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The Impact of Conformance and Experiential Quality on Healthcare Cost and Clinical Performance

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The quality of operational processes is an important driver of performance in hospitals. In particular, processes that reliably deliver both evidence-based and patient-centered care, which we call conformance and experiential quality, respectively, have been argued to result in better clinical outcomes. However, hospitals, in general, struggle to perform well on these quality dimensions. Operations management theory suggests that this may be due to the cost involved in combining these dimensions. In other words, there may be a tradeoff between clinical and financial performance. To investigate this issue in detail, we use longitudinal data from 3458 U.S. acute care hospitals and examine the relationships between conformance and experiential quality and two important dimensions of hospital performance: cost efficiency and clinical outcomes. We find that hospitals with high levels of both conformance and experiential quality demonstrate better clinical outcomes as measured by length of stay and readmissions, but have worse performance with regard to cost efficiency. This may result in hospitals inability to invest in both conformance and experiential quality due to the greater financial burden. We conclude by highlighting that although hospitals may need to persevere through a short term financial hardship to achieve high levels of both conformance and experiential quality, financial performance benefits are likely to emerge in the longer term. Our results have implications for researchers and policy makers investigating the operational processes, clinical outcomes, and financial performance of hospitals.

Key words: *healthcare, experiential quality, conformance quality, clinical outcomes, cost efficiency*

1.0. Introduction

The internal, operational processes of hospitals are an important driver of financial and clinical outcomes. In this paper, we examine two essential dimensions of the quality of these internal processes: the percentage of patients who receive the most appropriate, evidence-based care given their medical condition and the patients' perceptions of the extent to which care providers involve them in the process of care. We call these two dimensions conformance quality and experiential quality, respectively. Conformance quality measures the *level of adherence to evidence-based standards of care* achieved by the hospitals. In particular, for specific medical conditions (e.g. pneumonia, heart failure, and heart attack), the U.S. government has published standards of care that have been proven to result in better clinical outcomes (Chassin et al. 2010). Experiential quality, on the other hand, measures *the extent to which caregivers consider the specific needs of the patient in care and communication,* as perceived by the patient. Researchers also find that an increase in experiential quality can result in better patient's adherence to follow-up instructions and hence translates into better clinical outcomes (Blackwell 1973, Cameron 1996, Butler et al. 2002). To reflect the performance along both dimensions, we define combined quality as *the extent to which the hospital is able to achieve high levels of both conformance and experiential quality simultaneously*. From an operations management perspective, conformance and experiential quality – which occur during the care delivery – are measures of process quality (Flynn et al. 1995, Choi and Eboch 1998). These are distinct from measures of clinical outcomes – such as length of stay and readmissions – that can be influenced by process quality.

Healthcare researchers have long advocated the importance of individual dimensions of conformance and experiential quality to both clinical and cost performance. For example, Battleman and colleagues (2002) look at the relationship between conformance quality and clinical outcomes, in the form of length of stay, while Boulding and colleagues (2011) investigate the relationship between experiential quality and clinical outcomes, in the form of readmission rates. Similarly, Jha and colleagues (2009) study the cost consequences of conformance quality, while Bechel and colleagues (2000) investigate the cost consequences of experiential quality. However, several limitations exist within this stream of research. For instance, some studies suffer from small sample biases (Bechel et al, 2000, Battleman et al. 2002), or a mismatch between timeframes across process quality and performance (Jha et al. 2009, Boulding et al. 2011). These studies also fail to look at how process quality dimensions affect both clinical and cost outcomes simultaneously.

Additionally, empirical research in healthcare looking at both process quality dimensions together is lacking. This is somewhat surprising given the recognition for a combined approach to delivering quality of care to improve clinical outcomes. In the words of Donabedian (1988), "clearly, the interpersonal process [i.e. experiential quality] is the vehicle by which technical care [i.e. conformance quality] is implemented and on which its success depends (Donabedian 1988: p. 1744)." Unfortunately we find no empirical support for this statement in the healthcare literature. A parallel stream of research on operations and quality management has also recognized the benefits to combining conformance and experiential quality (e.g. Garvin 1986, Juran 1988, Oliva and Sterman 2001, Roth and Menor 2003, Voss et al. 2008). For instance, Roth and Menor (2003) have conceptually argued for a service operations strategy that integrates both infrastructural choices, such as the setting of service standards, and customer-perceived value of the total service concept. Similarly, Voss and colleagues (2008) have promoted the need for a better integration, in service design, between tangible elements, such as adherence to best practices, and customer experience. However, even this stream of literature offers limited empirical evidence on the synergies between the two quality dimensions or the cost incurred in combining them.

In practice, it has proven financially challenging for hospitals to combine conformance and experiential quality at a systemic level. Several factors might contribute to this challenge. First, the healthcare industry has historically focused on achieving technical excellence – which includes conformance quality – rather than delivering patient-centered care (Berwick 2009). This bias is reflected in medical education, which teaches technical skills to caregivers with little emphasis on the importance of interacting with patients (Razavi and Delvaux 1997, Buckman et al. 2011). Second, conformance quality involves following a set of guidelines, which can be achieved without much input from patients (Brase 2008). Meanwhile, experiential quality requires that patients have a voice in their care, which requires restructuring how the care is delivered so that patients are involved in the process (Weick and Sutcliffe 2006). Perhaps in recognition to this challenge, the Centers for Medicare and Medicaid Services (CMS) has recently changed their payment program to reward hospitals that achieve high levels on both process quality dimensions. The purpose of this research is to investigate the following research question on combining the two dimensions of quality at the hospital-level: *How does a dual focus on conformance and experiential quality affect hospitals' clinical and cost outcomes?*

We examine this research question using data from multiple sources for the 3458 U.S. acute care hospitals included in the CMS database as of December 2011. This sample provides longitudinal measures of cost, clinical outcomes (length of stay and 30-day readmissions), conformance quality as recorded by hospitals, and experiential quality as perceived by patients. Empirically investigating the performance implications of combining conformance and experiential quality at the hospital-level is of great importance. First, from a process quality standpoint, the new healthcare reimbursement policy, implemented in October 2012 by CMS, evaluates hospitals based on hospitals' aggregate scores on conformance and experiential quality (U.S. Department of Health & Human Services 2011). Hence, by mirroring this level, our study allows to derive important practical and policy implications for hospital administrators as well as policy makers. Second, from a performance standpoint, hospitals typically spend a large amount of financial resources in improving the overall quality of healthcare delivered within their system which could very well be different than the more variable individual learning rates experienced at the caregiver level (Pisano et al. 2001). For instance, Raman and Tucker (2012) report that at in 2009, all 42,000 employees at Cleveland Clinic received training on service standards (conformance quality), and the importance of patient experience (experiential quality). Such form of training does involve a large organizational cost, for which the performance implications in terms of clinical outcomes are not properly understood. Our study therefore addresses this missing gap on the benefit for a systemic approach to learning in care delivery. If benefits are found, they would encourage hospitals to implement this systemic dual quality focus. Furthermore, if unintended negative consequences result from combining both quality dimensions, policy makers would be better equipped to properly incentivize hospitals to manage the potential tradeoffs.

2.0. Conceptual Background

We draw from the literature in quality management, organizational learning and healthcare operations to investigate the relationships between conformance and experiential quality and hospitals' performance. Considering both conformance and experiential quality simultaneously provides a nuanced assessment of how these dimensions affect both clinical and cost performance.

2.1. Conformance Quality

Conformance quality is defined as "the degree to which a product [or service]'s design meets established standards" (Garvin, 1987). Generally, attention to conformance quality has been shown to reduce internal and external failures (Crosby 1979, Deming 1982, Flynn et al. 1995, Hendricks and Singhal 2001a).

In our study, conformance quality is the level of adherence to disease-specific standards of care (Donabedian 1988). It emphasizes following guidelines in a consistent and systematic manner. Emphasizing conformance quality requires that caregivers follow the most appropriate standards for a given condition (Neubauer et al. 2010, Kolodziej 2011). When caregivers follow such routine guidelines, it reduces the cognitive burden associated with healthcare delivery (Swensen et al. 2010). This can result in reduced variability and rework (Laffel and Blumenthal 1993). Conformance quality became highly scrutinized in healthcare delivery when the 1999 report by the Institute of Medicine, *To Err is Human*, was published. This report outlined the inherent fallibility of caregivers and the complexity of health care delivery that, together, result in serious medical errors (Kohn et al. 1999).

One manifestation of the increased interest in conformance quality was the development of a set of core process of care measures by CMS. CMS requires that hospitals follow these standards of care when admitting and treating patients with common and serious conditions. Studies have shown that following these standards improves clinical outcomes (Chassin et al. 2010). For example, when a heart attack patient is admitted to a hospital, CMS specifies a set of six essential conformance steps that need to be followed when caring for the patient (see Appendix A). Following these six steps is likely to facilitate patient's recovery and help maintain a better health. Therefore, we expect conformance quality to have a positive relationship with clinical outcomes. In this study, we specifically consider length of stay and 30-day readmission rate to measure immediate and leading indicators of clinical outcomes.

Hypothesis 1: *Higher conformance quality is related to shorter length of stay and a lower readmission rate.*

Following prescribed standards also makes processes more efficient because the need for rework is reduced by doing procedures correctly the first time. For example, adherence to checklists assures that no critical procedure was skipped and that no unnecessary step was included. However, the positive effect of conformance quality on cost efficiency is not clear. Researchers studying the implementation of conformance quality in a variety of manufacturing settings underline the high initial cost investment needed to stimulate learning and to achieve high conformance quality (Juran 1951, Garvin 1987, Hendricks and Singhal 2001b). These initial investments can be related to reporting systems, training, or monitoring and corrective feedback systems, among others (Ittner et al. 2001). These findings are also applicable in the context of healthcare. For instance, medical experts have noted the resource-intensive nature of documenting and monitoring conformance quality (Fonarow and Peterson 2009, Boulding al. 2011). Extracting precise information from varying medical charts is a time consuming and expensive process. As noted by the American College of Emergency Physicians, "the greatest drawback to medical record-derived data is the cost, as the data generally needs to be manually abstracted by trained abstractors, who may spend up to 30 minutes on a chart (www.acep.org)". These arguments suggest the following hypothesis.

Hypothesis 2: *Higher conformance quality is related to lower cost efficiency.*

2.2. Experiential Quality

The quality of interactions between service providers and consumers has long been considered by both operations and service management researchers. For example, Chase and Tansik (1983) classified services based on the degree of customer contact. Kellogg and Chase (1995) elaborated on this scheme by constructing a measurement model for customer contact. Similarly, Parasuraman and colleagues (1988) developed a scale to measure various elements of the interaction between service providers and consumers, as perceived by the consumer. Thus, customer experience has been well established as a defining organizational dimension in the service industry.

Accordingly, in healthcare, experiential quality is an important dimension of process quality. It relates to the extent to which caregivers consider the specific needs of the patient regarding care and communication. By interacting with the patient, caregivers acknowledge that the patient is a partner in the care delivery process. Creating a partnership between caregivers and patients can reduce length of stay. For example, consider the tests and procedures performed for each patient. Listening carefully to the patient might bring to light information that enables physicians to more efficiently diagnose the patient (Groopman 2008) and avoid time-consuming tests or procedures (Wen and Kosowsky 2012). Moreover, the partnership between patient and caregiver establishes a bond of trust that can eliminate patients' requests for unneeded tests or procedures (Thom et al. 2004, Brett and McCullough 2012). Thus, overall, higher experiential quality should relate to shorter length of stay.

In addition, this partnership is likely to be essential in providing patients with the knowledge and confidence to better care for themselves following discharge. For example, numerous studies have shown a positive association between experiential quality and adherence to discharge instructions (Blackwell 1973, Cameron 1996, Butler et al. 2002). This is particularly important because the lack of proper post-discharge coordination between subsequent caregivers (Jack et al. 2009) requires that the patient be knowledgeable about what is needed to facilitate recovery. Thus, high levels of experiential quality are likely to be associated with increased patient accountability for their care, which should result in lower readmission rates. Overall these arguments suggest the following hypothesis:

> Hypothesis 3: *Higher experiential quality is related to shorter length of stay and a lower readmission rate.*

Despite potential cost benefits from reduced procedures, we believe that high levels of experiential quality, on average, will lead to lower cost efficiency for two reasons. First, experiential quality implies individualized attention to the patient while providing care, to create a partnership between patients and caregivers. Developing these relationships require significant added time and effort from the caregivers, which translate in increased labor costs (Langer 1989, Weick and Sutcliffe 2006). Second, caregivers have typically not been trained on experiential quality. For instance, although medical schools are required to include the teaching and assessment of interpersonal skills, in their curriculum since 2002 (*acgme.org*), the teaching of experiential quality has been found to vary greatly across academic programs (Novack et al. 1993, Hojat et al. 2002) and is often neglected (Levinson et al. 2010). In fact, researchers note that medical students' interpersonal skills such as empathy even diminish over the course of medical school (Hojat et al. 2004, Bellini 2005). Thus, hospitals that seek to achieve high levels of experiential quality are likely to bear heavy costs to train their caregivers.

Given the importance of these labor and training costs, we expect them to outweigh the costs benefits derived through patient-centered care. This is line with previous healthcare findings. For example, Bechel and colleagues (2000) find that, overall, operationalizing experiential quality is costly for hospitals.

Hypothesis 4: *Higher experiential quality is related to lower cost efficiency*.

2.3. Combined Quality

The multi-dimensional nature of quality has long been established in the operations and quality management literature (Crosby 1979, Deming 1982, Garvin 1986, Juran 1988, Reeves and Bednar 1994, Flynn et al. 1995, Roth and Menor 2003, Silver 2004, Voss et al. 2008). It is the combination of these dimensions that affects the overall quality of the product or service (Oliva and Sternam 2001). In this research, we emphasize the conformance quality measures the standard of care delivery while experiential quality measures the level of interactions as perceived by the patient. In practice, quality systems such as lean management, total quality management, or Six-Sigma, require that both conformance to standards (conformance quality) and a focus on the specific needs of the consumer (experiential quality) be pursued simultaneously (Hackman and Wageman 1995, Ittner and Larcker 1997, Kaynak 2003). However, empirical evaluation of the synergies between those dimensions is lacking. We refer to the simultaneous pursuit of conformance and experiential quality as the pursuit of combined quality.

Consistent with practices in non-medical domains, the new CMS payment program requires caregivers to simultaneously focus on conformance and experiential quality dimensions when delivering care. The operations management and organizational learning literature suggest that there can be high levels of synergy between conformance and experiential quality (Levinthal and Rerup 2006, Voss et al. 2008). However, there is limited empirical evidence to this statement. High levels of conformance quality can provide a stable base of standards related to existing medical knowledge (Chandrasekaran et al. 2012). We argue that having these standards can allow the caregivers to create a more targeted interaction with the patient. This can eventually result in better clinical outcomes. Higher experiential quality can, in turn, result in better and faster identification of conditions to which conformance to standards can be applied. Such identification is important for caregivers given the typical complexity of their patients' symptoms (e.g. multiple co-morbidities, allergies).

As an illustration of the importance of experiential quality in enhancing the effect of conformance quality, consider CMS conformance quality guidelines. These guidelines dictate that a pneumonia patient should get an influenza vaccination in order to reduce chances of re-acquiring pneumonia as a complication of the flu (see PN7 in the Appendix). However, unless the caregiver communicates with the patient, he or she might miss that a patient has recently been vaccinated for influenza or whether the patient has any allergy that would preclude him from receiving the vaccine. Therefore, communication with the patient, centered on conformance quality standards, is critical to identify the guidelines for which the patient is truly eligible. Such identification avoids unnecessary or conflicting medications and procedures that could result in increased length of stay (Goold and Lipkin 1999). The presence of combined process quality should also be reflected in better patient's adherence to follow-up instructions upon discharge. Thus, we expect an overall positive relationship between the achievement of combined quality and clinical outcomes, as measured by readmission rate and length of stay.

> Hypothesis 5: *Higher combined quality is related to shorter length of stay and a lower readmission rate.*

However, the healthcare industry has long suffered from a bias towards conformance quality, at the expense of experiential quality. This can be seen in medical education where the main focus remains on teaching technical skills to caregivers (Razavi and Delvaux 1997, Buckman et al. 2011). This bias toward conformance quality is also underscored by noting that hospitals have traditionally been reimbursed based on a fee-for-service system, used to promote conformance quality (Goold and Lipkin 1999). Reimbursement that includes experiential quality has only recently been introduced beginning fiscal year 2013 as part of the new CMS payment program. Therefore, promoting a dual focus requires changing the mindsets of caregivers (Gavetti and Levinthal 2000, Pauker et al. 2005), who have come to embrace conformance quality and typically consider experiential quality as a mere "bonus" or an extra burden (Groopman 2008).

In addition, the pursuit of the conformance and experiential dimensions of quality can trigger different learning mechanisms, which can increase cost. As underlined by Donabedian (1988), "the management of the experiential process must adapt to so many variations in the preferences and expectations of individual patients that general guidelines do not serve us sufficiently well (p.1744)". At the same time, conformance relies on following general guidelines closely. Organizational learning theorists have recognized the challenges for one individual to simultaneously undertake activities that elicit different learning mechanisms (Gavetti and Levinthal 2000, Gupta et al. 2006). Therefore, caregivers that learn to focus on both quality dimensions might need to spend more time with the patient which can result in increased labor cost.

Overall, combining conformance and experiential quality, when delivering care, requires that hospitals initially devote significant financial resources to achieve this cultural shift (Bergman 2003, Levinson et al. 2010, Raman and Tucker 2011), and allow caregivers to spend additional time with patients. This suggests the following hypothesis:

> Hypothesis 6: *Higher combined quality is related to lower cost efficiency.*

3.0. Research Design and Data

The unit of analysis in this study is an U.S. acute care hospital. We used CMS data for three years from July 2006- June 2009. This yielded data on 3458 US acute care hospitals. We began our study with fiscal year July 2006 – June 2007 (defined as time period t) since it was the first year that the data on experiential quality was available.

As reported in Table 1, we used the following eight sources data collected from secondary sources to investigate our research question: CMS process of care measures (conformance quality), CMS Hospital Consumer Assessment of Healthcare Providers & Systems (HCAHPS) surveys filled out by patients (experiential quality), Medicare Cost Reports (cost efficiency and length of stay), CMS Outcomes Files (30-day readmission rate), Impact Files and Hospital Files developed by CMS (controls) and two websites that reflect state level legislations and which are maintained respectively by the Committee to Reduce Infection Deaths and by the National Association on State Health Policy (instruments).

-------------------------------- *Insert Table 1 about here* -----------------------------------

Table 2 shows the number of observations collected for the independent and dependent variables for the three time periods considered. Based on data availability, the final sample contains between 6864 - 7867 hospital years for between 2963 - 3014 hospitals, depending on the dependent variable considered. Hospitals in our sample are located in all 50 U.S. states and the District of Columbia.

-------------------------------- *Insert Table 2 about here* -----------------------------------

Clinical Performance

Length of Stay is measured as the ratio of total hospital bed days used to the total number of discharges, as reported on Medicare cost report. Hence, this ratio reflects the average length of stay of a patient for a given hospital (i) and is a good indicator of short-term clinical outcomes, providing we control for relevant factors such as case-mix index[1] (Devaraj et al. 2013). We collected hospital bed days and discharge data for hospital's fiscal years beginning in time periods t, t+1 and t+2. Hence the final *Length of Stay*[2] LOS_{it} value for hospital i with total number of used bed days B_{it} and number of discharges D_{it} in period t is:

[1] Some researchers have argued that some hospitals' units might discharge patients earlier than needed and hence increase their likelihood of readmissions (Kc and Terwiesch 2012). However we found a strong positive correlation between length of stay and readmissions, after controlling for case-mix index, which suggests that this behavior is exceptional rather than the norm (Chen et al. 2010) and that shorter length of stay is general benefits the patient (e.g. less time spent in the hospital, less potential to acquire infections that would lead to readmission)

[2] Extreme values of more than 10 days (total of 19 observations) were deleted in order to avoid extreme outliers to unduly affect our results. However, results remain consistent when those outliers are included.

$$\mathbf{LOS_{it}} = \frac{\mathbf{B_{it}}}{\mathbf{D_{it}}}$$

Readmission Rate is only reported by CMS as a 3-year rolling average (at the hospital-level) for three conditions: Heart Attack (AMI), Heart Failure (HF) and Pneumonia (PN). This measure provides a good lead indicator of clinical outcomes (Boulding et al. 2010). Following CMS guidelines, only measures that are based on a sample of at least 25 patients for a given condition were included in the study. CMS reported the average readmission rate from July 2006 to June 2009, which corresponded with our study timeframe and therefore we use that measure of readmission. We computed the weighted average of the three conditions' readmission rates for each hospital. Previous studies show that US states monitor and control the readmission rates for their hospitals through state-level initiatives such as regulations (Davis and Schoen 2007). Hence, we also controlled for potential state-level initiatives to reduce readmissions independently of hospitals' quality efforts. Hence the final *Readmission Rate* RR_{is} value for hospital i in state s with respective readmission rates (AMI_i, HF_i and PN_i) and the number of patients ($nAMI_i$, nHF_i and nPN_i) is given by:

$$\mathbf{RR_{is}} = \frac{\mathbf{(AMI_i \times nAMI_i + HF_i \times nHF_i + PN_i \times nPN_i)}}{\mathbf{nAMI_i + nHF_i + nPN_i}}$$

Cost Performance

Current Cost Efficiency, which is based on cost data collected in the same year as our quality dimensions, is measured as the hospital's total operating expenses divided by the number of discharges. Both operating expenses and discharges come from the Medicare cost report data. Operating expenses include the direct cost of caring for a patient as well as the general expenses such as training incurred by the hospital for the given year. We collected hospitals' total operating expenses and number of discharges for hospital's fiscal years beginning in time periods t, t+1 and t+2. We excluded 3 hospitals that had less than one discharge a day on average, to avoid abnormally high cost efficiency ratios. To satisfy normality and homoscedasticity requirements, we applied the natural logarithm transformation to the resulting ratio. The *Current Cost Efficiency* value CCE_{it} for hospital i in time period t with total operating expense O_{it} and number of discharges D_{it} is:

$$\mathbf{CCE_{it}} = -\mathbf{ln}\left(\frac{\mathbf{O_{it}}}{\mathbf{D_{it}}}\right)$$

A negative sign is added so that worse performance (e.g. higher costs) results in a lower *Current Cost Efficiency* measure.

To obtain a more complete picture of the relationship between process quality and cost, we also consider ***(One-year) Lead Cost Efficiency.*** This variable is measured in a similar manner as *Current Cost Efficiency* but is based on hospitals' total operating expenses and number of discharges for hospital's next fiscal year. The *Lead Cost Efficiency* value LCD_{it} for hospital i in time period t with total operating expense O_{it+1} and number of discharges D_{it+1} is:

$$\mathbf{LCE_{it} = -\ln\left(\frac{O_{it+1}}{D_{it+1}}\right)}$$

Similar to the previous measure, a negative sign is added to link higher costs to lower *Lead Cost Efficiency* measure.

Process Quality

Conformance Quality corresponds to the level of systematic adherence to technical standards achieved by hospitals when delivering care to the patient. We evaluate this construct using CMS process of care measures that report the percentage of eligible hospitalized patients who received care in accordance with the evidence-based guidelines in time periods t, t+1 and t+2. These measures were developed in 2003 by CMS and the Joint Commission and results are reported on the CMS Hospital Compare website (hospitalcompare.hhs.gov).

Specifically, consistent with our *Readmission Rate* measure, we considered the process of care measures for three conditions: AMI, HF and PN. Given the definition of *Conformance Quality* – level of systematic adherence to evidence-based standards—we focused our attention on the 11 measures that have been deemed to "accurately capture whether the evidence-based care has been delivered (Chassin et al. 2010: p. 685)". For each hospital, the measure reports the percentage of eligible patients who actually receive the treatment. A complete list of the conformance quality measures used in this study along with sample averages and standard deviations for the three years considered can be found in Appendix A.

Following CMS guidelines, only measures that are based on a sample of at least 25 eligible patients were included in the study. We computed hospital's weighted average percentage across all selected measures (Theokary and Ren 2011). Then, in accordance with statistical theory (Collett 2003) and previous research (Carman et al. 2000, Chandrasekaran et al. 2012), we transformed this percentage into its normally distributed logit form to satisfy the distributional assumptions such as normality and homoscedasticity required for regression analysis.

Conformance Quality for hospital i at time t with weighted average percentage across process of care measures P_{it} is hence given by[3]:

$$\mathbf{CQ_{it} = \ln\left(\frac{P_{it}}{1 - P_{it}}\right)}$$

Experiential Quality measures the quality of interactions between patients and caregivers, as perceived by the patient (Chandrasekaran et al. 2012). In the context of health care delivery, this construct is evaluated using patients' response to the HCAHPS survey obtained in time periods t, t+1 and t+2. These measures were developed by CMS and the U.S. Agency for Healthcare Research and Quality in 2006 and the results are also reported on the CMS Hospital Compare website. To form the *Experiential Quality* construct, we used the six items of this survey that measures the hospitals' emphasis on communicating with patients and involving them in the care process (Boulding et al. 2011). The items ask the patient to rate the extent to which their individual care needs were considered during the process of care, such as the level of communication from nurses and physicians (COMP1 and COMP2), how responsive caregivers are to patients' needs (COMP3), how well caregivers help patients manage their pain (COMP4), how well caregivers explain medications to patients (COMP5) and whether patients were given key information at discharge (COMP6). Full text of items is shown in Appendix A. Cronbach's alpha for these items is 0.93 which indicates excellent internal consistency (Hair et al. 2010).

Based on CMS guidelines, only data from hospitals that had survey responses from at least 100 patients were included in the study. The survey data are aggregated at the hospital-level by CMS. For each question COMP1 through COMP5, CMS reports the percentage of patients at the hospital who answered the question using the response categories "Never/Sometimes", "Usually" or "Always." We used the percentage of patients who answered "Always" as the measure for the items' individual scores. COMP6's response categories are only "Yes" or "No", so the percentage score for that item is the percentage of respondents who answered the question with "Yes." Finally, an overall score for each hospital was calculated computing the average of the percentage scores for the six items. Similar to the Conformance Quality measure, this percentage score was then transformed into its normally distributed logit form.

Experiential Quality for hospital i in time period t with composite percentage score E_{it} is given by[4]:

$$\mathbf{EQ_{it} = \ln\left(\frac{E_{it}}{1 - E_{it}}\right)}$$

[3] We had to drop the 30 hospitals that had an average conformance quality score of 100%. However, these hospitals did not have measures for all of the process conformance items and therefore had incomplete data which resulted in artificially high scores. None of the hospitals in our sample had P=0%.

[4] None of the hospitals in the sample had E=0% or E=100%.

Consistent with other studies that measure the ability of organizations to excel along two distinct dimensions (Gibson and Birkinshaw 2004, He and Wong 2004, Jansen et al. 2009), we measured ***Combined Quality*** as the product of *Conformance Quality* and *Experiential Quality* scores to reflect a hospital's ability to focus on both dimensions. This approach to measure combined quality best reflects the synergies between the two dimensions. To minimize multicollinearity issues, we centered the quality measures before computing the product term (Aiken and West 1991). The *Combined Quality* score for hospital i in time period t is given by:

$$\mathbf{C_{it} = CQ_{it} \times EQ_{it}} \text{ (with } CQ_{it} \text{ and } EQ_{it} \text{ centered over period t)}$$

Correcting for Endogeneity using Instruments

Conformance Quality and *Experiential Quality* are only proxies for a hospital's quality initiatives which may raise endogeneity concerns with respect to some of our dependent variables. For instance, a shorter length of stay in prior periods might have encouraged hospitals and provided them with additional resources to improve *Conformance Quality* and *Experiential Quality*. Similarly, *Conformance Quality* and *Experiential Quality* are likely influenced by the hospital's cost performance during the prior year, which is in turn likely correlated with the cost performance of the current year. Such reasoning does not apply to *Readmission Rate* since our study period (July 2006-June 2010) occurs while hospitals were still being reimbursed for readmitted patients, and hence did not financially suffer or benefit from changes in readmission rates (penalties for excess readmissions began in FY 2013). Thus, it is unlikely that hospitals focused their efforts on reducing readmissions. This argument is supported by our multiple conversations with hospital administrators, physicians and nurses across multiple hospitals[5]. Therefore, we use instruments to account for endogeneity issues among our independent variables of *Conformance Quality*, *Experiential Quality* and *Combined Quality* only when looking at *Length of Stay* and *Cost Efficiency* outcomes. Specifically, we use state level legislative initiatives on patient safety and patient centeredness as our instruments. Despite state legislation possibly providing an incentive for hospitals to improve their performance along *Length of Stay* and *Cost Efficiency*, this change in performance can only be affected through a change in hospital's behavior (e.g. process quality improvement) (Wilson and Collier 2000, James and Savitz 2011, Andritsos and Tang 2012, Boyer et al. 2012, Chandrasekaran et al. 2012). The following state level initiatives are used as instruments in this study.

HAI Legislation reflects state's attention to the reporting of Healthcare-Associated Infections (HAI) and is measured as the number of years, as of the end of 2009, 2008 and 2007, since the first state-level

[5] A Durbin-Wu-Hausman test, described in the "Analyses and Results" section also supports this lack of endogeneity concern for *Readmission Rate*. Moreover, as described in the "Robustness Checks", we also predicted *Readmission Rate* using 2SLS IV approach and found similar results despite larger standard errors.

initiative related to this topic was introduced. It is reported by the Committee to Reduce Infection Deaths (hospitalinfection.org) and varies in 2009 from 0 (no HAI legislation introduced as of the end of 2009) in DC and Hawaii to 6 (HAI legislation introduced in 2004) in Florida and Missouri. Previous research supports the relationship between HAI legislation and hospitals' focus on *Conformance Quality* (Chandrasekaran et al. 2012). Hence, it was used for its ability to predict *Conformance Quality* ($r=0.10$, $p<0.01$).

Similarly, ***PCMH Legislation*** reflects state's attention to the development of Patient-Centered Medical Homes (PCMH) and is measured as the number of years, as of the end of 2009, 2008 and 2007, since the first state-level initiative concerning this topic was undertaken and is reported by the National Academy for State Health Policy (nashp.org). For 2009, this measure varies from 0 (e.g. Arizona, Maryland and Wisconsin) to 12 (North Carolina – PCMH legislation introduced in 1998). A Patient-Centered Medical Home is a model for delivering primary care in which the patient is the focal point and works in partnership with his or her primary physician so that the patient's preferences are taken into account. Furthermore, there care is coordinated across the patient's complete care needs. Medical Homes have been consistently associated with the operationalization of *Experiential Quality* as demonstrated by the "Patient-Centered" adjective that usually precedes this denomination (National Committee for Quality Assurance). Thus, this measure was selected for its relationship with *Experiential Quality* ($r=0.20$, $p<0.01$).

Finally, after centering both state legislative measures, ***Combined Legislation*** is computed as the interaction term between them. This measure is used as an instrument to predict *Combined Quality* ($r=0.08$, $p<0.01$). We describe the relevant tests for endogeneity and instrument validity at the beginning of the "Analysis and Results" section (§4.0).

Control variables

Previous studies have identified several variables as potential sources of heterogeneity in acute care hospitals' performance. Hence, we controlled for their effects in this study. This can minimize concerns related to, for example, differences in service offerings (e.g. ability to treat more severe cases). Controls include ***Corporate Goals*** (for profit vs. non-profit), ***Ownership*** (public vs. private) (Weiner et al. 2006), ***Teaching Intensity*** (residents-to-beds ratio) (Sloan et al. 2001), ***Bed Size***, ***Location*** (Large Urban & Rural) (Jha et al. 2009), ***Case Mix Index*** and ***Wage Index*** (Shwartz et al. 2011) **–** after controlling for the effect of teaching intensity since teaching hospitals tend to treat a more complex case mix and have higher wages (Nath and Sudharshan 2006, Koenig et al. 2003), CMS Operating Disproportionate Share hospital payment adjustment factor – ***OPDSH Adjustment Factor*** – which reflects hospital's propensity to treat uninsured and Medicaid patients who often require more resources (Coughlin and Liska 1998) and CMS Operating Outlier adjustment factor – ***Outlier Adjustment Factor*** – which reflects unusually costly cases treated by the focal hospital (Jha et al. 2009). Both of these adjustment factors are calculated and reported by CMS. We also included year dummies to control for unobserved factors causing overall population change in hospital's performance. Finally, through panel-data modeling, we controlled for autocorrelations at the individual hospital level in the analyses concerning *Cost Efficiency* and *Length of Stay* and for state-level effects when considering *Readmission Rate*.

4.0. Analyses and Results

The 3458 acute care U.S. hospitals considered show a wide spread in terms of process characteristics (*Conformance Quality* and *Experiential Quality*) as well as cost (*Current* and *Lead Cost Efficiency)* and quality outcomes (*Length of Stay* and *Readmission Rate*). Table 1 shows summary statistics for all variables in this study. Table 3 presents the correlations among these variables. The negative and non-significant correlation between *Conformance Quality* and *Experiential Quality* (r = -0.01, p-value = 0.62) supports their conceptualization as distinct quality attributes of the process of care (Gupta et al. 2006).

-------------------------------- *Insert Table 3 about here* -----------------------------------

Modeling Length of Stay and Cost Efficiency

A Durbin-Wu-Hausman test comparing results between the instrumented regression and the regular OLS regression offered support for our endogeneity concerns ($\chi^2(11)=1015.94$, $p<0.01$ for *Current Cost Efficiency*; $\chi^2(11)=335.39$, $p<0.01$ for *Lead Cost Efficiency*, $\chi^2(11)=408.52$, $p<0.01$ for *Length of Stay*) (Davidson and MacKinnon 1993).

To address this endogeneity issue, we adopted a two-stage least squares (2SLS) random effects regression approach for panel-data using the command xtivreg in Stata11. This approach effectively separates the endogenous and exogenous components of the three independent variables (Angrist et al. 1996, Greene 2003). Specifically, we estimate the following models:

$$\mathbf{CCE_{it}} = \alpha_1 + \beta_1 \mathbf{X_{it}} + \delta_1 \mathbf{\hat{W}_{it}} + \mathbf{u_i} + \mathbf{v_{it}} \text{ for } \textit{Current Cost Efficiency}$$

$$\mathbf{LCE_{it}} = \alpha_2 + \beta_2 \mathbf{X_{it}} + \delta_2 \mathbf{\hat{W}_{it}} + \mathbf{u'_i} + \mathbf{v'_{it}} \text{ for } \textit{Lead Cost Efficiency}$$

$$\text{and } \mathbf{LOS_{it}} = \alpha_3 + \beta_3 \mathbf{X_{it}} + \delta_3 \mathbf{\hat{W}_{it}} + \mathbf{u''_i} + \mathbf{v''_{it}} \text{ for } \textit{Length of Stay}$$

where u_i /u'_i/ u''_i and v_{it} /v'_{it} /v''_{it} represent respectively the between- and within-hospital random effects.

$\mathbf{\hat{W}_{it}}$ is the fitted value from the first-stage regressions of endogenous variables – *Conformance Quality, Experiential Quality* and *Combined Quality* – on the controls and instruments, that is:

$$\mathbf{W_{it} = (\beta_0 + \beta_1 X_{it} + \gamma Z_{it}) + \varepsilon_{it} = \hat{W}_{it} + \varepsilon_{it}}$$

where W_{it} is a vector of endogenous variables for hospital i at time t, X_{it} is a vector of control (exogenous) variables for hospital i at time t, and Z_{it} is a vector of instrumental variables – *HAI Legislation*, *PCMH Legislation* and *Combined Legislation*– for hospital i at time t.

Modeling Readmission Rate

As stated earlier, we do not believe that an endogeneity issue arises in the model predicting *Readmission Rate*. The Durbin-Wu-Hausman test comparing results between the instrumented regression and the regular GLS regression ($\chi^2(11)=7.91$, $p=0.89$) offers support to this lack of endogeneity concerns with respect to *Readmission Rate* (Davidson and MacKinnon 1993). Thus, to achieve more efficient estimation, we do not use instrumental variables to predict *Readmission Rate* (Wooldridge 2008).

Many states have undertaken initiatives and provided dedicated resources to reduce hospitals' readmissions through, for example, better access to preventive care (Davis and Schoen 2007). Thus, we model *Readmission Rate* using both multi-level fixed and random-effects estimators to control for state-level effects. A Hausman (1978) test result indicated that modeling state-level effects as fixed rather than random is most appropriate in our analyses ($\chi^2(15)=42.78$, $p<0.001$)[6]. Hence we report the results from the multi-level fixed-effects regressions. Specifically, the following model represents the readmission rate for hospital i located in state s:

$$\mathbf{RR_{is} = \alpha_s + \beta X_{is} + v_{is}}$$

where X_{is} is the average of the independent and control variables over the three years considered, α_s represents the fixed state effect and v_{is} represent the within-state random effect.

4.1. Validity of Instruments

From a conceptual standpoint, the effect of instruments on the dependent variables (i.e. *Length of Stay* and *Cost Efficiency*) must exist only through the endogenous variable(s) (Davidson and McKinnon 2003). *Length of Stay* and *Cost Efficiency* occur while the patient is within the hospital. Thus, despite state legislation possibly providing an incentive for hospitals to improve their performance, this change in performance can only be affected through a change in hospital's behavior – that is hospitals investing in process improvement programs and training their caregivers (e.g. process quality improvement) (Wilson and Collier 2000, James and Savitz 2011, Andritsos and Tang 2012, Boyer et al. 2012, Chandrasekaran et al. 2012). This provides support to the exclusion criterion for the instruments (Wooldridge 2002).

[6] We also repeated our analyses treating state-effects as random which provided similar results.

Furthermore, the following tests were performed to test the validity of the instruments. First, the first-stage regressions of each dependent variable on all exogenous variables (including instruments) show a significant coefficient ($p<0.01$) for each instrument when predicting their corresponding endogenous variables.

Second, the Angrist-Pischke (2008) F-test for weak instruments based on first-stage regressions (with each endogenous variable regressed on all exogenous control variables and all instruments) is above 10 for all three endogenous variables considered ($F_{CQ}=11.72$, $p<0.01$; $F_{EQ}=218.96$, $p<0.01$; $F_{C}=21.39$, $p<0.01$), which supports the strength of the instruments (Staiger and Stock 1994).

Third, results from Anderson's (1984) canonical correlation test lead to the rejection of the instrumented model being unidentified ($\chi^2(1)=9.79$, $p<0.01$). This further buttresses the quality of the instruments.

4.2. Estimation Results

A Baltagi's (1981) two-stage least squares random-effects estimator (Error Component Two-Stage Least Squares – EC2SLS) is used in this study for the instrumental variable two-stage least squares regressions involving *Cost Efficiency* and *Length of Stay* dependent variables. This estimator allows us 1) to control for unobserved hospital specific effects through the random-effect model and 2) to avoid simultaneous-equation bias due to the presence of multiple endogenous variables. When multiple endogenous variables are included, the Baltagi's estimator provides a better estimation of instrumented effects when compared to the regular 2SLS random-effects estimators (Baltagi 1981,1984, Kinal and Lahiri 1993).

Table 4 summarizes the results from the analyses. The Variation Inflation Factor (VIF) for every independent variable in each model of this study is well below the cutoff of 10 recommended by Hair and colleagues (2010). Therefore, overall, multicollinearity does not appear to be a concern.

------------------------------- *Insert Table 4 about here* -----------------------------------

Models 1-4 test the effects of process quality on *Length of stay* and *Readmission Rate.* While Models 5-8 test the effects of process quality on *Current and Lead Cost Efficiency*. Specifically, Models 1 & 3 represent the main effects of *Conformance Quality* and *Experiential Quality* to predict respectively *Length of stay and Readmission Rate* while Models 2 & 4 show the full model with *Combined Quality*. Similarly, Models 5 & 7 represent the main effect of *Conformance Quality* and *Experiential Quality* with regard to *Current and Lead Cost Efficiency* while Models 6 & 8 represents the full model with *Combined Quality*.

Conformance Quality and Clinical and Cost Performance

Model 1 shows a significant negative coefficient for *Conformance Quality* when considering *Length of*

Stay (β_{M1}=-0.23, p<0.01). Similarly, Model 3 shows a significant negative coefficient for *Conformance Quality* when considering *Readmission Rate* (β_{M3}=-0.14, p<0.01). These results suggest that *Conformance Quality* is associated with a reduction in both *Length of Stay* and *Readmission Rate*. Hence, hypothesis 1 is supported.

Model 5 shows a significant negative coefficient for *Conformance Quality* (β_{M5}=-0.11, p<0.01) when considering *Current Cost Efficiency*. This offers empirical support, as expected, for a negative association between *Conformance Quality* and *Current Cost Efficiency* and suggests that *Conformance Quality*, initially at least, may not be free (Crosby 1979). However, as shown in Model 7, *Conformance Quality* no longer has a significant association with *Lead Cost Efficiency*[7] (β_{M7}=0.01, p=0.73). This result indicates that there could be a learning curve wherein the cost of *Conformance Quality* reduces and even disappears overtime (Crosby 1979, Fine 1986, Hatch and Mowery 1998). Overall these results offer only partial support to hypothesis 2.

Experiential Quality and Clinical and Cost Performance

Models 1 & 3 show a large and significant negative coefficient between *Experiential Quality* and both *Length of Stay* (β_{M1}=-0.87, p<0.01) and *Readmission Rate* (β_{M3}=-0.54, p<0.01). These results suggest that *Experiential Quality* plays a significant role in reducing both *Length of Stay* and *Readmission Rate*. Thus, results offer support for hypothesis 3.

Models 5 & 7 show no significant association between *Experiential Quality* and both *Current* (β_{M5}=0.01, p=0.99) and *Lead Cost Efficiency* (β_{M7}=0.05, p=0.41), failing to offer support to hypothesis 4. These results also suggest that from a cost standpoint, the cost benefits from developing better interactions with the patient cancel out with the corresponding resource requirements (e.g. training).

Combined Quality and Clinical and Cost Performance

Models 2 & 4 show a significant negative relationship between *Combined Quality* and both *Length of Stay* (β_{M2}=-1.35, p<0.01) and *Readmission Rate* (β_{M4}=-0.19, p<0.01). These results indicate that *Combined Quality* is related to both shorter *Length of Stay* and reduced *Readmission Rate.* Thus, hypothesis 5 is supported. Support for this hypothesis indicates that the previous results on the main effects of conformance and experiential quality with regards to clinical outcomes should be interpreted with caution (Aiken and West 1991).

It is also worth noting that the coefficient for *Conformance Quality* with regards to *Length of Stay* is no longer significant when *Combined Quality* is added to the model, i.e. Model 2 (β_{M2}=-0.01, p=0.98).

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[7] One could argue that hospitals decreased their levels of *Conformance Quality* in the following period, resulting in a decrease in costs. However our data supports continuous improvement overtime along both process quality dimensions (i.e. on an average both conformance and experiential quality increases over time for the hospitals in our sample)

Comparison of models' fit – $\chi(15)=2737$ for Model 2 vs. $\chi(14)=605$ for Model 1 – indicates that Model 2, which includes *Combined Quality,* is a better fit. Hence, these results suggest that the relationship between *Conformance Quality* and *Length of Stay* is fully dependent on levels of *Experiential Quality*. This further supports the importance of considering *Combined Quality* when studying hospitals' performance.

Figures 1 and 2 represent the interactions plot (Aiken and West 1991) between the *Conformance Quality* and *Experiential Quality* and *Length of Stay* as well as *Readmission Rate*. The importance of the combined effect of quality on clinical outcomes is reflected in these plots. Consider, for instance, a hospital that achieves high levels of *Conformance Quality* (75^{th} percentile). In this case, a 1% increase in average HCAHPS survey scores would correspond to an average 100 minute decrease in *Length of Stay* and a 3.23% decrease in *Readmission Rate*. This means that this hospital would, on average, save over one patient bed day for every 15 patients treated and avoid one readmission for every 31 patients discharged. To tie these results back to financial outcomes, let us consider a heart failure patient condition. A hospital receives at least $6000, regardless of length of stay, from Medicare for each heart failure admission, which provides a very conservative measure of potential revenues, and the average stay for this condition is 5.8 days (Bogaev 2010). This means that if a hospital can save 6 bed days for every 90 patients (1/15=6/90), it could potentially admit a new heart failure patient and earn, at a minimum, an extra $6000. Regarding readmissions, starting in October 2012, hospitals would progressively lose an increasing proportion of their Medicare reimbursement (up to 1% Medicare payments in FY2013, 2% in FY2014 and 3% in FY2015) if they show excessive 30-day readmission rates. This often translates into millions of dollars loss in annual revenues for hospitals (Greene 2012). On the other hand, for a hospital with relatively low levels of *Conformance Quality* (25^{th} percentile), a 1% increase in average HCAHPS survey scores would correspond to an average decrease of only 10 minutes in *Length of Stay* and a 2.36% decrease in *Readmission Rate*. This implies that, on average, close to 150 patients would have to be treated to save this hospital one bed day and that only one readmission in every 43 patients discharged would be avoided.

-------------------------------- *Insert Figures 1 & 2 about here* -----------------------------------

Models 6 & 8 show a significant negative association between *Combined Quality* and both *Current* (β_{M6}=-0.93, $p<0.01$) and *Lead Cost Efficiency* (β_{M8}=-0.35, $p<0.05$). This indicates that the costs associated with having a workforce that simultaneously focuses on conformance and experiential quality outweigh the benefits of providing customized patient care. However, by looking at the current (Model 6) and lagged (Model 8) effects, it seems that this cost penalty might decrease over time. Thus, one might speculate that hospitals and caregivers are constantly learning on how to integrate both conformance and experiential quality. Overall, these results support hypothesis 6. Again, support for this hypothesis undermines interpretation of the main effects of conformance and experiential quality with regards to cost efficiency (Aiken and West 1991).

Figures 3 and 4 represent the interactions plot between the *Conformance Quality* and *Experiential Quality* on *Cost Efficiency* performance (Aiken and West 1991). The importance of *Combined Quality* on *Cost Efficiency* performance is reflected in these plots. Consider, a hospital that achieves high levels of *Conformance Quality* (i.e. 75th percentile in our sample which corresponds to roughly 95% overall adherence to process of care measures). In this case, a 1% increase in average HCAHPS survey scores, which reflects an increase in *Experiential Quality,* would lead to a \$360 increase in average cost per discharge during that year versus only a \$38 increase one year later. Alternatively, for a hospital with low levels of *Conformance Quality* (i.e. 25th percentile in our sample which corresponds to roughly 86.5% overall adherence to process of care measures), a 1% increase in average HCAHPS survey scores would lead to a \$249 decrease in average cost per discharge during that year versus a \$188 decrease one year later. This suggests that the negative cost consequences of pursuing *Combined Quality* might not only decrease over time but also that this decrease might happen at a faster rate at high levels of combined quality (a \$322 savings at high levels versus only a \$61 savings at low levels).

-------------------------------- *Insert Figures 3 & 4 about here* -----------------------------------

4.3. Robustness checks

We conducted additional analyses to check the robustness of our results to alternative model specifications and to exclude alternative explanations. First, our approach to examine a system of equations can raise the possibility of unobserved variables "omitted" variable that can affect all four dependent variables (e.g. *Current Cost Efficiency*, (one-year) *Lead Cost Efficiency*, *Length of Stay* and *Readmission Rate*) simultaneously. This can result in inconsistent estimates of the coefficients and their standard errors (Zellner and Theil 1962). To rule out this effect, we employed a three-stage regression methodology (3SLS), wherein the contemporaneous standard errors of each of the simultaneous equations are allowed to be correlated with each other (Zellner and Theil 1962). That is, we jointly applied seemingly unrelated regression methodology along with the 2SLS methodology to obtain consistent estimates of the coefficients and their standard errors (Wooldridge 2008). The results were consistent to the results from the original analyses (see Appendix B).

Second, we considered the fact that a longer length of stay is likely to increase immediate operating costs per discharge and thus may reduce *Current Cost Efficiency*. Hence, we modeled *Length of Stay* as a mediating variable between *Combined Quality* and *Current Cost Efficiency*. This model was tested following the procedure outlined by Baron and Kenny (1986) using both simple OLS regressions and instrumental variable regressions (with Aroian version of the Sobel test to test mediation effect). Results using both regression methods show that the effect of *Combined Quality* on *Current Cost Efficiency* is only partially mediated by *Length of Stay*. More precisely, *Combined Quality* is related to a decrease in *Length of Stay* (β_{OLS}=-0.07, β_{IV}=-1.35; p <0.01 for both models) which, in turn, would lead to an increase in *Current Cost Efficiency* (β_{OLS}=-0.09, β_{IV}=-0.11; p <0.01 for both models). However, this indirect effect (β_{OLS}=0.01, β_{IV}=0.15; p <0.01 for both models) is outweighed by the direct negative relationship between *Combined Quality* and *Current Cost Efficiency* (β_{OLS}=-0.06, β_{IV}=-1.19; p <0.01 for both models). Thus, our overall finding of a cost-quality trade-off remains consistent.

Third, we repeated our analyses for our *Length of Stay, Current Cost Efficiency* and *Lead Cost Efficiency* dependent variables using an ordinary least squares (OLS) regression approach to rule out any instrument selection bias (Wooldridge 2008). The coefficient for *Combined Quality* remained consistent in both direction and significance. However we observe a strong bias (see Appendix C) supporting our logic to use instruments.

Fourth, the Durbin-Wu Hausman test did not support the use of instruments for *Readmission Rate*. Nevertheless, for consistency, we performed a 2SLS instrumental variable regression using the same set of instruments from the other regressions when studying the relationship between *Combined Quality* and *Readmission Rate*. The resulting coefficient for *Combined Quality* was in the same direction although not significant due to a much larger standard error (see Appendix C).

Finally, the weak-instrument-robust Anderson-Rubin (1949) tests ($\chi^2(3)$= 106.64, p<0.01 for model predicting *Current Cost Efficiency*; $\chi^2(3)$= 93.68, p<0.01 for model predicting *Lead Cost Efficiency*; $\chi^2(3)$= 121.20, p<0.01 for model predicting *Length of Stay*) and Stock-Wright (2000) LM S statistics ($\chi^2(3)$= 105.21, p<0.01 for model predicting *Current Cost Efficiency*; $\chi^2(3)$= 92.42, p<0.01 for model predicting *Lead Cost Efficiency*; $\chi^2(3)$= 119.36, p<0.01 for model predicting *Length of Stay*), support the significance of our endogenous variables with regards to cost efficiency and length of stay measures, even if the used instruments were to be weak (Moreira 2001).

5.0. Discussion and Conclusion

This study examines the relationship between hospital's focus on both conformance and experiential dimensions of quality and their impact on financial and clinical outcomes. These are important relationships to investigate because hospitals may face a tension between improving clinical outcomes and maintaining their financial bottom-line (Berwick et al. 2008). However, little is known on the joint impact of these dimensions on hospital performance in terms of cost and clinical quality. Our study is a first step towards understanding these relationships.

Results show that hospitals with high levels of combined quality are typically associated with higher costs, but better clinical outcomes, as measured by length of stay and readmissions. These results suggest that hospitals face a tradeoff between cost performance and clinical outcomes. We also find that the effect of conformance quality on length of stay is dependent on the level of experiential quality. Taken together, these findings underline the important synergy that exists between conformance and experiential quality with regards to clinical outcomes, which is completely ignored in the extant literature.

In healthcare the "*first, do no harm*" oath clearly underlines the importance of patient safety, which is mainly achieved through strict adherence to best technical practices defined by healthcare experts, not patients. Hence, integrating experiential quality into the delivery of care requires caregivers to understand that conformance quality is an important, but just one part of achieving excellent clinical outcomes. Other manufacturing and services environments do not face this challenge to the same extent because they have traditionally defined conformance quality as conformance to customer requirements (Berry et al. 1994, Krishnan et al. 2000). There is also lesser cultural resistance to change in these environments which is unlike the healthcare settings studied in our work. Experiential quality requires ensuring that patients have a voice in their own care. This might trigger cultural resistance given the inherent bias towards conformance quality. The need for hospitals to promote such radically new representation, despite its clear health benefits, implies an inevitable cost-quality tradeoff. However, as suggested by our results, this tradeoff might diminish overtime, as the culture slowly shifts and caregivers learn to better integrate both process quality dimensions in a more supportive environment.

Contributions to Theory

Our research offers two important theoretical contributions. First, we highlight two important quality dimensions in the healthcare context, conformance and experiential quality, and show that they are distinct dimensions which therefore require separate processes to manage them. This can be seen through the lack of correlation between conformance and experiential process quality constructs ($r=-0.01, p=0.62$), and also through the difference in their respective effects on current cost and clinical performance. Indeed, results show that conformance quality appears to negatively impact current costs while experiential quality seems to reduce length of stay. The fact that these two dimensions occur relatively independently of each other implies that it is important for researchers to include measures of both dimensions in their studies of effectiveness, as well as their interaction. This represents a particularly important insight to both healthcare and quality management literature given the lack of studies that consider both dimensions jointly. Such dual consideration might help clarifying relationships and reducing the amount of unexplained variation in performance. For example, a study that only considers conformance quality could have concluded that it significantly reduces length of stay. However, as shown by our results, by including combined quality in the model, we not only achieve a much better predictive power but also show that the effect of conformance quality is entirely moderated by levels of experiential quality. By investigating these two quality dimensions, our research addresses the call, in quality management, for empirical research that considers quality as a multi-dimensional rather than uni-dimensional construct and that identifies these important quality dimensions for specific industry contexts (Sousa and Voss 2002, Roth and Menor 2003).

Second, to our knowledge, our study represents the first large-scale empirical validation of the cost-quality tradeoff in healthcare settings. The quality management literature has suggested that organizations that achieve high levels of conformance and experiential quality will enjoy benefits, such as increased customer loyalty (Harvey 1998), or reduced cost of quality over time (Fine 1986). However, our study uses empirical data to test hypotheses about the impact of a "combined aspect" of service quality and we find that there can be a negative impact on the organization, at least initially. Hence it is important for studies in the healthcare environment to systematically include multiple dimensions of performance to reflect the tradeoffs that healthcare quality improvement efforts may experience (Berwick 2008, Pauker et al. 2005).

Contributions to Practice

Our study also provides important implications for hospitals. First, from a financial standpoint, hospitals that aim to achieve high levels of both conformance and experiential quality should anticipate cost increases, at least initially. However, combined quality is also related to a decrease in readmission rate. Thus, given that hospitals will soon be penalized for their excess readmissions, not implementing combined quality might save on costs but would likely lead to a significant loss in revenues. Therefore, investing in combined quality might overall become the most financially sound option for hospitals.

Second, from a clinical outcome standpoint, our results provide evidence that a dual focus on combined quality will reduce readmission rates and length of stay. This result underscores the importance of changing not only caregivers' mindsets such that they can deliver high levels of both quality dimensions, but also creating organizational structures to facilitate the integration of conformance and experiential quality. For example, in hospitals, conformance and experiential quality dimensions are typically handled by different departments, such as the Quality and Patient Safety Institute and the Office of Patient Experience at the Cleveland Clinic. The strong synergy found in our study should encourage hospitals to change their structures to better manage the interdependence between these two quality dimensions, and capture the synergies that can emerge. One possible solution is to integrate both the quality and patient safety institute and office of patient experience within a same entity.

Third, given the long-standing emphasis on conformance to technical guidelines, promoting experiential quality in hospitals has been difficult. As underlined by Pauker and colleagues (2005), medicine suffers from multiple layers of resistance, and changing each layer requires achieving buy-in. Therefore, our results suggests that hospitals may be able to create buy-in from caregivers for experiential quality by emphasizing that experiential quality is associated with reduced length of stay and readmissions.

Policy Implications

Finally, this study also offers important implications for policy makers. The dual focus emphasized by Medicare's value-based purchasing program (beginning in October 2012) appears well targeted at improving clinical outcomes in the form of length of stay and readmission rate. However, operationalizing this dual focus, which not only implies more time spent focusing on each patient, but also requires changing mindsets and training caregivers, seems to be costly for hospitals. The costs may stem from using dedicated resources to achieve the cultural shift required to achieve conformance and experiential quality improvement. The cost-quality tradeoff that we find implies that, for the policy to work, it is important that the benefits of achieving this dual focus outweigh its costs. Thus, this tradeoff needs to be properly managed not only at the hospital but also at a policy level.

Not rewarding hospitals enough for their dual quality efforts may discourage them from doing so. Indeed, under the new payment program, hospitals that do not perform well along both conformance and experiential quality dimensions would be financially penalized and could hence suffer millions of dollars losses in yearly revenues. Given the heavy cost of achieving combined quality, reducing hospitals' reimbursement is likely to reduce the opportunity for low performing hospitals to improve their process quality in the subsequent years. Hence, the current method adopted by CMS of using a "stick" over a "carrot" might increase the gap between high and low performers rather than leading to homogenously better care. Instead, our results suggest that CMS might want to consider providing assistance, such as free training, to low-performing hospitals at the beginning of the evaluation period instead of simply penalizing them at the end of the period. This would encourage these hospitals, as well as provide them with the means, to achieve combined quality. If such assistance is successful, the cost incurred could subsequently be deducted from the end-of-period reimbursement afforded to these hospitals.

Limitations and Conclusion

We acknowledge that our study has several limitations that might suggest avenues for further research. First, we do not control for physician-level characteristics that have been shown to influence clinical outcomes (Hannan et al. 1989, Jollis et al. 1997, Gawande 2012). However, considering only hospital-level data presents two major benefits, as described in the introduction. First, from a process quality standpoint, this level mirrors the hospital-level process quality scores considered by CMS new healthcare reimbursement policy (U.S. Department of Health & Human Services 2011). Thus, our study allows deriving important practical and policy implications for hospital administrators as well as policy makers. Second, from a performance standpoint, aside from individual learning rates, hospitals typically spend a large amount of financial resources in improving the overall quality of healthcare delivered within their system (Pisano et al. 2001, Raman and Tucker 2012). Our study therefore investigates the benefit for a systemic approach to learning in care delivery.

Second, the construct of *Conformance Quality* is measured with secondary data that measures only a subset of evidence-based guidelines and therefore fails to capture all possible evidence-based technical guidelines that hospitals may have pursued. Similarly, Experiential Quality only includes elements of the interactions between caregivers and patients measured by the HCAPHS survey, and may not represent other elements. Smaller scale studies in hospital environments could identify other items to bolster the *Conformance Quality* and *Experiential Quality* constructs and also allow further investigation of the reliability of our findings. Such studies would also assist policy makers in including more complete measures of conformance and experiential quality into their incentive plans. However, we believe that the benefits of this large scale study, made possible by the use of secondary, hospital-level data, outweigh these limitations.

Third, our study is not able to empirically demonstrate *why* combined conformance and experiential quality is associated with better clinical outcomes and increased costs. Future research could explore the specific organizational mechanisms that allow hospitals to integrate both dimensions and empirically investigate why these lead to higher costs. Third, due to data availability constraints, we were only able to observe cost efficiency for at most one year following the measurement of our independent variables. Although we speculated about the presence of a learning curve, the short timeframe covered by our data does not allow true observation of such phenomenon. Future research could develop on this intuition by analyzing cost efficiencies realized over a longer period, as data becomes available.

Overall, this research shows that the pursuit of combined conformance and experiential quality, as promoted by the value-based purchasing program, implies a cost efficiency-clinical outcomes tradeoff for hospitals. However, given the large synergy that exists between conformance and experiential quality, with regards to patient health, this tradeoff has to be faced and managed rather than avoided.

Tables and Figures

Table 1 Summary statistics and sources

Variables	Description	Mean	Std. dev.	Min.	Max.	Source
Controls						
Ownership	Dummy variable (public=1/private=0)	0.18	0.39	0	1	CMS Hospital Files
Corporate Goals	Dummy variable (for-profit=1/not-for-profit=0)	0.22	0.42	0	1	CMS Hospital Files
Teaching Intensity	Residents-to-beds ratio	0.06	0.15	0.00	1.75	CMS Impact Files
Case Mix Index	CMI residuals after regression on *Teaching Intensity*	0.00	0.30	-0.91	2.36	CMS Impact Files
Wage Index	Wage Index residuals after regression on *Teaching Intensity*	0.00	0.18	-0.64	0.97	CMS Impact Files
OPDSH Adjustment Factor	Operating disproportionate share payment reflects low income patient population	0.11	0.12	0.00	0.86	CMS Impact Files
Outlier Adjustment Factor	Operating outlier payment reflects exceptionally costly cases	0.04	0.08	0.00	2.80	CMS Impact Files
Bed Size	Ln (number of beds)	4.85	0.95	0.00	7.56	CMS Cost Reports
Large Urban Loc.	Dummy variable	0.40	0.49	0.00	1	CMS Cost Reports
Rural Location	Dummy variable	0.27	0.45	0.00	1	CMS Cost Reports
Process Quality dimensions						
Conformance Quality (prior to centering)	Logit of hospital's weighted average scores on AMI, HF and PN process of care measures	2.39	0.90	-3.90	7.27	CMS Process of Care measures
Experiential Quality (prior to centering)	Logit of hospital's average scores on COMP1-COMP6 HCHAPS survey	0.85	0.30	-0.71	3.37	CMS HCHAPS survey
Combined Quality	*Conformance Quality* x *Experiential Quality* (centered variables)	-0.01	0.29	-2.99	4.57	-
Instruments						
HAI Legislation (prior to centering)	Number of years, as of year t, since the first HAI initiative was enacted by the focal state	2.10	1.73	0	6	CRID database
PCMH Legislation (prior to centering)	Number of years, as of year t, since the first PCMH initiative was enacted by the focal state	0.91	1.96	0	12	NASHP database
Ambidextrous Legislation	*HAI Legislation* x *PCMH Legislation* (centered variables)	-0.27	1.97	-8.70	4.89	-
Performance Measures						
Cost Efficiency	-Ln(Total Operating Expenses / Number of Discharges) *Curr.*	-9.55	0.41	-7.39	-12.11	CMS Cost Reports
	Lead	-9.60	0.41	-7.80	-12.11	CMS Cost Reports
Length of Stay	Used bed days / Number of Discharges	4.37	0.97	0.12	9.91	CMS Cost Reports
Readmission Rate	Weighted average readmission rate across AMI, HF and PN	21.43	1.77	16.30	29.14	CMS Outcomes Files

Table 2 Time periods and number of observations available for key variables

Variable	Time Period	Number of observations (N=3458)
Process Quality Dimensions		
Conformance Quality	July 2006- June 2007 (t)	3075
	July 2007- June 2008 (t+1)	3074
	July 2008- June 2009 (t+2)	3054
Experiential Quality	July 2006- June 2007	2110
	July 2007- June 2008	3115
	July 2008- June 2009	3114
Combined Quality	July 2006- June 2007	2077
	July 2007- June 2008	2979
	July 2008- June 2009	2941
Performance Measures		
Cost		
Current Cost Efficiency	Fiscal Year beginning July 2006- June 2007	3209
	Fiscal Year beginning July 2007- June 2008	3237
	Fiscal Year beginning July 2008- June 2009	3256
Lead Cost Efficiency	Fiscal Year beginning July 2007- June 2008	3237
	Fiscal Year beginning July 2008- June 2009	3256
	Fiscal Year beginning July 2009- June 2010	2216
Quality		
Length of Stay	Fiscal Year beginning July 2006- June 2007	3206
	Fiscal Year beginning July 2007- June 2008	3237
	Fiscal Year beginning July 2008- June 2009	3257
Readmission Rate	July 2006- June 2009	3118

Table 3 Correlations

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1. *Ownership*	1.00																			
2. *Corporate Goals*	-0.25	1.00																		
3. *Teaching Intensity*	0.09	-0.13	1.00																	
4. *Bed Size*	-0.10	-0.16	0.39	1.00																
5. *Large Urban Location*	-0.10	0.04	0.23	0.26	1.00															
6. *Rural Location*	0.17	-0.05	-0.22	-0.39	-0.50	1.00														
7. *Case Mix Index*	-0.21	0.11	0.00	0.34	0.16	-0.40	1.00													
8. *Wage Index*	-0.06	-0.08	0.00	0.15	0.30	-0.27	0.10	1.00												
9. *OPDSH Adj. Factor*	0.12	0.04	0.34	0.27	0.12	-0.07	-0.12	0.09	1.00											
10. *Outlier Adj. Factor*	0.01	-0.02	0.18	0.13	0.12	-0.17	0.20	0.10	0.05	1.00										
11. *Conformance Quality*	-0.16	0.04	0.06	0.28	0.10	-0.20	0.36	0.12	-0.13	0.11	1.00									
12. *Experiential Quality*	0.13	-0.09	-0.16	-0.45	-0.31	0.28	-0.06	-0.28	-0.27	-0.09	-0.01	1.00								
13. *Combined Quality*	-0.05	-0.02	0.02	0.02	0.03	-0.06	0.07	0.07	0.10	0.03	-0.01	-0.19	1.00							
14. *HAI Legislation*	-0.07	0.01	0.04	0.11	0.11	-0.07	0.02	-0.01	-0.07	0.01	0.10	-0.16	-0.01	1.00						
15. *PCMH Legislation*	0.10	-0.04	-0.02	-0.02	-0.10	0.09	-0.04	-0.16	0.01	-0.04	-0.01	0.20	-0.04	-0.09	1.00					
16. *Combined Legislation*	-0.06	-0.02	0.01	-0.01	0.02	-0.01	0.05	0.10	0.01	0.03	-0.01	-0.09	0.08	-0.14	-0.32	1.00				
17. *Current Cost Efficiency*	-0.03	0.18	-0.27	0.03	-0.08	0.16	-0.29	-0.36	0.12	-0.34	-0.19	-0.10	-0.06	-0.03	0.06	-0.10	1.00			
18. *Lead Cost Efficiency*	-0.03	0.18	-0.24	0.07	-0.07	0.14	-0.29	-0.36	0.15	-0.32	-0.20	-0.12	-0.08	-0.03	0.05	-0.09	0.94	1.00		
19. *Length of Stay*	0.01	-0.13	0.33	0.50	0.19	-0.22	0.08	0.02	0.25	0.26	0.01	-0.30	0.01	0.09	-0.03	0.01	0.09	0.03	1.00	
20. *Readmission Rate*	-0.05	0.09	0.24	0.13	0.23	-0.05	-0.18	-0.01	0.27	-0.04	-0.09	-0.18	-0.01	0.05	0.03	-0.08	-0.23	-0.24	0.15	1.00

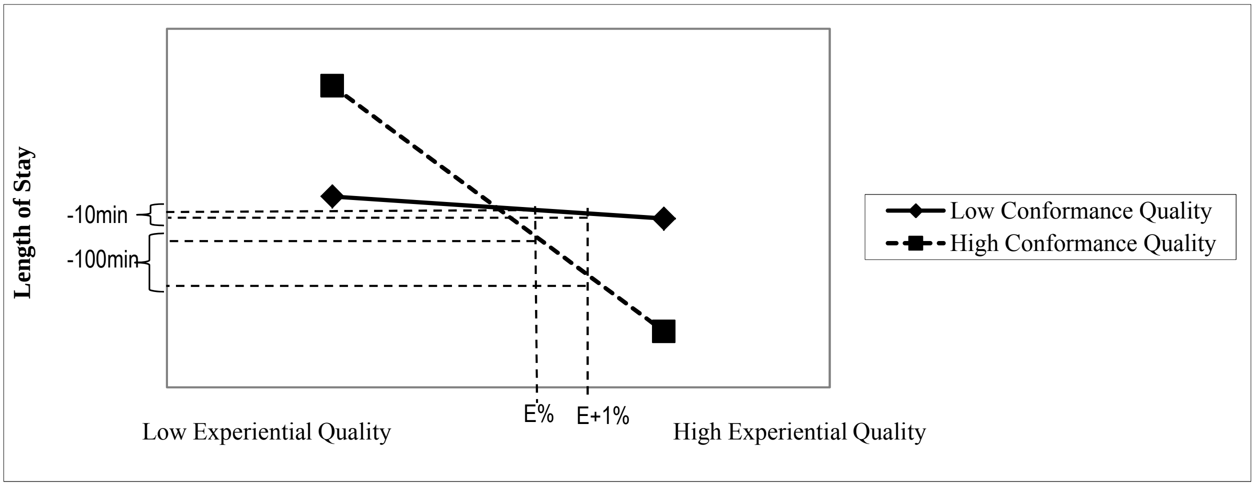
Note. Significance levels: $p \leq 0.01$ if $|r| > 0.03$; $p \leq 0.05$ if $|r| > 0.02$.

Table 4 IV and fixed-effects regressions predicting Cost Efficiency and Clinical Outcomes

	Clinical Outcomes				*Cost Efficiency*			
	LOS		*Readmission Rate*		*Current*		*(1-year) Lead*	
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Conformance Quality	-0.23***	-0.01	-0.14***	-0.13***	-0.11***	-0.12***	0.01	-0.01
	(0.09)	(0.09)	(0.04)	(0.04)	(0.03)	(0.04)	(0.03)	(0.03)
Experiential Quality	-0.87***	-0.81***	-0.54***	-0.60***	-0.01	-0.05	0.05	0.12
	(0.24)	(0.20)	(0.13)	(0.13)	(0.07)	(0.09)	(0.06)	(0.07)
Combined Quality		-1.35***		-0.19**		-0.93***		-0.35**
		(0.39)		(0.10)		(0.17)		(0.15)
Ownership	-0.01	-0.07*	-0.08	-0.08	-0.02	-0.06***	-0.01	-0.03*
(public=1/private=0)	(0.06)	(0.03)	(0.08)	(0.08)	(0.01)	(0.02)	(0.01)	(0.02)
Corporate goals	-0.19***	-0.26***	0.48***	0.47***	0.21***	0.16***	0.19***	0.20***
(for-profit=1/not for-profit=0)	(0.06)	(0.04)	(0.08)	(0.08)	(0.02)	(0.02)	(0.02)	(0.02)
Teaching Intensity	0.91***	0.71***	1.26***	1.25***	-0.91***	-0.88***	-0.91***	-0.87***
	(0.15)	(0.08)	(0.23)	(0.23)	(0.03)	(0.04)	(0.03)	(0.04)
Bed Size	0.28***	0.24***	0.24***	0.23***	0.14***	0.11***	0.14***	0.12***
	(0.03)	(0.03)	(0.05)	(0.05)	(0.02)	(0.02)	(0.01)	(0.02)
Large Urban Location	0.01	0.01	0.49***	0.49***	0.05***	0.05***	0.06***	0.06***
	(0.06)	(0.03)	(0.07)	(0.07)	(0.01)	(0.01)	(0.01)	(0.01)
Rural Location	0.01	0.02	0.24***	0.24***	0.01	-0.03**	-0.01	-0.01
	(0.06)	(0.03)	(0.08)	(0.08)	(0.01)	(0.01)	(0.01)	(0.02)
Case Mix Index	0.41***	0.27***	-1.42***	-1.38***	-0.30***	-0.18***	-0.38***	-0.32***
(after adjusting for Teaching)	(0.08)	(0.11)	(0.16)	(0.16)	(0.03)	(0.05)	(0.02)	(0.03)
Wage Index	-0.34***	-0.39***	1.30***	1.28***	-0.54***	-0.56***	-0.55***	-0.46***
(after adjusting for Teaching)	(0.11)	(0.09)	(0.34)	(0.34)	(0.03)	(0.04)	(0.03)	(0.03)
OPDSH Adjustment Factor	0.18	0.92***	2.19***	2.25***	0.28***	0.61***	0.45***	0.52***
	(0.17)	(0.17)	(0.27)	(0.27)	(0.05)	(0.08)	(0.05)	(0.07)
Outlier Adjustment Factor	0.70***	2.78***	-1.82**	-1.82**	-0.78***	-1.54***	-1.17***	-0.79***
	(0.17)	(0.24)	(0.80)	(0.80)	(0.06)	(0.10)	(0.07)	(0.09)
Year								
t+1	-0.06***	-0.07***			-0.06***	-0.09***	-0.05***	-0.06***
	(0.01)	(0.03)			(0.01)	(0.01)	(0.01)	(0.01)
t+2	-0.09***	-0.11***			-0.12***	-0.15***	-0.10***	-0.11***
	(0.01)	(0.03)			(0.01)	(0.01)	(0.01)	(0.01)
Observations	7867	7867	2997	2997	7867	7867	6864	6864
Hospitals	3012	3012	2997	2997	3014	3014	2963	2963
Chi-square	605***	2737***	668***	672***	3734***	2528***	3969***	2453***
Anderson-Rubin statistic		121.20***				106.64***		93.68***
Stock-Wright LM S statistic		119.36***				105.21***		92.42***

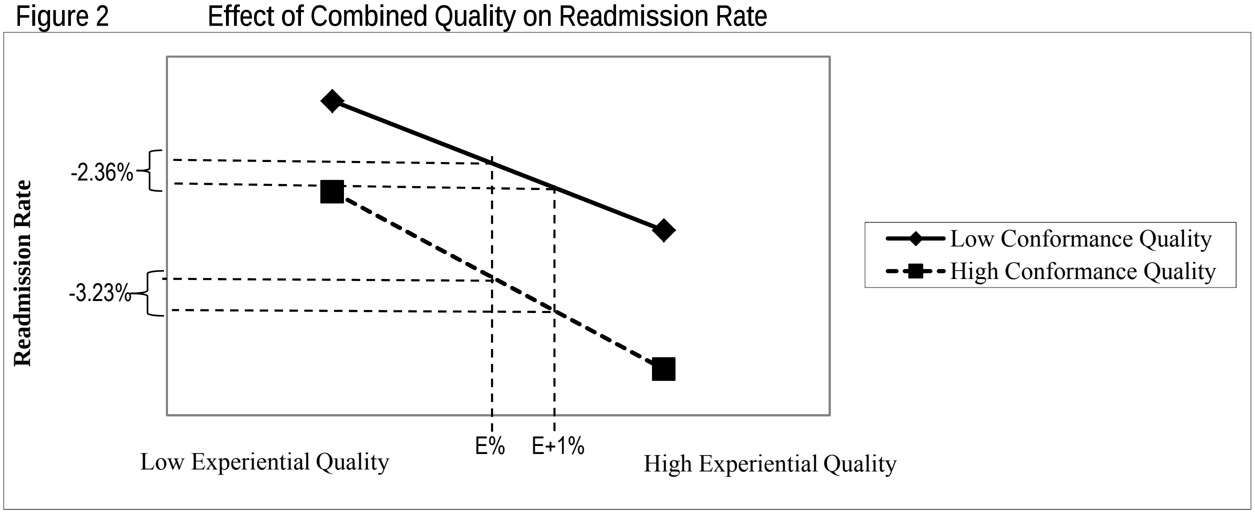
Note. *p ≤ 0.10; **p ≤ 0.05; ***p ≤ 0.01. Panel-data with individual hospital observations across three years. Baltagi (1981) random-effects estimator (EC2SLS) was used for Models 1-2 and 5-8. Instrumental variables *HAI Legislation*, *PCMH Legislation and Combined Legislation* and all control variables were used to predict *Conformance Quality*, *Experiential Quality* and *Combined Quality* in first stage regressions for these models. State-level fixed effects regression was used to estimate Models 3-4.

Figure 1 Effect of Combined Quality on Length of Stay



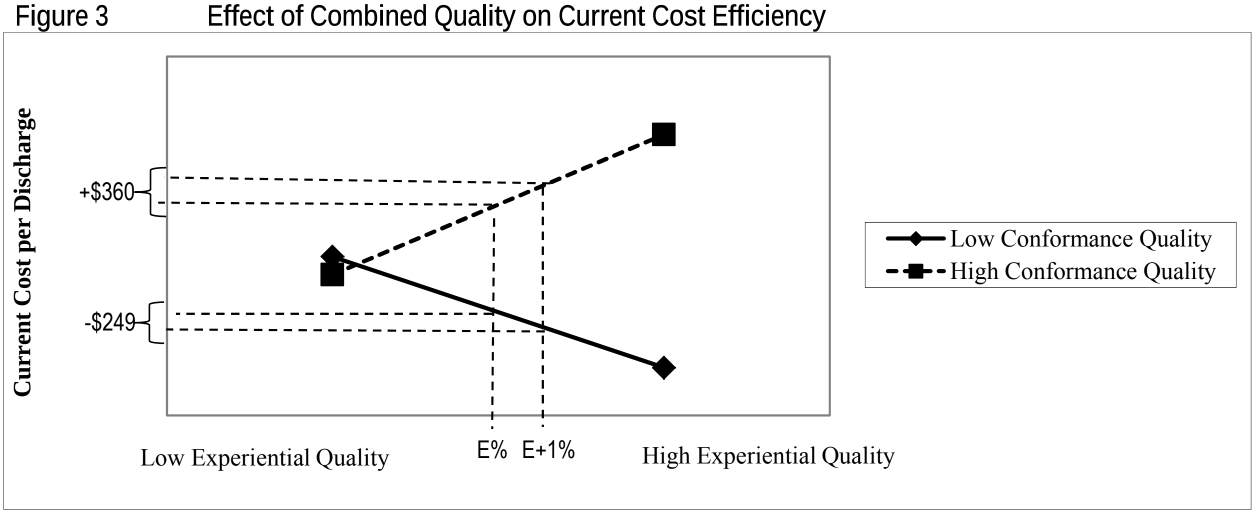
Note. 25th-75th percentile ranges are represented for Conformance Quality (86.5% - 94.9%)

Figure 2 Effect of Combined Quality on Readmission Rate



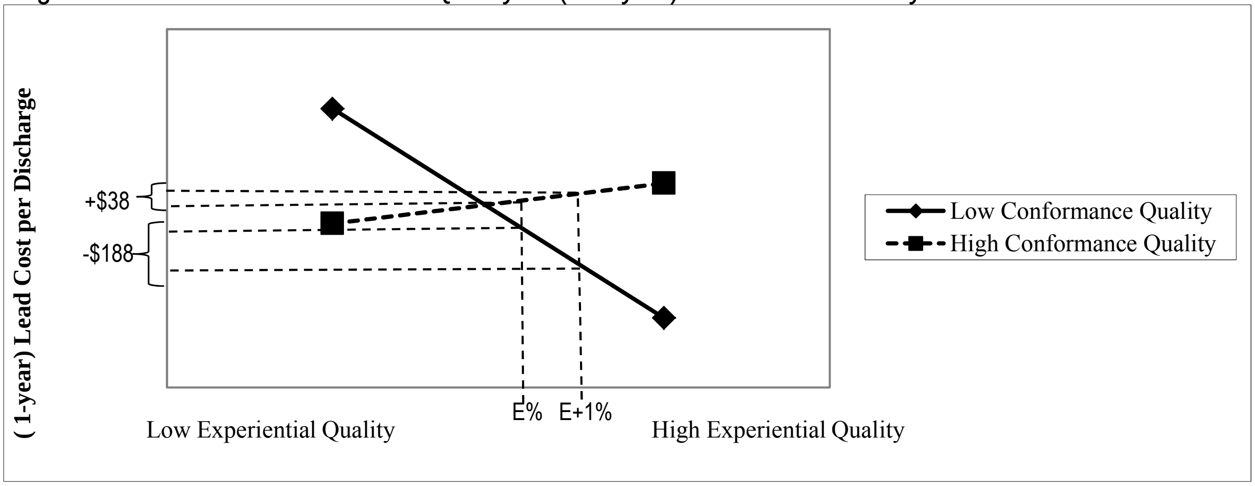
Note. 25th-75th percentile ranges are represented for Conformance Quality (86.5% - 94.9%)

Figure 3 Effect of Combined Quality on Current Cost Efficiency



Note. 25th-75th percentile ranges are represented for Conformance Quality (86.5% - 94.9%)

Figure 4 Effect of Combined Quality on (One-year) Lead Cost Efficiency



Note. 25th-75th percentile ranges are represented for Conformance Quality (86.5% - 94.9%)

Appendix A Process Quality Measurement Items and Descriptive Statistics

		Jul2008-Jun2009		Jul2007-Jun2008		Jul2006-Jun2007	
	Measure	Mean	St. Dev.	Mean	St. Dev.	Mean	St. Dev.
Conformance Quality		(n=3054)		(n=3074)		(n=3075)	
Process of care measures score		92.01%	7.76%	88.81%	9.30%	86.79%	9.51%
HEART ATTACK (AMI)							
Patients given aspirin at arrival	*AMI 1*	97.72%	3.26%	97.14%	3.88%	96.52%	4.02%
Patients given aspirin at discharge	*AMI 2*	97.13%	5.20%	96.19%	5.72%	95.63%	6.09%
Patients given ACE inhibitor or ARB for LVSD	*AMI 3*	94.93%	5.43%	93.30%	6.76%	88.95%	8.85%
Patients given beta blocker at discharge	*AMI 5*	97.35%	4.97%	96.72%	4.92%	95.70%	5.80%
Patients given fibrinolytic medication within 30 minutes of arrival	*AMI 7a*	72.57%	8.04%	66.29%	19.04%	70.00%	16.65%
Patients given PCI within 90 minutes of arrival	*AMI 8a*	84.86%	11.75%	77.89%	14.95%	64.29%	18.72%
HEART FAILURE (HF)							
Patients given ACE inhibitor or ARB for LVSD	*HF 3*	93.11%	7.19%	91.19%	7.92%	86.85%	9.58%
PNEUMONIA (PN)							
Patients assessed and given pneumococcal vaccination	*PN 2*	89.61%	12.53%	84.10%	15.77%	77.88%	18.51%
Patients whose initial ER blood culture was performed prior to admin. of the 1st hospital dose of antibiotics	*PN 3b*	93.79%	6.03%	91.47%	6.91%	90.00%	6.68%
Patients given the most appropriate initial antibiotic(s)	*PN 6*	89.88%	7.44%	88.25%	7.47%	87.39%	7.73%
Pneumonia patients assessed and given influenza vaccination	*PN 7*	87.47%	12.72%	80.78%	16.57%	77.96%	18.51%
Experiential Quality		(n=3114)		(n=3115)		(n=2110)	
HCHAPS survey score		70.07%	5.38%	69.74%	6.53%	68.81%	5.54%
Quality of communication with nurses	*COMP 1*	73.70%	6.33%	72.95%	7.27%	72.21%	6.66%
Quality of communication with doctors	*COMP 2*	79.05%	5.42%	79.18%	6.20%	78.69%	5.43%
Speed of delivery of help	*COMP 3*	61.06%	8.64%	60.68%	9.77%	58.98%	8.32%
Control of pain	*COMP 4*	67.93%	5.55%	67.67%	6.78%	66.92%	6.11%
Explanation about administered medicines	*COMP 5*	58.20%	6.13%	58.16%	7.86%	57.05%	7.02%
Instructions for recovery at home	*COMP 6*	80.46%	4.97%	79.81%	5.54%	79.01%	5.72%

Appendix B 3SLS regression predicting all outcomes simultaneously

	3SLS regression			
	Length of Stay	*Readmission Rate*	*Current Cost Efficiency*	*Lead Cost Efficiency*
Conformance Quality	-0.08***	-0.12***	-0.03***	-0.02***
	(0.01)	(0.03)	(0.01)	(0.01)
Experiential Quality	-0.23***	-0.46***	-0.09***	-0.10***
	(0.04)	(0.07)	(0.01)	(0.01)
Combined Quality	-0.09***	-0.15**	-0.08***	-0.08***
	(0.03)	(0.09)	(0.01)	(0.01)

Note. *p ≤ 0.10; **p ≤ 0.05; ***p ≤ 0.01. Instrumental variables and controls are used to predict first-stage estimates. Coefficients for controls not displayed for presentation clarity.

Appendix C Alternative OLS/IV regressions

	OLS regression			IV regression
	Length of Stay	*Current Cost Efficiency*	*Lead Cost Efficiency*	*Readmission Rate*
Conformance Quality	-0.07***	-0.02***	-0.02***	-0.26
	(0.01)	(0.01)	(0.01)	(0.56)
Experiential Quality	-0.17***	-0.08***	-0.06***	1.39
	(0.04)	(0.01)	(0.01)	(1.43)
Combined Quality	-0.07***	-0.06****	-0.07***	-0.40
	(0.03)	(0.01)	(0.01)	(1.98)

Note. *p ≤ 0.10; **p ≤ 0.05; ***p ≤ 0.01. All controls were included in each regression, coefficients not displayed for presentation clarity.

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