0.064	0.027	-0.008
Year Dummy (2014)	0.039	-----	-0.012	-----	0.057*	-----	-0.482***	-----	-0.125***	-----

Note: All coefficients are standardized; **p<0.1, **p<0.05, ***p<0.01; (2)* CMPs refer to Care Management Processes; hospitals receive factor scores indicating degree of use. (3) Model 1 refers to OLS; Model 2 refers to First Difference estimation. (4) MSPB and Readmission Reduction performance are reported as ratios relative to 1 where values ≤1 are ideal; HCAHPS, VBP and Clinical Care Outcome scores are reported as numeric values between 0-100 where higher values indicate better performance.

Appendix Exhibit A1. Care Management Processes by Domain

	Care Management Process (CMP)
Data Sharing & Monitoring	-Detect readmissions, even when the patient is readmitted to a different hospital -Systematically track the source of the readmission (e.g. readmitted from home, rehabilitation facility)
Chronic Care Management	-Chronic care management processes or programs to manage patients with high volume, high cost chronic diseases -Nurse care managers whose primary job is to improve the quality of outpatient care for patients with chronic diseases -Disease management programs for one or more chronic care conditions
Care Coordination	-Prospective management of patients at high risk for poor outcomes or extraordinary resource use by experienced case managers -Use of predictive analytic tools to identify individual patients at high risk for poor outcomes or extraordinary resource use -Assignment of case managers for outpatient follow-up to patients at risk for hospital admission or readmission -Medication reconciliation as part of established plan of care -Provision of visit summaries to patients as part of all outpatient encounters and scheduling of follow-up visit/specialty referrals at time of initial encounter -Post-hospital discharge continuity of care program with scaled intensiveness based upon a severity or risk profile for adult medical-surgical patients in defined diagnostic categories -Arrangement of home visits for homebound and complex patients for whom office visits constitute a physical hardship -Hospitalists for medical/surgical inpatients -Telephonic outreach to discharged patients within 72 hrs of discharge
Safe Transition	-Identifying patients transitioning between care settings -Sharing clinical information between settings of care -Providing patient discharge summaries to *primary care providers* -Providing patient discharge summaries to *other providers (e.g. rehab hospitals)* -Tracking the status of transitions, including timing of information exchange
Co-location of services	*Hospital provision of the following health care services:* Primary Care Routine Specialty Care Specialized Care Urgent Care/Emergency Care Hospital Inpatient Care Rehabilitation Care Home Health Skilled Nursing Behavioral Health Palliative/Hospice Care

Appendix Exhibit A2. Standardized Regression Coefficients in Imputed Data Models Regressing Hospital Performance on Composite CMP Scores

	Medicare Spending per Beneficiary (MSPB)		*Patient Satisfaction (HCAHPS)*		*Readmission Reduction*		*Value-based Purchasing (VBP)*		*Clinical Care Outcomes*	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
N	1,645	585	1,592	567	1,680	595	1,595	567	1,585	563
Dependent Variables										
Mean	0.985		41.6		0.997		47.4		57.6	
(Standard Deviation)	(0.067)		(18.1)		(0.004)		(13.5)		(17.5)	
Explanatory Variable										
Composite CMP	-0.037	0.056	0.072***	-.071*	0.014	-0.038	0.053**	-0.116***	0.031	-0.087**
Control Variables										
Network Affiliation	0.029	-----	0.002	-----	0.001	-----	0.019	-----	0.02	-----
Metro Location	0.234***	-----	-0.089***	-----	0.023	-----	-0.025	-----	0.087***	-----
Teaching Status	-0.012	-----	-0.115***	-----	-0.187***	-----	-0.074***	-----	-0.060**	-----
Bed Size (<200 beds)	-0.145***	-----	0.225***	-----	0.041	-----	0.117***	-----	0.021	-----
Strong Market Concentration (HHI>1800)	-0.032	-----	0.056**	-----	0.093***	-----	-0.013	-----	-0.022	-----
Not-for-profit	-0.063**	-----	0.072***	-----	0.027	-----	0.064***	-----	0.011	-----
ACO	0.039	0.050	0.019	-0.036	0.037	-0.021	0.039	0.022	0.057**	0.056
Bundled Payment Contract	0.054	-0.025	-0.015	-0.054	0.017	0.088**	-0.029	0.068	0.013	0.016
Year Dummy (2014)	-0.007	-----	-0.019	-----	0.085***	-----	-0.461***	-----	-0.101***	-----

Note: (1) All coefficients are standardized; **p<0.1, **p<0.05, ***p<0.01. (2)* CMPs refer to Care Management Processes; hospitals receive individual composite scores representing use of care management practices on a scale of 0-29. (3) Model 1 refers to OLS; Model 2 refers to First Difference estimation. (4) MSPB and Readmission Reduction performance are reported as ratios relative to 1 where values ≤1 are ideal; HCAHPS, VBP and Clinical Care Outcome scores are reported as numeric values between 0-100 where higher values indicate better performance.

Appendix Exhibit A3. Standardized Regression Coefficients in Imputed Data Models Regressing Hospital Performance on Care CMP Scores by Domain

	Medicare Spending per Beneficiary (MSPB)		*Patient Satisfaction (HCAHPS)*		*Readmission Reduction*		*Value-based Purchasing (VBP)*		*Clinical Care Outcomes*	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
N	1,653	589	1,600	571	1,688	599	1,603	571	1,593	567
Dependent Variables										
Mean	0.985		41.6		0.997		47.4		57.6	
(Standard Deviation)	(0.067)		(18.1)		(0.004)		(13.5)		(17.5)	
Explanatory Variables										
Data Sharing & Monitoring	0.025	0.013	0.009	0.000	0.021	-0.041	0.028	0.021	0.021	0.033
Co-location of Services	-0.103***	0.032	-0.029	-0.013	0.065**	0.039	-0.007	-0.050	-0.029	-0.031
Transitional Care	-0.027	0.014	-0.028	-0.070*	0.034	-0.019	-0.031	-0.095**	-0.016	-0.033
Care Coordination	0.048	0.044	0.091***	0.009	-0.041	-0.087	0.092***	-0.052	0.101***	-0.036
Chronic Care Management	-0.038	-0.003	0.014	-0.043	0.001	0.022	-0.033	-0.019	-0.065*	-0.043
Control Variables										
Network Affiliation	0.037	-----	0.009	-----	-0.004	-----	0.020	-----	0.035	-----
Metro Location	0.235***	-----	-0.081***	-----	0.024	-----	-0.018	-----	0.094***	-----
Teaching Status	-0.008	-----	-0.116***	-----	-0.192***	-----	-0.075***	-----	-0.060**	-----
Bed Size (<200 beds)	-0.158***	-----	0.228***	-----	0.049*	-----	0.119***	-----	0.019	-----
Strong Market Concentration (HHI>1800)	-0.026	-----	0.055**	-----	0.091***	-----	-0.012	-----	-0.018	-----
Not-for-profit	-0.052**	-----	0.067***	-----	0.014	-----	0.061***	-----	0.010	-----
ACO	0.052**	0.052	0.028	-0.035	0.033	-0.026	0.044*	0.023	0.068**	-0.060
Bundled Payment Contract	0.058**	0.026	-0.007	-0.059	-0.0018	0.084**	-0.024	-0.073*	0.021	0.019
Year Dummy (2014)	-0.008	-----	-0.026	-----	0.086***	-----	-0.465***	-----	-0.104***	-----

Note: All coefficients are standardized; **p<0.1, **p<0.05, ***p<0.01; (2)* CMPs refer to Care Management Processes; hospitals receive factor scores indicating degree of use. (3) Model 1 refers to OLS; Model 2 refers to First Difference estimation. (4) MSPB and Readmission Reduction performance are reported as ratios relative to 1 where values ≤1 are ideal; HCAHPS, VBP and Clinical Care Outcome scores are reported as numeric values between 0-100 where higher values indicate better performance.

Chapter 3

The Role of Risk Contracting in Transitioning Hospitals from Fee-for-Service to Risk-based Payments

Introduction

As health care delivery shifts incentives away from volume-oriented FFS, providers have begun to concentrate their efforts on increasing the value of care delivered to patients. In particular, providers are increasingly engaging in risk contracting largely in response to the federal push toward value-based payment ("Better Care. Smarter Spending. Healthier People: Paying Providers for Value, Not Volume," 2015; Burwell, 2015). The range of options available to providers for assuming risk has begun to increase participation in a variety of different contracts, notably alternative payment models (APMs) incentivized by both public and private payers. Moreover, we are beginning to see organizations layer payment structures. For example, a health system may incorporate bundled payments and a medical home within their broader accountable care entity (Mechanic & Zinner, 2016). This suggests that a single provider organization can simultaneously participate in multiple risk-related contracts spanning diverse risk portfolios and care priorities.

The delivery of high-value health care, the core objective of these new value-based payment models, is more likely if providers – both hospitals and physicians - are better able to coordinate the clinical process of patient care across the continuum (Cuellar & Gertler, 2006; Robinson, 1997). These processes are more likely to occur among integrated organizations, as they are better positioned to implement strategies necessary to affect the process of care delivery. The challenge, however, is that few hospitals are assuming significant downside risk, thereby limiting organization integration (Borah et al., 2012; Vogus & Singer, 2016). And, downside (two-sided) risk assumption is associated with decreased spending and improved quality (Song et al., 2014).

Though hospital participation in APMs, such as ACOs, is on the rise (David Muhlestein, 2013; David Muhlestein, Saunders, & McClellan, 2017), evidence suggests that provider revenue is still predominantly based in FFS. Initial survey findings reveal that the majority of hospitals attribute less than 10% of their revenue to risk (Barkholz, 2017). Further evidence suggests that even among hospitals participating in value contracts, providers prefer to take upside (one-sided) risk only (Castellucci, 2017; de Lisle, Litton, Brennan, & Muhlestein, 2017). Thus, mere participation in APMs does not necessarily translate to more revenue at risk (Lawton R Burns & Pauly, 2018).

Mandatory vs. Voluntary Risk

In effort to increase the amount of risk that providers assume, the federal government has expanded its portfolio of APMs through offerings of both voluntary and mandatory programs. In particular, the Affordable Care Act (ACA) of 2010 required CMS to establish mandatory hospital pay-for-performance, or value-based, programs such as the Value-Based Purchasing (VBP) and Hospital Readmissions Reductions (HRRP) programs. Under these programs, a portion of the hospital's Medicare FFS payments is determined according to the organization's performance on specific quality metrics. This represents a source of financial risk as the hospital remains uncertain whether they will receive full or deducted payments. Accordingly, hospitals in mandatory value programs such as the VBP, have on average 1-1.5% of their Medicare revenue tied to risk (Gilman et al., 2015).

In addition to these mandatory programs, hospitals also have the option to assume risk through several optional APMs offered by CMMI. The Bundled Payments for Care Improvement and ACO programs are examples of such voluntary programs in which the hospital is expected to bear some risk and reform care delivery in order to reduce FFS payments while maintaining a certain standard of performance. Although CMMI did briefly mandate few APMs such as bundled payments in certain geographic areas, there remains few mandatory models in the present day (Kuehn, 2018; Wadhera, Yeh, & Maddox, 2018). While there continues to be debate over the extent to which value-based payment

programs should be mandatory, the broader objective of pushing providers towards risk assumption remains constant.

Assuming Risk

A lack of organizational capacity and infrastructure often contributes to provider hesitation towards taking on downside or full risk (Mechanic & Zinner, 2016). Tools and organizational strategies that promote integration, such as care coordination capabilities; tend to facilitate greater risk assumption (Lawton R Burns & Pauly, 2018). Spreading risk across the multiple arrangements can also help facilitate key investments in care redesign necessary for delivering integrated, high-quality care (Pierce-Wrobel & Micklos, 2018). Moreover, participation in a contract, such as a bundled payment, is also associated with providers partaking in additional risk arrangements. For example, provider entities managing patients through a hip-and-knee replacement bundle tend to simultaneously contract with post-acute services (e.g., home health agencies) and pursue joint ventures with specialty hospitals or ambulatory surgery centers (Courtney, West, & Hozack, 2018). These risk-related contracting strategies afford providers with economies of scale to coordinate care delivery and thereby optimize performance under new value-based payment schemes.

Regardless of the risk contract, clinicians and provider organizations must work together and coordinate closely to achieve the value that these new payment models demand. Agency theory explains that a greater degree of financial risk bearing induces a greater need for integration (McGuire, 2000; Pontes, 1995). Strong integration between provider organizations and their clinicians can reduce duplication of care efforts, reduce inappropriate clinical variation, and increase operating and capital efficiency (Lawton Robert Burns & Muller, 2008; Cuellar & Gertler, 2006; Robinson, 1997; Robinson & Casalino, 1996). Hence, increasing the accountability for the provided care theoretically enhances provider integration - a precondition for the creation of value.

This theoretical insight however, is not adequately supported by empirical evidence. The extant literature has primarily focused on integration strategies for managed care contracts (Lawton Robert Burns & Muller, 2008; Esposto, 2004; Morrisey, Alexander, Burns, & Johnson, 1996). Few studies have also examined the relationship between economic and clinical integration as it relates to provider performance (G. J. Bazzoli, Dynan, Burns, & Yap, 2004). Despite what we know about how integration affects provider performance, this dynamic has not been adequately studied in the current value-based payment environment. To address this gap in the literature, this study will (1) evaluate trends in risk assumption among hospitals in the value-based payment era; and (2) determine which risk-related contracting strategies contribute to increased revenue at risk. Examination of organizational strategies for managing risk may reveal mechanisms that increase care integration, which in turn, may help accelerate the transition from volume to value-based care delivery.

Theoretical Framework

To examine my focal relationship between hospital participation in risk-related contracting arrangements and assumption of financial risk, I draw upon Donabedian's Model for Evaluating Health Care Quality (Donabedian, 1966). I use Donabedian's Model to adapt the framework for evaluating integration (Devers et al., 1994) to develop a conceptual model (Exhibit 1). I consider the broader policy context of value-based payment reform as a structural antecedent to the independent variable of interest, hospital participation in risk-related contracting engagements. Hospitals that engage in value-based payment programs are more likely to participate in risk contracting which will in theory increase the level of organizational integration. Integration effectively mediates the relationship between risk contracting and the amount of financial risk that hospitals assume. Thus, greater engagement in risk-related contracting arrangements should positively affect the dependent variable, financial risk assumption. Since more risk is associated with quality and efficiency gains, risk contracting should improve overall hospital performance.

Donabedian's structural designation includes organizational attributes and fiscal organization (Donabedian, 1988). I define structure as value-based payment that provide financial incentives to systematically change how hospitals operate. In these models, providers are increasingly at risk for the entire continuum of care, which encourages the formation of stronger financial and/or clinical relationships between other providers and health services (Fowler, Grabowski, Gambrel, Huskamp, & Stevenson, 2017; M. McHugh et al., 2016). The care of any one patient typically spans multiple care settings. By changing the process of patient care and coordinating care across sites, risk-sharing arrangements such as joint ventures may improve the ability of hospitals and physicians to exploit economies of quantity, quality, and monitor performance relative to benchmarks. Therefore, the drive for high value care delivery in response to these incentives will demand new forms of risk-related contracting.

Organizational Integration Mediates the Relationship between Risk Contracting and Risk Assumption

Economic theory suggests integration occurs primarily due to scale incentives. Scale incentives for physicians usually change in response to changes in payment and reimbursement (Liebhaber & Grossman, 2007). In the past, horizontal integration was a common product of the new gatekeeping and risk-sharing models introduced by health maintenance organizations (HMOs) (Robinson & Casalino, 1996). Horizontal integration refers to "the coordination of functions, activities, or operating units that are at the same stage in the process of delivering services" such as a merger between hospitals (Gillies, Shortell, Anderson, Mitchell, & Morgan, 1993). Today, newer value-based payment models that spread risk across the care continuum suggest that vertical integration will be more likely. Vertical integration is refers to linkages between "different stages of the [care delivery] process" (Gillies et al., 1993) such as partnerships between a hospital and a home health agency.

Economies of scope theories predict that quality and efficiency could rise if physicians and hospitals are better able to coordinate the clinical process of patient care across the continuum. These

changes are more likely to occur among the more integrated relationships, because these organizations are better able to implement the infrastructure and processes necessary to innovate patient care. Thus, if improved hospital performance, via increased risk assumption, is to be achieved, establishing strong internal alignment and integration is essential. However, only a few economically integrated provider arrangements have managed to have an impact on performance at the hospital level (Lawton Robert Burns & Muller, 2008). Organizational integration is most successful if economic integration is tied to shared accountability at the clinical level (Devers et al., 1994). In an environment of reform focusing on quality and access to care, providers have not adequately focused on clinical integration as a complement to economic integration to improve performance (Gillies et al., 1993). I define clinical integration as efforts in which "patient care services are coordinated across various functions, activities and operating units" of a provider organization (Devers et al., 1994; Gillies et al., 1993). Since financial risk assumption drives quality and efficiency improvements (G. J. Bazzoli, Dynan, L., Burns, L.R. and Lindrooth, R., 2000), I expect that providers with more revenue at risk will be more likely to meet the objectives of value-based care delivery. Risk assumption is the outcome of interest because a core objective of current reforms is to reduce the amount of hospital payments tied to FFS as a mechanism to improve the value of care delivered ("Better Care. Smarter Spending. Healthier People: Paying Providers for Value, Not Volume," 2015; Damberg et al., 2014; VanLare et al., 2012).

Confounders to the Focal Relationship

A hospital's ability to participate in risk-related contracts, and thereby assume more risk, may vary by individual hospital characteristics and resources (Barney et al., 2001; Yeager et al., 2015). Hospitals with greater or superior resources may be more likely to have well-developed integration processes and strategies that leverage such resources. For example, hospitals that possess an electronic health records (EHR) system generally exhibit improved clinical outcomes due to increased capacity for clinical integration (Reiter et al., 2006). Accordingly, I control for covariates representing aspects of a hospital's resources that may positively influence participation in risk arrangements and revenue at risk

such as teaching status and hospital size. I also control for the influence of organizational leadership and functional integration. Functional integration is defined as the "extent to which key support functions such as financial management, marketing, and quality improvement" are coordinated across the provider organization (Devers et al., 1994). In this vein, organizational learning and leadership support can influence provider capacity to manage financial risk (Hockenberry & Becker, 2016; Reiter et al., 2006). Physician engagement within the organization and receptiveness to hospital leadership are also likely to be positively tied to hospital performance (Frølich et al., 2007). Since it is difficult to measure the specific strategies and systems put in place at the system and individual clinician level for functional management (e.g., monitoring practice guidelines), I identify these hospital leadership constructs as an unobservable confounder to the focal relationship. The directionality of all the aforementioned covariates will likely be positive.

Hypotheses

Providers engaging in risk-related contracting arrangements such as APMs and joint ventures are associated with higher percentages of hospital revenue tied to capitation or shared risk (Auerbach, Liu, Hussey, Lau, & Mehrotra, 2013; G. J. Bazzoli, Dynan, & Burns, 1999). Similar to how changes in payment incentives during the managed care era led to increased risk contracting and as a result, more revenue tied to capitation, a form of risk (G. J. Bazzoli, Dynan, L., Burns, L.R. and Lindrooth, R., 2000); hospitals engaging in more risk-related contracting arrangements are likely to assume more revenue at risk. Therefore, hospitals whose financials are more dependent on value-based programs may have a greater incentive to modify their behavior, through efforts to increase integration, and thereby improve performance. Accordingly, I make the following hypothesis:

> *H1. After controlling for confounders, hospital participation in risk-related contracting arrangements is associated with increased amounts of hospital revenue at risk.*

Data and Methods

This study employs data from the annually updated, nationally representative American Hospital Association (AHA) *Annual Survey of Hospitals* for the years 2005, 2009, 2011 and 2015. The survey data provides hospital information pertaining to facilities, services offered, demographics, staffing, finances and other structural characteristics. To capture the explanatory variables, risk-related contracting arrangements, I used survey measures tracking hospital participation in various structural arrangements, such as joint ventures and physician employment. It should be noted that data for APM arrangements reflects a newer survey measure that is only present in years 2011 and 2015. Lastly, I calculated hospital revenue at risk, the primary outcome of interest, using the Annual Survey's financial measures reporting revenue tied to capitation and shared risk.

A four-year sample of hospitals reporting their revenue information on the AHA survey in all years 2005, 2009, 2011 and 2015 was first examined to establish a baseline of trends pre- and post-enactment of the ACA, which was a key driver of value-based payment reforms. However, the analytic sample (depicted in Exhibit 2) was limited to a consistent group of hospitals reporting any metric of risk-based revenue in both 2011 and 2015. To increase sample size, I imputed responses for hospitals that reported only one measure of revenue at risk – capitation or shared-risk – by assuming a nonresponse to the other measure is zero. Sensitivity analyses (see Appendix Exhibits A1-A5) were conducted on variations of this sample with and without the imputed values. The results of the sensitivity analyses were consistent with my primary results. All analyses were conducted in STATA Version 12.0.

Measures

Explanatory Variables

I evaluated hospital participation in risk-related contracting as a vector of the following arrangements: HMO, preferred provider organization (PPO), medical home, joint ventures, and hospital

employment of physicians. HMOs and PPOs, although not directly incentivized through new payment reforms, are still associated with revenue tied to risk, most commonly tied to capitation. I measured HMO and PPO contracting using indicator variables for hospital participation. Since HMOs and PPOs are longstanding risk contracts that were not directly impacted by the ACA's push towards value-based payment, the key variables of interest are the latter three arrangements. These three arrangements were selected because they foster organizational integration.

Medical homes in particular, promote integration of clinical care (Klein, 2009). The medical home is intended to provide patients with "whole person" care through a suite of primary care services (American Academy of Family Physicians, 2007). This primary care-oriented APM incentivizes providers and other stakeholders to collaborate and coordinate care practices to improve patient outcomes. As discussed in Chapter 1, effective care coordination – a care management strategy – is a key factor in the provision of high-quality, efficient patient care. Hence, I consider the medical home to be a risk-related arrangement that promotes clinical integration. To measure medical home contracting, I created an indicator to represent whether or a not a hospital has any form of a medical home arrangement in place.

Another form of integration depends on organizational ownership of health services, commonly established through joint ventures (Fowler et al., 2017). Joint ventures are a mechanism by which a hospital can engage with related partners in a joint effort or partnership to offer services or products that are not easy to provide or scale within the existing organizational structure (Zajac, Golden, & Shortell, 1991). These arrangements are known to enhance innovation in care delivery particularly as it relates to meeting the demand for patient services flowing bi-directionally across the continuum of care (Gillies et al., 1993). In theory, hospitals with more joint ventures should be more integrated. To capture this type of organizational integration, I calculated joint venture factor scores (DiStefano et al., 2009; Moseley & Klett, 1964) for each hospital. Joint ventures for core health services were selected based on their relevance to achieving the objectives of value-based care. For example, hospital coordination with ambulatory care providers is incentivized through value-based programs such as the Hospital

Readmissions Reduction Program (Burwell, 2015). Moreover, urgent care centers are associated with increased patient access to care and substantial cost savings (Weinick, Burns, & Mehrotra, 2010). Accordingly, hospital participation in the following nine joint ventures were evaluated: physician arrangements, non-physician arrangements, ambulatory services, ambulatory surgery centers, urgent care centers, transportation to health services, rural health clinics, physical rehabilitation outpatient centers, and home health services. Higher factor scores represent hospitals with more joint ventures.

It is also necessary to recognize that physicians ultimately deliver the care that affects hospital performance. The more hospitals can align themselves with physician interests, the more likely they are in achieving the objectives of value-based care delivery. Smaller, independent physician practices in particular, impede effective risk pooling and thereby create inefficiencies (G. J. Bazzoli et al., 1999). Hence, it is worthwhile to consider physician employment, particularly for primary care practitioners (G. J. Bazzoli, Dynan, L., Burns, L.R. and Lindrooth, R., 2000), as another mechanism underlying integration. This is pertinent as integrated physicians more likely to engage in quality improvement initiatives (Mehrotra et al., 2006). Integration between hospitals and its physicians create synergies that improve efficiencies under risk-based payment (G. J. Bazzoli, Dynan, L., Burns, L.R. and Lindrooth, R., 2000; Lawton R Burns & Thorpe, 1993; Devers et al., 1994). To account for this dynamic, I measured the rate of physician employment for each hospital in the sample. Analysis by percent of employment, rather than number of employed physicians, allows for direct comparisons across hospitals. To calculate these percentages, I divided the number of employed physicians by the total number of privileged physicians.

Dependent Variables

Hospital participation in risk-related arrangements should in theory have a positive relationship on the amount of financial risk assumed. Accordingly, I measured hospital risk assumption by the amount of hospital net patient revenue tied to risk. This amount reflects the impact of hospitals participating in both mandatory and voluntary value-based payment program. I considered three separate measures for

risk assumption: (1) total revenue at risk; (2) capitated revenue; and (3) shared-risk revenue. Total revenue at risk is the sum of a hospital's revenue tied to capitated and shared-risk arrangements. The amount of capitated revenue reflects payments tied to capitation and revenue tied to shared-risk reflects payments tied to arrangements such as ACOs with shared savings. All revenue measures are considered as percentages of total net patient revenue.

Confounders to the Focal Relationship

I control for confounders representing aspects of a hospital's resources that may positively influence hospital risk-related contracting and risk assumption. These confounding variables include market concentration, teaching status (Allison et al., 2000; "Hospital Value-Based Purchasing (VBP) Program: Trend Analysis," 2014), network affiliation, metropolitan location, and hospital size, (Lehrman et al., 2010) and ownership (not-for-profit)(Fisher et al., 2003). Market concentration was determined using the Herfindhl-Hirschman index (HHI), where high concentration (HHI>1800) was controlled for. Teaching status was determined by the ratio of full-time residents to the number of hospital beds, where a ratio greater than or equal to 0.25 denoted a teaching hospital. Hospital size was measured according to the number of beds. For most analyses, I used an indicator for different categories of bed sizes to exploit more variation. However, for certain models – notably those in which we use the first differencing approach – I created an indicator variable for small hospitals defined as hospitals with <200 beds.

Statistical Analyses

First, I examined characteristics of hospitals with no risk assumption compared to those with revenue tied to risk. I examined only hospitals that completed the AHA Annual Survey in 2005, 2009, 2011 and 2015. However, since most of my explanatory variables of interest were surveyed after 2010, my primary analysis is focused on the two-year sample from 2011 to 2015.

To test my focal relationship, I used standard linear regression methods to determine what specific risk-related structural arrangements influence hospital assumption of risk. I specified a generalized linear model (GLM) with a Gaussian distribution and log link to determine the percent of hospital revenue at risk. I considered both total revenue at risk, as well as individual measures of capitated and shared risk net patient revenue as outcomes. The specific model I estimated was of the following general form:

$$\mathbf{Y_{risk}} = \beta_0 + \beta_1 x_{MH} + \beta_2 \mathbf{x}_{Contracts} + \beta_3 x_{Jointventures} + \beta_4 \mathbf{x}_C + \varepsilon;$$

where $\mathbf{y_{risk}}$ represents the vector of revenue outcomes, $\mathbf{X_{MH}}$ represents hospital adoption of a medical home; $\mathbf{X_{Contracts}}$ is a vector for participation in HMO and PPO contracts; $x_{Jointventures}$ is a factor score representing the number of joint ventures for select health services; and X_C represents the vector of confounder variables. For all GLM models, standard errors were clustered at the hospital level.

Next, to evaluate whether changes in risk-related contracting structures facilitate changes in the amount of risk hospitals assume, I conducted first-difference estimation using the two-period panel data, which is equivalent to a hospital fixed effects model (Wooldridge, 2010). This approach controls for time invariant heterogeneity. In effect, in the first difference models I am estimating the effects of risk-related contracting arrangements based on the variation of hospitals that made changes in their participation in these various contracts between the two survey periods. The specific first-difference models I estimated were of following general form:

$$\Delta \mathbf{y} = \beta_0 + \beta_1 \Delta \mathbf{x}_{MH} + \beta_2 \Delta \mathbf{x}_{Contracts} + \beta_3 \Delta \mathbf{x}_{Jointventures} + \beta_4 \Delta \mathbf{x}_C + \Delta \varepsilon;$$

where Δ denotes the change from years 2011 to 2015.

Lastly, I conducted a series of analyses focused on hospital participation in medical home arrangements. Medical home contracting was selected for additional analyses due its direct relevance to current policy discussions around the future of APMs. I first examined organizational characteristics and risk-related arrangements of hospitals according to when they adopted or disadopted a medical home.

Then, I used logistic regression models to measure which aspects of a hospital's risk portfolio – revenue at risk and other risk-contracting arrangements – predict how likely a hospital is to adopt a medical home. All analyses were conducted using STATA Version 12.

Tests of Alternative Explanations

It is of course possible that the focal relationship (see dashed arrows in Exhibit 1) works in the reverse direction. Accordingly, I explored the extent to which hospital risk assumption affects the likelihood of pursuing risk-related contract arrangements. To test this reverse relationship, I similarly used GLM modeling. For physician employment, medical home participation and joint venture outcomes, I specified a Gaussian distribution. Whereas, for HMO and PPO contracting measures - both count variables - I specified a negative binomial distribution. It should be noted that for this supplemental analyses, I considered the *number* of HMO and PPO contracts whereas the primary analysis considers *participation in* any HMO and PPO contract.

Results

Trends in Revenue at Risk

From 2005-2015, majority of hospitals had no net patient revenue at risk (Exhibit 3). The distribution of hospital revenue tied to risk over time is shown in Exhibit 4. In 2005, 14.9% of hospitals had some revenue at risk. The proportion of hospitals assuming risk then declined by a few percentage points in 2009 and 2011, but then increased to 15.7% by 2015. Among hospitals assuming risk (Exhibit 5), the average amount of hospital revenue tied to risk decreased from 11.2% in 2005 to 10.8% in 2015. During this time, hospitals decreased their percent of revenue tied to capitation by 2.5 percentage points and increased revenue tied to risk sharing by 2.04 percentage points.

For my primary analysis using the 2011-2015 hospital sample, I find consistent trends to the four-year sample used for descriptive trends. While most hospitals are risk averse, there was a slight increase

in the proportion of hospitals assuming risk from 2011 to 2015 (Exhibit 6). In 2011, 11.2% of hospitals assumed risk, and by 2015, 15.1% of hospitals had some revenue at risk. However, even among hospitals assuming risk, most had less than 30 percent of their revenue tied to risk (Exhibit 7). Exhibit 8 presents the revenue portfolios among hospitals assuming risk. On average, hospitals had 10.9% of their revenue tied to risk, which increased to 11.3% by 2015. Specifically, hospitals decreased the amount of revenue paid on capitated basis from 4.19% to 3.10%; and increased shared-risk revenue from 6.33% to 8%. Similarly, I observe an 18.2% drop in the number of capitated lives.

Participation in Risk-Contracting Arrangements

Exhibit 9 shows rates of hospital participation in various risk-related contracting arrangements from 2011-2015. Participation in HMO and PPO contracts remained relatively unchanged in this time period. HMO contracting increased by 1.7 percentage points, whereas PPO contracting increased by 0.6 points. More notably, hospital participation in medical homes increased from 14.4% in 2011 to 25.5% in 2015. Joint ventures for all health services also increased. The largest increases in hospitals forming joint ventures were for ambulatory services (4.2 percentage points), home health (2.42 percentage points) and arrangements with non-physicians (2.3 percentage points).

I also examined differences in characteristics between hospitals with no risk and those with revenue at risk (Exhibit 10). Hospitals assuming risk have more medical home and HMO contracts. On average, they also have a greater percent – approximately 6-percentage point difference - of employed physicians. Risk takers are also more likely to be not-for-profit and be affiliated with a teaching hospital.

Factors Influencing Risk Assumption

Participation in risk-related contracting arrangements affects how much risk hospitals assume (Exhibit 11). Participation in a medical home and a HMO increase revenue tied to shared risk by 1.6% and 0.05%, respectively. When evaluating total percent of hospital revenue at risk, I find that medical home participation and HMO contracting increase the percent of risk assumed by 1.2% and 0.05%, respectively. Moreover, for every additional percent of physicians that are employed, hospitals increased percent of revenue at risk by 1.06%. Alternatively, PPO contracting reduces the amount of revenue at risk by 0.05%. Joint ventures did not have a significant relationship with revenue at risk. Not-for-profit and teaching status is also associated with increased risk assumption by 0.42% and 0.48%, respectively. Network affiliation and metropolitan location similarly have a positive influence on revenue at risk. Hospital bed size has a direct relationship on the amount of revenue at risk where larger hospitals (500 or more beds) facilitate greater risk assumption.

I also examined the effect of changes in risk-related contracting arrangements on changes in risk assumption (Exhibit 12). Although I found no statistically significant causal relationships, there appears to be a notable relationship between risk-related contracting arrangements and revenue at risk. For every 1% change in physician employment, there is about a 0.5% change in total risk assumption. Similarly, adding a medical home contract is also associated with a 0.5% change in revenue at risk. Changes in the number of joint ventures have the potential to change revenue at risk by approximately 0.87%. The effect of additional risk contracting structures – HMOs and PPOs – are presented in the Appendix (Exhibit A6).

I also considered the reverse relationship to examine whether risk assumption influences participation in risk-contracting arrangements (Exhibit 13). I found that for every additional 10% of risk assumption, hospitals are 8% more likely to have a medical home, 9% more likely to have a HMO contract, and 5% less likely to have a PPO structure. Organizational characteristic, such as teaching status and bed size, appear to be a better predictor of whether hospitals partake in a risk-related contracting arrangement.

Risk Contracting Through Medical Homes

Since medical homes were associated with the greatest percent change in revenue at risk, I conducted additional analyses. Exhibit 14 shows risk contracting characteristics associated with medical home adoption. Hospitals that had a medical home in place by 2011, or early adopters, had more revenue at risk (2.48 percentage points) in 2015 than hospitals that adopted a medical home between 2011-2015. Early adopters also had more revenue at risk initially in 2011 than hospitals that adopted a medical home after 2011. Hospitals who disadpoted a medical home between 2011-2015 on average had less revenue at risk and fewer employed physicians than both categories of adopters.

I then explored predictors of medical home adoption (Exhibit 15). A 10% increase in the amount of revenue at risk increases the likelihood of a hospital adopting a medical home in 2011 by 10%, but does not significantly influence adoption between 2011-2015. Increased physician employment was a significant contributor to early adoption of medical homes. However, having more joint ventures was also significant predictor for early adoption and medical home adoption between 2011-2015.

Discussion

Despite recent policy efforts to move providers of care away from FFS, the proportion of hospitals assuming risk has only increased by one percentage point from 2005 to 2015. On average, I find that hospitals have only 11% of their revenue tied to some form of risk. These findings are consistent with prior survey research estimating hospitals to have 10% of revenue at risk (Barkholz, 2017). This amount of risk is unaffected by the enactment of the ACA, which established CMMI and a host of value-based payment models. While overall risk assumption remains unchanged, we do see a shift in the type of financial risk assumed. Among hospitals assuming risk, there has been a notable shift away from capitation to the extent that majority (≈80%) of revenue at risk is now attributed to shared-risk arrangements. This shift parallels the waning interest in capitation as evidenced by declines in HMO enrollment in the early 2000s (Zuvekas & Cohen, 2010). Though capitation had fallen out of favor, rising

concern over inefficiencies associated with FFS led to renewed focus on payment incentives to manage costs and improve quality. As a result, we have seen a federal push towards blended, shared-risk models that pair capitation with quality incentives since the enactment of the ACA in 2010.

In evaluating lessons learned from managed care, or the "HMO era", I find that the amount of capitated revenue was directly proportional to the number of and enrollment within HMO contracts (Zuvekas & Cohen, 2010). This suggests that a hospital's risk-related contracting arrangements have a direct impact on revenue at risk. Thus, changes in the type of risk providers assume may be attributed to emergence of new payment models that establish shared-risk agreements. Our analyses echo earlier lessons by showing how participation in risk-related contracting arrangements, such as medical homes, can increase the amount of risk assumed. Consistent with the extant literature ("Hospital Value-Based Purchasing (VBP) Program: Trend Analysis," 2014; Spaulding et al., 2018), I also find that certain organizational characteristics, such as bed size and teaching status, may predispose hospitals to increased success under value-based arrangements. However, the evidence suggests that risk-related contracting strategies have a greater influence on risk assumption than organizational characteristics.

The overall slow pace of risk assumption and influence of risk contracting suggests that by in large, providers are not comfortable with taking on risk and need to build capacity to do so first (Mechanic & Zinner, 2016). Although we see that hospitals adopting medical homes in 2011 may have a slight advantage in risk assumption, this does not hold true in later years. Increases in medical home contracting, physician employment and joint ventures between 2011 and 2015 signal the fact that providers are beginning taking steps to integrate and scale care delivery in order to take on additional financial risk. Furthermore, my analysis of medical home contracting also suggests that payment models alone, similar to the decline of the HMO, are not sufficient prepare providers for risk assumption (Auerbach et al., 2013). This is an important consideration given that much of the current policy debate has centered on the effectiveness and future of APMs. Rather, providers rely on a combination of strategies and tools to facilitate risk assumption (Devers et al., 1994).

The increased need for providers to be more accountable for the total continuum and cost of care fundamentally alters the way in which health care is delivered. This new dynamic necessitates changes to manage care transitions and financial risk through tighter integration with clinicians and heath services (J. P. McHugh, Trivedi, Zinn, & Mor, 2014). Current incentives for hip-and-knee bundles and primary care transformation for example, would explain the increase in medical home contracting and joint ventures for home health services in recent years. Joint ventures are also strategies for integrating and aligning the hospital with physicians (L. P. Casalino, November, Berenson, & Pham, 2008). Physician alignment promotes coordination of evidence-based practices, which improves efficiency and quality (L. P. Casalino et al., 2008). As more physicians become employed through risk contracts, hospitals will be better positioned to reduce excess costs associated with unnecessary practice variation among physicians. This scenario favors physician employment models, particularly for primary care practitioners (Kocher & Sahni, 2011). Moreover, increased physician employment gives hospitals more direct control over care delivery (G. J. Bazzoli, Dynan, L., Burns, L.R. and Lindrooth, R., 2000) and confidence in succeeding under value-based payment (L. P. Casalino et al., 2008), and therefore more likely to engage in downside risk. The additional scale and resourced afforded by such contracts enhance the degree of clinical integration and coordination (J. P. McHugh et al., 2014), making providers more comfortable with taking financial risk for the full continuum of patient care.

Policy Implications

While current policy priorities continue to emphasize value-based APMs, policymakers must consider building additional support mechanisms and incentives to help providers succeed in the new environment. Participation in an alternative delivery model alone does not necessarily yield high value care, but rather how providers adapt and integrate their internal processes and resources. Future policy efforts should consider establishing more consistency among value-based performance measures and reporting requirements across individual payment contracts to enhance integration and shared accountability (Devers et al., 1994). Consideration should also be given to mechanisms that enhance

clinician-level integration through policies for data sharing and evidence-based practices. It may also be worthwhile to establish investment subsidies, similar to the HITECH Act, for infrastructure (e.g., predictive analytics that facilitates efficient care delivery. As it relates to the future of current APM offerings, policymakers should limit one-sided risk models. While it is important for providers to still have access to one-sided risk incentives, they also reduce commitment to new processes and infrastructure that these new models demand. Thus, attention should be given to designing payment and delivery models like bundles that encourage care coordination and integration, but simultaneously push providers towards downside risk. Pairing these efforts alongside policies that foster competition (R. H. Miller, 1996) based on quality will help accelerate the transition from volume to value.

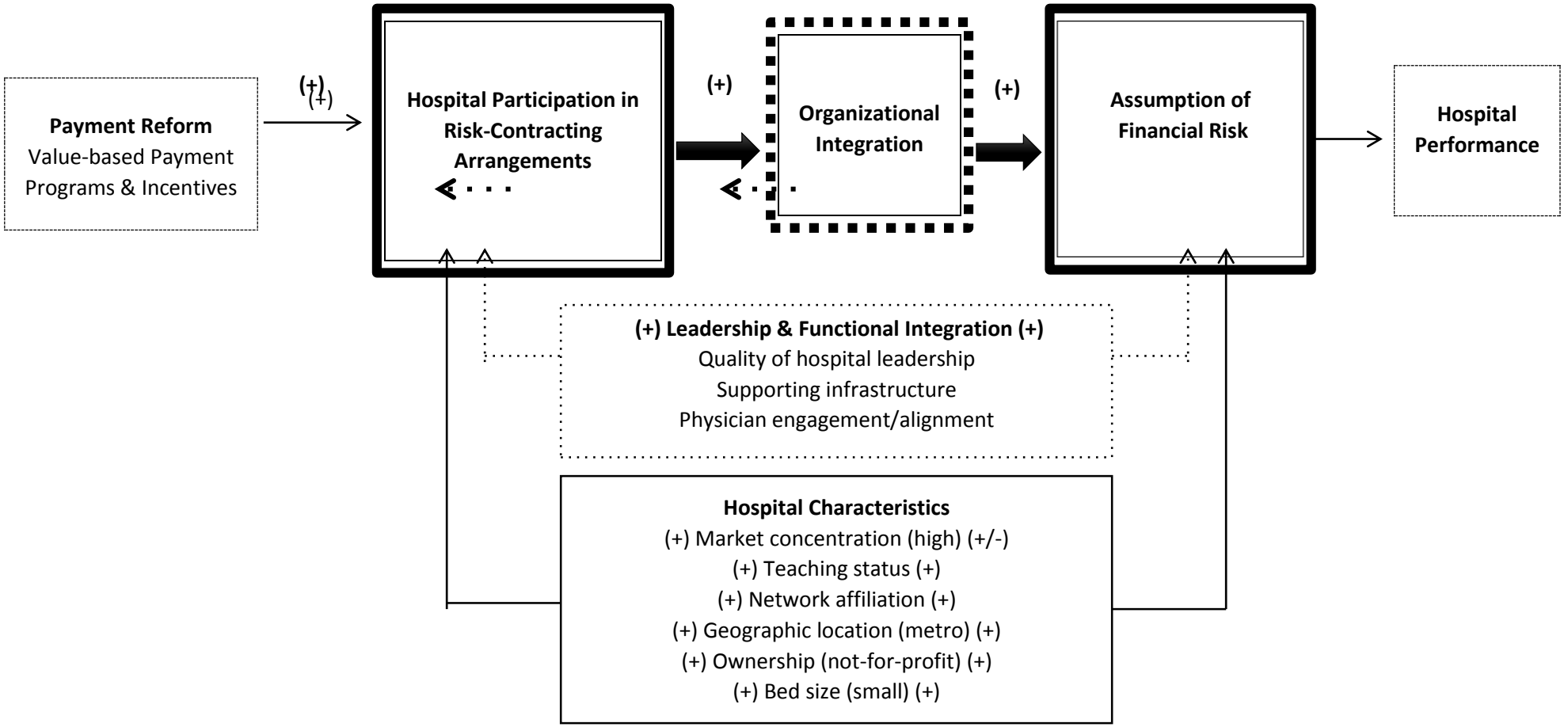
To the extent that there is question whether policymakers should prioritize voluntary or mandatory programs, findings from this study suggest that a combination approach is likely needed. Considering the findings from a recent evaluation of mandatory versus voluntary bundled payment arrangements, both approaches contribute to hospital engagement in care redesign and risk assumption (Navathe et al., 2018). Some contend that voluntary programs are biased by self-selection, as hospitals with stronger capability and infrastructure are more likely to opt into such models, therefore warranting the need for more mandatory programs (Wadhera et al., 2018). However, voluntary programs have been found give hospitals the incentive to strengthen and build up their capacity for risk (Ryan et al., 2017). Given that the findings from this study highlight the importance of hospitals needing to expand their scale and infrastructure before assuming risk, maintaining voluntary programs is an important step in this endeavor. Likewise, policymakers should continue to also support mandatory programs to continue pushing hospitals towards increased risk assumption. Special contingencies such as stop-loss thresholds should be considered (Wadhera et al., 2018) in the design of such mandatory programs in order to further incentivize providers towards risk, but also increase buy-in from physicians and other provider partners. Leveraging both mandatory and voluntary approaches in concert with other incentives for care delivery

redesign and investments in new infrastructures, are likely to accelerate the transition from FFS to risk-based payments.

Conclusion

Despite the emergence of new payment and delivery models through the ACA, providers remain hesitant to take financial risk for the quality of care delivered. To overcome this hurdle, providers must engage in organizational arrangements that increase economic, clinical and human capital integration in order to effectively manage and assume risk. While no significant causal relationships can be established from the present study, there are strong associations between medical home, joint venture and physician employment contracting and the amount of hospital revenue at risk. These risk-related contracting mechanisms that prompt structural changes can work synergistically to provide hospitals with the scale and resources to assume financial risk, a precondition for effective delivery of high value care.

Exhibit 1. Conceptual Framework



Note. This framework evaluates the focal relationship between hospital risk-contracting arrangements and hospital revenue tied to risk. Dashed boxes denote unobservable constructs. +/- denote the hypothesized directionality of impact on the related construct.

Exhibit 2. Analytic Sample

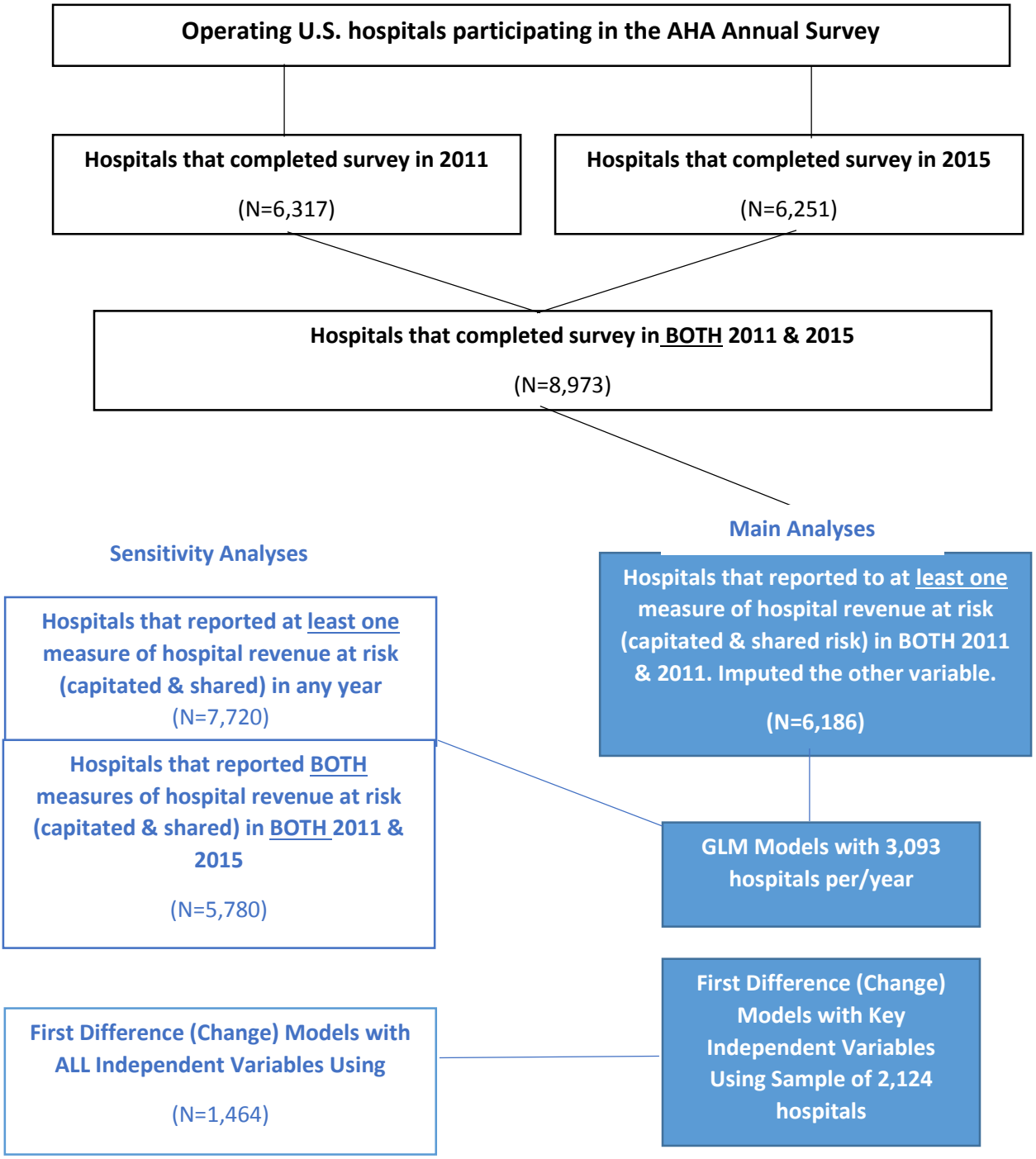


Exhibit 3. Percent of Hospital Revenue at Risk, 2005-2015

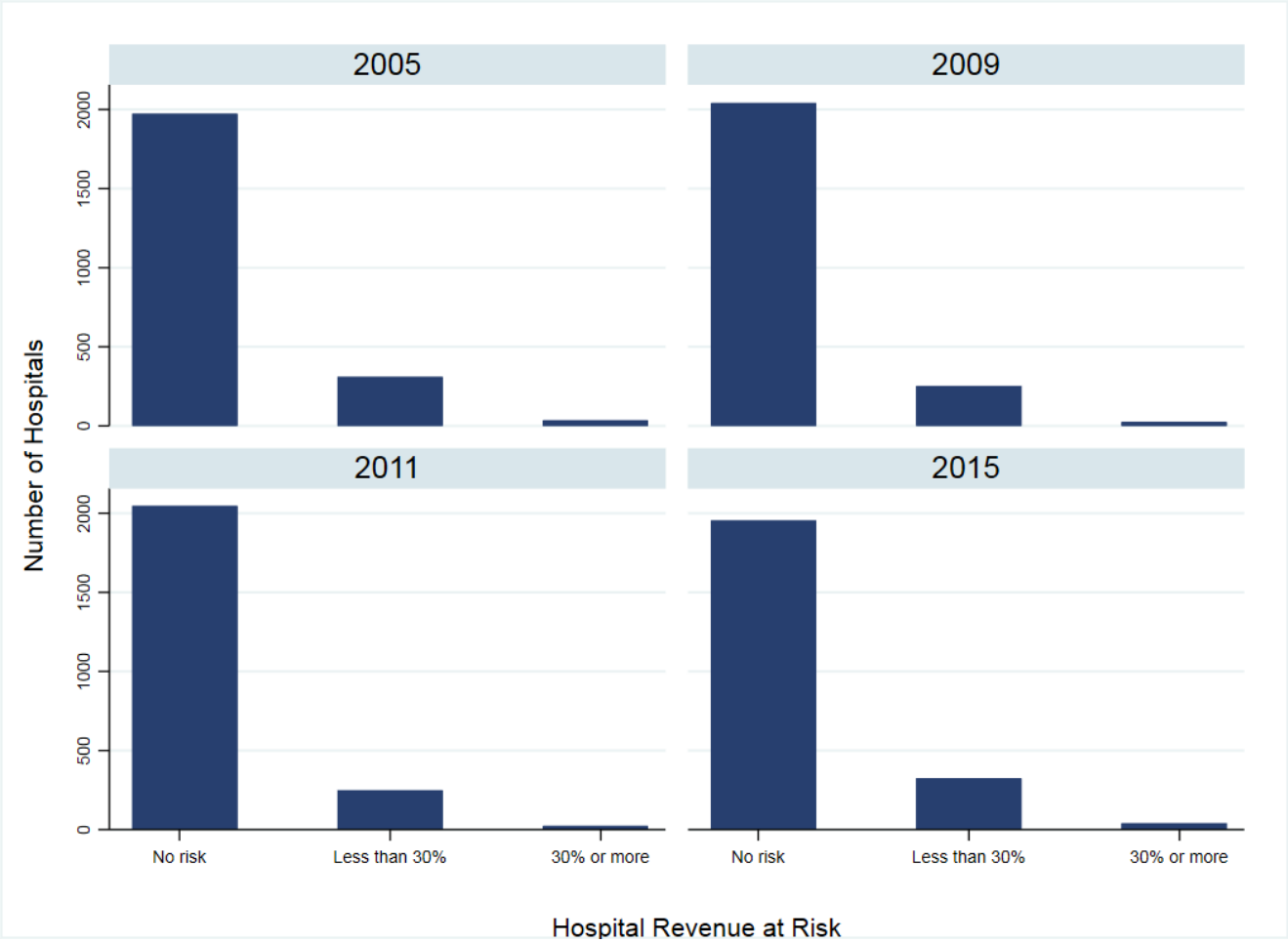
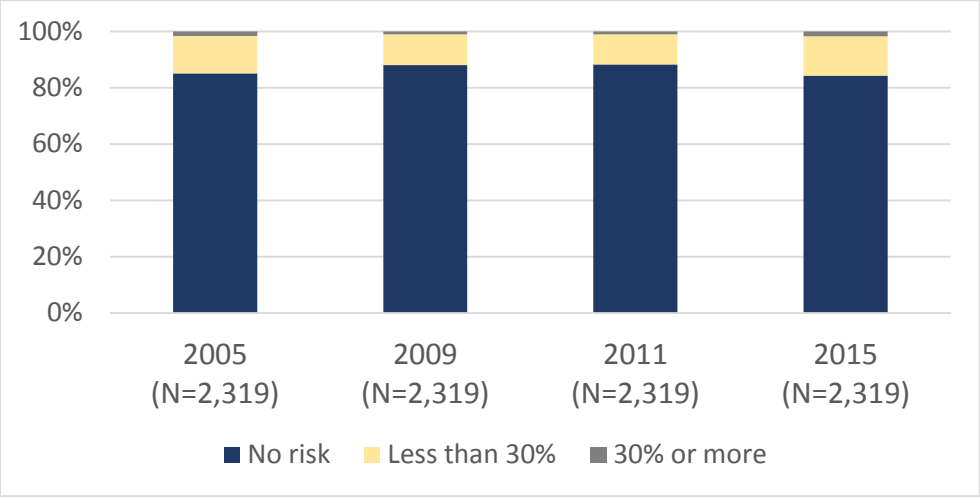
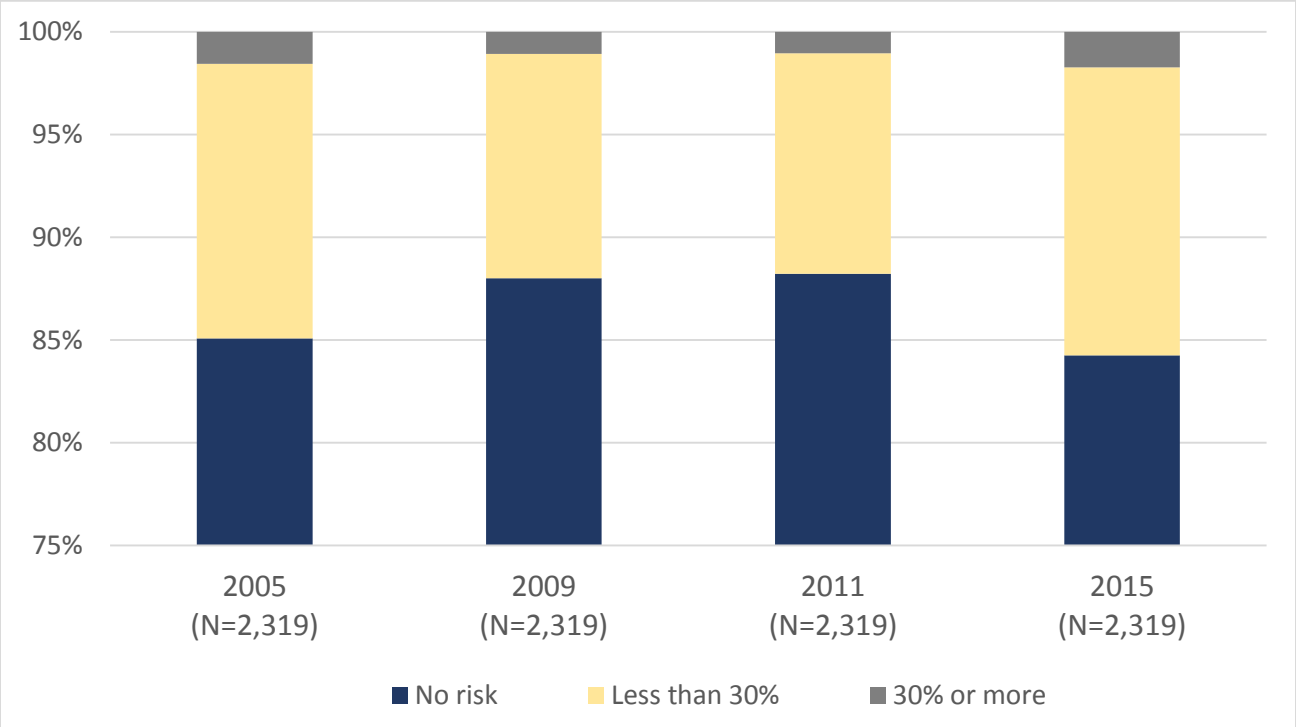


Exhibit 4. Distribution of Hospital Revenue at Risk, 2005-2015

4a. Distribution of Revenue with Unadjusted Y-Axis Scale (Overall View)



4b. Distribution of Revenue with Adjusted Y-Axis Scale (Zoom View)



Note: The two exhibits represent the same data. 4a shows the data on a complete Y-axis, whereas 4b zooms in and only shows a segment of the whole axis.

Exhibit 5. Risk Portfolio Among Hospitals Assuming Risk

	Risk Portfolio Among Risk-Takers *Mean (Std Error)* *[95% CI]*			
	2005 **N=346**	**2009** **N=278**	**2011** **N=273**	**2015** **N=365**
% Revenue at Risk	**11.2** (0.88) [9.49, 13.0]	**9.94** (0.97) [8.03, 11.8]	**10.4** (1.07) [8.29, 12.5]	**10.8** (0.79) [9.27, 12.4]
% Revenue Paid on Capitated Basis	5.4 (0.63) [4.15, 6.64]	3.95 (0.49) [2.98, 4.91]	3.64 (0.41) [2.84, 4.44]	2.90 (0.31) [2.28, 3.51]
% Revenue Paid on a Shared-risk Basis	6.06 (0.62) [4.84, 7.29]	6.13 (0.82) [4.52, 7.74]	6.87 (0.97) [4.96, 8.79]	8.10 (0.74) [6.65, 9.55]
Contracts				
Number HMO Contracts	11.3 (1.12) [9.06, 13.5]	11.6 (1.44) [8.77, 14.4]	11.2 (0.6) [9.99, 12.3]	12.3 (0.65) [11.0, 13.6]
Number of PPO Contracts	21.2 (1.59) [18.1, 24.4]	19.2 (1.17) [16.9, 21.5]	18.3 (0.75) [16.8, 19.8]	22.4 (1.72) [19.0, 25.8]
Number of Lives Covered on Capitated Basis	49030 (28195) (-6499, 104559)	16068 (2300) [11535, 20601]	20986 (3434) [14219, 27753]	17023 (2296) [12504, 21542]

Note: The percent of revenue at risk variable represent a sum of the capitated and shared-risk revenue measures.

Exhibit 6. Percent of Hospital Revenue at Risk, 2011-2015

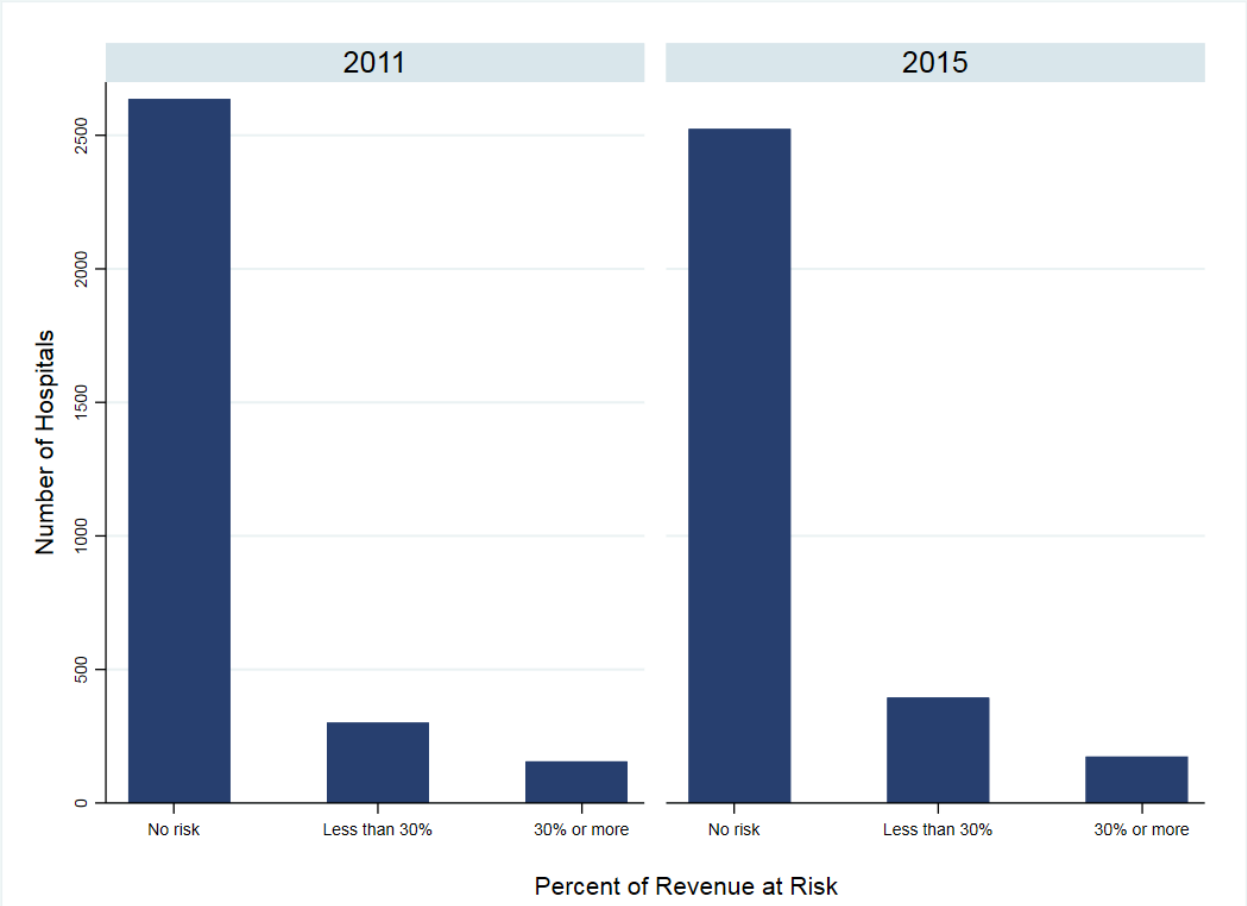
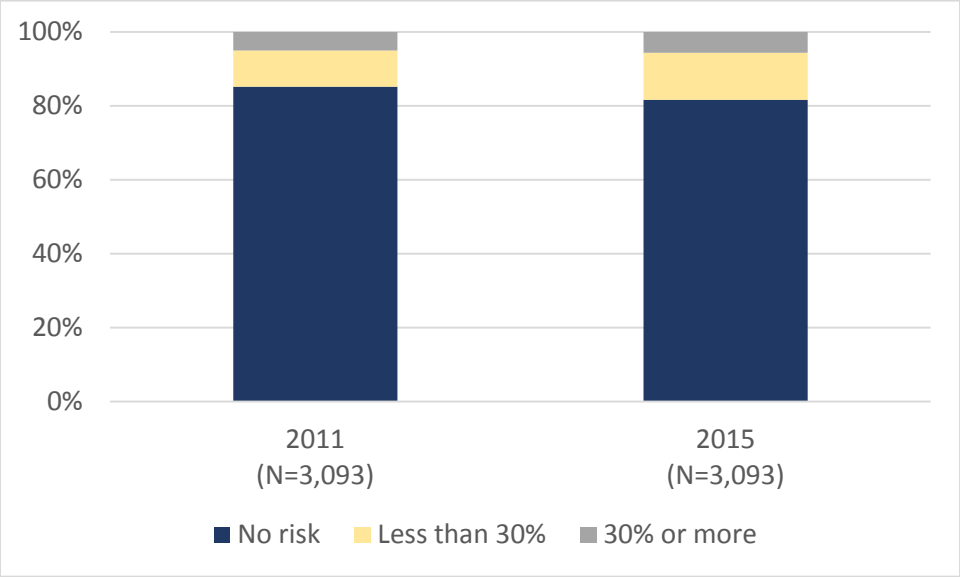


Exhibit 7. Distribution of Hospital Revenue at Risk, 2011-2015

7a. Distribution of Revenue with Unadjusted Y-Axis Scale (Overall View)



7b. Distribution of Revenue with Adjusted Y-Axis Scale (Zoom View)

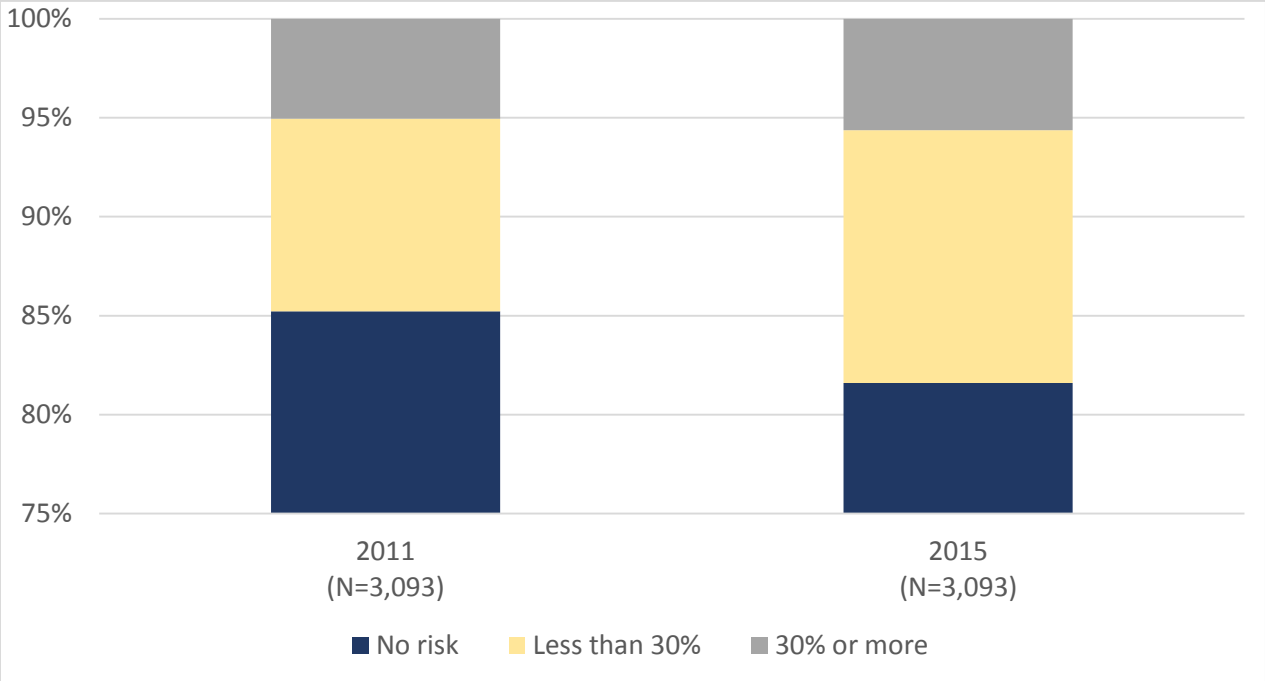


Exhibit 8. Risk Portfolio Among Risk Takers, 2011-2015

	Risk Portfolio Among Risk Takers *Mean (Std Error)* *[95% CI]*	
	2011 **N=457**	**2015** **N=569**
% Revenue at Risk	**10.9 (1.02)** [8.89, 12.9]	**11.3 (0.76)** [9.79, 12.8]
Median (25th, 75th percentile)	3 (1, 13)	4 (2, 14)
% Revenue Paid on Capitated Basis	**4.19 (0.51)** [3.19, 5.20]	**3.10 (0.38)** [2.35, 3.85]
Median (25th, 75th percentile)	1 (0, 2)	0 (0, 2)
% Revenue Paid on a Shared-risk Basis	6.33 (0.81) [4.73, 7.92]	8.00 (0.65) [6.71, 9.28]
Median (25th, 75th percentile)	1 (0,5)	2 (0, 8)
Contracts		
Number HMO Contracts	10.6 (0.48) [9.70, 11.6]	11.9 (0.51) [10.9, 12.9]
Median (25th, 75th percentile)	8 (5, 14)	8 (5, 15)
Number of PPO Contracts	17.6 (0.59) [16.5, 18.8]	21.2 (1.30) [18.6, 23.7]
Median (25th, 75th percentile)	16 (10,23)	16 (11, 23)
Number of Lives Covered on Capitated Basis	21,504 (2917) [15766, 27241]	17,584 (2176) [13307, 21861]
Median (25th, 75th percentile)	288 (0, 19,000)	0 (0, 15,374)

Exhibit 9. Percent of Hospitals Assuming Risk by Arrangement

	2011 N=3,093	2015 N=3,093
HMO Contract	74.2	75.9
PPO Contract	84.0	84.6
Medical Home	14.4	25.5
Joint Ventures		
Physician Arrangement	28.6	29.4
Arrangement with Non-Physician Group	27.1	29.4
Ambulatory Service	23.4	27.6
Ambulatory Surgery Center	5.95	7.18
Urgent Care Center	2.04	2.33
Transportation to health services	11.2	13.2
Rural health clinic	1.10	1.55
Physical rehabilitation outpatient center	5.40	6.27
Home health services	9.28	11.7

Exhibit 10. Characteristics of Hospitals by Risk Portfolio, 2011-2015

	No Risk (N=5,160)		Revenue at Risk (N=1,026)	
	2011 (N=2,636)	2015 (N=2,524)	2011 (N=457)	2015 (N=569)
Hospital Structure				
Network Affiliation	38.5%	41.2%	41.6%	33.4%
Teaching Status	5.05%	5.15%	16.4%	14.8%
Number of beds (<200)	71.0%	73.1%	52.9%	53.4%
Location				
Metropolitan	47.6%	61.6%	48.4%	79.4%
Strong Market Concentration	97.1%	98.6%	97.8%	99.1%
Ownership				
For-profit	16.7%	18.8%	9.41%	6.85%
Not-for-profit	61.8%	59.6%	69.8%	78.0%
Government	21.5%	21.6%	20.8%	15.1%
Clinical Staff (*Mean (Std Error)*)				
Total # Employed Physicians	42.6 (2.79)	52.2 (3.17)	120 (14.6)	158 (14.1)
Total # Privileged Physicians	272 (7.45)	292 (7.79)	462 (26.5)	598 (33.8)
% of Employed Physicians	18.5% (0.005)	18.9% (0.005)	24.0% (0.016)	27.2% (0.14)
Risk Contracts				
Medical Home	12.5%	21.1%	24.9%	44.8%
HMO	72.5%	73.2%	83.8%	88.0%
PPO	83.6%	82.8%	86.6%	92.3%

Exhibit 11. Do Structural Changes Affect Percent of Revenue at Risk?

	% Capitated (N=3,753)	% Shared Savings (N=3,724)	% Total Risk (N=3,701)
Medical Home	0.316 (0.69)***	1.106 (0.259)***	1.365 (0.307)***
# HMO Contract	0.006 (0.002)***	0.037 (0.006)***	0.052(0.005)***
# PPO Contract	-0.007 (0.003)**	-0.038 (0.008)***	-0.055 (0.012)***
% Employed MDs	0.524 (0.082)***	0.367 (0.371)	1.204 (0.261)***
Joint Venture Score	0.050 (0.222)	0.028 (0.654)	-0.432 (0.802)
Teaching Hospital	0.060 (0.084)	0.087 (0.199)	-0.176 (0.368)
Not-for-profit	-0.092 (0.086)	0.678 (0.842)	0.422 (0.595)
Network affiliation	-0.311 (0.076)***	0.233 (0.209)	-0.161 (0.324)
Metro	0.076 (0.82)	0.850 (0.343)**	0.425 (0.297)
Strong Market Concentration	0.402 (0.453)	1.156 (0.849)	0.938 (1.161)
Bed Size 6-24 beds	Ref	Ref	Ref
25-49 beds	-0.313 (0.186)*	1.087 (0.798)	0.598 (0.809)
50-99 beds	-0.134 (0.191)	-0.814 (0.829)	-1.333 (0.858)
100-199 beds	-0.111 (0.179)	0.218 (0.665)	0.005 (0.782)
200-299 beds	-0.208 (0.196)	-1.100 (0.709)	-1.536 (0.825)*
300-399 beds	0.959 (0.214)***	0.777 (0.759)	1.169 (0.908)
400-499 beds	0.398 (0.254)	1.273 (1.380)	1.881 (1.336)
500+ beds	0.399 (0.263)	0.229 (0.753)	1.158 (0.925)***
Year Dummy (2015)	-0.278 (0.067)***	-0.531 (0.287)*	-0.113 (0.233)

Notes: (1) Coefficients denote marginal effects resulting from GLM regression models; (2) Total Risk represents the sum of hospital net patient revenue tied to shared risk and revenue tied to capitation; (3)*$p<0.1$, **$p<0.05$, ***$p<0.01$; (3) Joint venture scores obtained from factor scoring where higher scores represent hospitals with more joint venture partnerships.

Exhibit 12. First Difference Model

	Change in Total % Revenue at Risk	Change in % Capitated Risk	Change in % Shared Risk
N	2,124	2,198	2,142
Explanatory Variables			
Medical Home	-0.536 (0.430)	-0.114 (0.144)	-0.319 (0.269)
% Employed MDs	-0.515 (0.572)	0.028 (0.254)	-0.411 (0.445)
Joint Venture Score	-0.866 (0.989)	-0.384 (0.472)	-0.33 (0.718)
Controls			
Teaching Hospital	0.085 (0.951)	0.118 (0.464)	0.049 (0.554)
Not-for-profit	-0.448 (1.025)	0.150 (0.331)	-0.385 (0.849)
Network affiliation	0.789 (0.445)*	-0.030 (0.159)	0.448 (0.315)
Metro	1.415 (0.427)***	-0.379 (0.145)***	1.440 (0.340)***
Strong Market Concentration	0.126 (0.591)	0.014 (0.778)	0.124 (0.585)
Bed Size (<200 beds)	1.401 (0.567)**	-0.027 (0.122)	1.374 (0.447)***

Notes: (1) Coefficients denote marginal effects resulting from first difference models; (2) Total % Revenue at Risk represents the sum of hospital net patient revenue tied to shared risk and revenue tied to capitation; (3) *$p<0.1$, **$p<0.05$, ***$p<0.0$; (3) Joint venture scores obtained from factor scoring where higher scores represent hospitals with more joint venture partnerships.

Exhibit 13. Consider the Reverse - Does Risk Assumption Drive Structural Changes?

	Medical Home (N=5,687)	**% Employed MDs** (N=5,051)	**Joint Venture** (N=5,865)	**HMO Contract** (N=4,454)	**PPO Contract** (N=5,012)
% Revenue at Risk	0.008 (0.002)***	0.004 (0.003)	0.000 (0.002)	0.009 (0.002)***	-0.005 (0.001)***
Teaching Hospital	0.421 (0.066)***	0.567 (0.075)***	-0.008 (0.053)	0.250 (0.054)***	-0.008 (0.056)
Not-for-profit	0.485 (0.080)***	0.172 (0.068)**	0.375 (0.040)***	0.214 (0.044)***	0.111 (0.046)**
Network affiliation	0.193 (0.056)***	0.034 (0.050)	0.221 (0.032)***	-0.085 (0.034)**	0.123 (0.063)*
Metro	0.164 (0.069)**	-0.202 (0.494)***	0.160 (0.036)***	0.258 (0.043)***	0.307 (0.050)***
Strong Market Concentration	0.138 (0.188)	-0.200 (0.162)	-0.134 (0.063)**	0.103 (0.164)	0.141 (0.107)
Bed Size					
6-24 beds	Ref	Ref	Ref	Ref	Ref
25-49 beds	-0.027(0.167)	0.090 (0.110)	0.004 (0.084)	0.092 (0.089)	0.157 (0.072)**
50-99 beds	0.122 (0.167)	0.221 (0.111)**	0.154 (0.089)*	0.279 (0.087)***	0.155 (0.071)**
100-199 beds	0.320 (0.156)	0.162 (0.111)	0.549 (0.081)***	0.342 (0.082)***	0.349 (0.131)***
200-299 beds	0.739 (0.155)***	0.190 (0.123)	0.691 (0.084)***	0.506 (0.094)***	0.245(0.074)***
300-399 beds	0.730 (0.162)***	0.312 (0.133)**	0.749 (0.086)***	0.478 (0.088)***	0.274(0.079)***
400-499 beds	0.924 (0.165)***	0.267 (0.153)*	0.738 (0.094)***	0.561 (0.099)***	0.298(0.094)***
500+ beds	1.062 (0.153)***	0.384 (0.129)***	0.918 (0.090)***	0.510 (0.092)***	0.325 (0.080)***
Year Dummy (2015)	0.449 (0.045)***	0.108 (0.031)***	0.090 (0.018)***	0.137 (0.031)***	0.049(0.046)

Notes: (1) Coefficients denote marginal effects resulting from GLM regression models; (2) Total Risk represents the sum of hospital net patient revenue tied to shared risk and revenue tied to capitation; (3)*$p<0.1$, **$p<0.05$, ***$p<0.01$; (3) Joint venture scores obtained from factor scoring where higher scores represent hospitals with more joint venture partnerships; (4) HMO and PPO contract variables represent counts for the number of contracts.

Exhibit 14. Characteristics of Hospitals Adopting Medical Homes

	Medical Home Adoption Status					
	In Place by 2011 (N=445)		Adopted Between 2011-2015 (N=389)		Disadopted Between 2011-2015 (N=78)	
	2011	2015	2011	2015	2011	2015
Revenue at Risk (%)	2.81 (0.50)	4.51 (0.61)	1.51 (0.40)	2.03 (0.39)	1.05 (0.46)	1.62 (0.66)
Employed Physicians (%)	27.2 (0.01)	28.8 (0.01)	22.7 (0.01)	27.1 (0.02)	13.1 (0.03)	15.1 (0.03)
Number of HMO Contracts	10.7 (0.49)	12.9 (0.71)	9.14 (0.44)	10.2 (0.47)	8.75 (0.73)	9.36 (0.72)
Venture Score	0.213 (0.01)	0.233 (0.01)	0.165(0.01)	0.211 (0.01)	0.214 (0.02)	0.179 (0.02)

Notes: (1) Values reported are means with standard errors in parentheses; (2) Venture scores obtained from factor scoring where higher scores represent hospitals with more joint venture partnerships.

Exhibit 15. Factors Affecting Medical Home Adoption

	Medical Home In Place by 2011 (N=1,766)	Medical Home Adopted Between 2011-2015 (N=1,935)
% Revenue at Risk	0.003 (0.001)***	0.004 (0.001)***
# HMO Contract	0.002(0.001)	-0.001(0.001)
# PPO Contract	-0.003 (0.000)*	-0.001 (0.000)**
% Employed MDs	0.126 (0.030)***	0.233 (0.033)***
Joint Venture Score	0.340 (0.054)***	0.384 (0.058)***
Teaching Hospital	0.055 (0.028)*	0.152 (0.033)***
Not-for-profit	0.132 (0.025)***	0.117 (0.023)***
Network affiliation	0.042 (0.017)**	0.055 (0.019)***
Metro	0.028 (0.018)	-0.001 (0.025)
Strong Market Concentration	0.076 (0.069)	0.020 (0.071)
Bed Size 6-24 beds	Ref	Ref
25-49 beds	-0.028 (0.042)	-0.026 (0.040)
50-99 beds	0.009 (0.043)	-0.024 (0.041)
100-199 beds	0.027 (0.042)	-0.015 (0.040)
200-299 beds	0.048 (0.044)	0.139 (0.046)***
300-399 beds	0.020 (0.046)	0.111 (0.051)**
400-499 beds	0.109 (0.054)**	0.183 (0.062)
500+ beds	0.136 (0.053)**	0.260 (0.071)

Notes: (1) Coefficients denote marginal effects resulting from logistic regression models; (2) % Revenue at Risk represents the sum of hospital net patient revenue tied to shared risk and revenue tied to capitation; (3) *$p<0.1$, **$p<0.05$, ***$p<0.0$; (3) Joint venture scores obtained from factor scoring where higher scores represent hospitals with more joint venture partnerships.

Appendix

Exhibit A1. Percent of Hospitals Assuming Risk by Arrangement for Hospitals That Completed the Survey in Both Years 2011& 2015 and Indicated Both Measures of Revenue at Risk

	2011 N=2,890	2015 N=2,890
HMO Contract	74.7	76.3
PPO Contract	84.6	85.0
Medical Home	14.7	25.9
Joint Ventures		
Physician Arrangement	29.0	30.0
Arrangement with Non-Physician Group	27.6	30.2
Ambulatory Service	22.63	26.75
Ambulatory Surgery Center	6.09	7.37
Urgent Care Center	2.04	2.35
Transportation to health services	11.4	13.3
Rural health clinic	1.07	1.63
Physical rehabilitation outpatient center	5.36	6.19
Home health services	9.07	11.63

Exhibit A2. Characteristics by Risk Portfolio Among Hospitals That Completed the Survey in Both Years 2011& 2015 and Indicated Both Measures of Revenue at Risk

	No Risk (N=5,018)		Revenue at Risk (N=762)	
	2011 (N=2,566)	**2015 (N=2,452)**	**2011 (N=324)**	**2015 (N=438)**
Hospital Structure				
Network Affiliation	38.7%	41.7%	47.1%	55.4%
Teaching Status	5.03%	5.14%	21.3%	17.1%
Number of beds (<200)	70.8%	72.7%	43.8%	47.7%
Location				
Metropolitan	47.4%	61.5%	47.5%	83.8%
Strong market concentration	98.7%	98.6%	98.8%	99.1 %
Ownership				
For-profit	16.9%	18.6%	6.2%	5.9%
Not-for-profit	61.5%	60.1%	77.2%	81.5%
Government	21.6%	21.3%	16.7%	12.6%
Clinical Staff *Mean (Std Error)*				
Total # Employed Physicians	42.5 (2.85)	52.5 (3.23)	145 (18.7)	171 (16.1)
Total # Privileged Physicians	271 (7.56)	294 (7.95)	544 (32.5)	644 (39.3)
% of Employed Physicians	18.4% (0.006)	18.9% (0.005)	25.3% (0.019)	27.3% (0.015)
Risk Contracts				
Medical Home	13.3%	21.3%	33.3%	52.1%
HMO	73.0%	74.0%	93.8%	92.2%
PPO	84.6%	83.8%	95.3%	95.2%

Exhibit A3. Percent of Hospitals Assuming Risk by Arrangement for Hospitals That Completed the Survey in Any Year 2011 or 2015 with Response to At Least One Measure of Revenue at Risk and Imputed the Other

	2011 N=4,493	2015 N=4,480
HMO Contract	*63.6*	*63.8*
PPO Contract	*72.4*	*70.8*
Medical Home	*12.3*	*21.4*
Joint Ventures		
Physician Arrangement	24.1	24.9
Arrangement with Non-Physician Group	22.5	24.2
Ambulatory Service	20.7	24.1
Ambulatory Surgery Center	5.00	5.91
Urgent Care Center	1.67	2.10
Transportation to health services	9.97	11.7
Rural health clinic	0.912	1.43
Physical rehabilitation outpatient center	4.81	5.45
Home health services	7.70	10.1

Exhibit A4. Characteristics by Risk Portfolio Among Hospitals That Completed the Survey in Any Year 2011 or 2015 with Response to At Least One Measure of Revenue at Risk and Imputed the Other

	No Risk (N=7,620)		Revenue at Risk (N=1,106)	
	2011 (N=3,873)	2015 (N=3,747)	2011 (N=495)	2015 (N=611)
Hospital Structure				
Network Affiliation	33.8%	35.4%	41.8%	51.5%
Teaching Status	4.36%	4.24%	17.2%	15.2%
Number of beds (<200)	73.5%	75.1%	49.1%	51.7%
Location				
Metropolitan	48.8%	63.9%	47.9%	82.3%
Strong market concentration	96.9%	98.5%	98%	98.4%
Ownership				
For-profit	20.9%	23.3%	9.70%	9.17%
Not-for-profit	56.2%	54.4%	72.5%	76.8%
Government	22.9%	22.4%	17.8%	14.1%
Clinical Staff *Mean (Std Error)*				
Total # Employed Physicians	39.7 (2.31)	49.8 (2.66)	135 (15.7)	156 (12.3)
Total # Privileged Physicians	252 (6.11)	278 (6.67)	517 (27.1)	586 (31.5)
% of Employed Physicians	18.8% (0.005)	19.3% (0.005)	24.3% (0.017)	27.3% (0.013)
Risk Contracts				
Medical Home	10.9%	18.1%	25.4%	44.5%
HMO	62.5%	61.2%	77.8%	93.1%

Exhibit A5. Effect of Structural Changes on Total Revenue at Risk for Other Hospital Samples

	% Total Revenue at Risk	
	Sample Described in Exhibits A1 & A2 (N=3,615)	**Sample Described in Exhibits A3 & A4** (N=4,456)
Medical Home	1.226 (0.171)***	1.307 (0.169)***
# HMO Contract	0.047 (0.002)***	0.045 (0.002)***
# PPO Contract	-0.051 (0.006)***	-0.046 (0.005)***
% Employed MDs	1.107 (0.136)***	0.758 (0.130)***
Joint Venture Score	-0.423 (0.308)	-0.228 (0.316)
Controls		
Teaching Hospital	-0.101 (0.144)	-0.053 (0.137)
Not-for-profit	0.368 (0.198)*	0.152 (0.178)
Network affiliation	-0.113 (0.113)	0.035 (0.104)
Metro	0.347 (0.149)**	0.535 (0.145)***
Strong Market Concentration	0.838 (0.820)	0.742 (0.875)
Bed Size		
6-24 beds	Ref	Ref
25-49 beds	0.175 (0.331)	0.549 (0.420)
50-99 beds	-2.275 (0.959)**	-1.412 (0.749)
100-199 beds	-0.142 (0.340)	0.114 (0.427)
200-299 beds	-7.759 (8.833)	-6.352 (4.928)
300-399 beds	0.560 (0.353)	0.831 (0.421)**
400-499 beds	0.691 (0.348)**	0.829 (0.434)*
500+ beds	0.395 (0.341)	0.559 (0.428)
Year Dummy (2015)	-0.092 (0.091)	-0.404 (0.090)***

Exhibit A6. First Difference Analysis with Additional HMO & PPO Contract Variables

	Change in Total % Revenue at Risk	Change in % Capitated Risk	Change in % Shared Risk
N	1,464	1,498	1,477
Explanatory Variables			
Medical Home	-0.920 (0.968)	-0.156 (0.159)	-0.257 (0.349)
% Employed MDs	-0.771 (1.168)	-0.173 (0.314)	-0.754 (0.514)
Joint Venture Score	-1.866 (1.949)	-0.458 (0.504)	-0.691 (0.932)
# HMO Contracts	-0.019 (0.021)	0.003 (0.007)	-0.006 (0.016)
# PPO Contracts	-0.00 (0.007)	-0.002 (0.004)	-0.002 (0.010)
Controls			
Teaching Hospital	0.224 (0.198)	0.107 (0.483)	0.033 (0.669)
Not-for-profit	-0.136 (1.055)	-0.086 (0.422)	-0.255 (0.921)
Network affiliation	0.942 (0.867)	0.136 (0.191)	0.213 (0.459)
Metro	0.974 (0.538)*	-0.336 (0.154)**	1.173 (0.366)***
Strong Market Concentration	0.175 (0.738)	0.015 (0.776)	0.242 (0.863)
Bed Size (<200 beds)	1.030 (0.522)**	-0.071 (0.135)	1.121 (0.478)**

Chapter 4

The Role of Clinical and Operational Standardization in Delivering High-Value Care: A Case Study of Emory Healthcare's Value Acceleration Strategy for Sepsis

Introduction

Current health care reforms seek ways to improve care quality and reduce costs. Trends toward greater efficiency continue with the expectation that providers adopt value-based payment models designed to address many of the systemic inefficiencies attributed to how care is delivered and the provision of unnecessary services (Olsen, Saunders, & Yong, 2010). The use of data to identify opportunities for improvement and standardization of processes, operational changes co-led by physicians and nurses, and facilitation by hospital administration are all factors attributed to value creation among health systems participating in new payment models (Hougaard, 2004; Lee et al., 2016; Stutz, 2013). Despite these best practices, the delivery of high-value care is difficult, even for esteemed provider organizations (Goitein & James, 2016).

Academic medical centers (AMCs) in particular, have the added burden of delivering value-based care within a traditionally higher cost organizational structure. For many reasons, including higher patient complexity contributing to the lack of standardization in care pathways, academic centers must balance the objectives of value-based payment with the inherently costly nature of delivering highly-specialized clinical care (Lee et al., 2016; H. D. Miller, 2015; Swensen, Dilling, Harper Jr, & Noseworthy, 2012). As AMCs increasingly face the pressures of payment reform, many organizations are beginning to explore strategies to reduce variation in clinical practice to thereby decrease to in turn, cut costs in preparation for risk.

Interventions to reduce variation can improve care quality and efficiency by establishing consistency amongst clinicians based on evidence-based practices (Sniderman & Furberg, 2009; Timmermans & Mauck, 2005). The clear gap between recommended clinical guidelines and clinician adherence when treating patients warrants the need for broader scale implementation of standardization interventions (Tricoci, Peterson, & Roe, 2006). The use of evidence-based guidelines can facilitate care standardization, which enables provider organizations to more effectively track and avoid costly adverse outcomes, particularly for patients with high-risk conditions such as sepsis and heart failure. These guidelines can affect several dimensions of care delivery. For example, standardization practices can influence diagnostic decision-making (e.g., what tests to order), when a provider initiates certain care processes, or how to administer a specific protocol or procedure (Timmermans & Mauck, 2005).

While much of the variation in clinical care is unwarranted (Gauld, Horwitt, Williams, & Cohen, 2011), the delivery of high-value care also demands some degree of clinical nuance to ensure patient-centeredness (Farias et al., 2013). Given the increasing complexity of patient profiles for a given condition – such as in the case of a patient presenting with multiple comorbidities -, the recommended treatment options according to the clinical standard may be insufficient or ineffective (Lavelle, Schast, & Keren, 2015). Concerns about how clinical standardization efforts may promote "cookbook" medicine are important to reconcile when designing a high-value delivery system. Thus, to be successful in the new payment environment, AMCs will need to develop evidence-based care pathways that both leverage structured data and processes, but also permit clinical subjectivity. While the literature discusses the need for clinical and operational standardization, less is known about what strategies are available to provider organizations to create efficiencies.

Emory Healthcare's Value Acceleration Strategy

Emory Healthcare (EHC) is an example of a provider organization that has instituted a system-wide strategy to navigate the transition towards value-based care delivery. EHC, based in Atlanta, GA, is

a multidisciplinary academic center comprised of seven hospital facilities. Their approach for responding to the new payment structure is known internally as the Value Acceleration Program (VAP). The VAP, led by EHC's Director New Care Models in Office of Quality and Risk, deploys operational and clinical standardization strategies to support process improvement and cost reduction. External review of the system was previously conducted to determine which clinical areas have the most cost variation in order to prioritize value improvement initiatives. The review identified that across EHC's four primary hospitals, a potential of $34-53 M in cost savings was tied to operational and clinical standardization opportunities. Accordingly, the VAP convened clinician-led teams for each high priority service line, defined as clinical areas with the most direct variable costs, to design and implement evidence-based interventions for quality improvement and cost reduction.

This article examines the effectiveness of specific VAP interventions deployed across EHC's clinical services with high variability, as identified by the external review. Management of sepsis was one such high variability area noted both as a clinical priority, and as having a potential savings opportunity upwards of $1.61-2.39 million. Accordingly, I present a case study describing and evaluating the strategies deployed for managing the adverse costs and outcomes associated with variability in sepsis management. This case study analysis (1) measures the cost savings and improvement in outcomes associated with the sepsis interventions; and (2) identifies key elements attributed to successful implementation of the operational and clinical interventions deployed across EHC hospitals.

A Focus on Sepsis Management

Early detection and management of sepsis among infections present on admission (POA) is an increasing clinical priority (Howell & Davis, 2017). This is largely due to the fact that majority of sepsis hospitalizations are due to community-acquired infections, as opposed to hospital-acquired and post-discharge complications (Prescott & Angus, 2018). The Surviving Sepsis Campaign recommends health

systems should implement formal programs for improving sepsis care and management by incorporating process improvements related to timely antibiotic administration and stewardship, fluid resuscitation and mechanical ventilation (Howell & Davis, 2017). The effectiveness of these improvement initiatives will likely depend on the extent to which the health system provides its clinicians with the tools (e.g., checklists) to actually engage with these standardization initiatives (Damiani et al., 2015; Howell & Davis, 2017).

Theoretical Framework

To examine my focal relationship between implementation of clinical and operational standardization initiatives and provider performance, I leverage Donabedian's Model for Evaluating Health Care Quality (Exhibit 1) (Donabedian, 1966). I consider the broader policy context of value-based payment reform as an antecedent to the establishment of formal structures to optimize performance. In the context of this study, the resulting formal structure at EHC is the VAP. VAP provides the incentives and support for the development of new processes for clinical standardization. These quality improvement processes will in theory, make care delivery more efficient resulting in improved performance outcomes. Changes in clinical practice however, disrupt the status quo (Gupta, Boland, & Aron, 2017). Thus, physician engagement within the organization and receptiveness to hospital leadership are also likely to be positively tied to compliance with the new care pathways (Frølich et al., 2007; Reiter et al., 2006). Accordingly, I identify these hospital leadership constructs as an unobservable confounder to the focal relationship (Sniderman & Furberg, 2009).

Hypotheses

Hospitals engaging in strategies to reduce clinical variation are more likely to deliver higher quality, efficient health care (Sniderman & Furberg, 2009; Timmermans & Mauck, 2005). Therefore,

providers with clinical and operational standardization processes in place will be better positioned to improve performance. The degree to which a given intervention yields comparable efficiency gains across multiple care facilities will depend on extent to which each organization adjusts its internal resources and approaches to engage frontline clinicians and align with this standardization strategy (Alexander, 2001; Burgelman, 1991; Farias et al., 2013; Gupta et al., 2017; Spaulding et al., 2018). Hence, I make the following hypotheses in the context of evaluating standardization initiatives at EHC:

> *H1. Implementation of clinical and operational standardization processes for managing sepsis at EHC will be associated with positive improvements in clinical/quality and financial outcomes.*
>
> *H2: The degree to which individual EHC hospitals take steps to internally to engage and monitor clinicians in these new initiatives, as primarily reflected by the proportion of clinicians using the sepsis powerplan, will have a direct relationship with the magnitude of improvements observed.*

Data & Methods

A case study of EHC was conducted from 2012-2017 using a mixed-methods approach. A pre-post, longitudinal study design was used to evaluate the effectiveness of sepsis-related interventions in improving clinical and financial outcomes. Data were further analyzed using qualitative assessments of intervention implementation.

Data Sources

Semi-structured interviews were conducted from November 2017 to February 2018 with VAP clinical leaders at the system- and hospital-level. Interviews lasted approximately 45 minutes in length. I also observed one monthly VAP sepsis working group meeting at each of the four hospitals. Information regarding the specific sepsis-related interventions that were implemented in 2014 was collected via interviews with EHC system leadership (shown in Exhibit 2). The primary initiative deployed was the use

of powerplans for both nurses and physicians to use. These powerplans use patient data from the electronic health records to generate recommended evidence-based order sets. For example, if a nurse initiates the suspected sepsis powerplan, it will generate screening options such as immediate blood draws and lactate culture collections. Interviews at the hospital-level were intended to better understand organizational factors that facilitate and hinder successful implementation of quality improvement initiatives. For clarifying information, I also informally interviewed administrative personnel in the EHC's Finance Department as well as the data managers supporting the Office of Quality.

The case study was based upon EHC's four multi-specialty hospitals: Emory University Hospital (EUH), Emory University Hospital - Midtown (EUHM), Emory John's Creek Hospital (EJCH), and Emory Saint Joseph's Hospital (ESJH). EUH and EUHM are the largest hospitals located in the metropolitan center with 733- and 529-staffed beds, respectively. Whereas, ESJH and EJCH are relatively smaller, located in suburban neighborhoods with 410 and 118 beds, respectively.

Clinical and financial data was obtained from Emory Healthcare's database of de-identified patient records. Emory University Institutional Review Board approved use of this data for the study. The analytic sample was limited to patient observations with a septicemia or severe sepsis diagnosis denoted with MS-DRG codes 870-872 ("MDC 18 Infectious & Parasitic Diseases, Systemic or Unspecified Sites Septicemia or Severe Sepsis,"). I excluded outlier observations, defined as any patient with a length of stay duration more than three times the Vizient benchmark for length of stay days per DRG. *Vizient (formerly known as University Hospital Consortium (UHC)) Database. Vizient is an alliance of 5,200 health systems and their affiliated hospitals representing independent, community-based healthcare organizations, integrated systems and academic medical centers.*

Measures

To characterize the study sample, I evaluated the risk profile, or acuity, of sepsis patients coming through EHC. To do so, I relied on two key measures: All Patient Refined (APR) risk of mortality and APR severity of illness. A patient's severity of illness or risk of mortality scores considered the interaction between the level of the secondary diagnoses, age, primary diagnosis, and the procedure indications (e.g., surgical, non-surgical).[1] Scores ranged from 1 to 4 indicating -minor, moderate, major or extreme severity or risk levels, respectively. While both APR measures seem analogous, a patient may score high on one metric but low on the other. For example, a patient suffering from a car accident may have low severity of illness, but extremely high risk of mortality.

For my primary analyses, I selected the following performance measures to evaluate based upon core sepsis measures evaluated in the literature[2] and pertinent to EHC leadership: the number of patient safety indicators, number of 30-day readmissions, mortality rates, clinician use of sepsis powerplans, hospital length of stay, ICU length of stay and total direct variable costs per patient. Mortality was measured as the occurrence of an inpatient death during the course of hospitalization. I measured use of sepsis powerplans as an indicator variable for whether a sepsis encounter resulted in initiation of the suspected sepsis or sepsis management protocol by a nurse or physician during the course of a patient's hospitalization. Length of stay counts are based off the number of days that are charged according to the CMS' and EHC Finance's methodologies. This means that even if a patient is admitted for an hour, they will be documented as a length of stay of one day. Total variable direct costs represents the component of costs that is directly associated with the care of a patient.

[1] https://archive.ahrq.gov/professionals/quality-patient-safety/quality-resources/tools/mortality/Hughes2.html
[2] Add cite

To measure the effect of VAP initiatives on financial performance, I consider total variable costs (dollar amount per patient) as well as break costs down by domain. I measure costs along five key domains: labor, benefits, implants, drugs, and medical/surgical. Other costs not directly examine would include spending for blood products administered and other minor treatment costs. As it relates to sepsis, labor-related costs are primarily attributed to care provided by nurses as a function of their time. These costs do not include professional fees such as physician salary. Benefit costs are closely related to labor costs. Labor and benefits can be used as a proxy for length of stay insofar as the longer a patient spends in the hospital, the more FTE nursing hours that are attributed. Labor and benefits are an important measure to consider in sepsis management because much of patient care occurs on the floors or ICU, as opposed to costs attributed to procedures. Costs related to implants refer to any object or device that stays within the patient body (e.g., cardiac valve, dialysis catheter). Drug costs refer to any drugs that are administered to the patient during course of treatment. For sepsis patients, the most common type of drugs administered are antibiotics, vasopressors and albumin. Lastly, medical/surgical costs refer to material items used in the operating room for procedures or surgeries (e.g., IV tubing, sutures).

Statistical Analyses

One-tailed, t-tests for unequal variances were conducted to evaluate the effect of sepsis-related VAP interventions on clinical and financial outcomes. All interventions were rolled out system-wide throughout the course of 2014. Accordingly, I classified 2012-2013 as the pre-period and 2015-2017 as the post-period. I then compared EHC's performance to peer group of 40 other AMCs. Data for two primary sepsis measures – length of stay and mortality – were obtained for the peer group from Vizient. Both measures were already risk adjusted. I used the following general model to conduct a pre- post-test with concurrent control:

$$\mathbf{y}_{it} = \beta_0 + \beta_1 \text{ VAPintervention\_Post}_{it'} + \beta_2\mathbf{X} + \beta_3\text{Pre\_Post}_{it} + \varepsilon_{it}\mathbf{;}$$

where **y** is the vector clinical and financial performance outcomes; **X** is a control variable for number of cases; and VAPintervention_Post represents the time effect pertaining to the implementation of the sepsis initiatives. The results of the control group comparisons are shown in Appendix Exhibits A1 and A2. My primary analyses do not account for the results of the peer comparison due to substantial variation in the control group. For example, the control group includes hospitals ranging in size from 272 to 1251 beds. Since Vizient only provides peer data as aggregated outcomes for the entire group, it is difficult to parse out such variation. All analyses were conducted in STATA Version 12.

Results

Characteristics of the Study Sample

Exhibit 3 presents descriptive information characterizing the patient population examined at the system and individual hospital level. From 2012-2017, EHC treated and managed sepsis for 11,889 patients, or approximately 15% of all EHC's cases. 66% of all sepsis cases were seen at EUH and EUHM hospitals. EUH and EUHM hospitals also have greater proportion of Medicaid patients relative to EJCH and ESJH. Yet, across all EHC hospitals, Medicare covered the majority (59-70%) of sepsis patients. In addition to financial classification, I also examined differences in patient acuity across each hospital facility. On a scale of 1 to 4 where 4 indicates the most severe/risky patients, the average severity of illness for sepsis patients at EHC is 3.19. Severity scores are as low as 3.07 at ESJH to 3.28 at EUH. Whereas the risk of mortality is 3.01 for EHC, but ranges from 2.94 to 3.04 across its hospitals.

Coding Sepsis

Depending on the clinical presentation, sepsis patients are coded as one of three DRG codes: 870,

871 or 872. Examination of coding practices from 2012-2017 (Exhibit 4) reveals an increase from the pre to post periods in the number of sepsis cases detected, or documented, across EHC. The visual presented in Exhibit 4.A. shows a change in the distribution of which sepsis DRGs are coded over time; and Exhibit 4.B. presents a more specific breakdown by individual hospital. It is evident that across all EHC hospitals there has been a decline in the proportion of cases coded as DRG 870, a product of the VAP initiatives. In both pre and post periods, DRG 871 comprises the greatest proportion of all sepsis cases. With the exception of EUHM, there appears to be a modest decline in the number of cases documented as DRG 872 resulting from the initiatives.

To adequately assess the implications of changes in DRG coding over time, it is important to understand key clinical and financial attributes associated with managing patients within each DRG (Exhibit 5). DRG 870 is attributed to patients with higher acuity with an average illness severity score of 4; whereas DRG 872 is associated with lower acuity patients averaging a severity score of 2.46. The risk of mortality is nearly double for 872 patients compared to those in DRG 870. The level of patient acuity is proportional to the costs associated with treatment. On average, 870 patient are admitted to the hospital for 15.2 days, of which 74% of the time is spent in the ICU. Comparatively, 871 and 872 patients spend 6.5 and 4.5 days in the hospital, respectively. Among these lower acuity patients, approximately 40-46% of treatment time is spent in the ICU. Acuity and treatment days also correlate with total costs. The average cost for managing an 870 patient ($28,690) is almost seven times more the cost of an 870 patient and 3.7 times the cost of an 871 patient.

Comparing Outcomes Pre and Post Implementation of Sepsis Initiatives

All clinical and quality performance outcomes improved upon implementation of EHC's sepsis standardization initiatives except for the rate of hospital readmissions. For financial performance, EHC

improved on most metrics except for costs associated with benefits and implants. Exhibit 6 details the specific changes pre and post implementation for all performance outcomes. More details regarding performance trends for each outcome by system and hospital are provided in the Appendix (Exhibits A3-A15). The most notable improvements in quality were reductions in the average length of stay in the hospital and ICU by 0.8 and 0.06 days, respectively. From a financial perspective, implementation of VAP initiatives resulted in an average reduction in total cost per patient of $1,523. Of this amount, the largest amount of savings were attributed to labor costs with a reduction of $999 between the pre and post periods.

The primary standardization initiative deployed by VAP was the implementation of the sepsis powerplan for nurses and physicians. On average, more providers used the powerplan in the post period (Exhibit 6) suggesting that the widespread improvements in financial and clinical outcomes are a direct result of the changes in care delivery prompted by such initiatives. Exhibit 7 further shows the proportion of clinicians – nurses and physicians – that use the powerplan over time and by individual hospital. Trends reveal that ESJH experienced the greatest increase in the use of the powerplan. Overall, ESJH and EJCH were the hospitals with the highest rates of clinician use of the powerplan.

An analysis of changes in cost distribution is provided in Exhibit 8. Then overall distribution of cost inputs remains relatively unchanged after implementation of standardization protocols. Labor and benefits constitute (approximately 70%) of the greatest proportion of costs associated with managing a sepsis patient. I find that implant and other costs accounted for a relative increase of one percentage point between the pre and post periods. Alternatively, medical/surgical and drug costs make up a smaller portion of total costs in the post period, but this change is still relatively small.

Qualitative Analysis

The results of the empirical analysis show that all four EHC hospitals improved their clinical and financial performance as a result of the VAP initiatives despite some variation by hospital in clinician use of the sepsis powerplan. I find that the key elements supporting EHC successful implementation of sepsis improvement initiatives can be attributed to: streamlined documentation practices, the role of the clinical nurse specialist, robust data and transparency, and bottom-up leadership and shared governance.

Streamlined Documentation Practices

Standardized processes for documenting and coding patients presenting with sepsis contributes to improved performance system-wide. While all EHC hospitals have a general documentation process and standard in place, each hospital varies in its implementation. Notably, ESJH has the most comprehensive template and practices for documentation. ESJH embraces the practice of early sepsis screening by formally documenting all suspected cases of sepsis POA. By doing so, the documentation input signals to care providers to initiate the powerplan and other sepsis-related protocols as early as possible. The powerplan presents orders for septic patients such as lactate blood tests and urine cultures. By documenting early, providers are at least prompted to screen patients and if a patient is negative for sepsis, then they go back and amend patient note that patient isn't septic. Amending the patient note ensures that the patient does not show as septic upon discharge. Alternatively, if suspected sepsis is not written into the patient note upon admission and the patient is truly septic, then a patient's condition is likely to worsen or remain undetected for a longer period of time, putting the patient at greater risk and susceptible to adverse outcomes. These nuanced changes in coding make a big difference in terms early interventions to prevent negative downstream effects, but also in terms of reimbursement. A patient with sepsis POA if coded correctly, will receive sufficient payment to cover valuable resources upfront as opposed to having inadequate coverage when coded later. For example, if a patient is coded as a primary

diagnosis of chest pain and already has an infection, but isn't coded, the care provider is losing out on valuable resources to manage both conditions. Moreover, the provider may receive penalties if the infection wasn't coded as sepsis upfront as it may be considered as a complication due to the care being provided for chest pain.

Part of the challenge in observing early documentation practices uniformly throughout the health system is variation in clinical judgment, or clinical nuance. According to feedback from EHC coding and administrative services, providers have different definitions and interpretations of what sepsis is. Characterizing sepsis when presented with other conditions poses additional challenges. For example, how would a physician code a patient that presents with symptoms resembling both a perforated bowel and severe sepsis? Rather than waiting to determine the diagnosis, according to EHC practices, the provider should have coded the patient as sepsis initially and then change the patient note to perforated bowel upon diagnostic confirmation. This is because from a clinical perspective, there is no harm in responding to a perforated bowel with a sepsis protocol when the etiology is unknown. The concept of declaring a patient with sepsis POA, particularly in settings like the emergency department, is uncomfortable for many physicians. Providers usually want a lot more information and labs run before making a call on sepsis in order to be exactly right about a patient's condition. ESJH has overcome some of these challenges with constant education and communication with physicians to convey that early screening or therapy administration for sepsis, based on vitals and not absolute testing, will not harm the patient even if the primary diagnosis is different. Rather, there are most positives to gain such as more cases detected, early intervention and appropriate reimbursement for treatment.

Earlier documentation for sepsis is more robust in ICU settings as opposed to the emergency department. This is because critical care is more amenable to protocolization given the more consistent

presentation of patient conditions. Whereas in the emergency department, there is a much larger and more clinically diverse patient population that is being treated. One way EHC has begun to address this gap in documentation practices by care setting is by providing documentation templates. Following the example of ESJH, hospitals are posting a template in high traffic areas around the hospital to guide physicians in terms of clinical indicators to assess for, and sample language to effectively code suspected sepsis. Lastly, a few physicians also expressed hesitation in calling sepsis early due to recent changes in sepsis guidelines. Every few years, the evidence-based guidelines for critical care and sepsis management are updated. In recent years, there has been a change in the recommended amount of fluids that should be administered to a patient with sepsis as well as some differences in classification between sepsis and severe sepsis. Accordingly, physicians all have different notions of what is clinically defined as sepsis depending on how up to date they are with guidelines or when they completed their training.

Role of the Clinical Nurse Specialist

While the VAP initiatives are aimed at reducing sepsis through implementation of systematic processes, I find that nurses are at the core of these initiatives. At EHC, clinical nurse specialists (CNS) are dedicated to sepsis improvement function as on-site experts to ensure that clinicians follow clinical standards and guidelines. A CNS is considered as an expert clinician with advanced education and training in a specialized area of nursing practice. CNS' partake in the more traditional clinical duties of diagnosis, treatment, and ongoing management of patients; but are distinguished in their provision of expertise and support to nurses caring for patients at the bedside. These individuals help drive practice changes throughout the organization, and ensure the use of best practices and evidence-based care to achieve the best possible patient outcomes.

Within EHC, EUH and EUHM have a CNS per clinical unit, whereas EJCH and ESJH have 1-2 for the entire hospital. Nonetheless, a single CNS is designated as the nurse lead for sepsis quality improvement within each hospital. This individual is responsible for managing a broader clinical team of

nurses, physicians, pharmacists, etc. that will be discussed in detail in the following sections. A unique feature of the CNS role is that they are the "clinical boss" of the other nurses, but not their manager. This means that the CNS does not weigh into hiring or promotion decisions which helps with gaining buy-in with the frontline nurses. This is important because as it relates to sepsis management, the CNS educates staff and tracks data collected through the EHR to monitor both clinician adherence to VAP initiatives as well as performance on sepsis-related outcomes. When staff are not engaging in use of the sepsis powerplan or other VAP initiatives, the CNS has the credibility with the frontline nurses to check in at an individual level and understand reasons for deviation.

Integrating all these functions, the CNS leads view themselves as "cultural change agents". These leaders take a system-level view to integrate evidence-based care approaches for patient populations, not just individual patients. More than just managing patient care at the bedside, the CNS is actively engaged in reviewing the literature on new protocols and best practices for sepsis treatment. This clinical perspective paired with a broader understanding of the broader system as it relates to changes in reimbursement and the increased emphasis on quality and performance outcomes, enables the CNS to effectively champion sepsis improvement initiatives.

Robust Data and Transparency

As a system, EHC employs the principle of "dynamic democratization of data" when designing, implementing, and evaluating VAP initiatives. As a result, EHC created its own in-house "value dashboard" to provide sepsis leadership with real-time, accessible and relevant data. Hospital leads have access to view all system or individual hospital data as a visual dashboard to view trends in financial and quality metrics over time, down to the specific month. These trends are also shown as comparisons against the national average or benchmark for each respective measure. Perhaps more importantly, sepsis team leaders are also provided with detailed data points for process measures that directly drive outcomes. A list of some of the core processes tracked monthly across EHC and by individual hospital is provided:

- *Sepsis encounters* – The number of encounters discharged from EHC during a given month with a sepsis MS-DRG code.
- *Present on arrival and severe sepsis* – The percent of all sepsis encounters with sepsis present on admissions (time zero within 24 hours of arrival) who had an administrative code for severe sepsis or septic shock.
- *ICU encounters* – The percent of all sepsis encounters who spent at least 1 night in an ICU, or expired on day of ICU arrival.
- *Encounters with ventilation* – The percent of all sepsis encounters with non-invasive and invasive mechanical ventilation.
- *Screened for sepsis* – The percent of all sepsis encounters with a completed sepsis screen performed at any point during their hospitalization.
- *Screened positive for sepsis* – The percent of all sepsis encounters who screened positive for sepsis at any point during their hospitalization.
- *Sepsis protocol initiation* – The percent of sepsis encounters with documentation of sepsis protocol, or powerplan, initiation during their hospitalization. This measure reports the use of the two different powerplans: (1) initial or suspected sepsis; and (2) sepsis management or severe sepsis.
- *Blood culture collection* – The percent of all sepsis encounters with a blood culture collected within three hours of time zero, among POA encounters with severe sepsis.
- *Time to collect blood culture* – The average number of minutes between time zero and the first blood culture collection, among POA encounters with severe sepsis Excludes cultures collected before time zero.
- *Blood culture order to collection* – The average number of minutes between when a blood culture was ordered and collected, limited to the first order, among all sepsis encounters.
- *Antibiotic initiation* – The percent of encounters with antibiotics administered within three hours

of time zero among POA encounters with severe sepsis.

- *Antibiotic order to initiation* – The average number of minutes between antibiotic order and administration, limited to first administered antibiotic, among POA encounters with severe sepsis. Excludes antibiotic orders placed after administration.
- *Fluid administration* – The percent of encounters with at least 30 ml/kg of IV fluids administered within three hours of time zero, among POA encounters with severe sepsis.
- *Physical therapy* – The percent of encounters who received at least one physical therapy treatment session in the ICU, among all sepsis encounters who spent at least one night in the ICU.

Equipped with this data, formal unit leaders are responsible for reviewing process and outcome performance. With data that is sourced to the individual clinician, such as nurse time to respond to sepsis alert trigger, unit leads can engage with noncompliant staff at a one-on-one level. For example, if a nurse floor lead notices that there is one nurse that is consistently ignoring the trigger alert system, the CNS will check in with the nurse in question to identify why this is the case. Based off the nurse's response, the CNS or unit lead can work with the nurse to overcome any challenges that may be contributing to low compliance. In other cases, the simple act of monitoring and showing individual clinicians their personal data reports, there is a greater sense of accountability. Many of the unit leaders mentioned in their interviews that after speaking with a noncompliant clinician once, there were rarely any issues moving forward.

Bottom-up Leadership and Shared Governance

At the system level, EHC's Director of New Care Models appoints a physician and nurse lead to oversee all VAP initiatives for sepsis. System leadership convenes monthly and now bimonthly (as of January 2018) meetings with all hospital-level sepsis leads. These monthly meetings are used as a time

for each hospital team – lead physician and lead clinical nurse specialist – to present their progress on sepsis improvement and discuss any challenges or resources needs. System meetings usually begin with review of the data dashboard to see how all hospitals are performing in terms of both process and outcome measures (e.g., mortality rate). There is a greater emphasis put on process measures as it relates to adherence to the VAP initiatives. These process measures include provider use of the sepsis powerplan, time to administer an antibiotic or draw labs, and provider response time to a sepsis trigger. While reviewing each hospital's progress, each hospital team shared their experiences with the tactical implementation. This discussion results in a collaborative, shared learning experience in which all sepsis leads seek ways to troubleshoot common challenges, such as improving the percent of physicians who use the powerplan, and identify pertinent best practices. Weaved into these discussions were hospital team requests for additional support from EHC system. Requests were infrequently related to financial support, but rather asks for documentation templates, more frequent data progress reports, or suggestions for additional data measures that would be helpful in facility efforts to improve compliance with standardized protocols. Lastly, each system meeting ended with a discussion of action items and goals. Although the meeting is convened by EHC, the hospital teams lead goal setting. System leadership recognizes that the differences in outcomes across each facility are inevitable due to the differences in patient populations. Moreover, successful implementation of the VAP initiatives will depend on hospital-level leadership and the extent to which individual clinicians are aligned with sepsis improvement objectives. Accordingly, EHC does not expect all of its hospitals to achieve the same clinical benchmarks nor does it set specific performance targets (e.g., reduce readmissions rate by 2-3%). Rather, system leaders defer to hospital leaders to set achievable goals specific to their facility's unique situation and monitor progress directionally.

While every EHC facility has a designated physician and CNS lead for sepsis quality improvement, an interdisciplinary committee supports each hospital team in these efforts. The dynamic between the two leads is very collaborative and supportive. Yet across all hospital, the physician lead

defers to their nurse counterpart for day-to-day oversight of VAP initiatives making the CNS the primary lead at the hospital level. Hospital sepsis committees consist of representatives from physician leadership, nurses on every floor or clinical unit, pharmacy, phlebotomy, and coding/billing services. Most hospital committees meet monthly to bimonthly, whereas EUHM meets quarterly. The structure of these monthly meetings are in a "working group" format in which all in attendance have a shared responsibility for improving the way sepsis is managed and treated. Prior to each meeting, the lead CNS sends the committee an updated progress report, which includes data metrics for process and outcome measures by unit (e.g, intensive care, emergency department). The first five to ten minutes of each meeting is spent reviewing the details of the progress report, but the majority of the time is spent on active discussion and strategy development. Each physician and nurse representative (for each clinical unit) reports out to the group presenting key issues and challenges with their respective teams. If issues are raised, then the team works through them together. For example, if a clinician mentions a delay in patient labs - important because sepsis patients require a lab turnaround time of 15-20 minutes to avoid further spread of infection – the lab team is present and can address why this occurred and/or how to work through the issue to avoid similar occurrences in the future. Talking through these scenarios allows clinicians to identify gaps in care and then how to improve the broader processes (e/g. labs) to facilitate care pathways and protocols. In addition to reported concerns, the working groups review data defects for the previous months. Data defects are reports of variation in practice that are captured formally. For example, a data defect may be that a physician administered a different dose of antibiotics than recommended by the powerplan. The purpose of defect review is not to penalize those who didn't comply, but to understand scenarios of warranted variation or cases in which additional support or resources are needed to ensure the highest quality of care delivery. Taking all these points into consideration, all monthly meetings conclude with each unit leader stating their goals for the next month or several months. These goals range from setting specific clinical targets to optimizing processes. For example, some common goals mentioned were to start an education campaign for staff who are unfamiliar with sepsis, improve the turnaround time for antibiotic deployment, and improve physician use of the

powerplan by a certain percentage. Based off individual unit goals, the meeting concludes with a joint consensus of an overall focus for the entire hospital. All decisions are made collectively, with each representative contributing actively and equally.

At the unit level, frontline nurses are informal leaders in their commitment to improving sepsis management. According to a hospital CNS, "it is the informal leadership of our nurses that have been the key to our success with sepsis initiatives". Formal leaders, or those with designated titles for sepsis improvement, "make or sign-off on decisions, whereas informal leaders are the ones who actually make the improvements happen". Informal leadership is effective at EHC because nurses have an incentive. Across the health system, nurses are evaluated in large part based off their service and engagement in clinical projects in order to be considered for career advancements. In essence, promotions are not just determined by the number of years a nurse has been with the organization, but based upon their individual contributions. This structure incentivizes informal leadership despite EHC's anecdotally claimed lower pay rate compared to other hospitals in the Atlanta area. Contributions are also based upon publications and clinical initiatives undertaken. To maintain accountability, every nurse employed by EHC submits a "playbook" of their proposed clinical improvement or education project to his or her supervisor. As it relates to VAP, many of the nurses have focused on sepsis for their projects, further encouraging widespread adoption of sepsis improvement initiatives.

Discussion

While the average severity of illness differs by hospital, all EHC hospitals managed to improve their clinical/quality and financial outcomes associated with the managing patients with sepsis. These system-wide improvements are a direct function of the various VAP initiatives implemented in 2014, which have reduced unnecessary clinical and operational variation. There is a strong positive association

between EHC hospitals with higher percentage of powerplan use amongst clinicians and performance outcomes. This suggests that efficiency gains across the health system can be attributed to the use of the suspected sepsis and severe sepsis management powerplans.

Increased use of the sepsis powerplans has not only improved outcomes, but has contributed to an increase in the number of sepsis cases identified. This suggests that more patients at risk for sepsis are being identified early in the care process, further preventing downstream adverse outcomes. This is further evidenced by the reduction in the proportion of cases coded as MS-DRG 870, the code for the most severe form of sepsis. This change in coding likely contributes cost savings across the health system. Moreover, early intervention of patients and more streamlined care delivery results in decreased length of stay. As patient severity lessens, we've also seen a reduction in ICU length of stay. Since the ICU has a higher staff to patient ration, reduction in the ICU days contributes to substantial proportion of cost savings. This is because labor and benefits constitute the greatest faction of total sepsis management costs per patient.

While the powerplan has been successful, there remain opportunities to improve clinician use of the order set tool. Analysis of the sepsis working group meetings suggests that clinicians are not against the use of the powerplan, nor feel the initiatives promote "cookbook" medicine. Rather, clinicians are not familiar with the new practices and have varying clinical definitions of what constitutes sepsis. Furthermore, the open communication fostered by defect reviews during working group meetings, suggests that clinicians are not penalized for demonstrating clinical nuance and modifying recommended treatments. Even so, moving forward it is important for EHC to maintain continuous education and awareness campaigns to keep clinicians apprise of new guidelines changes and the benefits of utilizing the sepsis powerplans. This is particularly important to note for all AMCs in that teaching facilities with

constant rotation of residents and trainees will also require trainings about specific sepsis protocols and practices. This puts an added responsibility on physician attendings to make sure their students are not just learning the clinical delivery aspects of managing sepsis but to also engage in the systemic processes to ensure appropriate documentation and use of evidence-based practices.

Creating and implementing new care pathways and evidence-based protocols is only one step toward reducing clinical variation. Provider organizations also need to develop strong analytic solutions to evaluate the effectiveness of these improvement initiatives and, perhaps just as importantly, create methods to engage and provide real-time feedback to frontline clinicians in cases of both compliance and non-compliance. The processes are only as effective insofar as all clinicians are engaged and can champion quality improvement initiatives at the bedside.

Hospital Readmissions

While EHC has generally observed widespread success with its VAP initiatives, the rate of hospital readmissions did not improve at all. This is not surprising as the standardization interventions deployed are focused exclusively on active treatment, as opposed to post-discharge patient management. Readmissions for patients with sepsis are inevitable, regardless of the quality of care delivered during the course of hospitalization, due to the biological nature of the condition (Donnelly, Hohmann, & Wang, 2015). Patients with sepsis are more prone to immunosuppression after inpatient treatment, making them more susceptible to recurring infections and other physical and cognitive impairments (Iwashyna, Ely, Smith, & Langa, 2010; Krumholz, 2013; Wang et al., 2014). Accordingly, for EHC to sustain its success and continue to promote efficiency gains, they will need to build upon current strategies for inpatient management of sepsis to develop new interventions for post-discharge management. Interventions for mitigating post-sepsis morbidity and complications should consider process improvements pertaining to

medication management, referrals to ancillary services and self-management educational services (Prescott & Angus, 2018).

Conclusion

Clinical and operational standardization strategies are a valuable tool that providers can leverage to create efficiencies and succeed under new value-based payment schemes. However, care standardization that permits clinical nuance and improves the quality of care delivered is difficult to achieve and sustain. While embedded care pathways or protocols into electronic health records is an important step towards value creation, improved outcomes stems from clinical behavior change and engagement with corresponding protocols. In this study, lessons learned from EHC's VAP experience for sepsis reveal the importance of bottom-up leadership and data transparency in fostering clinician accountability and engagement with new processes and care pathways. Moreover, provider organizations must be adaptable and constantly innovating. Rather than setting absolute performance benchmarks or rigid care processes, it is important for frontline clinicians to have input into the process and still exercise clinical judgment in treatment decisions. Thus, the health system's responsibility is to provide clinicians with the infrastructure and tools to support evidence-based care delivery, but as a collective entity – system leadership and its clinicians – the priority is to continually optimize standardization interventions that reflect evolving clinical guidelines and best practices.

Exhibit 1. Conceptual Framework

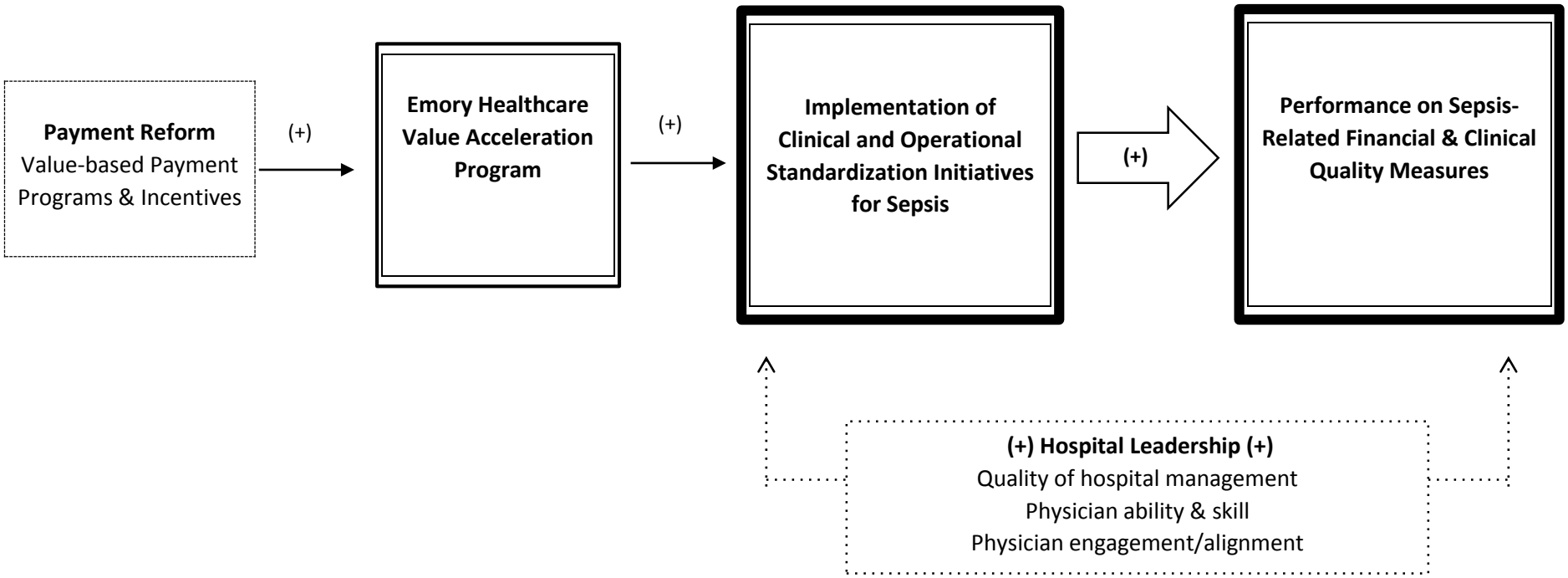


Exhibit 2. VAP Interventions for Sepsis

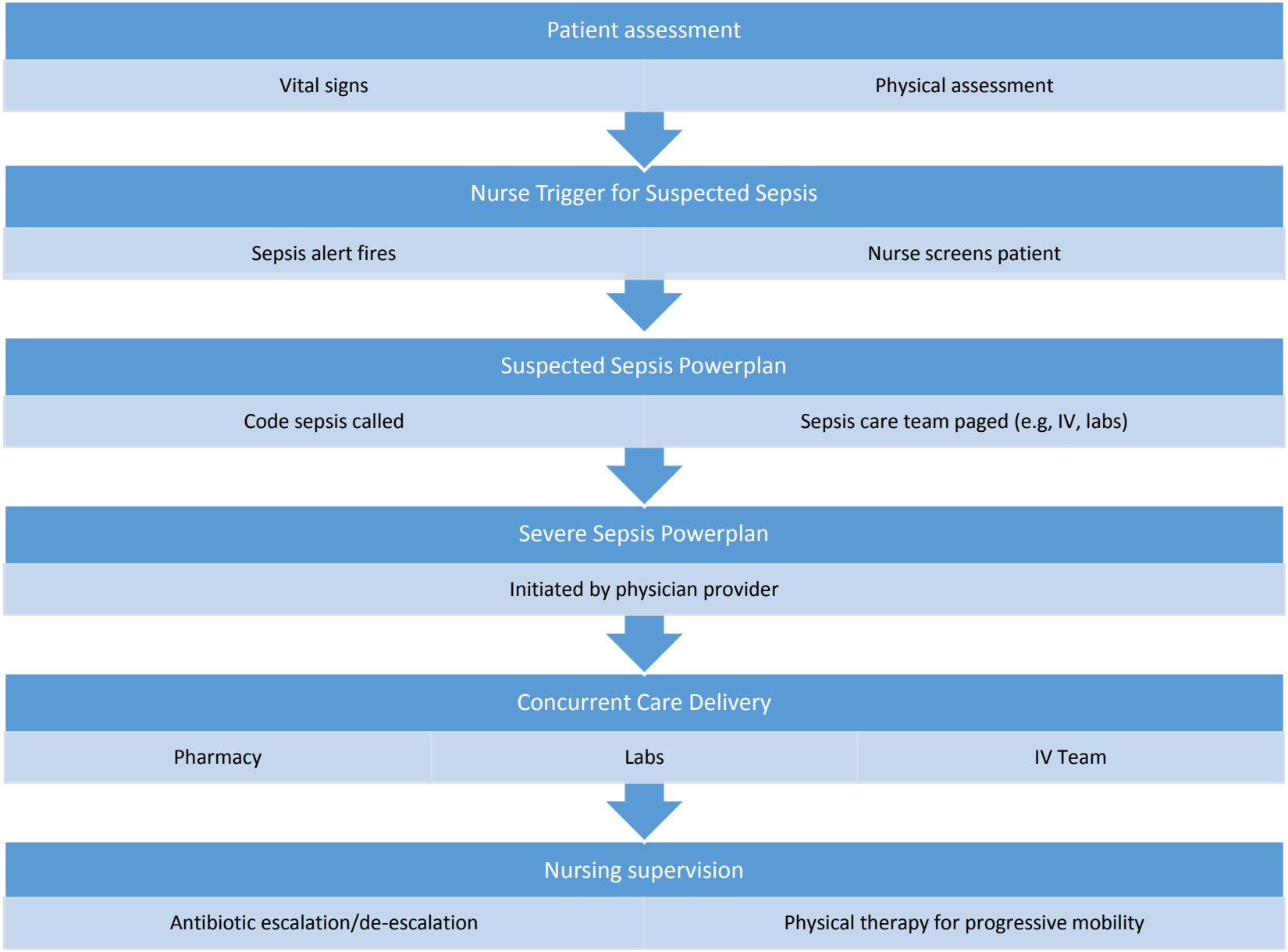


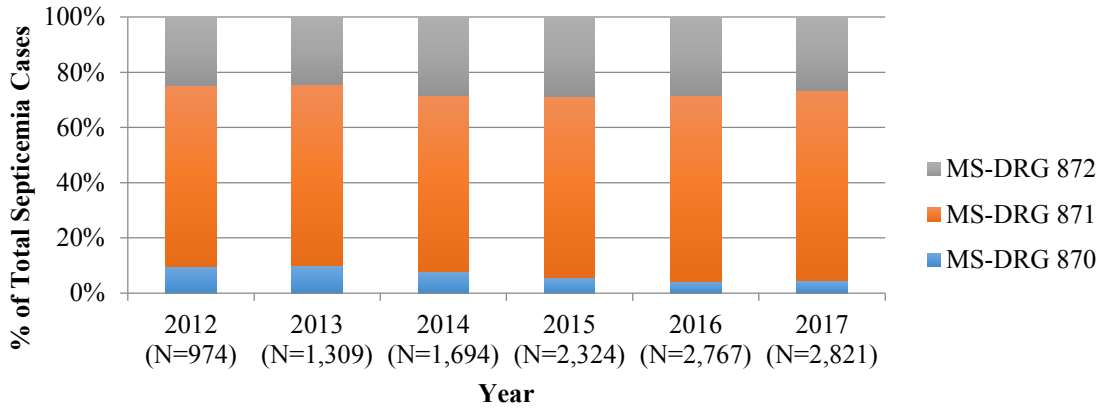
Exhibit 3. Characteristics of Case Study Sample at the System and Hospital Level

	EHC (N=11,889)	**EUH** (N=4,799)	**EUHM** (N=3,072)	**EJCH** (N=1,253)	**ESJH** (N=2,765)
Patient Acuity ***Mean (SE)***					
Average Severity of Illness	**3.194 (0.007)**	3.277 (0.011)	3.196 (0.014)	3.136 (0.022)	3.075 (0.015)
Average APR Risk of Mortality	**3.012 (0.009)**	3.043 (0.014)	3.044 (0.017)	2.972 (0.028)	2.942 (0.019)
Patient Financial Group ***(%)***					
Blue Cross	**4.43**	5.54	3.06	5.99	3.33
HMO	**16.32**	18.40	12.27	23.30	14.03
Medicaid	**7.85**	9.34	11.00	2.87	4.01
Medicare	**63.43**	59.47	64.49	60.57	70.42
Other	**0.73**	0.85	0.88	0.24	0.58
PPO	**2.25**	2.92	1.86	2.63	1.34
Self-Pay	**5.00**	3.48	6.45	4.39	6.29

Note: Patient acuity scores are measures range from 1 to 4, where 1 indicates minor severity/ risk and 4 indicates high or extreme severity/risk.

Exhibit 4. DRG Coding Distribution at the System and Hospital Level

4.A. Distribution of Sepsis Cases (by DRG) across Emory Healthcare



4.B. Distribution of Sepsis Cases (by DRG) by Hospital

	EHC		**EUH**		**EUHM**		**EJCH**		**ESJH**	
	Pre (N=3,997)	**Post (N=5,588)**	Pre (N=1,996)	Post (N=1,925)	Pre (N=1,213)	Post (N=1,306)	Pre (N=353)	Post (N=629)	Pre (N=415)	Post (N=1,728)
DRG Code	*Proportion of Cases (%)*									
870	**8.95**	**4.38**	8.87	5.14	10.96	4.67	7.08	3.97	5.06	3.47
871	**64.77**	**68.13**	64.33	68.62	67.77	69.22	64.31	71.38	58.55	65.57
872	**26.28**	**27.49**	26.80	26.23	21.27	26.11	28.61	24.64	36.39	30.96

Exhibit 5. Select Attributes for Managing Sepsis by DRG

	Mean LOS (days)	ICU LOS (days)	Total Variable Costs ($)	Severity of Illness (Scale 1-4)	Risk of Mortality (Scale 1-4)	Proportion of Deaths (%)
Sepsis DRG Code	*Mean (Standard Error)*					
870 (N=733)	15.2 (0.32)	11.2 (0.21)	28,689.6 (566.2)	4 (0)	3.99 (0.00)	30.56
871 (N=7,911)	6.49 (0.05)	2.98 (0.04)	7,832.1 (66.6)	3.42 (0.01)	3.32 (0.01)	11.43
872 (N=3,245)	4.48 (0.05)	1.80 (0.06)	4,273.6 (59.3)	2.46 (0.01)	2.03 (0.01)	0.86

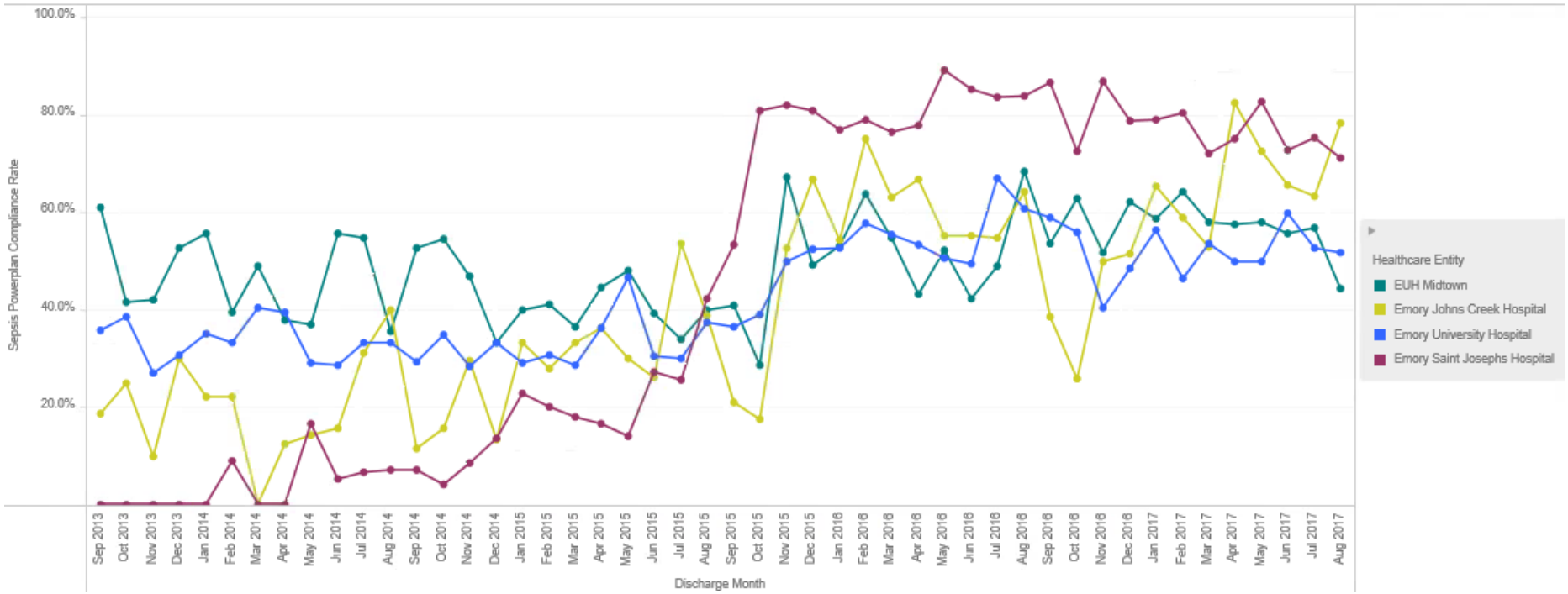
Note: Patient acuity scores are measures range from 1 to 4, where 1 indicates minor severity/ risk and 4 indicates high or extreme severity/risk.

Exhibit 6. Clinical Quality and Financial Outcomes Before (Pre) and After (Post) Implementation of Sepsis Improvement Initiatives

	Pre-Implementation 2012-2013		Post-Implementation 2015-2017					
	Mean	**N**	**Mean**	**N**	**Mean Difference**	**95% CI**	**Std Error**	**P-Value**
Clinical/Quality Performance								
Patient Safety Indicators (#)	0.004	3,967	0.000	4,157	0.004	0.002, 0.006	0.001	0.0000***
30-day Readmissions (#)	0.093	3,977	0.119	5,588	-0.026	-0.038, -0.013	0.006	0.0000***
Mortality (# Deaths)	0.133	3,977	0.079	5,588	0.054	0.041, 0.067	0.006	0.0000***
Sepsis Powerplan (# Encounters)	0.186	3,977	0.613	5,588	-0.427	-0.445, -0.410	0.009	0.0000***
Length of Stay (# Days)	6.99	3,977	6.16	5,588	0.835	0.623, 1.05	0.108	0.0000***
ICU Length of Stay (# Days)	4.37	2,052	3.77	2,026	0.594	0.339, 0.848	0.130	0.0000***
Financial Performance								
Total Variable Direct Costs ($)	**9,105**	**3,977**	**7,582**	**5,588**	**1,523**	**1174, 1872**	**178**	**0.0000*** **
Labor Costs ($)	5,529	3,977	4,530	5,588	999	800, 1198	101	0.0000***
Benefits Costs ($)	789	3,977	953	5,588	-164	-204, -124	20.2	0.0000***
Implants Costs ($)	32.3	3,977	79.8	5,588	-47.5	-64.4, -30.5	8.63	0.0000***
Drugs Costs ($)	1,381	3,977	1,014	5,588	367	293, 441	37.9	0.0000***
Medical/Surgical Costs ($)	630.6369	3,977	313.3015	5,588	317.3354	282, 352	17.7	0.0000***

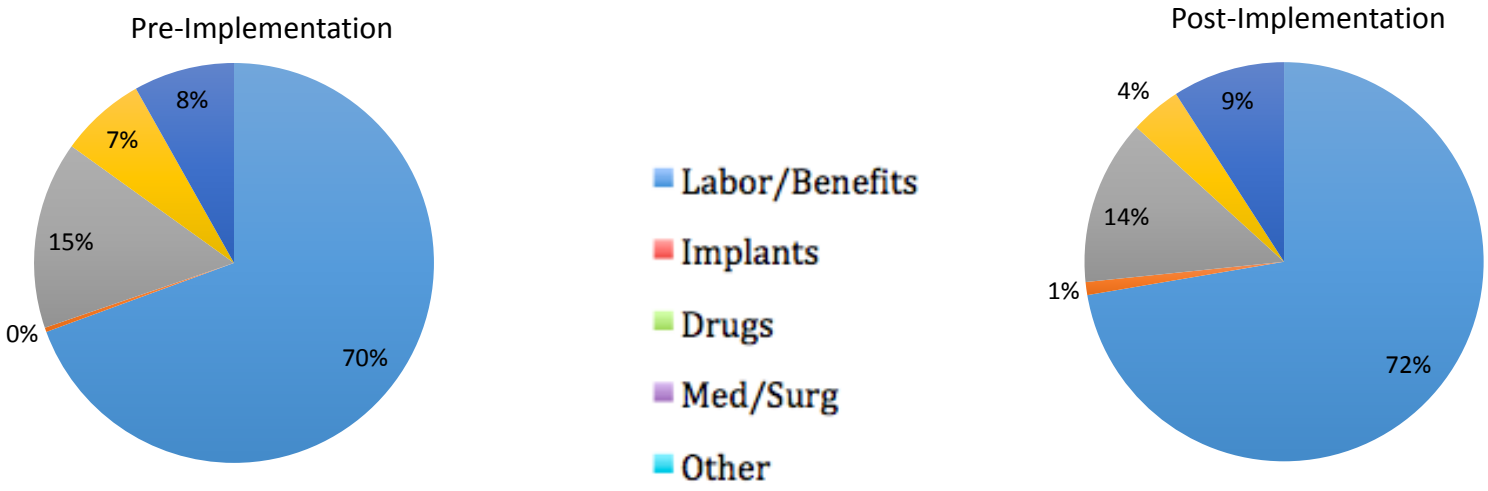
Notes: Length of stay counts are consistent with CMS determination for per day charges. Labor, benefits, implants, drugs, and medical/surgical costs are all components of total variable direct costs. The cost sub-categories may not sum exactly to total costs, since as not all cost categories were considered for our analyses.

Exhibit 7. Sepsis Powerplan Utilization Rates by EHC Hospital



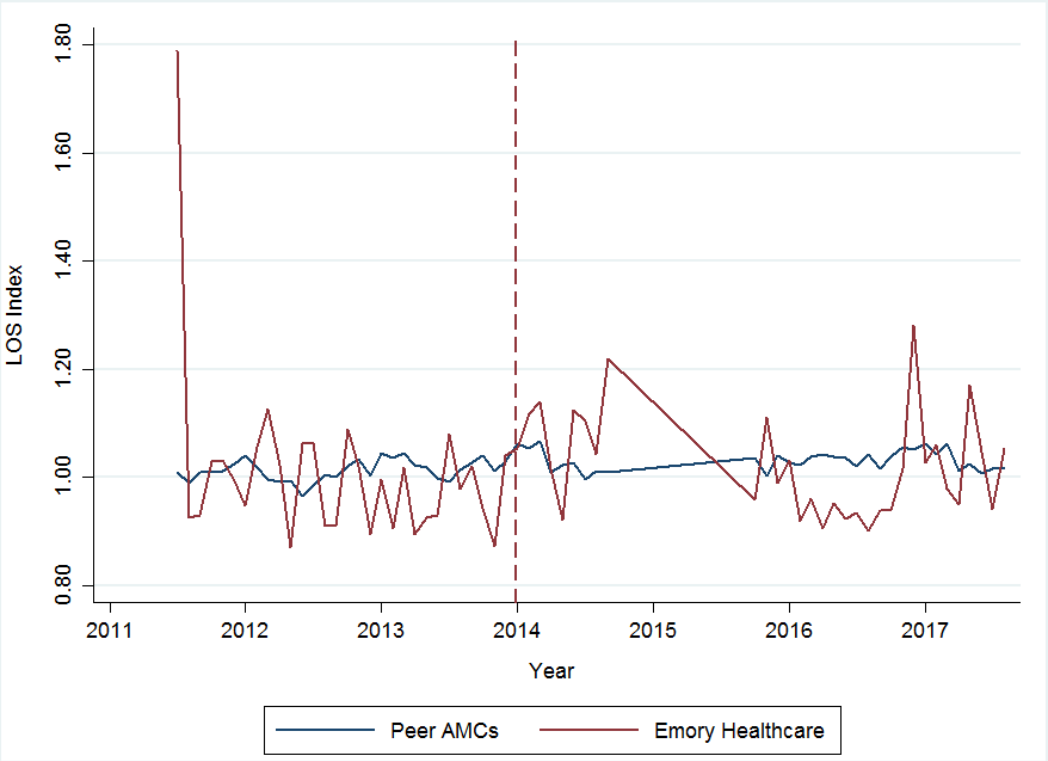
Note: This figure was generated using EHC's internal data platform.

Exhibit 8. Distribution of Costs Before (Pre) and After (Post) Implementation of Improvement Initiatives for Sepsis Management



Appendix.

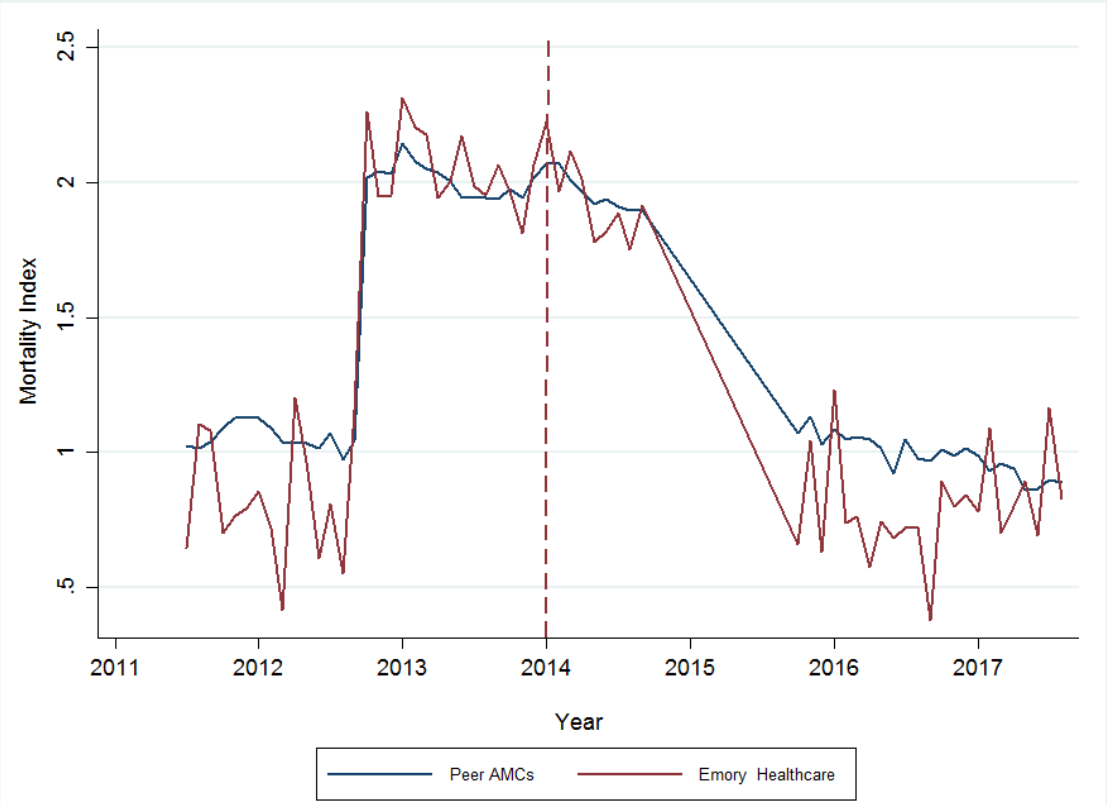
Exhibit A1. Comparison of EHC Length of Stay Before (Pre) and After (Post) Implementation of Sepsis Improvement Initiatives Against Peer Academic Medical Centers



Source	SS	df	MS	Number of obs	=	106
				F(4, 101)	=	0.43
Model	.016586084	4	.004146521	Prob > F	=	0.7871
Residual	.975400394	101	.00965743	R-squared	=	0.0167
				Adj R-squared	=	-0.0222
Total	.991986478	105	.00944749	Root MSE	=	.09827

losindex	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
1.EHC	.039771	.0811445	0.49	0.625	-.1211978	.2007399
1.post	-.0137945	.0656464	-0.21	0.834	-.1440193	.1164302
EHC#post						
1 1	.003293	.0697579	0.05	0.962	-.1350878	.1416739
cases	6.38e-06	.0000113	0.56	0.574	-.0000161	.0000288
_cons	.9690307	.0802689	12.07	0.000	.8097989	1.128263

Exhibit A2. Comparison of EHC Mortality Before (Pre) and After (Post) Implementation of Sepsis Improvement Initiatives Against Peer Academic Medical Centers

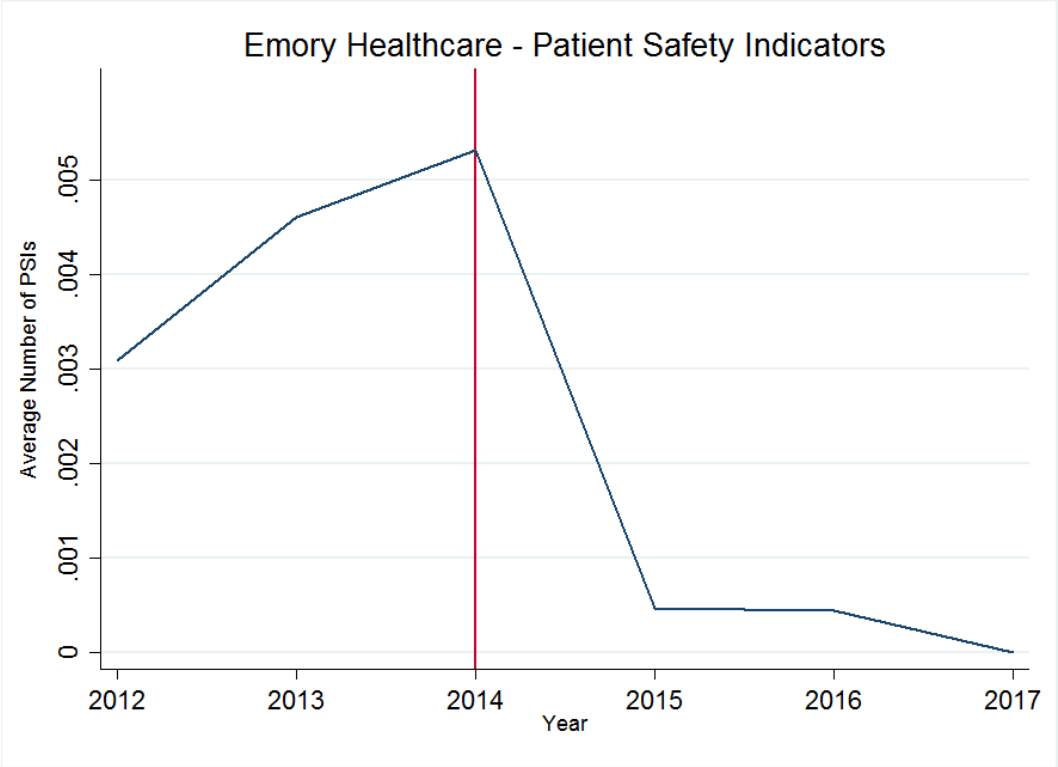



```
. reg mortalityindex EHC##post cases
```

Source	SS	df	MS	Number of obs	=	106
				F(4, 101)	=	22.16
Model	13.9590951	4	3.48977379	Prob > F	=	0.0000
Residual	15.908997	101	.157514822	R-squared	=	0.4674
				Adj R-squared	=	0.4463
Total	29.8680922	105	.284458021	Root MSE	=	.39688

mortalityi~x	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
1.EHC	1.53084	.3277094	4.67	0.000	.8807524	2.180927
1.post	-1.80115	.2651189	-6.79	0.000	-2.327074	-1.275225
EHC#post						
1 1	1.126924	.2817235	4.00	0.000	.5680604	1.685788
cases	.0002385	.0000457	5.21	0.000	.0001478	.0003292
_cons	-.1148995	.3241731	-0.35	0.724	-.7579717	.5281728

Exhibit A3. Patient Safety Indicator Performance at the System and Hospital Level



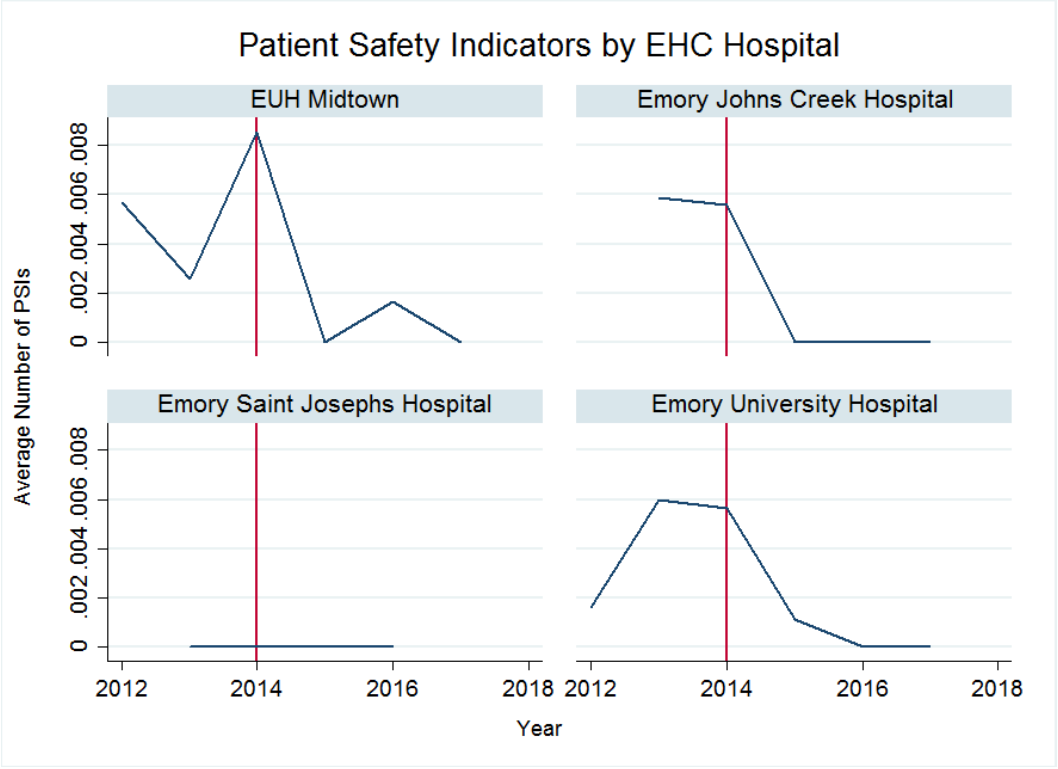
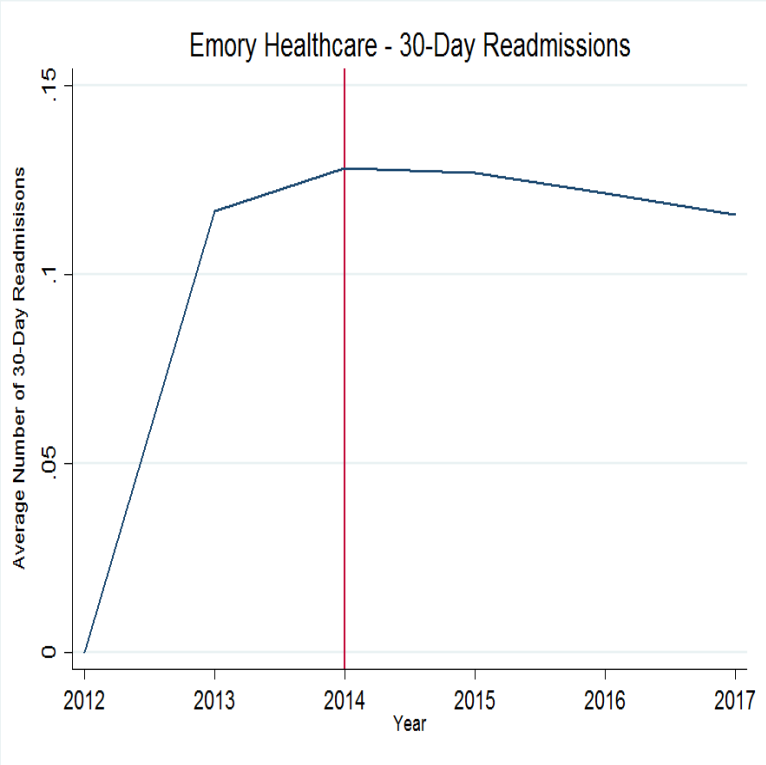


Exhibit A4. Number of 30-day Readmissions at the System and Hospital Level



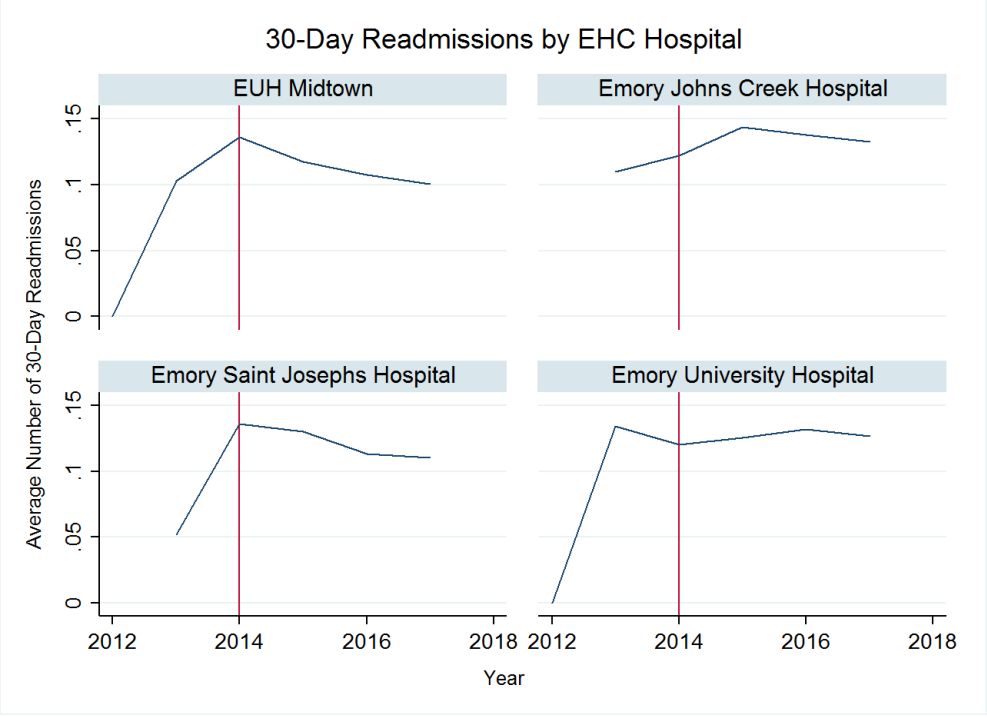
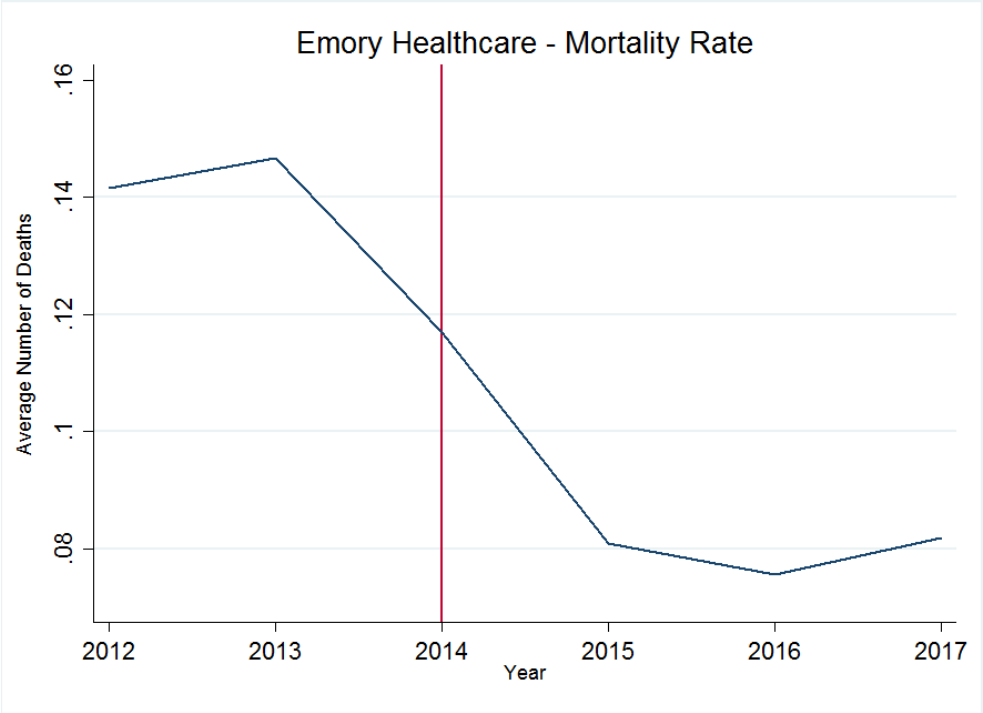


Exhibit A5. Mortality Rate at the System and Hospital Level



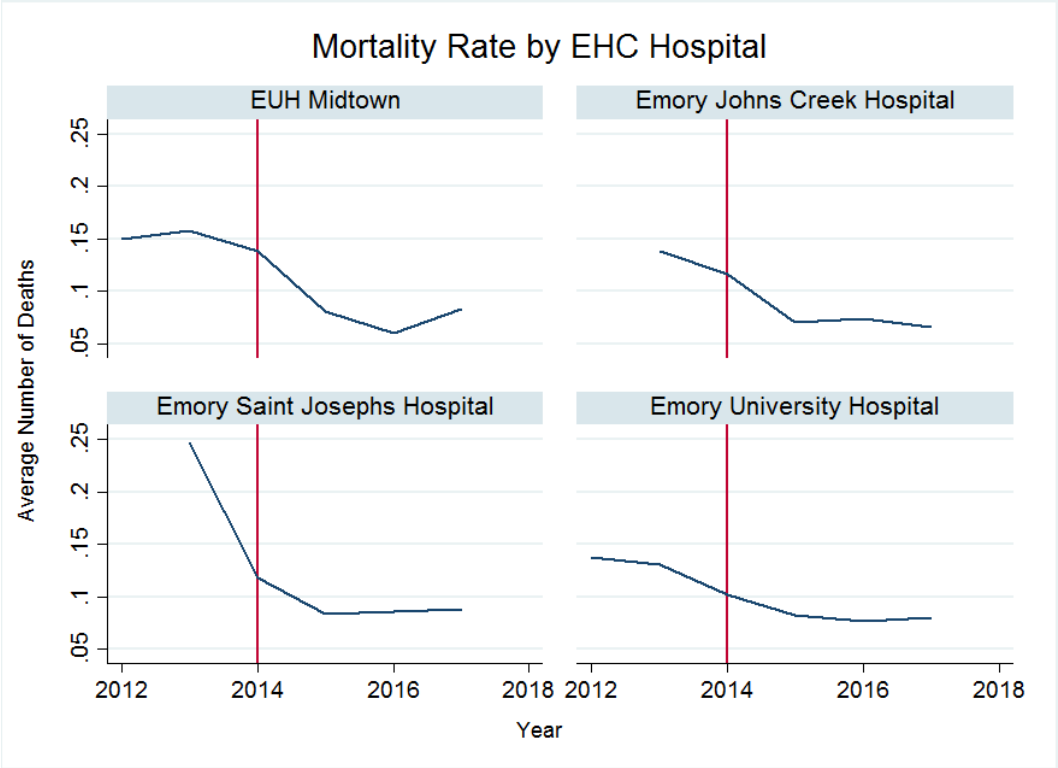
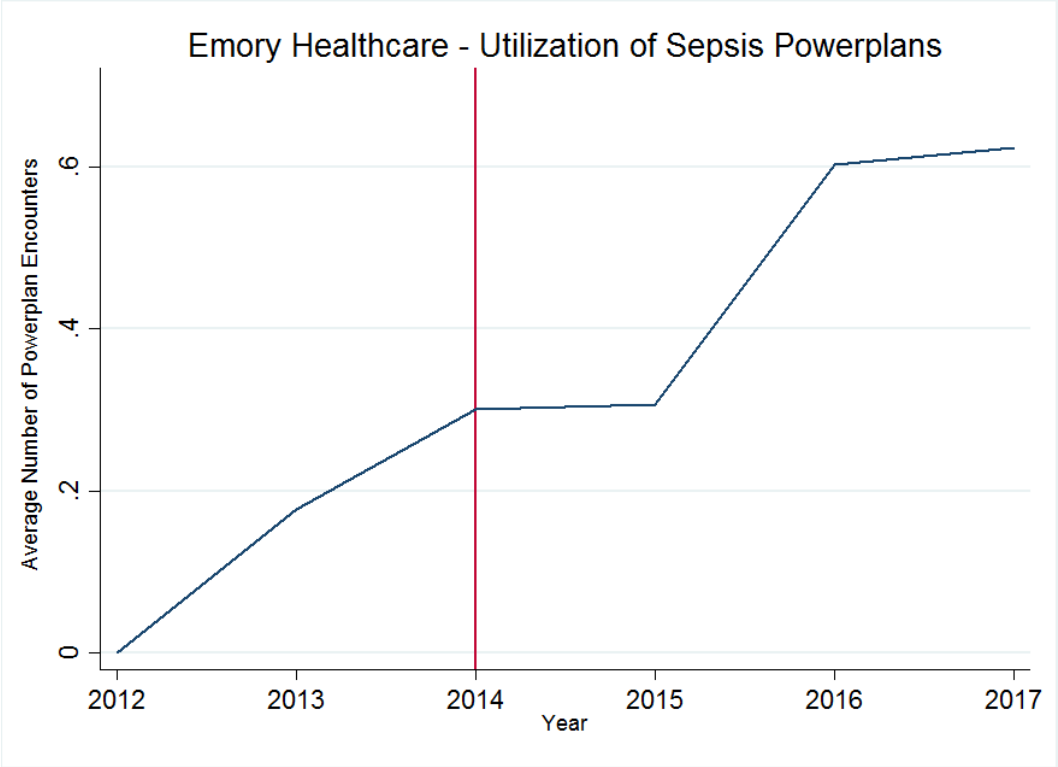


Exhibit A6. Sepsis Powerplan Utilization at the System and Hospital Level



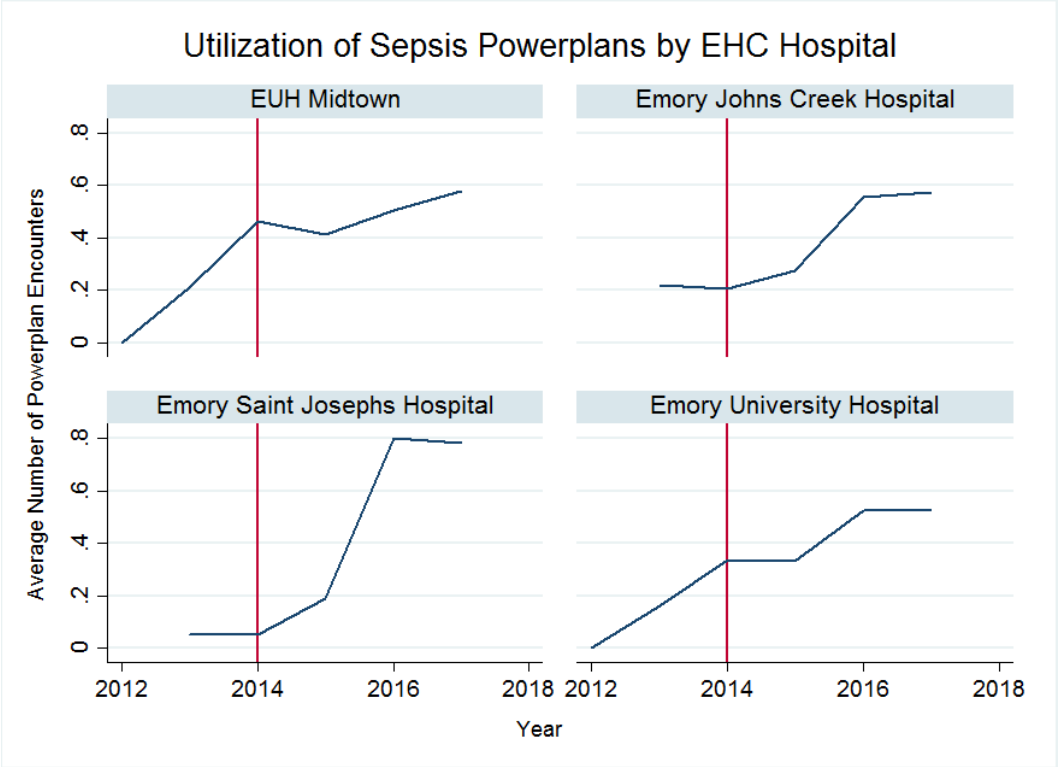
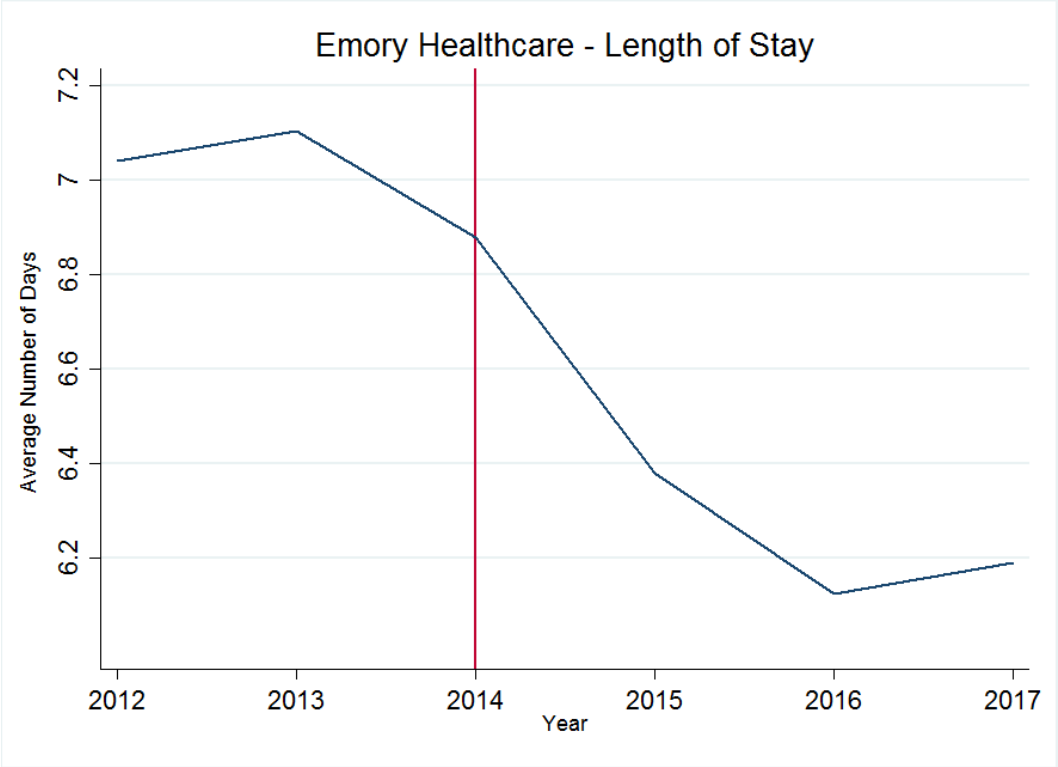


Exhibit A7. Length of Stay at the System and Hospital Level



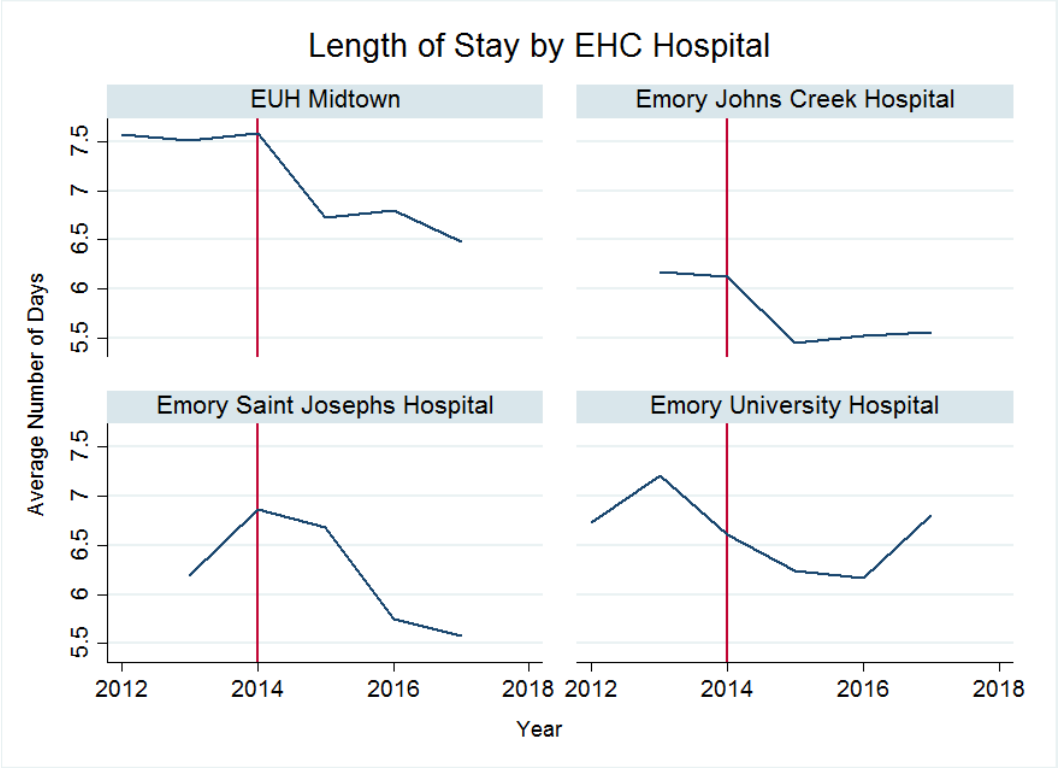
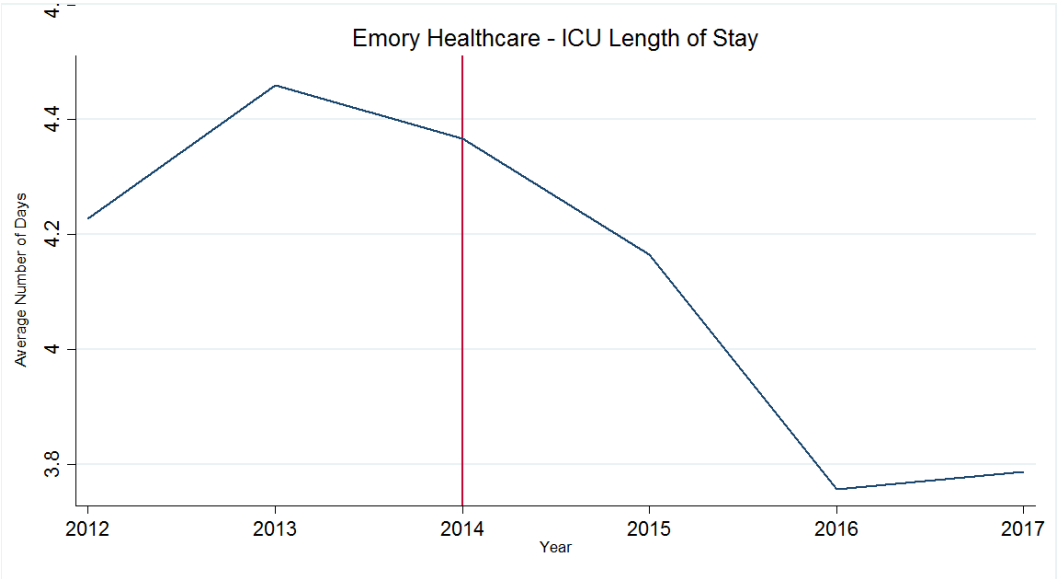


Exhibit A8. ICU Length of Stay at the System and Hospital Level



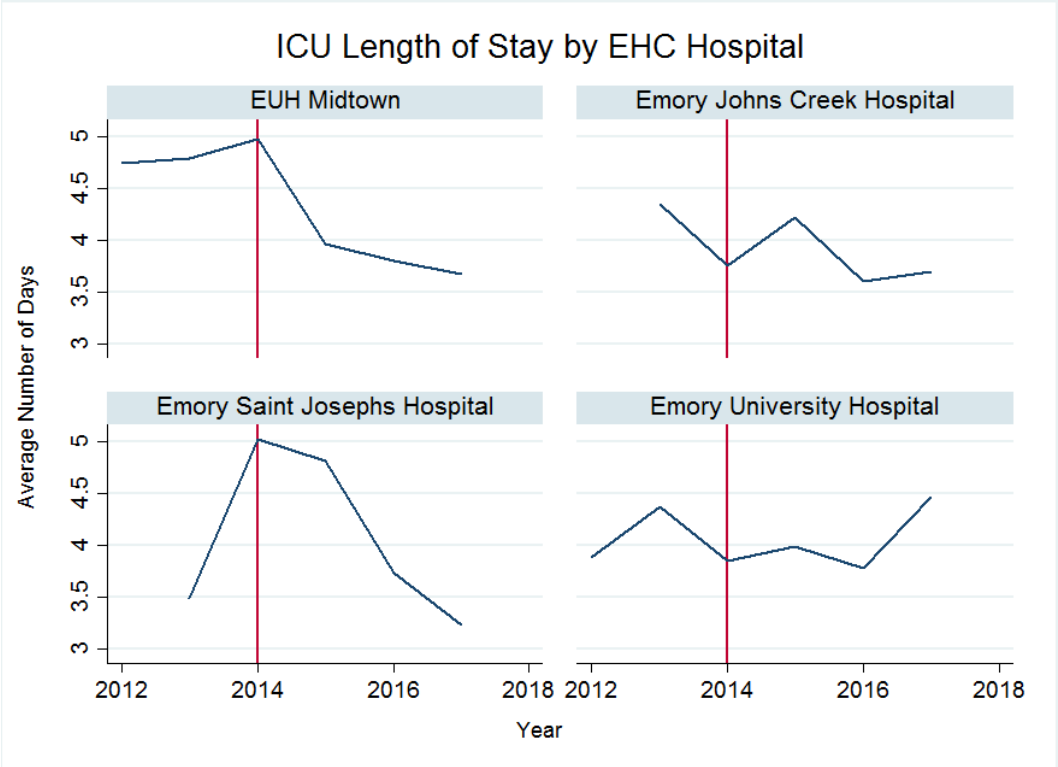
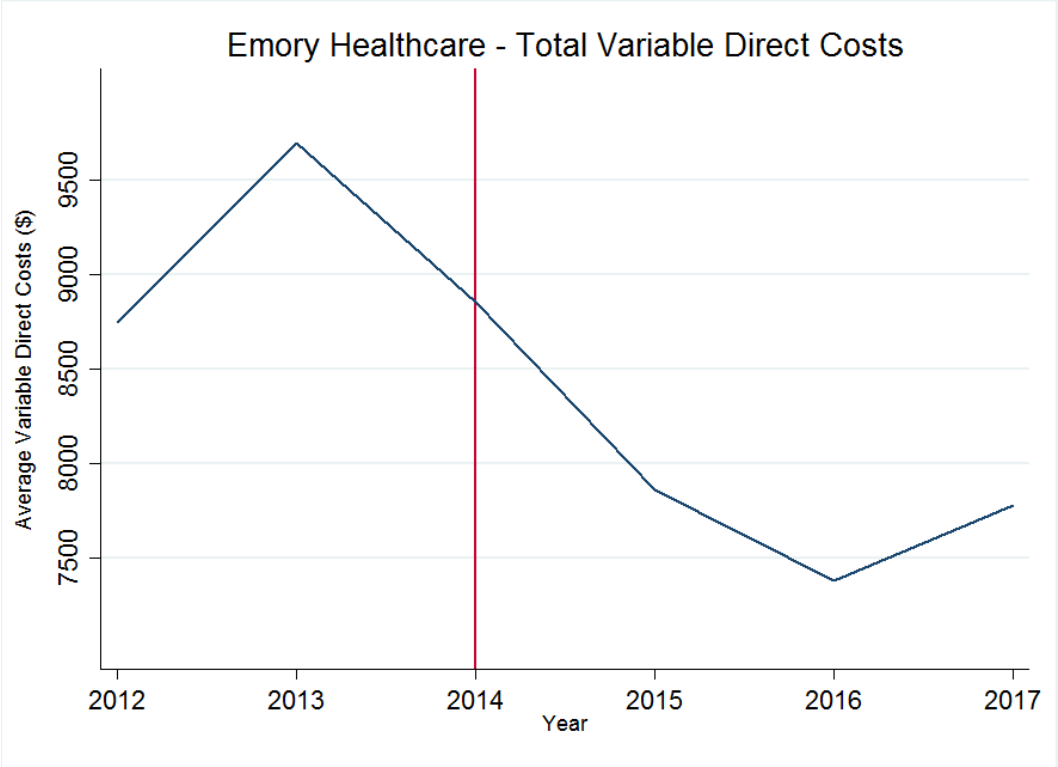


Exhibit A9. Total Variable Costs at the System and Hospital Level



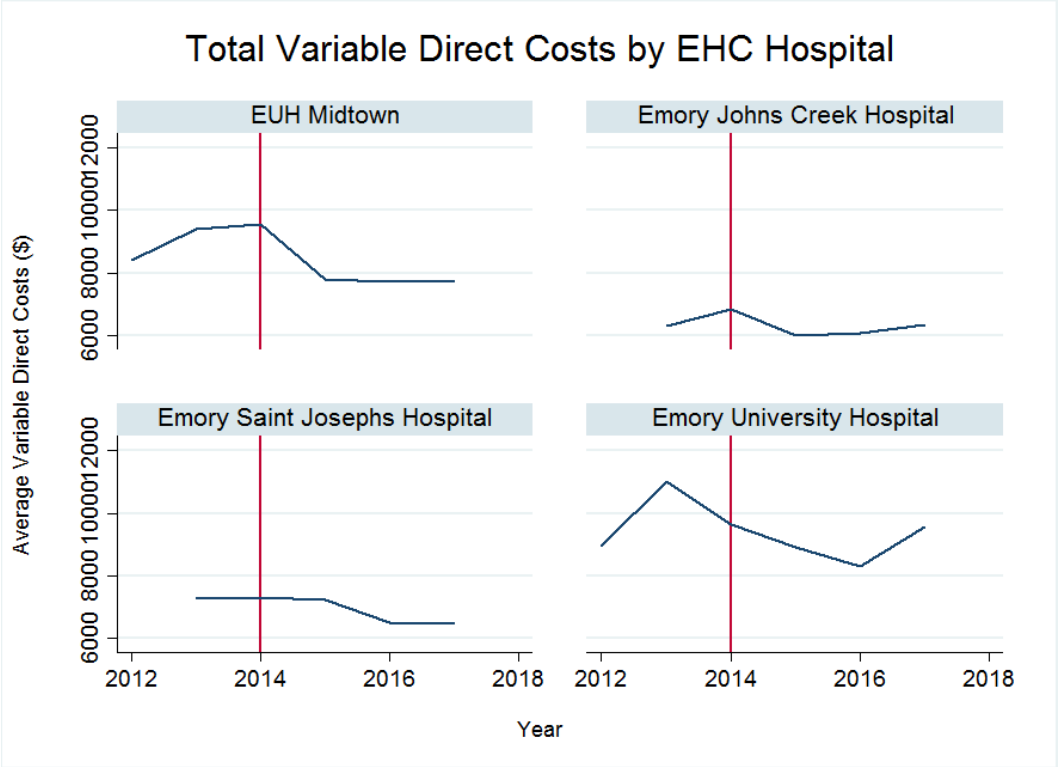
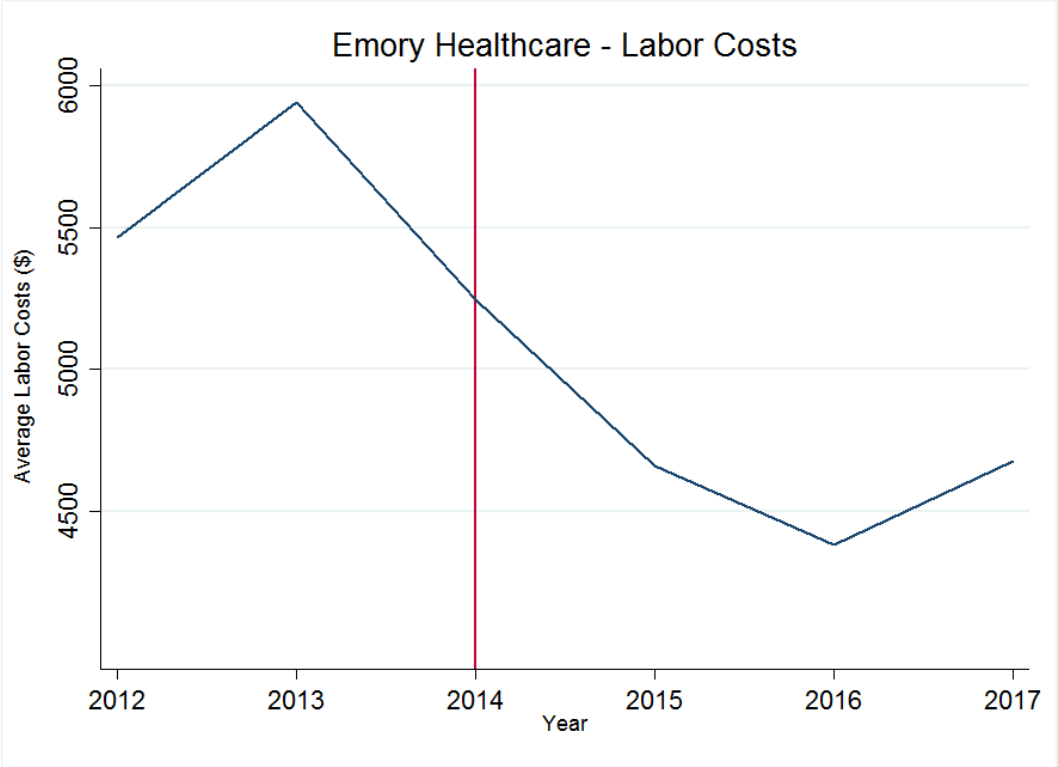


Exhibit A10. Labor Costs at the System and Hospital Level



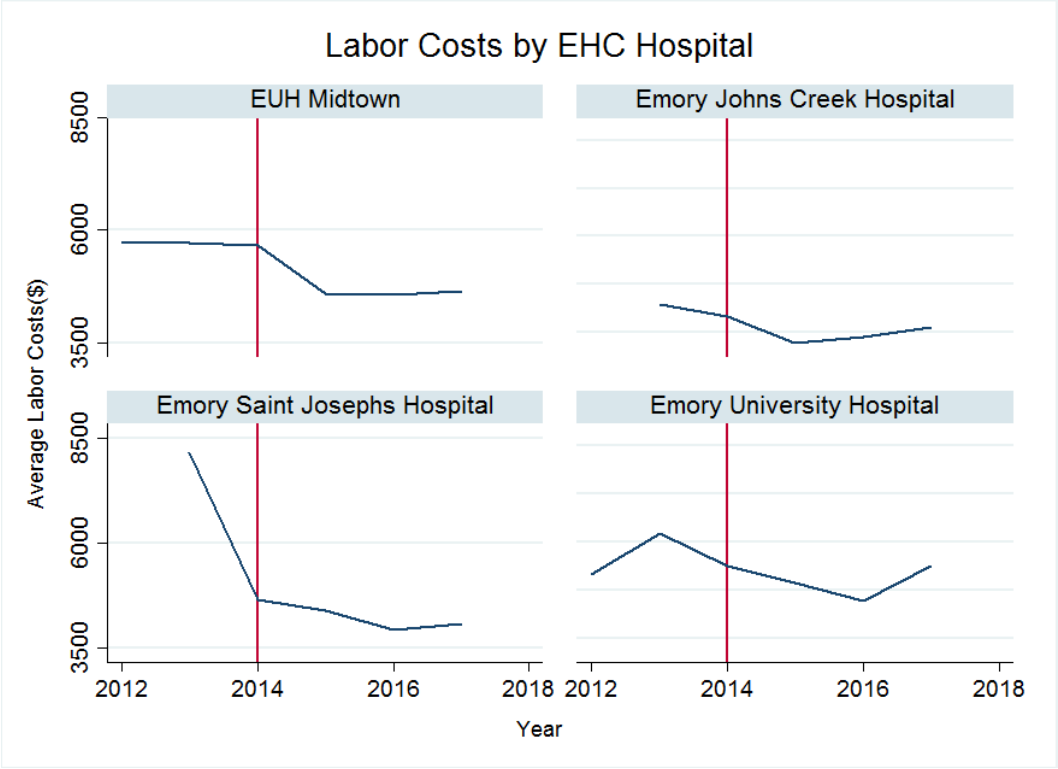
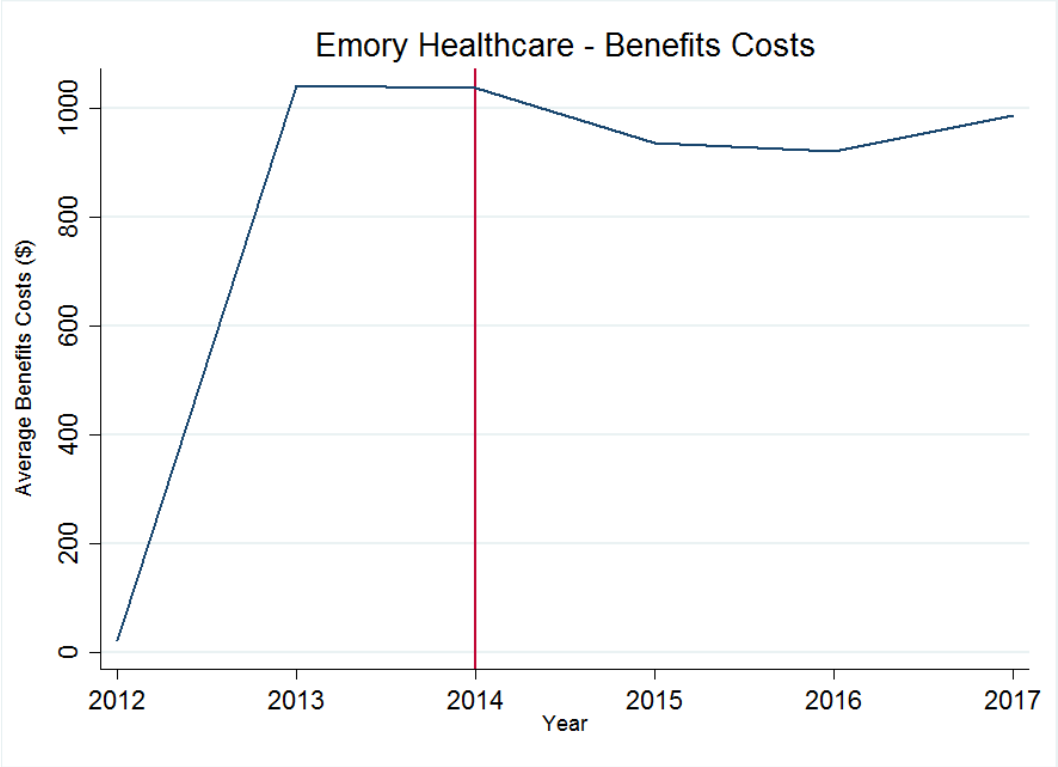


Exhibit A11. Benefits Costs at the System and Hospital Level



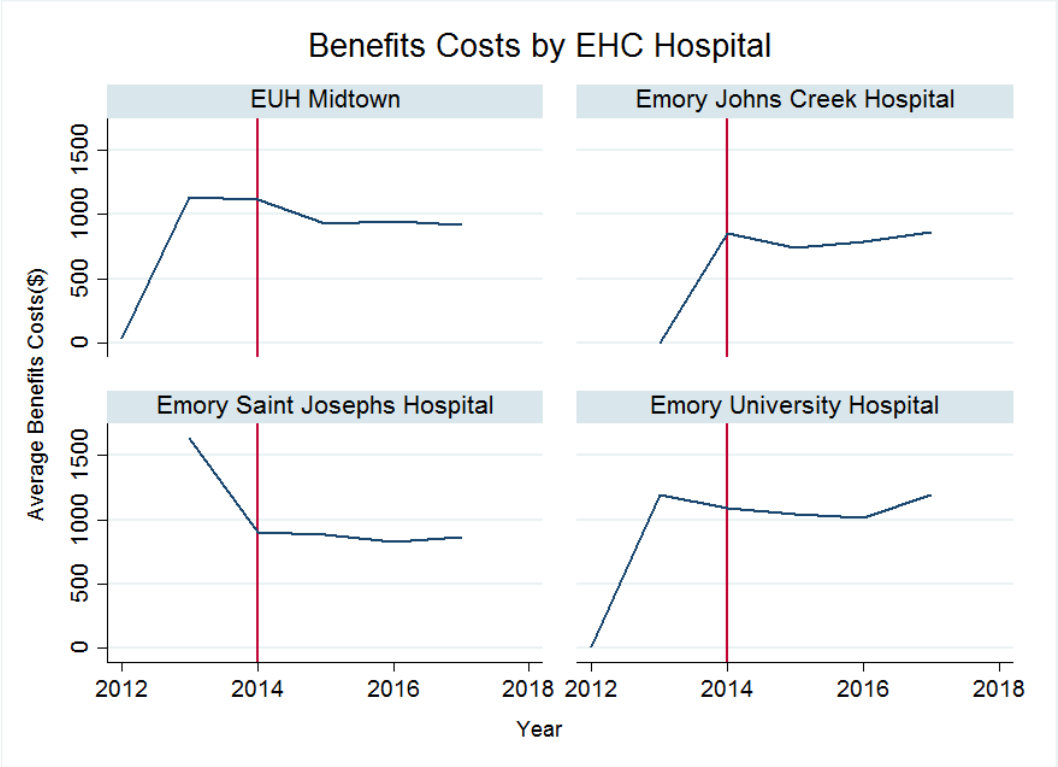
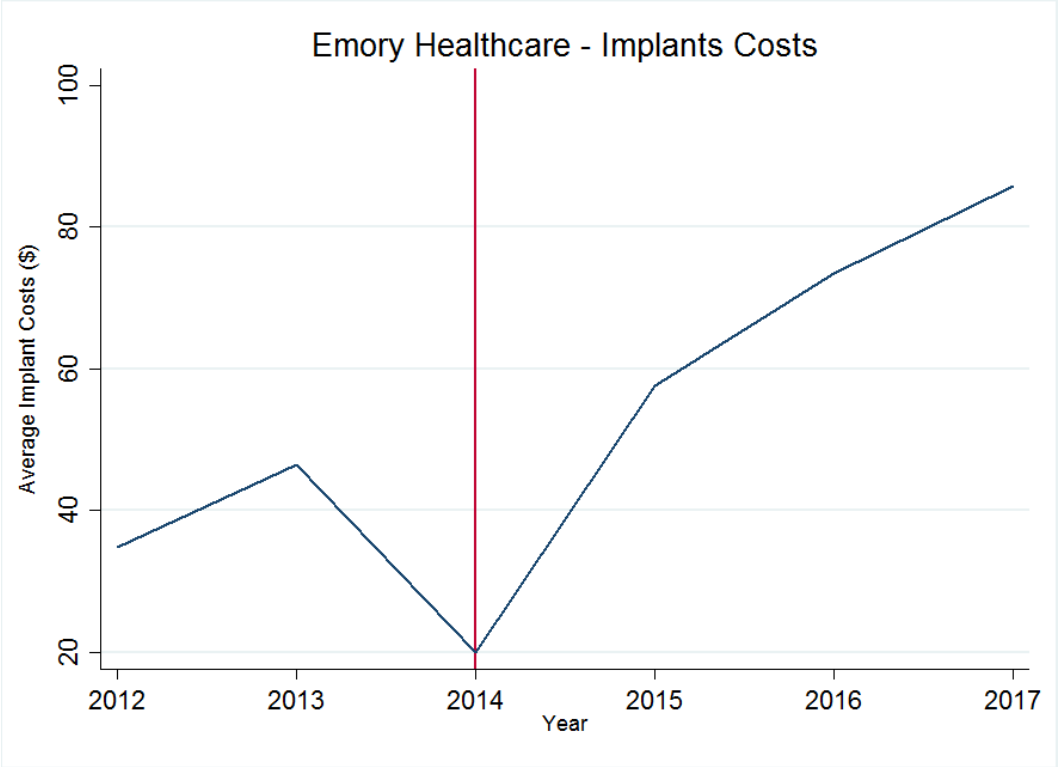


Exhibit A12. Implants Costs at the System and Hospital Level



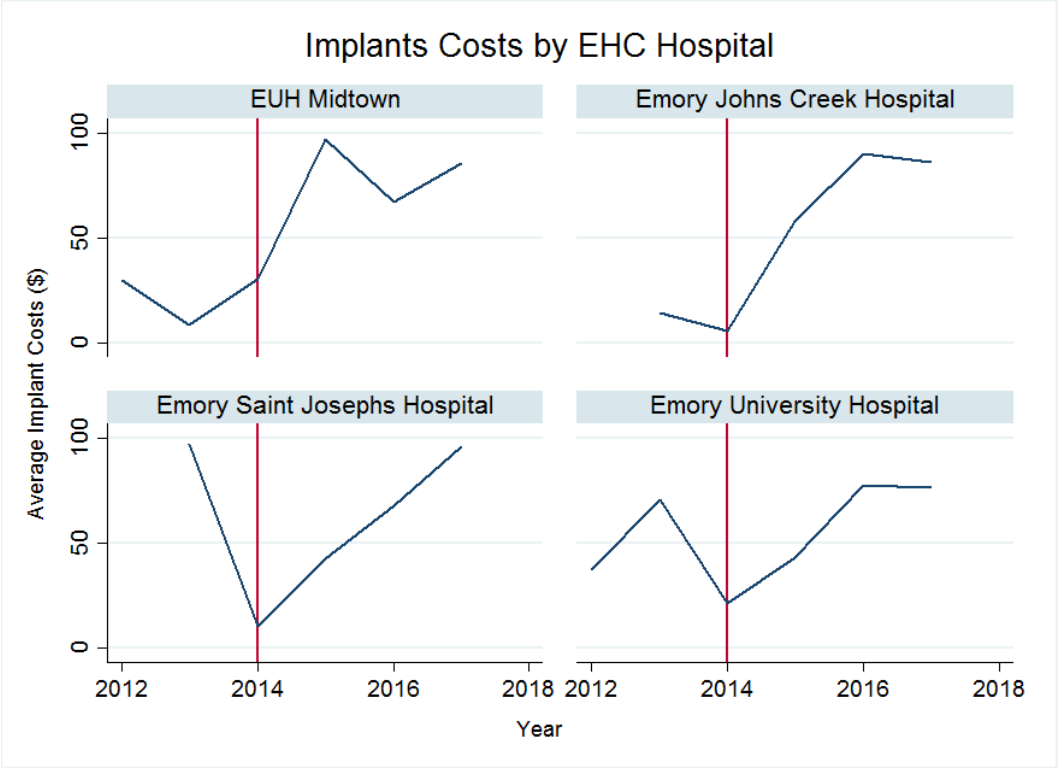
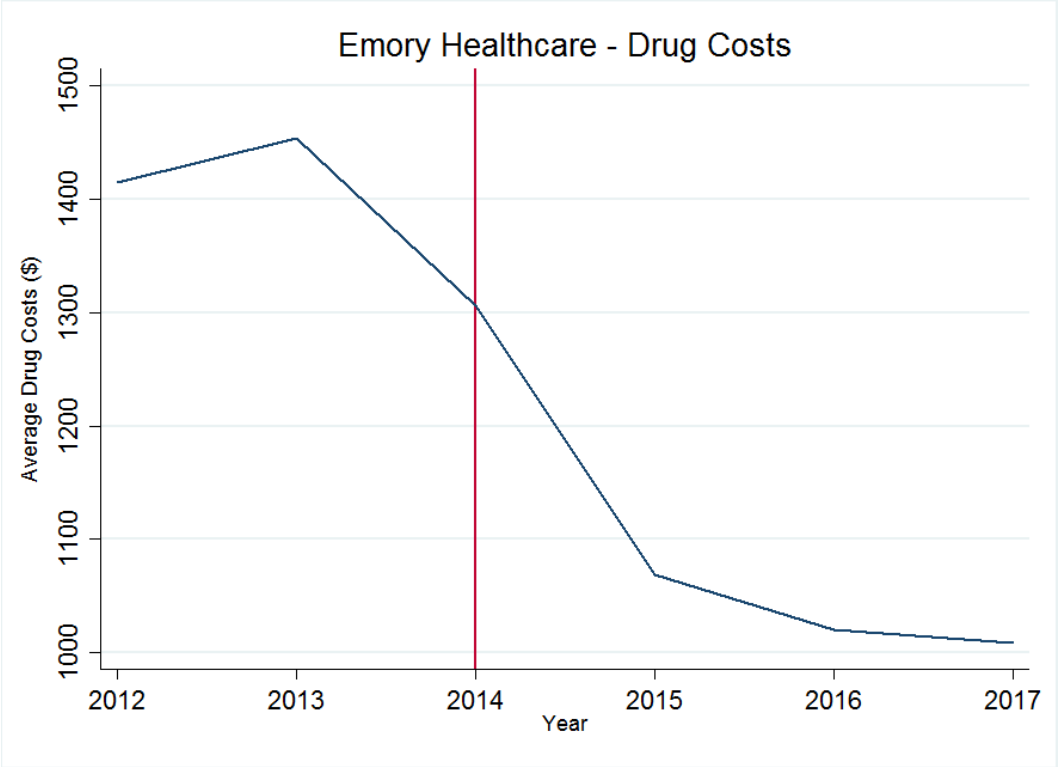


Exhibit A13. Drug Costs at the System and Hospital Level



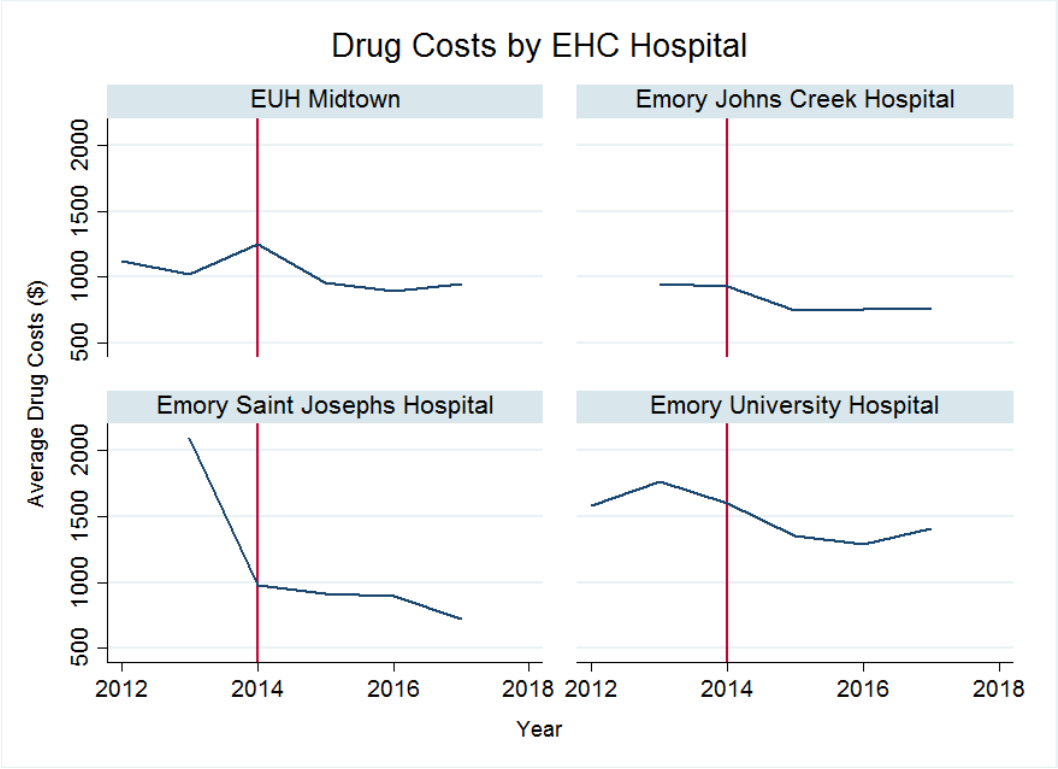
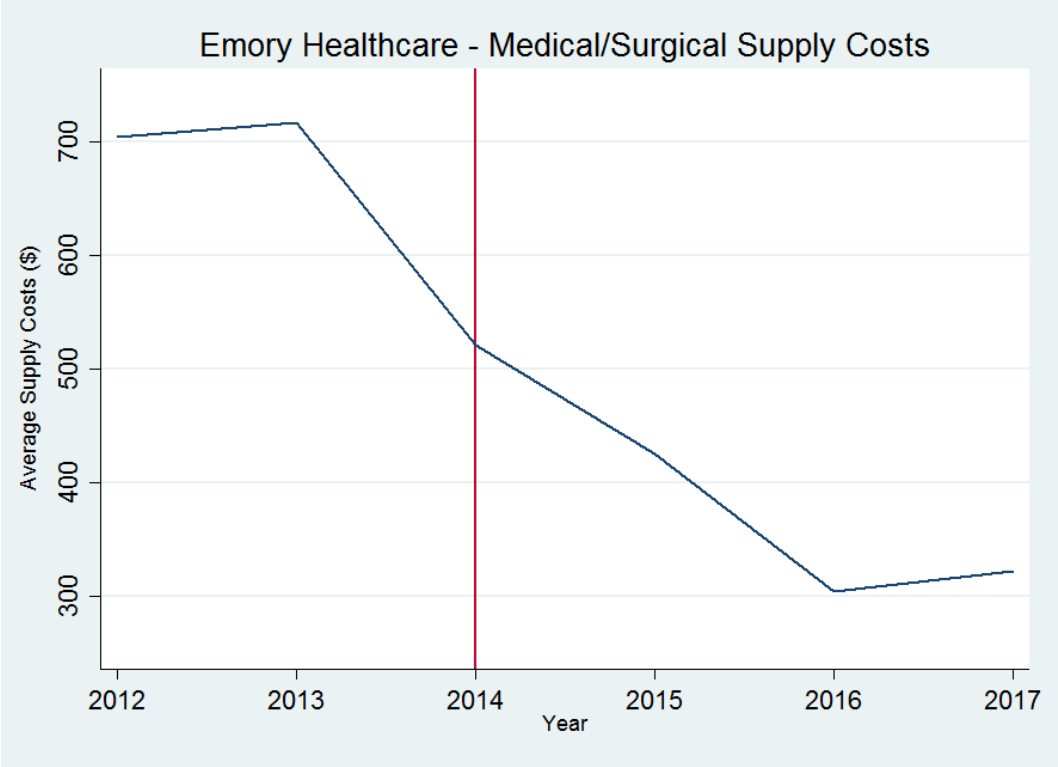


Exhibit A14. Medical/Surgical Supply Costs at the System and Hospital Level



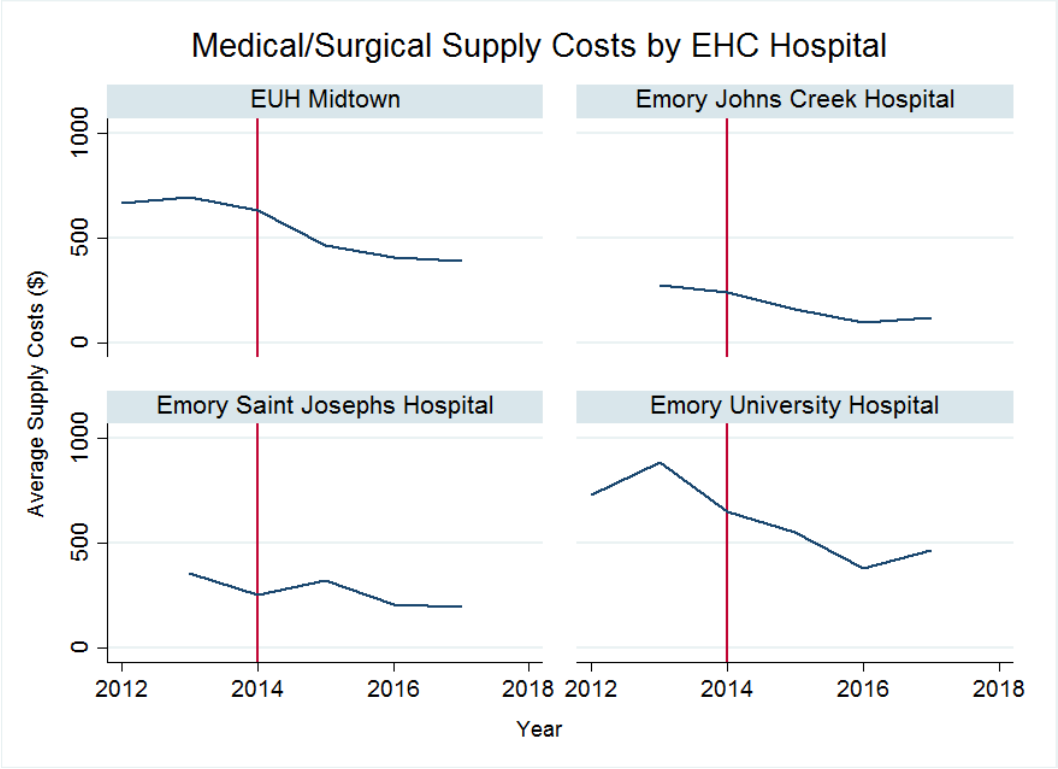
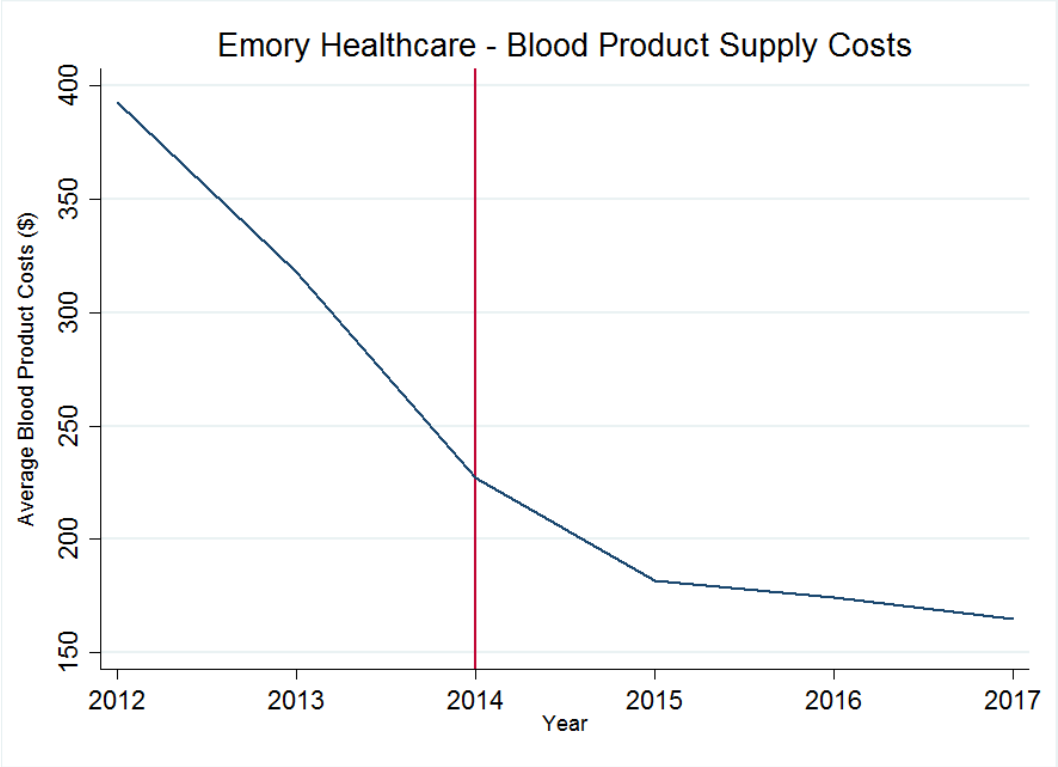
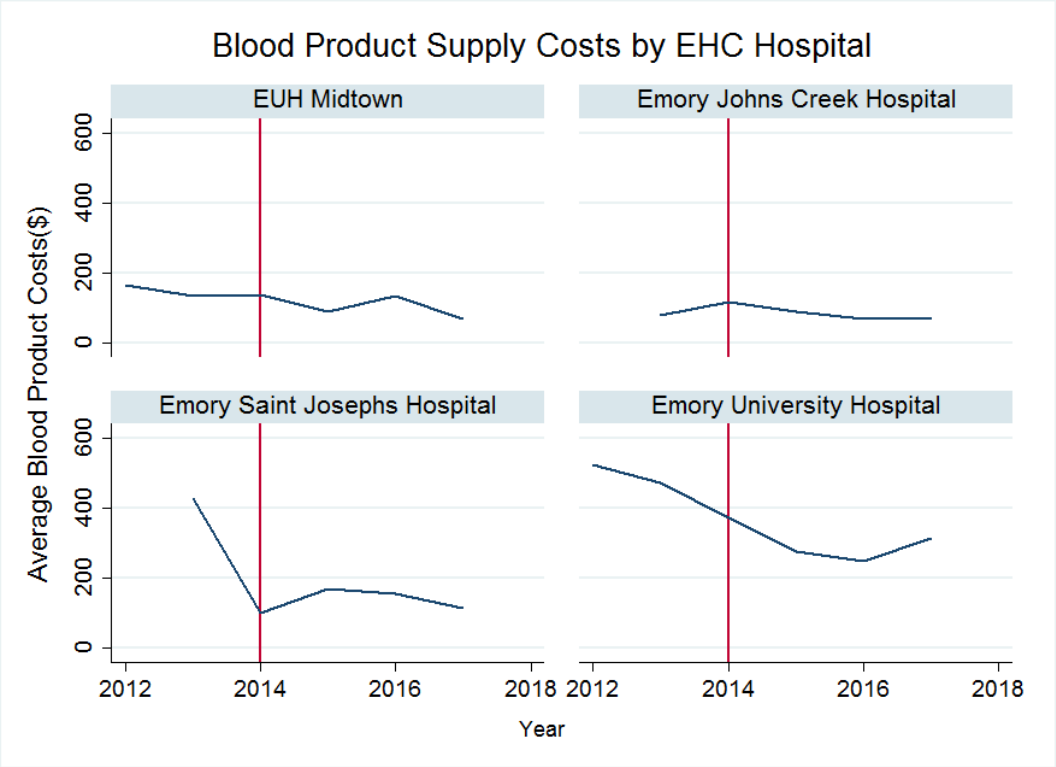


Exhibit A15. Blood Product Supply Costs at the System and Hospital Level





Chapter 5

Conclusion

With FFS no longer a financially sustainable means of clinical operations, hospitals are increasingly facing the challenges of delivering high quality, efficient care under risk-based payment. My dissertation takes a hospital-level perspective to capture responses to payment reform and implementation trends. Specifically, I assess how hospitals manage and prepare for risk by exploring the following three strategies underlying value-based care delivery: care management (Chapter 2), risk-related contracting (Chapter 3), and clinical and operational standardization (Chapter 4). This research expands the literature by offering unique insight into the strategies leveraged by hospitals to succeed under these new payment models and incentives.

I note a few limitations of my study. First, estimates presented in Chapter 2 may be impacted by measurement error. Given the 2010 Affordable Care Act's introduction of value-based payment reforms, we can expect that providers began instituting changes well before the *Care Systems & Payment* survey began tracking hospital responses in 2013. Thus, study estimates may be impacted by measurement error as many hospitals may have already been implementing care management practices prior to the study period. Ceiling effects, due to disproportionate representation from high CMP users in the sample, may reduce the power of the estimated relationship between care management and hospital performance. Finally, the likelihood of an effectiveness lag from the time of CMP implementation to impact on the hospital may also underestimate the effects on performance. Lastly, there may be some measurement error depending on who completed the AHA surveys within each hospital (e.g., administrative assistant, financial executive), which would also affect the estimates obtained in Chapter 3. Moreover, due to data constraints for Chapter 3, my approach is limited in its ability to capture the broader landscape of risk contracting arrangements, notably ACOs and bundled payments. While these variables are of interest from a policy perspective, the dependent variable – revenue at risk – inherently captures the effect of

these other APMs. Where it is difficult to distinguish the amount of voluntary versus mandatory risk assumed at the hospital level, my measure of revenue at risk captures the totality of both risk categories. Finally, the case study of approach leveraged in Chapter 4 may pose concerns of generalizability to other clinical service lines and delivery systems.

Despite these limitations, the findings from this research offer important, foundational knowledge about an increasingly uncertain sector of health care delivery. To my knowledge, this is one of the first projects to leverage the new *Care Systems & Payment* survey. My research is unique in its focus on organizational behavior and strategy as it relates to current payment reform efforts. This is an important dynamic to understand as hospitals play a key role in care coordination, cost control, and infrastructure investment. Thus, success under value-based payment should largely depend on whether hospitals can support physicians in their attempt to achieve meaningful clinical improvements. Insight into organizational processes or strategies such as care management practices, provide depth into the mechanisms through which hospitals achieve variation in value-based performance. This topic is particularly relevant as current policies reflect continued commitment to reward provider quality over the quantity of care delivered.

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