Predictors of Hospital Quality and Efficiency

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PREDICTORS OF HOSPITAL EFFICIENCY AND QUALITY

by

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ABSTRACT

American hospitals have made serious efforts to implement and expand their health information technology capabilities and to integrate different specialized care or high-tech services in order to maximize the efficiency and quality of care. In providing a variety of HIT-related services, these hospitals expanded their national reputation in line with integrated care goals. As a result, hospitals are encouraged to establish effective communication channels to facilitate patient-physician sharing of the patient care experience, to enhance effective pain management, and to transform patient-centered care modalities to solidify the adequacy of patient care processes. By analyzing national data sets publicly available, this investigation explored the relationship of acute-care hospitals' performance to the contextual, organizational and patient characteristics, using a cross-sectional study design. This study developed and evaluated the quality and efficiency of hospitals with respects to the structural complexity, process adequacy, efficiency, and quality of care. The structure-process-outcome theory in quality of care developed by Donabedian (1980), is adopted for this investigation. Statistical methods such as confirmatory factor analysis (CFA) and covariance structure model are employed. The population surveyed by the American Hospital Association (AHA) are acute care hospitals throughout the United States, including more than 3000 acute care hospitals of all types of ownership. The data provided by HIMSS Analytics and AHA are available for 2015 and the data provided CMS quality indicators are available for 2016. The key finding of this research is that process adequacy mediates the relationship between hospital structure and performance variables. The efficiency variable played an important role in shaping the quality. The location and hospital teaching status have a moderate impact in determining hospital performance through affecting the structure and process of hospitals.

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LIST OF ACRONYMS AND ABBREVIATIONS

ACO	**Accountable Care Organizations**
AE	Adverse Events
AHA	American Hospital Association
AHRF/ARF	Area Health Resources Files
AHRQ	Agency for Healthcare Research and Quality's
AMI	Acute Myocardial Infarction
AMOS	Analysis of Moment Structure
CAHPS	Consumer Assessment of Healthcare Providers and Systems
CMS	Centers for Medicare & Medicaid Services
DEA	Data Envelopment Analysis
DRG	Diagnosis-Related Groups
ECHO	Experience of Care and Health Outcomes
HIMSS	Health Information Management Systems Society

CHAPTER 1: INTRODUCTION

The healthcare system is characterized by high costs and gaps in quality Payers, system administrators, and policy makers at different levels are looking for ways to reduce costs and increase the efficiency of the delivery system and allocate resources to increase the value of the healthcare. Consumers are also looking for guiding principles to maximize the value of costs that have incurred, especially as they seek to have a positive experience in the treatment system. In such a context, research on efficiency and quality based on an empirical and validated foundation contributes to improve the healthcare system.

This research seeks to measure the impact of contextual and organizational factors in combination with the process of care delivery on the quality and efficiency of the hospital confirmed that affect the performance of hospitals.

Purpose of the Study

The purpose of this study is to identify and analyze the factors influencing hospital efficiency and quality at the organizational level. Structural and process characteristics coupled with contextual factors may contribute to the variability in hospital performance. In addition, this study seeks to understand the interrelationship between hospital efficiency and quality.

The performance domains consist of hospital efficiency and quality. Hospital efficiency is concerned about the process, cost and technical efficiency (Wan, 2002). Process efficiency is an indicator of efficiency, which measures the average length of stay of patients at the hospital. The technical efficiency is defined by the ability of hospitals' decision makers to maximize the results with the least amount of resources used. Technically efficient achievement results in the combination of health outcome and cost-effective efficiency. Data Envelopment Analysis is used to measure and compare the efficiency level of acute care

hospitals based on teaching status, operating expenses, and labor (Full-Time Equivalent, FTE) variables.

The quality of hospital is based on measures of the 30-days mortality rate and 30-days readmission rate for heart failure, pneumonia and acute myocardial infarction (AMI) or heart attack. Process adequacy, measured by patient-physician communication, pain management, and care transition from the data available from the Centers for Medicare and Medicaid Services (CMS), is one critical predictor of hospital performance.

Factors influencing the variability in hospital efficiency and quality were measured including contextual factors (location and hospital teaching status), structural characteristics (integration or complexity, HIT application, etc.), and aggregated patient experiences (transition of care, pain management, and patient-physician communication). Based on theoretical specifications of the SPO model, structural complexity is assumed to be directly influencing the process adequacy and, in turn, indirectly affecting hospital performance.

Quality indicators were developed as standardized and evidence-based measures of healthcare quality to evaluate clinical performance and outcomes based on hospital inpatient administrative data. Inpatient quality indicators are defined as a set of measures based on mortality ratio for specific conditions utilization of services. The Agency for Healthcare Research and Quality (AHRQ) developed different types of healthcare quality measures, which asses and compare the quality of care bases on classification of structure, process and outcome measures. The health quality components specified by Donabedian’s SPO model (1988) consist of three categories: structure, process, and outcome. The structural factors are generally viewed as the structural complexity, the integration across divisions of care and integration of the health information technology (HIT) into practice (Gain, 2004; Kakeman, Forushani, & Dargahi, 2016; Walters & Bhuian, 2004: Wan, 1995). The process adequacy is reflected by the level of physician-patient communication and sharing information, pain management, and

transition of care. The contextual factors of hospital performance include teaching status of hospitals and location that may indirectly affect the variation in hospital performance.

For hospital efficiency, this study intends to include two dimensions of efficiency: 1) technical efficiency and 2) process efficiency. Technical efficiency is a weighted ratio of output and input variables. Data Envelopment Analysis (DEA) used to measure technical efficiency for each acute care hospital. Process efficiency measured by applying the indicator of the average length of stay at the hospitals, which is an indication of the level of commitment to standardized guidelines for common conditions (Litvak & Bisognano, 2011; Stephen & Berger, 2003).

Quality is a theoretical construct of outcome that is usually measured by two indicators: 30-days mortality rate, 30-days readmission rate (CMS, 2007; Kansagara et al., 2011; Keenan et al., 2008; Krumholz et al, 2009; Tsai, Joynt, Orav, Gawande, & Jha, 2013). Three data sources are used to provide data including the CMS, American Hospital Association (AHA), and Healthcare Information and Systems Society (HIMSS).

The theoretical literature seems to support that a reciprocal relationship exists between efficiency and quality of hospital care (Ferreira &amp, 2018; Marques, 2018; Valdmanis, 1996). However, empirical evidence for the trade-off relationship between hospital efficiency and quality is still lacking. This study explored empirically how hospital efficiency and quality are interrelated before and after controlling for the factors that may influence the variability in hospital efficiency and quality.

Significance of the Study

The health care system designed to achieve two important goals, providing the high quality of care and achieving less cost of care (Straube, 2005). Historically, hospitals have been among the first providers of health care. At the same time, hospitals are the most important

consumer of resources (Nayar & Ozcan, 2008). At the national level, extensive efforts are being taken to publish systematic reports on the quality of care (Jha, Li, Orav, & Epstein, 2005). In early August 2008, these reports expanded to include information on treatment costs, which created an important opportunity to examine two critical questions: 1) Is hospital's efficiency associated with the quality of care? 2) How is the balance of quality and efficiency to be optimized? (Steinbrook, 2004).

The hospital performance analysis is essential to identifying the relationship among a complex set of predictor variables analyzed at the hospital level. This research is timely and contributed to hospital management literature, especially in view of the emphasis on decreasing inefficiency due to the inappropriate structural and process (functional) platform observed in the hospital industry. Also, the investigation on the efficiency-quality relationship of hospitals may lead to better understanding of performance improvement mechanisms for optimizing hospital performance.

Health Information Technology (HIT) applications hold the promise to improve the health of population and the performance of providers aimed to improved quality, cost-savings and more involvement of patients with their own health care (Blumenthal, 2010). It has been reported that hospitals with more advanced health technology systems had fewer complications, lower mortality rates, and lower costs compared to hospitals with the less advanced HIT (Chernew, Cutler, & Keenan, 2005; Weston & Gore Jr, 2006). However, there is lack of consistent and confirmatory evidence showing how HIT adoption may streamline administrative complexities. Especially, it was found that HIT may increase administrative complications in the short run (DesRoches et al., 2008; Himmelstein, Wright, & Woolhandler, 2010). The unintended consequences of implementing HIT system may be detrimental to quality, efficiency, and safety. These implications include new/more work for nurses, changes

in patterns and communication procedures, new types of errors, changes in the power structure, and excessive dependence on technology (Harrison, Koppel, & Bar-Lev, 2007).

In the articles reviewed, there is scanty evidence to document that hospital quality and efficiency are positively associated. On the contrary, Jarman (2006) confirmed that there is no relationship between mortality and reimbursement rates, while other studies suggested that the reduction of human error and efficiency score, reflected by the readmission rate are interrelated (Berg et al., 2005). This study, in addition to measuring the predictors of efficiency and quality, also examined the relationship between hospital efficiency and quality, using a multiple indicators approach. This study used AHA and HIMSS surveys in addition to CMS data to identify the indicators of structural, process, and outcome aspects of hospital care.

With the complexity of the contextual factors, hospitals are encouraged to implement “complicate mechanisms”, which indicates procedures and structures that facilitate the exchange of information, communication, and interpretation of the information. It has been demonstrated that complex structures and process tend to be associated with higher performance if hospitals are matched with the increased complexity (Walters & Bhuian, 2004).

One of the main challenges in hospitals is to achieve an optimal balance of complex structural, process and therapeutic strategies that ultimately affect the overall performance of the hospital (Walters & Bhuian, 2004). The evaluation of the relationship between structure metrics, process indicators and outcome measures in many cases is not a simple matter. In fact, increasing complexity at the structural level accompanied by employing new communication channels to improve the process of care that may not necessarily lead to improved processes and outcomes (Donabedian, 1997). Understanding the extent that hospitals achieved improved performance through the application of new integrated technology and communication may facilitate and enhance organizational complexities and their performance. The examination on the impact of external context on hospital performance is an essential part of this study.

Similarly, the study's implications on important structural and process factors for enhancing hospital performance may help enlighten hospital managers, executive administrators, and health policy-makers in their professional practice. This study's primary aim is to clarify the causal mechanisms or paths leading to better hospital performance in both quality and efficiency levels.

From a public affairs point of view, results of this study can reflect the sources of variation in the treatment process, and in particular in hospitals, by studying the impact of integrated technology implementation and the management of complex care systems that contributes in quality and efficiency of the hospital. Also, differences in geographic areas and teaching status of hospitals are examined and led to policies and interventions that maximizes ways to improve efficiency and quality.

CHAPTER 2: LITERATURE REVIEW

This chapter provided an overview of the theoretical framework and explain~~s~~ how each of the theoretical constructs and measurement indicators are used in the literature. The investigation is centered in identifying contextual-structural-process predictors of variability in hospital efficiency and quality. Relevant literatures on structural complexity, process adequacy, hospital efficiency and quality indicators were discussed. This chapter developed a systems framework based on Donabedian’s (1989) model on the quality of care, including the structure-process-outcome model for hospital performance improvements that modified to contain contextual variables.

Frameworks for Hospital Performance

Over the past 25 years, assessment of the performance of the health care system and associated reports have grown substantially and helped to improve the health care system. There is a widespread need to increase the accountability of health professions and health care institutions. Many factors contributed to this growth. From the demand side, the health care system is under severe pressure to cut costs; meanwhile, patients expect to be more involved in their treatment decisions. From the resource side, a significant progress in information technology has greatly facilitated the data collection, processing, and dissemination of data (Smith, 2009).

Hospital performance has been measured for decades. In general, models derived from Donabedian structure-process-outcomes (SPO) framework are often used in the study of the performance of hospitals. In the Donabedian model, the structural indicators of the quality are specialized care and organizational resources that are available to provide services. Measuring the process refers to things that are done by professionals for patients. The outcomes are the health status of patients that resulted from the care processes. Frequently, each component of

this model is individually examined to measure quality. In other cases, structural factors have been linked causally to patient or process outcomes. Infrequently, each section of this framework is linked causally to other sectors: the structure is linked to the process, which is related to the outcome. Even less, Donabedian model forms patterns of inter-relationship between components (Unruh & Wan, 2004; Whitman, 2002).

Theoretical Framework

As it proposed by Ogrinc et al., 2015, process evaluation is an effective tool to overcome the limitations available to improve the quality and spread of information at the hospital level. For example, collaborative process evaluation resulted in reducing delays and waiting time by 50% within 12 months in Sewickley Valley Hospital in Sewickley (Ferrara, Ramponi, & Cline, 2016). This view confirms Donabedian's approach that all specialized departments should act in a coordinated manner, through targeted goals and measurable changes.

Donabedian's theory proposed that each component has the direct effect on the next one. The process of care is expected to be influenced by variables of structure, which ultimately affect the outcome. In a study conducted by Haj, Lamrini, & Rais (2013), indicators of outcomes are reviewed and classified into two categories: Indicators of intermediate outcomes which reflects activities and quality of service delivery at each stage of the process such as percentage of unplanned readmission, the failure rate; and the overall effect of the care provision which is considered as patient satisfaction or overall quality of health. However, it is complex to set goals at the hospital level in order to improve efficiency and quality of care, simultaneously; as it should reduce the proportion of costs while improving the health of patients and the quality of health care services.

Donabedian's structure-process-outcome approach (SPO) assumes multi-dimensionalities of each of the triadic components (1996). The components of the structure, process, and outcome were conceptualized for the measurement of quality of care. For instance, Donabedian (1989) stated as follows:

> While the primary reliance in our quest for quality is on the knowledge, skill, motivation, integrity, and dedication of health care practitioners, we cannot expect them to be unflaggingly heroic or self-sacrificing in the service of quality. It is the responsibility of the organization, rather, to create the conditions under which good practice is as effortless and rewarding as it can possibly be (p.73).

Based upon this theoretical formulation, the structural domain of hospital care refers to the setting where the services are provided and the characteristics of providers of the care. The structural factors focus on the characteristics of personnel such as education, training, experience, and certification, as well as the structural features of the setting such as the proportion of personnel, equipment, devices, and the overall infrastructure. The process domain reflects how care has been delivered to patients during the delivery of care. Outcome points out whether goals such as better health status have been achieved (Ibn El Haj, Lamrini, & Rais, 2013).

The Donabedian model (1988), advocates that good structure leads to good process and good process leads to better outcome, which indicates a linear relationship across structure, process, and outcome. Thus, the structure or the environment in which the hospital provides the service includes features of material resources such as buildings, facilities, and medical and technological equipment as well as human resources. The structure also includes features such as ownership and type of communications between specialized sections. The process involves actions taken within structural features in the hospital environment and by a specialized team,

as well as actions that patients are taking in engaging the practitioners. Outcome shows the effectiveness of the process of care on the health of the patients.

Figure 1 Structure-Process-Outcome Model

According to Donabedian (1989), process evaluation applied to system design and performance monitoring. Efficiently, process evaluation involves a comprehensive and ongoing collaboration across all parts of the system that guarantees the quality and appropriate performance of the health system. As Donabedian raised, “formal monitoring is conducted by: (1) systematically collecting information about the process and outcome of care, (2) identifying patterns of practice, (3) explaining these patterns, (4) acting to correct deficiencies, and (5) verifying the effects of remedial actions” (Donabedian, 1989, p. 3).

Considering the large financial resources that are being spent on healthcare systems, there is a growing interest in assessing the efficiency of hospitals with regard to the value of money. Recently, in line with the demand for a better quality of health care, treatment costs have risen sharply, which is in contradiction with the limited government resources that are allocated for the healthcare systems (Moshiri, Aljunid, & Amin, 2010).

Given the need for a framework that analyzes the causal relationship and complexity of a hospital's performance, a type of SPO model provides this framework. However, the original model is somewhat limited, especially that it does not take into account the efficiency. The original SPO model’s weaknesses are: 1) the lack of consideration of the impact of environmental factors such as the location, and type of hospitals. 2) the failure to include efficiency as a measure of hospital performance; and 3) no potential causal link between the structure and outcome variables.

Figure 1 demonstrates the original theoretical component that is the basis for the

following analysis. Structure, process, outcome triad depicts a liner model. The patient care outcome should include indicators of quality, while hospital efficiency should contain measures of how patients care was processed and how outputs are optimized with inputs or resources available at the hospital. Therefore, a modified Donabedian's model of quality performance presented to serve as a theoretical foundation for this study to enhance the understanding of interrelationships among hospital structure, process and performance. In addition, the potential direct and indirect effects of contextual on hospital performance is measured.

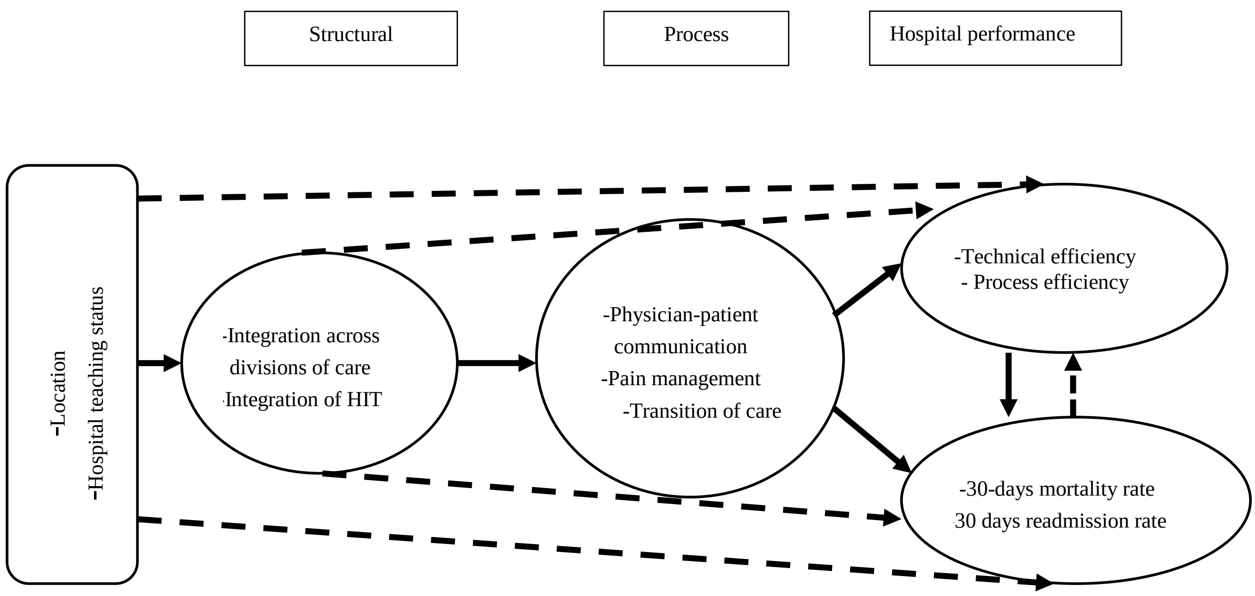

Figure 2 Conceptual Model

Hospital Efficiency

Over the past two decades, measuring efficiency has been centered on the use of multiple indicators (Wan, 1995; Ruggiero, 2007; Wan, 2002). Multiple definitions of efficiency are available from different research perspectives. In one economic classifications of efficiency, three main measures were developed. Technical efficiency "implies the maximum possible output from a given set of inputs", which refers to the very precise use of

productive resources. “Allocative efficiency reflects the ability of an organization to use inputs in optimal proportions, given their respective prices and the production technology” (Moshiri, Aljunid, & Amin, 2010, p 3).

Allocative efficiency actually refers to choosing from the most efficient combination of resources to get the most output of the product. Productive efficiency or total economic efficiency are present when two other types of efficiency have already been achieved. Thus, if an organization uses its resources allocated and technically efficient, the organization has reached productive efficiency.

Within the context of healthcare services, variations in organizational structures such as location and teaching status considered to determine productive efficiency (Wang & Wan, 1999). Location is an important factor in the healthcare industry when remote services are not transferable (Goldstein, Ward, Leong, & Butler, 2002). This research has examined whether the location has a direct or indirect impact on the hospital's performance and whether the structural and process mechanisms moderate this relationship.

Process performance is another indicator of measuring efficiency, evaluated through the average total charge per discharge, so-called cost-effectiveness that reflects hospital efficiency (Wang & Wan, 1999). This concept evaluates whether hospital resources are managed and used to reduce costs. The higher the ratio of charges to discharges, the more the care process has been inefficient.

Lack of resources in the health system is one of the most important reasons for considering efficiency and proper use of available facilities (Hatam et al., 2010). Measuring efficiency of a healthcare facility is a relative term and has taken specific definitions in various domains. Despite the variety of operational definitions and different methods developed for measuring hospital efficiency, efficiency is considered as one of the major predictors of improved outcomes. A hospital’s efficiency refers to the extent that it maximizes output for a

given set of inputs/resources. Thus, minimizing inputs/resources may optimize the outputs observed (Chasm, 2001).

Hussey et al. (2009) have taken a systematic review to characterize different measures of efficiency in a healthcare facility, and provided multiple efficiency measures for hospitals such as risk-adjusted average length of stay; cost per risk-adjusted discharge; and the cost of producing both risk-adjusted hospital discharges and hospital outpatient visits (Conrad et al, 1996 & Weingarten et al. 2002).

Technical efficiency can be an input or output-oriented. In the output-oriented technical efficiency, the focus is on expanding the results without altering the number of resources used. On the other hand, in the input-oriented technical efficiency, the focus is on reducing inputs without changing the number of products generated (Zere et al., 2006). The technical efficiency is defined by the ability of hospitals' decision makers to maximize the results with the least amount of resources used. Technically efficient achievement resulted in the combination of health outcome and cost-effective efficiency (Jehu-Appiah et al., 2014).

Many studies have been carried out to evaluate the technical efficiency of hospitals and various indices were used for the evaluation. Ownership type, size, hospital practice, and type of hospital, are used as indicators (Kakeman, Forushani, & Dargahi, 2016). In a study to measure technical efficiency with particular emphasis on maternal healthcare services taken by Ram Jat & San Sebastian (2013), the number of doctors, nurses, beds, outpatient services, women with three completed antenatal checkups, deliveries, C-section deliveries, women receiving post-natal care within 48 hours after delivery, medical termination of pregnancies, male and female sterilizations, and inpatient and outpatient admissions were used to measure the technical efficiency.

Most of the studies have used the Data Envelopment Analysis (DEA) technique to measure technical efficiencies, which "is a non-parametric linear programming approach, and was first

introduced by Charnes, Cooper, and Rhodes in 1978 and further formalized by Banker, Charnes, and Cooper in 1984" (Gain, 2004, p 2). Milstein & Lee (2007) proposed that despite the widespread interest in evaluating efficiency, there are many uncertainties on how well evaluation methods have been developed. They concluded that measures of efficiency are subject to a few numbers of evaluations. However, a greater evaluation of validity and reliability of efficiency measurements requires further development. The current study used DEA to measure technical efficiency of hospitals based on a variety of measures.

The cost of stay in hospitals in America is estimated at $ 377.5 billion per year. In proportion to value-based care, hospitals are under increasing pressure to avoid human error towards patients and reducing costs while keeping the quality appropriate. Reducing average length of stay in a hospital (LOS) is one of the most important criteria in preventing unnecessary costs (Maisels & Kring, 1998).

LOS is an indicator used in many studies to measure the process efficiency (Weingarten, Lloyd, Chiou, & Braunstein, 2002). If all the other things are fixed, a shorter stay in hospital reduces the cost of discharge and change the treatment from being hospitalized to alternative therapies after the acute care. Reducing LOS is one of the main priorities in health policies to increase process efficiency (Kaboli et al., 2012). Current study used LOS as an indicator of process efficiency.

Hospital Quality

According to the Institute of Medicine (IOM), there are many indices for assessing hospital quality such as patient safety measures, effectiveness measures, patient-centeredness measures, timeliness measures, efficiency measures, and equity measures (IOM, 2011). In assessing quality, multiple indicators are used, such as inpatient quality indicator, the patient safety indicator, and the pediatric quality indicator (Brubakk, Vist, Bukholm, Barach, &

Tjomsland, 2015; Hawkins et al., 2016) The current study used hospital mortality rate and readmission rate as the indicators of hospital quality.

The Centers for Medicare and Medicaid Services collected the measures of mortality rate within 30 days of admission as an indicator for evaluating hospital performance (CMS, 2007). This measure is important because, according to Donabedian, increasing structural resources or process indicators does not necessarily lead to a reduction in the patient mortality (Donabedian, 1997). A 30-day period is defined so that the outcome of each patient is monitored in a consistent fashion and the variation in the duration of stay in the hospital does not affect the mortality rate.

Readmission rate has been used in many studies as the indicator of hospital quality (Kansagara et al., 2011; Keenan et al., 2008; Krumholz et al., 2009; Tsai, Joynt, Orav, Gawande, & Jha, 2013). Hospitalization accounts for roughly half of the total cost of care in the United States, and it is estimated that 13% of hospitalized patients use more than half of the total hospital resources due to hospital readmissions (Jencks, Williams, & Coleman, 2009).

Readmission is defined as a repeated hospitalization within 1, 2, 4, or 12 months after discharge. Between 9% and 48% of all readmissions are considered to be preventable, since they were associated with indicators of non-compliance with standards during the hospitalization, such as low transparency about the main problem, unstable therapy at the time of discharge, and disproportionate care to post-discharge conditions (Benbassat & Taragin, 2000). In the current study, the 30-days readmission rate and 30-days mortality rate are considered as one of the quality indicators. Given that these two indicators are negative, they were reversed by dividing the number one and used as indicators of quality assessment.

Process Adequacy

The concept of process adequacy involves planning and operational activities that significantly reduce factors affecting the inadequacy of clinical services in a health care setting. As the process affects tangible results like product, it is appropriately interpreted that the process may mediate the influence of the structural factors on hospital outcomes. It will certainly influence management initiatives and intervention strategies for efficiency (Kohlbacher & Reijers, 2013; Vera & Kuntz, 2007). Measuring the mediating effect of process adequacy explains how, and why organizational and outcome variables are related, where process adequacy hypothesized to intermediate the relation between structural, organizational and quality and efficiency outcome (Fairchild & MacKinnon, 2008). The level of complexity in the process, coupled with the connection of structural complexity to efficiency and quality, requires the integration of elements of human interaction along with an adequate use of communication technologies. Physician-patient communication is, therefore, one of the key elements for building a therapeutic relationship and ensures the quality of outcome in a treatment process (Ha & Longnecker, 2010).

Much of the patient's dissatisfaction with the process and even the result of the treatment is caused by the lack of an established patient-doctor relationship. The doctor's ability to communicate leads to better information gathering, more accurate diagnosis, appropriate counseling, better transfer of treatment instruction, and establishing a caring physician-to-patient relationship (Van Zanten, Boulet, McKinley, DeChamplain, & Jobe, 2007; Bredart, Bouleuc, & Dolbeault, 2005; Duffy, Gordon, Whelan, Cole-Kelly, & Frankel, 2004).

The ultimate goal of the physician-patient relationship is to effectively transform the knowledge and treatment modalities, and to improve patient's condition and medical treatment. Because the relationship between doctor and patient is necessary, an ineffective and inappropriate relationship is detrimental to achieving better understanding of the diagnosis

made by the doctor and the treatment process (Baile et al., 2000). These important factors may affect patients' decisions about the treatment and the end of the treatment process, which has a great potential impact on the disease and the outcome of the treatment (Hak, Koeter, & van der Wal, 2000).

The ten-year total hospitalization rate has increased by 11 percent, from 31.7 million in 2000 to 35.1 million in 2010 (CDC, 2010). In 2004, almost 35 million patients were discharged from U.S. hospitals, of which 46 percent had a surgical procedure and 16 percent discharged with one or more diagnostic procedures (Kozak, DeFrances, & Hall, 2006). Pain is a common and expected complication after surgery. According to the data, 80 percent of patients experience postoperative pain and between 11 percent and 20 percent of patients experience severe pain (Apfelbaum, Chen, Mehta, & Gan, 2003;). Despite the presence of “analgesics—particularly opioids—and national guidelines to manage pain”(Dolin, Cashman, & Bland, 2002), the post-operative pain remains. Therefore, severe pain associated with surgery and therapeutic operations is a major problem in US hospitals, which is poorly managed for many patients (Wells, Pasero, & McCaffery, 2008).

Permanent and untreated pain leads to the activation of the pituitary-adrenal axis that disrupts the immune system and leads to post-operative infections and no healing of the wound. The cardiovascular, gastrointestinal and intestinal problems are other consequences of postoperative chronic pain. One of the important implications is the reduced mobility of the patient, leading to many other dilemmas for the patient such as deep vein thrombosis, pulmonary embolus, and pneumonia. The problems caused by inappropriate management of pain negatively affect the health and well-being of the patient and the performance of the hospital, because it may also affect the length of patient's stay in a hospital, re-admission, and mortality during hospitalization. All of these problems affect the efficiency of hospital (Wells, Pasero, & McCaffery, 2008).

Inappropriate pain management affects the patient's and family members' mental status. The patient's common response to pain over time is a feeling of hopelessness and helplessness that may even discourage the patient from continuing treatment (McCaffery & Pasero, 2011). Poor management can put the medical team in jeopardy. Current standards, such as the national standards outlined by the Joint Commission (formerly known as the Joint Commission on Accreditation of Healthcare Organizations) (JCAHO, 2011) for managing pain require that pain is immediately diagnosed and managed. Lack of commitment to standards of pain management leads to legal problems for the hospital and the clinical team, which affects hospital efficiency and quality through destroying the reputation of the hospital, patient satisfaction, and increasing the costs of legal issues for the hospital (D'arcy, 2005; Furrow, 2001).

Centers for Medicare and Medicaid Services (CMS) defined “transition of care” as transferring a patient from one care setting (e.g., a hospital, nursing facility, primary care physician, long-term care, home health care, or specialist care) to another (CMS, 2014). The transition of care is considered a vulnerability period for all patients and in some cases leads to patient remission, often occurs due to the lack of coordination during the transition. Breakdowns in this process and the lack of proper communication between providers leads to a poor transfer of the patient, resulting in confusion about the treatment plan, repeating of tests, lack of transparency about medications, and loss of appointments after discharge. Ultimately, a poor transition of care leads to a defective treatment process, patient dissatisfaction, and high costs for the hospital and the patient (Mansukhani, Bridgeman, Candelario, & Eckert, 2015).

Process adequacy is concerned with estimating the extent to which patients are ready to move to the next stages of treatment, whether or not the necessary information has been appropriately transmitted and whether the drug and dietary regimens have been taken into consideration to prevent the patient from redundancy and readmission to the hospital (Coleman

& Berenson, 2004). A series of interventions that incorporate components of patient needs assessment, patient education, medication reconciliation, scheduled appointments for the patient after discharge, and telephone follow-up after discharge are factors that have successfully contributed to improving the patient's health status and preventing hospital readmission (Kripalani, Theobald, Anctil, & Vasilevskis, 2014). The current study examined several variables to create indicators of patient-physician communication, pain management, and transition of care as the indicators of process adequacy.

Structural Complexity

The hospital industry has a wide variety of organizational structural characteristics. Even without considering other specialized units, such as psychiatry or long-term treatment, the diversity among acute care hospitals is evident (Wang, Ozcan, Wan, & Harrison, 1999). Increasing complexity in the hospital structure leads to more complex strategies, recruiting fundamental structures, and participating in comprehensive analysis approaches. Hospital structures that operate in complex environments, coupled with the dynamics of the environment, and combine a hybrid strategy that is integrated into a higher performance. It has been proposed that the performance of a hospital with a complex structure is more likely to be stronger as this structure requires more sophisticated procedures and a more robust analytical approach to control the process of care and administration (Walters & Bhuian, 2004).

The hospital industry is encouraged to apply an integrated care across all divisions of care. Integrated care is often used against fragmented care and is used synonymously as a coordinated care- which provides services, tasks, and patient treatment processes within an integrated system of specialized and organizational boundaries. Integrated across the divisions of care is defined as an approach to strengthening patient-centered health delivery that is

tailored to the multifaceted needs of individuals and the provision of services in a coordinated way and with a multidisciplinary team of providers (Nolte, 2012).

At the structural level, culture and values are built and sustained to ensure that resources and funding are integrated seamlessly and goals of different parts of the organization are aligned with each other. An effective communication mechanism exists between specialized departments and complex structures. The patient has improved the experience of access and navigation in the process of care and elements, including information sharing and effective communication (American Academy of Family Physicians, 2008).

Nevertheless, this integrated system should be effectively managed to ensure an optimal outcome and appropriate use of resources based on an evidence-based approach. There should be feedback loops in order to continuously improve the performance of the health system to improve the delivery of health services and people's well-being (Armitage, Suter, Oelke, & Adair, 2009).

The hospital industry is distinctly different from other industries. Hospitals face challenges in defining and measuring output, coordination between diverse professional groups, organizational controls, ambiguities in role and contradictions in the role of autonomy, and inter-system and intra-systems relations (Bart & Tabone, 1998).

The coordination and integration across divisions of care coupled with the integration of health technologies considered in the current study as the indicators of structural complexity, which are discussed in the measurement models of study variables.

The Efficiency-Quality Trade-off in Hospitals

The excessive increase in healthcare expenditure has raised concerns about efficiency containment. One of the main efforts to achieve this goal is health policies that increase the efficiency of hospital management and limiting waste of resources (Martini, Berta, Mullahy,

& Vittadini, 2014). The regulation of hospitals' reimbursement for treatment that they provide, such as the implementation of a prospective payment system, are among the main example of these policies. One alternative to fee-for-service is the “global capitation”, which provides incentives for cost-containing through providing decision makers with a fixed budget for all the medical needs of their enrollees. This model works well for highly integrated practices, but not for independent centers without an external unit to coordinate treatment (Luft, 2009; Martini, Berta, Mullahy, & Vittadini, 2014). Under this system, repayments are classified according to the diagnosis-related groups’ codes, which provide very strong incentives to reduce the patient's length of stay (LOS).

As a response to these incentives, hospital managers applied methods and guidelines to increase labor and capital productivity, especially through increasing the total discharge rate per bed and per unit of labor (Martini, Berta, Mullahy, & Vittadini, 2014). These trends have raised concerns about the quality of care in hospitals. Given this approach, it is very important to evaluate whether there is a trade-off relationship between efficiency and quality of care in the hospital sector.

in November 2011, Health and Human Services Secretary Tommy G. Thompson announced the quality initiative, a commitment to ensure the quality of healthcare for the American people through information released to customers coupled with the promotion of the quality of health care through Medicare’s Quality Improvement Organizations. The voluntary hospitals participating in the quality initiative were assessed on 10 quality measures, which was also provided with an incentive. The CMS’s payment performance program also rewards top ten hospitals in terms of quality, through increased payments for Medicare patients (Nayar & Ozcan, 2008).

Carey and Burgess (1999) studied a sample of US Department of Veterans Affairs’ hospitals to measure the relationship between hospital efficiency and quality during 1988-93.

They assessed a positive trade-off between efficiency and quality. In a study conducted by McKay and Deily (2008), a variety of relationship between hospital inefficiency and health outcomes were reviewed. The authors have assumed that, by keeping other factors intact, inefficiency may be a determining factor in hospital-level health outcomes. The authors did not find any significant constant impact of inefficiency on health outcomes, where good health outcomes were considered as having lower rates of inpatient mortality and inpatient complications.

In a comparative perspective, Gok & Sezen (2013) examined the relationship between efficiency, quality and patient satisfaction for small, medium and large size hospitals across Turkey. According to the results, the efficiency of the hospital as a moderator variable changes the relationship between structural quality and patient satisfaction. The trade-off between quality and efficiency has proven to be diverse in proportion to the size of the hospitals. There is a negative relationship between the quality and efficiency for small hospitals, while a positive relationship between efficiency and quality for large hospitals is statistically significant.

Nayar & Ozcan (2008), investigated an example of Virginia hospitals to study the relationship between efficiency and quality. They realized that efficient hospitals had worked well on quality indicators as well. However, some inefficient hospitals have also been working well with respect to the quality. Therefore, the results of this study indicate that the quality of hospitals has not been compromised by the efficiency of hospitals. This finding does not provide a strong evidence for the inevitable trade-off relationship between efficiency and quality.

In theory, quality can be separated from efficiency. However, in practice, this separation is not so clear. Each hospital may improve its quality level by increasing medical technology, using more resources and maintaining medical personnel, regardless of

efficiencies. On the other hand, the level of efficiency could be improved only by focusing on the effective use of resources and not necessarily taking into account the quality. At this stage, the final solution can be the “optimal care”. As Donabedian (1997) argued, the “optimal care” can be achieved by considering a balance between efficiency and quality (Gok & Sezen, 2013).

Reviewing studies on the trade-off between quality and efficiency has policy implications, as it shows that managerial focus on efficiency improvements is not necessarily consistent with quality. One of the questions of the current study is the relationship between quality and efficiency across the sample, given the emphasis by third-party payers like Medicare on the quality-based payment.

Some research reported that there is a positive trade-off relationship between efficiency and quality. Therefore, reducing efficiency was associated with decreasing the quality of the hospital in terms of increasing negative outcomes in hospitalized patients. The results of this study confirm that if a hospital operates efficiently, it helps to reduce the negative qualitative outcomes. The findings of this study are especially important for policymakers and administrators, as there is evidence that hospitals can maximize quality and quantity, and there is no need for efficiency to be created at the expense of quality (Lee & Wan, 2002; Wan, 1995).

Components of the Expanded SPO Model

In the original SPO framework described by Donabedian (1988), the quality of the healthcare system is a combination of components that are connected to the organizational features of health care providers (structures), clinical and non-clinical processes involved in providing care (process), and the impact of care on health of the patient. Factors that are not included in the original model are the external influences of environment on healthcare providers and institutions. These include the social, legal, and political environment in which

providers and institutions operate, such as the rules of government, the market competition, and the compliance with customers and laws (Unruh & Wan, 2004).

The extensive review of articles in this study led to the reformulation of a conceptual model based on Donabedian’s 1988 Triad of Structure, Process, and Outcome. The theoretical premise is founded on four primary latent variables and one observable variable based on the literature reviewed. Structural complexity, process adequacy, hospital efficiency, and hospital quality are considered as latent variables, while contextual factors are specific observable variables such as location and hospital teaching status. Investigating these factors in this process helps to better understand the complexity of hospital-level relationships in line with desired goals of quality and efficiency.

The effect of quality assessment programs can be very significant, for example, since November 2011, and after the announcement of the "Quality initiative" that is aimed at ensuring the quality of health care system for all people, hospitals voluntarily participate in the "Quality Initiative" and report based on a 10 clinical quality measures. The enactment of Section 501(b) of the Medicare Prescription Drug, Improvement, and Modernization Act of 2003 has created incentives for hospitals to provide data based on the ten measures of quality assessment, since the law has explicitly stated that a hospital that does not provide performance data for qualitative assessment will receive 0.4% less annual payment compared to the hospital that presents this report.

On the other hand, CMS rewards hospitals with the best performance by increasing their payments to hospitals for Medicare patients. Using the data obtained through the Hospital Quality Alliance (HQA), which is a public–private collaboration led by the American Hospital Association (AHA), CMS provides consumers with comparative information on the performance of hospitals. Assessing the quality of hospitals by HQA is based on three critical medical conditions: heart failure, pneumonia and acute myocardial infarction (AMI) or heart

attack. This information is publicly available at: (http://www. .hhs.gov/Hospital/Static/Data-Professionals.asp?dest=NAV) (Nayar & Ozcan, 2008; Shettian, 2017).

The healthcare system defined as a high contact service industry and location becomes more important when services are not delivered remotely. Few studies have looked at location in relation to other structural and process variables, although in other research, it has been pointed out the important role of location, especially in relation to market competition (Wu et al., 2007; Capps et al,.2003; Calem et al.,1995). Generally, location in rural or urban areas is considered an important factor for hospitals. In recent years, hospitals in rural areas have struggled with many challenges, and their survival has required the adoption of special measures designed for rural areas. Location and proximity to the market are important factors for service providers such as hospitals. In particular, whether the hospital is located in rural or urban areas is an important factor for hospital because it has a large part in determining the hospital's market share. Rural hospitals sometimes have no competition in the area, so it is not clear that the rural location is inherently disadvantaged. On the other hand, hospitals in rural areas face challenges to maintain in a competitive environment, unless appropriate strategies are tailored to the region. Rural hospitals have been attracting attention in recent years from the chain hospitals to be invested due to lower prices and moderate market competition. (Goldstein, Ward, Leong, & Butler, 2002; Li, Benton, & Leong, 2002; Pittet et al., 2000). In this study, the role of location examined with an emphasis on urban or rural location on the performance of the hospital.

The comparison between teaching and non-teaching hospitals has shown that teaching hospitals have become widely known to offer a high level of quality, which have positively impacted public opinion. This public and professional approach towards teaching hospitals reflects the characteristics of teaching hospitals that are intended to provide a higher quality of care, including the treatment of specific and complex patients, the provision of specialized

services with advanced technologies, and biomedical research projects. Training medical scholars, innovations in clinical treatments, especially in public teaching hospitals, are other distinctive features of teaching hospitals (Bazzoli, Chan, Shortell, & D'Aunno, 2000; Tennyson & Fottler, 2000).

Considering the controversy about the impact of factors of location and teaching status on hospital performance, especially the dual effect based on the studies in terms of quality and efficiency, these factors were as control variables in the measurement model and their indirect impact on the performance of the hospital was measured.

Research Questions

The conceptual model developed in accordance with previous research and measured in the form of latent exogenous (predictive) and endogenous (effect or consequences) variables. The proposed study aimed to answer the following research questions derived from the model:

1. How to explain the mediating role of process adequacy in the relationship between structural complexity and hospital efficiency and quality?

   Hypothesis 1. It is a consensus that these two constructs may directly influence hospital efficiency and hospital quality.

2. How do contextual factors, structural complexity and process adequacy influence hospital efficiency and hospital quality?

Hypothesis 2. The construct of process adequacy mediates the relationship between structural complexity and process adequacy.

3. Do hospital efficiency and hospital quality positively relate to each other?

Hospital efficiency may influence hospital quality. A systematic improvement in efficiency enhances hospital quality. It has been confirmed that ambiguously reducing the inputs or increasing the outputs to increase efficiency can be detrimental to hospital quality. Thus,

Hypothesis 3. Hospital efficiency leads to better hospital quality.

CHAPTER 3: METHODOLOGY

This chapter begun with the data sources, the population studied and sampling. Then the measuring of variables studied, data collection methods and analytical tools that used are described. In the end, the proposed analytical approach considered.

A cross-sectional study design is employed in this study. A complex set of different databases were combined to create data collection for this study. Data for predictive variables were gathered in 2015 whereas the outcome variables were collected in 2016. Structural equation modeling applied to examine the theoretically specified constructs or variables influencing the variability in hospital efficiency and quality. By merging the dataset from several sources, this study formed a meta-database for major domains of hospital performance research (Curtright, Stolp-Smith, & Edell, 2000).

Latent variables are variables that are not measurable directly through observations but are evaluated through mathematical modeling of a set of related observable variables or indicators. Exogenous predictor are variables that are not affected by other existing variables in the model, while the endogenous variables are variables that are affected by other variables present in the model (Hansen, 2017; Wan, 1995).

Data preparation involved merging data structures and distribution of the data employing the data definition dictionary of CMS, the database documentation of HIMSS analytics, and data descriptions and data layouts of AHA survey to generate a data set that contains all relevant data into a single meta database by using the platform Microsoft ® Access® 2016 MSO.

Data Sources for Measurement Indicators

Over the past 100 years, the number of performance evaluation systems have been developed and evaluated by organizations active in the field of healthcare (McIntyre, Rogers,

& Heier, 2001).

American Hospital Association

The AHA organizes a survey each year and provides an annual database that provides comprehensive information on hospitals throughout the United States. The database consists of approximately 6,300 hospitals and includes about 1,000 fields of information including:

- Organizational structure
- Inpatient and outpatient utilization
- Physician arrangements,
- Staffing
- Geographic indicators (AHA, 2016).

HIMSS Analytics

HIMSS Analysis is an institution that works in the healthcare research and advisory area. The annual database provides a comprehensive data collection of 5,300 hospitals, in particular providing comprehensive information on the profile of the hospital and the infrastructure and IT applications.

CMS Hospital Compare

Hospital Compare in 2016 is part of the CMS hospital quality initiative that directs hospitals to improve the quality of services they provide. It provides information on the performance of hospitals, quality information, and patient perspectives.

Population and Sample

The population surveyed were acute care hospitals throughout the United States that include more than 6,000 inclusive of all types of ownership. Three data sources, including CMS

Hospital Compare, AHA survey, and HIMSS Analytics, contain many related data required. The “AHA database contains data of 6,251 hospitals and systems. HIMSS analytics database has 5,473 acute care hospitals. The CMS dataset for general information has data for 4,807 hospitals of which 3,370 hospital types were marked “acute care hospitals” (CMS,2015). These types of hospitals refer to hospitals that patient receive services, but in a short time, for injury or episodes of illness, and not for long-term treatment.

All these data were merged, and a database was created containing a list of hospitals with all needed information. Data verified by comparing, combining, and transmitting the factors required for use for creating the desired variables. The data was checked and cleaned, and a portion of the data with variables required for the study were obtained. The final sample includes 1313 hospitals in regard to three databases. Wolf et al. (2013) created a table that specifies the minimum number of samples needed according to sufficient statistical power, minimal bias, and overall solution propriety. The sample of 1313 hospitals is more than the minimum sample size given the expected number of factors and indicators, magnitude of factor loadings, magnitude of factor correlations, magnitude of regressive paths and missing data in both CFA measurement model and covariance SEM, which indicates that there it is no need to use of arithmetic (power or logarithm) and two-step process that SEM needs to achieve the minimization to increase the normality of the endogenous variables (Templeton, 2011).

Determining the sample size in SEM has been raised in some ways. Although there is no consensus on the acceptable sample size, to deal with missing or non-normally distributed data, it is better to have a relatively larger sample size. The rule of thumb for sample size is the N:q, which N is number of cases and q is the number of model parameters that supposed to be estimated. An ideal ratio for sample size to parameters is 20:1 regarding applying maximum likelihood (ML) estimation method. The expected q in the current study was 8, so the minimum sample size was 421 cases (Kline, 2011, p.12).

However, previous studies recommended for at least 200 sample for any SEM when the assumptions related to the data were provided. Also, 200 sample would be enough when multiple measures of data are moderately independent, when multiple indicators are available for any construct, and when the reliability of the model is moderately high.

Another way to calculate the number of samples needed for a SEM study is based on the number of visible and latent variables in this model. The sample size for this study measured through the Website of https://www.danielsoper.com/statcalc/calculator.aspx?id=89, which needs the anticipated effect size (acquired based on previous studies), desired statistical power level, number of latent variables, number of observed variables, and probability level. The sample size for the proposed model was 1613 hospitals.

The data provided by HIMSS Analytics and AHA are available for 2015 and the data provided CMS is updated for 2016. The observable variables were specified or created to verify latent variables through measurement models. Certain assumptions for implementing SEM examined, then the hypotheses of the research tested.

Data validity was considered as the validation of data collection and procedures is carried out on a regular basis under the supervision of specific organizations. Since indirect data were used in this study, direct validation of data was not available. Further, the internal consistencies of constructs were assumed to be regularly evaluated by related organizations that are managing the data, which allows to assume reliability.

The following table reflected the operational definition of each indicator of latent variables that were belong as well as the data sources.

Table 1 Operational Definition of Study Variables

Theoretical Concept	Construct	Indicators	Operational Definition	Source of Data	Measurement Scale	Exogenous/ Endogenous
Structural Complexity	Organizational Complexity	Integration across Division of Care	A coordinated care among provides, services, tasks, and patient treatment processes	AHA survey (2016)	Binary	**Exogenous Variable**
		Integration of Health Information Technology:	advanced health technology systems resulted in fewer complications, lower mortality rates, and lower costs	HIMSS Analytics (2016)	Binary	
Process Adequacy	Process Adequacy	Physician-Patient Communication	building a therapeutic relationship that ensures the quality of the outcome of treatment.	CMS (2015)	Binary	
		Pain Management	Current standards of (JCAHO, 2011) to manage and diagnose the pain immediately.	CMS (2015)	Binary	
		Transition of Care	proper coordination of care during the transition	CMS (2015)	Binary	
Hospital Performance	Efficiency	Technical Efficiency	refers to the extent that a hospital maximizes output for a given set of inputs/resources	AHA survey (2016)	Continues	**Endogenous Variables**
		Length of Stay (inverted index)	it is one of the priorities of efficiency improvement to reduces the duration of the patient's presence	AHA (2016)	Continues	
Hospital Performance	Quality	30-days Mortality rate (inverted index)	Examined the mortality rate of patients within a 30-day from heart failure, pneumonia and acute myocardial infarction (AMI) or heart attack from the date of initial admission	CMS (2015)	Continues	
		30- days Readmission rate (inverted index)	Defined as a repeated hospitalization within 1, 2, 4, or 12 months after discharge from heart failure, pneumonia and acute myocardial infarction (AMI) or heart attack	CMS (2015)	Continues	
Control Variables	Contextual Factors	Location	Rural vs. urban hospitals	AHA survey (2015)	Binary	**Control Variables**
		Teaching status	Teaching vs. nonteaching hospitals	AHA survey (2015)	Binary	

The following section elaborates on each of latent variables with an explanation of the measuring indicators based on the literature review.

Structural Complexity: Latent Exogenous Construct and Measurement Variables

Structural complexity as a latent exogenous variable measured with two different observable variables, including integration across divisions of care, and integration of the information technology. According to Donabedian's quality assessment and monitoring cycle (2003, p. xxviii), it's essential to assess the current structural characteristics in terms of organizational resources and capacities to analyze the quality of a healthcare system.

Integration across Divisions of Care

Lee & Wan (2002) raised integration across divisions of care as one of the factors of complexity across a hospital, which is measured by two indicators: breadth of services and case management. The breadth of services implies the availability of multiple facilities, care units, and services in a hospital. This indicator is derived from the total number of high-tech services at the hospital level. Hospitals with advanced services are more complex than hospitals with a limited number of services, resulting in more clinically integrated services to patients. Hospitals with multiple medical services including adult cardiology services, pediatric cardiology services, adult diagnostic catheterization, pediatric diagnostic catheterization, chaplaincy/pastoral care services, chemotherapy, children's wellness program, chiropractic services, community outreach, complementary and alternative medicine services, computer assisted orthopedic surgery (CAOS), crisis prevention, and emergency services are distinguished from hospitals offering specialized services. Case management is required to provide clinically integrated services, measured by whether a hospital has already implemented this system.

Integration of the Health Information Technology (HIT)

Integration of health information technology should be designed in such a way as to cover all core functional areas of patient care. The integrated information system implies that all core

functions of the hospital are supported by the information technology system and that these systems are fully coordinated/integrated. This concept is measured by the fact that the more a hospital employed application systems in different sectors, more structurally complex. it is because more capital is dedicated to the integrated information technology system (Lee & Wan, 2002).

HIT integration in the current study measured by indicators of hospitals' ability to receive lab results electronically and track patients' health information, including lab results, tests, and referrals electronically between visits. IT operating expense, IT capital expense, number of employed IT staff (in FTEs), Number of outsourced IT staff (in FTEs), and the availability of Electronic Health Record (EHR) identified to measure the integrity of health information technology at the hospital level. EHR "integrates electronically originated and maintained patient-level clinical health information, derived from multiple sources, into one point of access. An EHR replaced the paper medical record as the primary source of patient information" (AHA, 2016, p 103).

Process Adequacy: Latent Intervening Construct and Measurement Variables

According to the modified SPO model, structural complexity is expected to affect process adequacy, which is defined as the intervening latent variable, affecting hospital efficiency and hospital quality. The data analysis determined if it is mediating the outcome. This variable was collected based on information obtained from patients that later were aggregated at the hospital level. The hospital consumer assessment of healthcare providers and systems (HCAHPS) Patient Survey or Hospital CAHPS was used to collect the data. Process adequacy emphasizes the treatment process and the way in which services have been delivered during the care delivery. It referred to the interpersonal communication aspect by assessing human interactions and patients' expectations of "information, answering questions, asking

about their preferences, involvement in taking decisions" during care process (Hanae et al, 2013). Data is aggregated at the hospital level. For the data to be used in the current study, the data were classified to 50% high and 50% low based on the Median and were grouped in 1 and 0.

Elements of patient-physician relationships, pain management in the patient- especially postoperative pain and facilitating the process of transfer of care, are fundamental to the quality assurance of the hospital.

Physician-patient Communication

Physician's communication behavior combined to contribute to patient satisfaction for out-patient experience (Stewart 1995; Williams, Weinman, and Dale 1998) with an important effect on hospitalized patients (Rubin 1990; Hall, Elliott, and Stiles 1993; Moller-Leimkuhler et al. 2002). In the current study, factors of respect, communication with doctors and the communication about medicines were considered as the main indicators of the physician-patient communication.

Pain Management

Pain management points to the importance of cultural sensitivity and its emphasis on the patients' different understanding of pain. Health practitioners should be trained to distinguish emotional and physical pain so as to be able to provide treatments that are appropriate (Berry and Dahl, 2000). The physicians and nurses' effective communication with patients about pain, explaining ways to control pain, and considering different sensitivities of patients to pain and ways of expressing pain are proposed for defining the variables of pain management.

Communication on pain and ways to treat pain effectively, and pain management by taking medicine, are indicators that were used based on the literature review to measure the observable variable of pain management in the existing study.

Transition of Care

According to (Coleman & Berenson, 2004, p 1), “transitional care has been defined as a set of actions designed to ensure the coordination and continuity of health care as patients transfer between different locations or different levels of care in the same location”. Evidence of problems during the patient's transition has emerged, which raised a national awareness to avoid medical errors and quality deficiencies at any stage of care transition (Coleman & Boult, 2003).

To improve the transition of care, the first step is to identify and recognize the challenges that patients face when they are moving to the next treatment stage. A system-level performance measurement is needed to recognize challenges and potential solutions efficiently (Wenger et al., 2003). Providing adequate education for a patient about medications and medical follow-up with the patient or their primary caregiver are indicators of care transition that were considered in the current study.

Hospital Efficiency: Latent Endogenous Construct and Measurement Variables

The hospital efficiency is concerned with how the hospital maximizes the utilization of the limited financial resources. And, how can hospitals achieve the highest possible value for the well-being of patients. Hospital efficiency is looking for existing mechanisms to decide on the best way to use mechanisms to improve the conditions of a hospital. Achieving these goals requires dealing with the concept of production efficiency (Wang, Ozcan, Wan, & Harrison, 1999).

Technical Efficiency

Technical efficiency compares "the total factor productivity of individual firms to the best practice frontier-total factor productivity" (Valdmanis, 1990, p 552). Indicators of service mix, operating expenses, and labor (Full-Time Equivalent, FTE) were combined to form a technical efficiency index.

Process Efficiency

Process efficiency refers to the adherence to the standardized guidelines that ultimately affect the efficiency of a hospital; it is one of the priorities of efficiency improvement (Weingarten, Lloyd, Chiou, & Braunstein, 2002). In this study, LOS used as an indicator to measure process efficiency. Based on the AHA annual survey database, if a separate long-term unit was reported and long-term admissions were greater than one-half of total admissions, then LOS is 1; otherwise LOS is 0. If a separate long-term unit is not reported and the ratio of inpatient days to admissions is 30 or more, then LOS is 1; otherwise LOS is 0. To use the data in this study, data was recoded from 1 to 0 and vice versa.

Hospital quality: Latent Endogenous Construct and Measurement Variables

There is a focused effort on improving the quality of care in hospitals. 30-days mortality rate and readmission rate were used to assess quality improvement. Readmission and mortality data for heart failure, pneumonia and acute myocardial infarction (AMI) or heart attack were selected and summed among all available data for each hospital and divided by the total admission of each hospital to equally weight readmission and mortality ratios. To be able to use the data as positive indicators of quality, ratios later divided by 1 and used as indicators of readmission and mortality rate.

30-days Mortality Rate

The 30-days mortality rate is evaluated as one of the indicators of quality assessment and examined the mortality rate of patients within a 30-day from heart failure, pneumonia and acute myocardial infarction (AMI) or heart attack from the date of initial admission. Mortality rate measured over a 30-day period, because deaths that occur over a longer period are less associated with the quality of treatment provided in the hospital, and often related to other complicating illnesses, patient's behavior and other treatments that the patient has received after leaving the hospital (CDC, 2016).

30-days Readmission Rate

As discussed in the literature review, readmission rate has been used in many studies to measure quality. The measure of 30-day unplanned readmission measures were used to estimate unplanned readmissions to any acute care hospital within 30 days of discharge from a hospitalization for medical conditions caused by heart failure, pneumonia and acute myocardial infarction (AMI) or heart attack.

Contextual Factors: Observed Endogenous Variables

The effect of location and teaching status considered as the contextual variables in the analytical model and their impact on hospital performance is analyzed.

Data Analysis

Descriptive statistics used in the first phase to depict the univariate distribution of variables and provide an overview of the status of the hospitals at the national level. In the following, existing variables were recorded, re-categorized or computed to be fitted with the purpose of the study and create desired variables.

Measuring Hospital Efficiency

The DEA used to estimate the hospital efficiency and the ranking of hospitals determined accordingly. DEA is a very powerful tool for services management and benchmarking techniques initially developed by Chanes, Cooper, and Rhodes (1978) to evaluate public and non-profit organizations. This method compares the analyzed units of analysis referred to as the Unit of Decision Making (DMU) based on all the resources used and the services produced and introduces the most efficient units and inefficiencies that can be promoted (Sherman & Zhu, 2006).

DEA measures the efficiency of DMU Z compared with then DMUs in the data set based on the mathematical expression as follows:

$$\max E_z = \frac{\sum_{r=1}^{s} u_r y_{rz}}{\sum_{i=1}^{m} v_i x_{iz}}$$

where z is the DMU being evaluated in the set of i = 1…n DMUs

Constraints

$$\frac{\sum_{r=1}^{s} u_r y_{rj}}{\sum_{i=1}^{m} v_i x_{ij}} \leq 1; j = 1 \ldots n$$

$$u_r > 0 ; r = 1 \ldots s$$

$$v_i > 0 ; i = 1 \ldots m$$

Outputs: yrj = observed amount of rth output for the jth DMU

Inputs: xij = observed amount of rth input for the jth DMU

Table 2 represents measures used to estimate the rate of technical efficiency across the sample.

Table 2 Measures of Hospital Efficiency

Inputs	FTRNTF (Full-time registered nurses) FTLPNTF (Full-time licensed practical or vocational nurses) FTAST (Full-time nursing assistive personnel) FTTOT (Full-time total personnel) PTRNTF (Part-time registered nurses) PTLPNTF (Part-time licensed practical or vocational nurses) PTAST (Part-time nursing assistive personnel) PTTOT (Part-time total personnel) BDTOT (Total facility beds set up and staffed at the end of reporting period)
Outputs	ADC (Average daily census) OPRA (Number of Operating Rooms) VOTH (Other outpatient visits) VTOT (Total outpatient visits) VEM (Emergency room visits) SUROPTOT (Total surgical operations) SUROPOP (Outpatient surgical operations) SUROPIP (Inpatient surgical operations) Adjusted admissions (Calculated: Admissions + (Admissions * (Outpatient Revenue/Inpatient Revenue) Adjusted patient days (Calculated: Inpatient Days + (Inpatient Days * (Outpatient Revenue/Inpatient Revenue) IPDTOT (Total facility inpatient days) ADMTOT (Total facility admissions)

Structural Equation Modeling (SEM) used as a statistical method to explain the plausibility of the relationships among the variables considered in the conceptual model (Bentler & Dudgeon, 1996). This method allowed the entire model to be evaluated and looked at the data analysis from a macro-level perspective. The basic conceptual model was dealt with and subsequently corrected.

The basis of SEM is the covariance, which is expressed as follows,

$$COV_{xy} = R_{xy} SD_x SD_y$$

where x and y are two observable continues variables. Rxy represents the Pearson correlation, while standard deviations are shown by SDx and SDy. The covariance leads to understanding patterns of covariance among the observed variables and explaining these variances with the model that is being tested. The Confirmatory Factor Analysis (CFA) evaluates the measurement model to evaluate the factors and associated impacts of the indicators on the basis of the sample (Markus, 2012). SEM includes specification,

identification, estimation, and model fitness (Wan, 2002).

In summary, the following steps were taken during the study:

1. Selected an appropriate sample of hospitals
2. Verified the required assumptions of SEM
3. Analyzed covariance and the correlations between indicators of the measurement model
4. Evaluated the final model
5. Reported goodness-of-fit statistics
6. Considered theoretically plausible alternative models (Markus, 2012), if the generic model did not fit the data.

Measurement and Structural Models

SEM is a combination of factor analysis and path analysis which sets how the two main components of this method are characterized: the model measurement and the structural model. The measurement model describes the relationship between observed variables and the constructs that these variables are assumed to form. On the other hand, the structural model explains the interrelationship among construct. The composite or the full model is when both measurement model and structural model are considered together.

SEM requires certain assumption on data through hypothesis testing procedures, confidence intervals, and efficiency claims. The independency of observations and the distributional requirements such as multivariate normal distribution should be meet. The analysis will check for excluding any variable with more than 25% cases of missing values and a series mean will be used to replace for variables with lower missing values. The correlation matrix and extraction based on Eigen values greater than 1 for the principal components analysis used to help excluding variables with low loading factors or to loading those variables into multiple components.

Measurement Model

Measurement model allowed the researcher to evaluate to what extent the observed variables are well combined to form latent variables. Confirmatory Factor Analysis (CFA) used to test the measurement model. Each of the considered indicators was separate measure that together represented the underlying hypothetical variable.

Structural or Causal Model

This equation the structural model defined the relationships between latent variables that are indicated by covariance, direct effect or indirect (mediated) effect. Covariance is similar to relationships that are defined as non- directional relationships among independent latent variables. Direct effects defined as relationships among measured and latent variables, while indirect effects are relationships between an independent latent variable and a dependent latent variable that is mediated by one or more latent variables (Weston & Gore Jr, 2006, p 727-728). Mediation can be full or partial.

SEM experts have emphasized on the six steps necessary in model testing. After data collection, next steps are a model specification, identification, estimation, evaluation, and modification (Hoyle, 1995; Kaplan, 2000; Kline, 2005; Schumacker & Lomax, 2004).

Model Specification

This concept means that the researcher distinguishes the hypothetical relationships between the observed and the latent variables. This distinguishing relationship is very important because any indistinct relation between variables is assumed to be 0 or equal.

Model Identification

The purpose of model identification is to estimate the most parsimonious result of the relationships between the variables, which accurately shows the relationships observed in the

data. The identification of over-identification, just-identified, and under-identification is the process that is determined by the number of degrees of freedom. If the number of degrees of freedom is negative, the model is under-identified and can't be estimated.

Estimation

Estimating the model occurs when the model is specified, identified, and the data was collected from a large enough sample and when the data problems were resolved. This step involves determining the values of the unknown parameters associated with the estimated values. The values of the parameters and coefficients are calculated both standardized and not standardized. The standardized model operates like β regression model.

Model Fit and Interpretation

Model identification occurs after model estimation. The goal is to determine whether the relationships between observed and latent variables of the model properly represent the relationships within the data. The model fit is estimated through multiple indices.

GFI and $\chi 2$

> The absolute fit indices include the goodness-of-fit index and $\chi 2$. GFI is analogous to R2, used in a regression to summarize the variance explained in a dependent variable, yet GFI refers to the variance accounted for in the entire model. However, researchers do not report GFI as consistently as $\chi 2$ (Weston & Gore Jr, 2006, p 741)

It's considered that $\chi 2$/df should be less than 5, the RMSEA should be less than .08. This study reports $\chi 2$ and GFI for each of the CFA and SEM models presented.

Model Modification

Model modification and re-specification may be needed to guarantee that the model is best fitted with the data, which always happens by removing or adding more parameters in the model.

CHAPTER4: RESULTS

In this chapter, the results from the implementation of these two steps of CFA and SEM were discussed. After cleaning the data and preparing the sample, the researcher reviewed the measurement models, which included steps of specification, identification, estimation, model fits, and re-specification using AMOS graphics to compare several models. The AMOS graphics set for Maximum Likelihood discrepancy estimation to fit both saturated and independence models. To achieve the model that closely fit the theoretical and practical concepts confirmed with statistical fit estimates, numerous runs were executed in line with the nested-revised model. However, only the most parsimonious models that are closest to the conceptual model and statistical fit estimates are presented. Discussions on the results and statistical estimates as well as theoretical and statistical significance of results presented at the end of the chapter after the presentation of tables and SEM models.

Descriptive Results

Descriptive results are presented below.

Table 3 Frequencies and Percentages for Nominal Descriptive Data (N = 1313)

Demographic	N	%
Integrated HIT		
No integration	221	16.83
Fully or somehow integrated	1092	83.16
Integrated Care		
No integration	345	26.27
Fully or somehow integrated	968	73.72
Pain Management		
Non- effective pain management	567	43.19
Effective pain management	746	56.81
Transition of care		
Non- effective transitional care	413	31.45
Effective transition of care	900	68.54
Physician-patient communication		
Non -effective communication	276	21.02
Effective communication	1037	78.98
Location		
Rural	120	9.13
Urban	1194	90.93
Teaching Status		
Demographic	N	%
Teaching hospital	134	10.20
Non -teaching hospital	1180	89.87

Table 4 Means and Standard Deviations for Continuous Descriptive Data (N = 1313)

	Minimum	Maximum	Mean	Std. Deviation
Mortality (Inverted Index)	0.4	31.89	0.6043	1.64
Readmission (Inverted Index)	1.82	987.17	480.5209	405.65
Technical efficiency	0.54266	1	0.8905342	0.115
Length of Stay (Inverted Index)	2	114	37.534	69.765

Correlation results of study indicators are shown in the table below.

Table 5 Correlations

	Readmission	Mortality	Location	Teaching status	Physician patient communication	Transition of care	Pain management	Technical Efficiency	Length of Stay	Integrated HIT	Integrated Care
Readmission	1	0.431**	0.543**	0.445*	0.382**	0.382**	0.511**	00.413*	0.527*	0.394*	0.422*
Mortality	0.431**	1	0.352*	0.553*	0.287*	0.344*	0.383*	0.451**	0.493**	0.252*	0.422*
Location	0.543**	0.352*	1	0.432**	0.277**	0.573*	0.343*	0.432**	0.231**	0.632*	0.523*
Teaching status	0.445*	0.553*	0.432**	1	0.465*	0.455*	0.567*	0.213*	0.421*	0.654*	0.102**
Physician-patient communication	0.382**	0.287*	0.277**	0.465*	1	0.732**	0.787**	0.553**	0.332*	0.776*	0.435**
Transition of care	0.382**	0.344*	0.573*	0.455*	0.732**	1	0.553**	0.496**	0.543*	0.765*	0.234**
Pain management	0.511**	0.383*	0.343*	0.567*	0.787**	0.553**	1	0.365**	0.354*	0.465*	0.532*
Technical Efficiency	0.413*	0.451**	0.432**	0.213*	0.553**	0.496**	0.365**	1	0.787*	0.469**	0.479**
Length of Stay	0.527*	0.493**	0.231**	0.421*	0.332*	0.543*	0.354*	0.787*	1	0.634*	0.114**
Integrated HIT	0.394*	0.252*	0.632*	0.654*	0.776*	0.765*	0.465*	0.469**	0.634*	1	0.804**
Integrated Care	0.422*	0.422*	0.523*	0.102**	0.435**	0.234**	0.532*	0.479*	0.114**	0.804**	1

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Covariance Structure Equation Models

Covariance Structural Equation Model for Hospital Efficiency

The covariance structure equation model was run to measure the mediating effect of process adequacy on relationship between structural complexity and hospital efficiency.

The initial model that the researcher tried was similar to the conceptual model. The final model was different, especially in terms of direct effect of contextual variables on structural complexity. Although the initial model indicated direct linkage from context to structure, it seems likely that these may indirectly affect structure but may directly affect process adequacy and hospital efficiency.

The researcher treated the construct of process adequacy, as an endogenous variable mediating between exogenous variable of structural complexity and hospital efficiency in the

second model. The first model was designed to measure the effect of structural complexity on hospital efficiency. Results show that the first model with structural complexity as an exogenous and hospital efficiency an endogenous is statistically significant though based on R-squred, the model explains for 0.50 of hospital efficiency. After adding process adequacy as the latent mediator, the amount of explanation for hospital efficiency increased to 0.742. Considering the significance of the structure equation of both models before and after mediating effect of process adequacy, process adequacy was partially mediating the effect of structural complexity on hospital efficiency.

Figure 3 demonstrated the covariance based structural equation model analyzing the effect of structural complexity on hospital efficiency. Results are shown in Table 3.

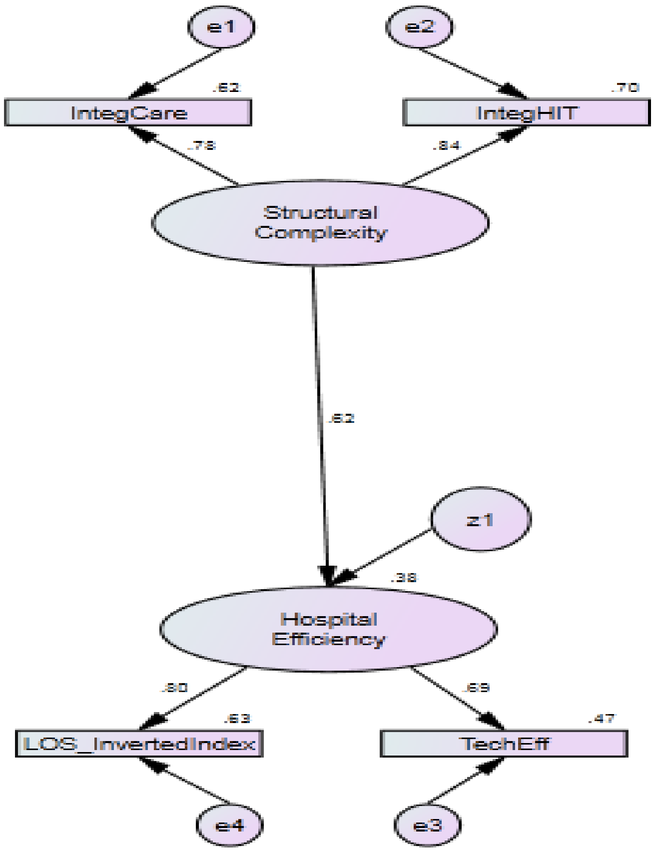

Figure 3 Covariance Structural Equation Model for Hospital Efficiency

Table 6 Estimates and GOF Statistics for Hospital Efficiency SEM

Indicator	**Std.Reg.Wt.**	**Reg.Wt.**	**S.E.**	**C.R.**	**P**
Hospital_Efficiency<---Structural_Complexity	.615	1.000	.007	20.295	***
*** Unstandardized estimates statistically significant at p < .001**					
Squared Multiple Correlations (R^2) Estimate:					
Hospital_Efficiency .379					
Goodness of fit (GOF) statistics for the model:					
Chi-square = 166.036, Degrees of freedom =4 and probability level = .000					
RMR=.022, GFI=.942, AGFI=.856 PGFI=.377, NFI=.863, RFI = .795, IFI=.866, TLI=.799					
CFI=.577, FMIN=.127, RMSEA = .036, AIC=178.36, HOELTER (.01) =19					

Examining the effect of process adequacy showed that process adequacy is partially mediating the relationship between structural complexity and hospital efficiency which led to a higher explanatory of model for hospital efficiency. Results reflected in Figure 4 and Table 7.

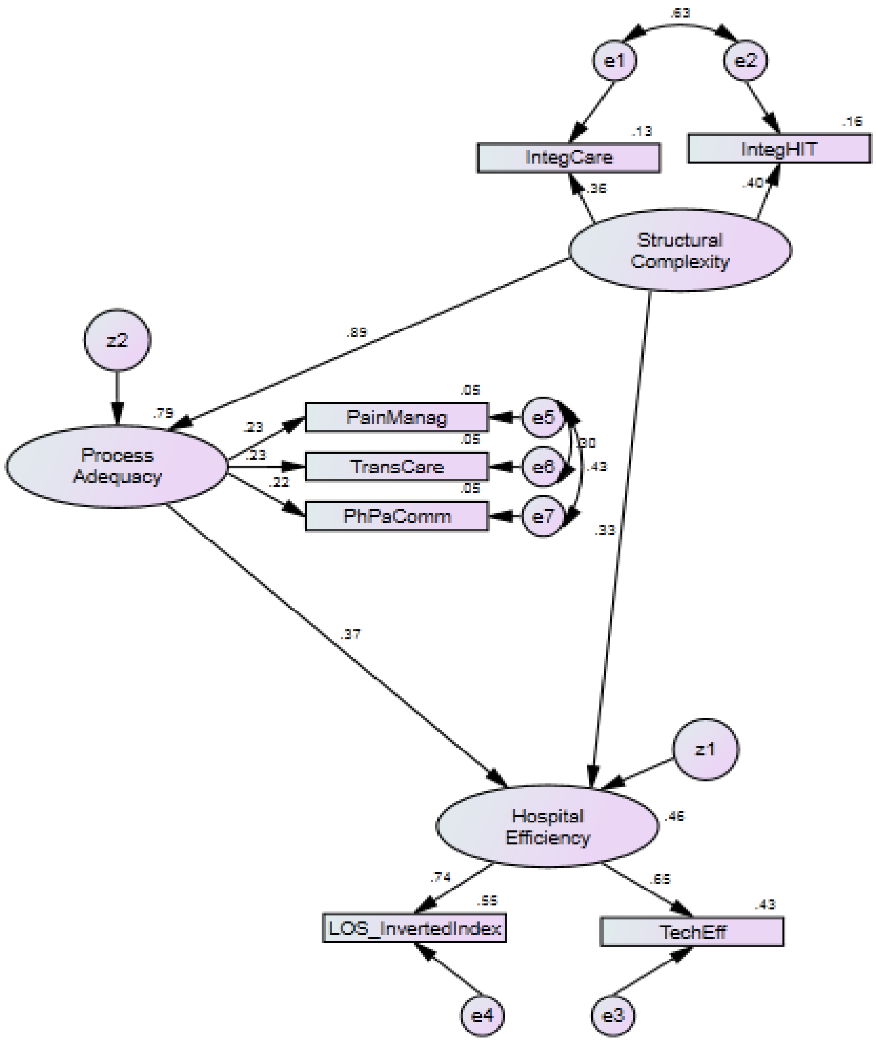

Figure 4 Covariance Structural Equation Model for Hospital Efficiency

The model was the optimal fit based on the data and the GOF statistics. The model showed that process adequacy was positively correlated with hospital efficiency. The standardized regression estimates of 0.37 indicated a moderately direct effect of indicators of physician-patient communication, pain management and care transition on hospital efficiency with a 0.33 direct effect of standardized regression estimates of structural complexity on hospital efficiency.

Table 7 Estimates and GOF Statistics for Hospital Efficiency SEM

Indicator	Std.Reg.Wt	Reg.Wt.	S.E.	C.R.	P	Std.Direct Effect	Std. Indirect Effect
Process_Adequacy<--- Structural_Complexity	.890	1.000	.007	13.277	***	.890	
Hospital_Efficiency <--- Structural_Complexity	.392	1.000	.002	12.316	***	.329	.329
Hospital_Efficiency<----- Process_Adequacy	.370	1.000	.002	17.505	***	.370	
*** Unstandardized estimates statistically significant at p < .001**							
Squared Multiple Correlations (R^2) Estimate:							
Hospital_Efficiency .463, Process_Adequacy .792							
Goodness of fit (GOF) statistics for the model:							
Chi-square = 495.215, Degrees of freedom =15 and probability level = .000							
RMR=.025, GFI=.921, AGFI=.842 PGFI=.461, NFI=.820, RFI = .730, IFI=.825, TLI=.737,							
CFI=.825, FMIN=307, RMSEA = .065, AIC=430.811, HOELTER (.01) =95							

Covariance Structural Equation Model for Hospital Quality

Figure 5 presented the covariance structural equation model that analyzed the effect of structural complexity on hospital quality. Table 5 showed the results with estimates and model fit statistics. The model explained for 26% of the hospital quality construct. This moderate presentation of hospital quality suggested that quality is the concept that is measurable within the framework of hospital structure and process. To assess the mediating effect of process adequacy, a covariance structure equation model of the effect of structure complexity and process adequacy was designed, which explain for 56% of variation in hospital quality. The covariance structure equation was confirmed a partially mediating of process adequacy on the relationship between structure complexity and hospital quality. There was a direct effect of

structural complexity on hospital quality with the standardized direct effect of 0.22 and standardized indirect effect of 0.34. Process adequacy showed 0.65 of standardized direct effect on hospital quality. Table 9 showed the results with estimates and model fit statistics.

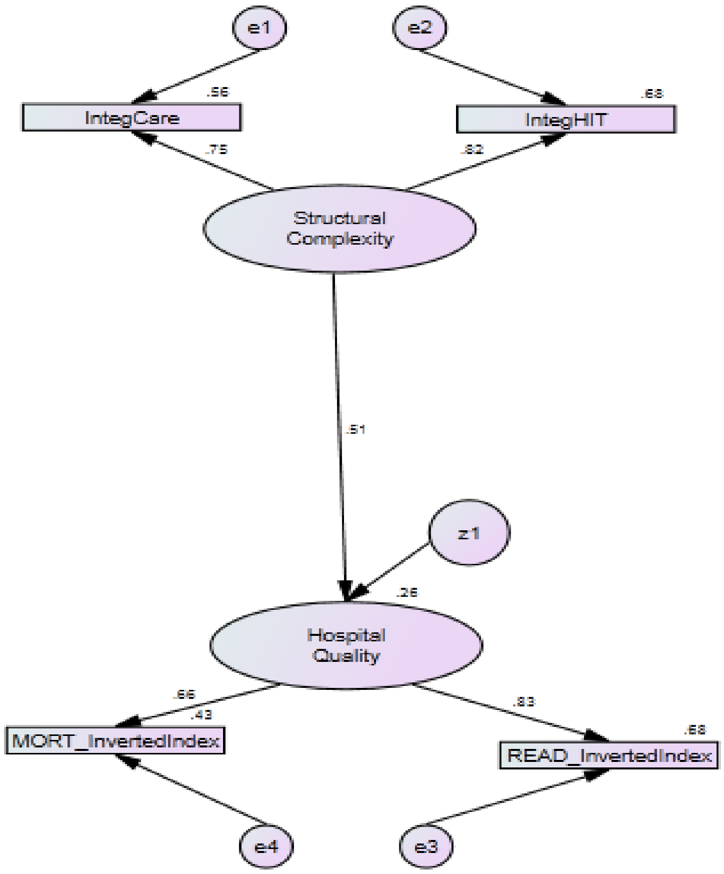

Figure 5 Covariance Structural Equation Model for Hospital Quality

Table 8 Estimates and GOF Statistics for Hospital Quality SEM

Indicator	**Std.Reg.Wt.**	**Reg.Wt.**	**S.E.**	**C.R.**	**P**
Hospital_Quality <--- Structural_Complexity	.506	1.000	.007	21.037	***
*** Unstandardized estimates statistically significant at p < .001**					
Squared Multiple Correlations (R^2) Estimate:					
Hospital_Quality .265,					
Goodness of fit (GOF) statistics for the model:					
Chi-square = 242.409, Degrees of freedom =4and probability level = .000					
RMR=.053, GFI=.917, AGFI=.792 PGFI=.367, NFI=.837, RFI = .756, IFI=.839, TLI=.759,					
CFI=.839, FMIN=.158, RMSEA = .065, AIC=254.409, HOELTER (.01) =15					

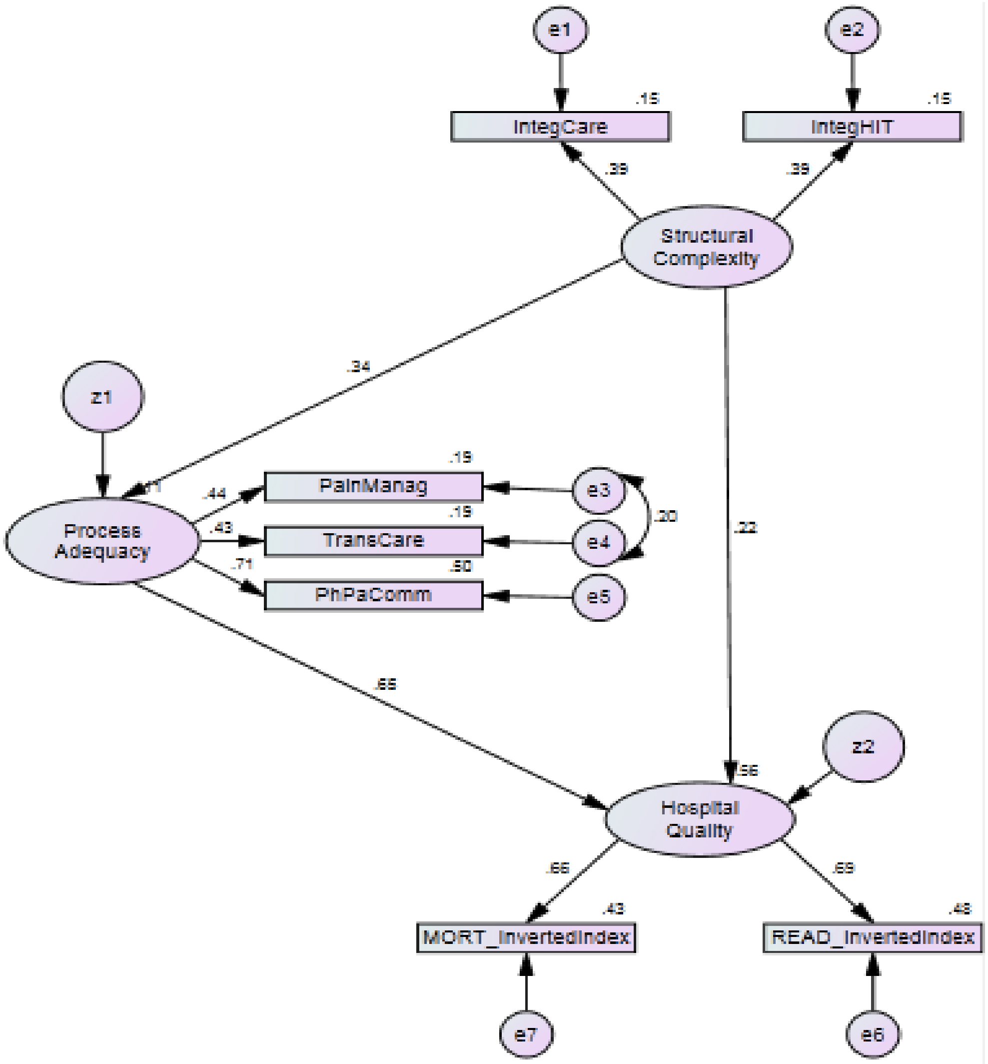

Figure 6 Covariance Structural Equation Model for Hospital Efficiency

Table 9 Covariance and GOF Statistics for Hospital Efficiency SEM

Indicator	**Std.Reg.Wt.**	**Reg.Wt.**	**S.E.**	**C.R.**	**P**	**Std.Direct Effect**	**Std.Indirect Effect**
Process_Adequacy<--- Structural_Complexity	.342	1.000	.005	8.779	***	.337	
Hospital_Quality<----- Process_Adequacy	.653	1.000	.022	3.380	***	.646	.218
Hospital_Quality <--- Structural_Complexity	.224	1.000	.002	9.813	***	.218	
*** Unstandardized estimates statistically significant at p < .001**							
Squared Multiple Correlations (R^2) Estimate:							
Hospital_Quality .563, Process_Adequacy .312							
Goodness of fit (GOF) statistics for the model:							
Chi-square = 456.181, Degrees of freedom =14 and probability level = .000							
RMR=.047, GFI=.901, AGFI=.801 PGFI=.450, NFI=.819, RFI = .729, IFI=.824, TLI=.735,							
CFI=.823, FMIN=.348, RMSEA = .068, AIC=484.181, HOELTER (.01) =84							

Figure 7 showed the full structure equation model of which analyzes the effects on hospital quality and hospital efficiency. The model explains for 78% of hospital efficiency and

46% of hospital quality. Process adequacy is not mediating the relationship between structural complexity and hospital quality while this relationship remains for hospital efficiency. Hospital efficiency mediated the relationship between process adequacy and hospital quality. As the SEM analysis demonstrated, there was a positive influence of hospital efficiency on hospital quality. Results showed in table 10.

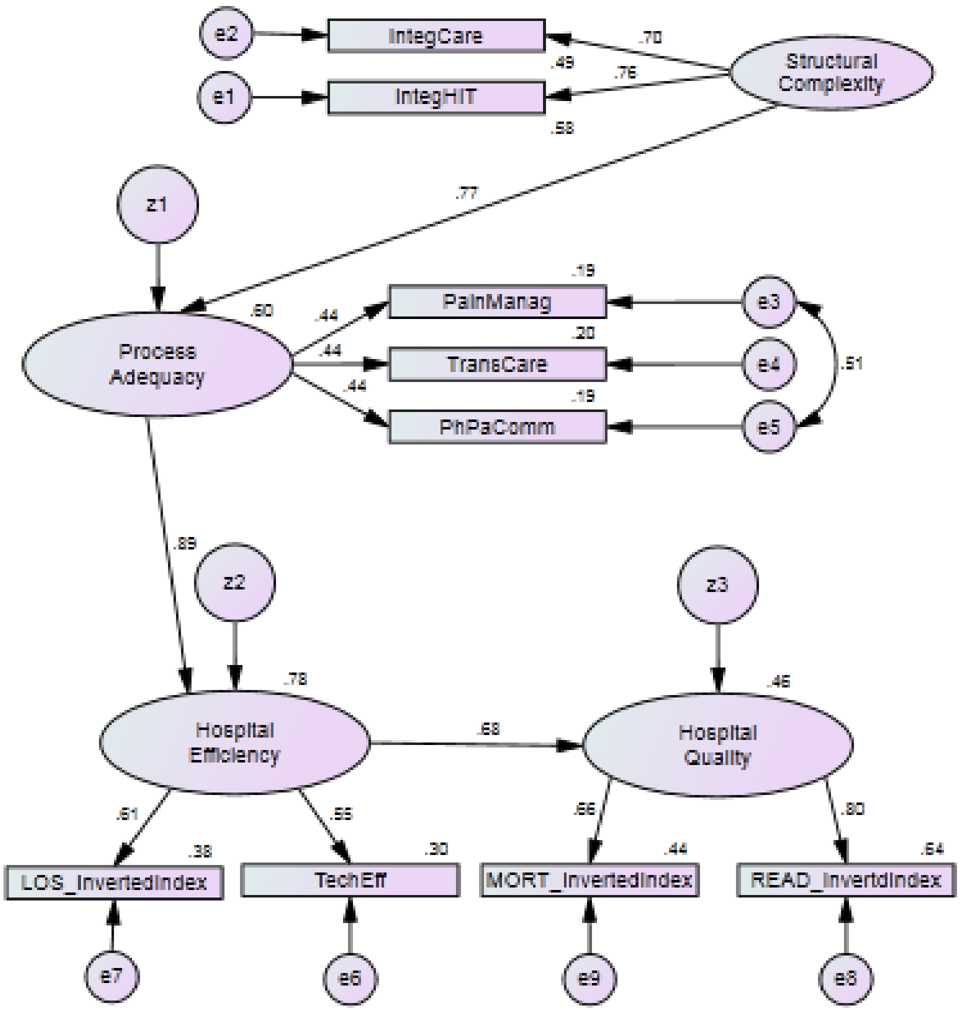

Figure 7 Structure Equation Model for Hospital Efficiency and Quality

Table 10 Covariance and GOF Statistics for Hospital Efficiency and Hospital Quality

Indicator	**Std.Reg.Wt.**	**Reg.Wt.**	**S.E.**	**C.R.**	**P**
Process_Adequacy<--- Structural_Complexity	.772	1.000	.006	-7.609	***
Hospital_Efficiency <----- Process_Adequacy	.893	1.000	.002	7.236	***
Hospital_Quality <--- Hospital_Efficiency	.682	1.000	.003	10.573	***
* **Unstandardized estimates statistically significant at $p < .001$**					
Squared Multiple Correlations (R^2) Estimate:					
Process_Adequacy .601 Hospital_Efficiency .462 Hospital_Quality .783					
Goodness of fit (GOF) statistics for the model:					
Chi-square = 684.885, Degrees of freedom =26 and probability level = .000					
RMR=.036, GFI=.899, AGFI=.825 PGFI=.519, NFI=.763, RFI = .672, IFI=.770, TLI=.681,					
CFI=.769, FMIN=.522, RMSEA = .056, AIC=722.885, HOELTER (.01) =88					

Covariance Structural Equation Model with Contextual Variables for Hospital Efficiency and Quality

Contextual variables of location and hospital teaching status were included in the model and their relationship with structural complexity was examined. Although it was predicted in the initial model that location and teaching status directly affect structural complexity, but in the final model, location influenced structural complexity though hospital teaching status influenced process adequacy. The standardized effect of hospital efficiency on hospital quality improved to 0.69 with a more explanatory factor of the model on hospital efficiency with 76% and hospital quality with 73%. Results and model fit are shown in table 11.

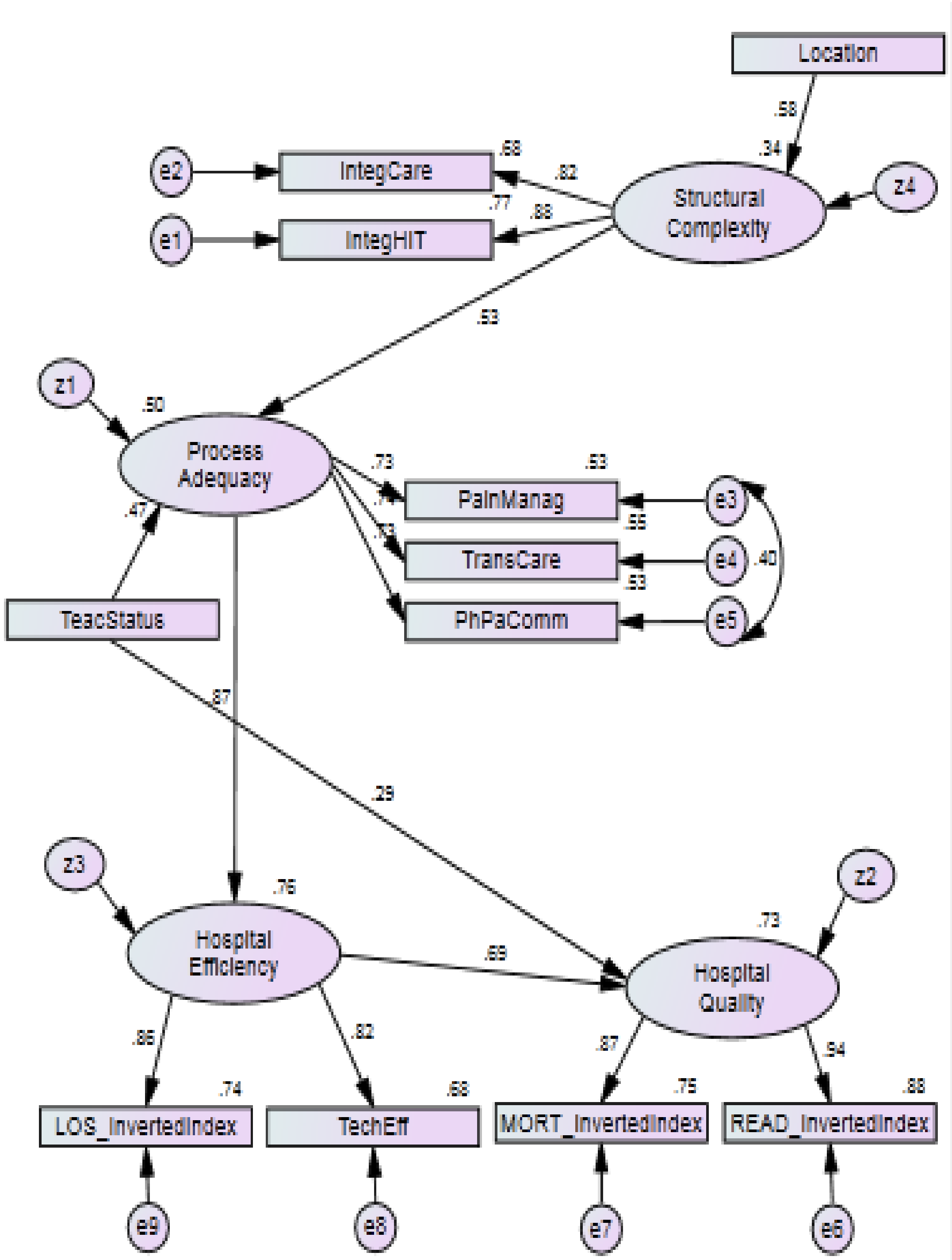

Figure 8 Full Covariance Structural Equation Model for Hospital Quality and Hospital Efficiency with Contextual Variables

Table 11 Covariance and GOF Statistics for Hospital Efficiency and Hospital Quality with Contextual variables.

Indicator	**Std.Reg.Wt.**	**Reg.Wt.**	**S.E.**	**C.R.**	**P**
Structural_Complexity<--- Location	.580	1.000	.001	25.612	***
Process_Adequacy <--- Structural_Complexity	.527	. 678	.005	14.957	***
Process_Adequacy <--- TeachStatus	.473	1.000	.002	25.612	***
Hospital_Efficiency <----- Process_Adequacy	.873	1.000	.007	7.549	***
Hospital_Quality <----- Process_Adequacy	.287	.764	.021	4.361	***
* **Unstandardized estimates statistically significant at p < .001**					
Squared Multiple Correlations (R^2) Estimate:					
Structural_Complexity .336 Process_Adequacy .501 Hospital_Efficiency .762 Hospital_Quality .729					
Goodness of fit (GOF) statistics for the model:					
Chi-square = 2126.579, Degrees of freedom =49 and probability level = .001					
RMR=.105, GFI=.795, AGFI=.724 PGFI=.590, NFI=.323, RFI = .240, IFI=.328, TLI=.245,					
CFI=.327, FMIN=1.621, RMSEA = .066, AIC=2160.579, HOELTER (.01) =47					

CHAPTER5: DISCUSSION

The results of this study provided a broad discussion on structural complexity and process adequacy as determinants of hospital performance.

The purpose of this research was to examine the mediating effect of process adequacy on the relationship between structural complexity and hospital performance. According to the results, it was found that process adequacy has a significant influence on the relationship of structural complexity with both hospital efficiency and quality. On the other hand, results showed that process adequacy has no effect on hospital quality when impact on hospital quality is measured at the overall model with both hospital efficiency and quality.

The results of the present study indicate that structural complexity exerts both direct and indirect effects on hospital quality and efficiency. Process adequacy is represented by some factors such as pain management system, the transition of care and physician-patient communication. Hospitals that have (1) an adequate process, (2) an integrated system of information technology and care delivery, (3) well defined system of transition and pain management and (4) effective patient-physician communication model, a higher efficiency score is expected. On the other hand, the fact that process adequacy is partially mediating the relationship between structural complexity and hospital performance indicates that structure directly promotes good performance, structure promotes appropriate process and appropriate process, in turn, advances desired and positive performance.

Findings from the mediation path models (Fig. 4 and 6) showed that two structural complexity-related dimensions of hospitals (integrated information technology and integrated system across the division of care) correlated directly with two indicator-related concepts of quality and efficiency. Independent of structure, adequate process correlated with efficient outcome and higher quality, an indication that process adequacy partially mediated the relationship between structure and performance.

These discussions lead to the second research question that sought to determine the influence of structural complexity and process adequacy on hospital quality and efficiency in a full SEM model. In accordance with hypotheses, it is confirmed from prior studies and Donabedian theory that structure may directly influence process adequacy and process adequacy affect hospital efficiency and quality. The current study confirmed a direct effect of structure on process adequacy and also proved to display a direct effect of process adequacy on hospital efficiency. Instead, this study showed that hospital efficiency was the mediator through which process adequacy indirectly affected the variability in hospital quality.

The process adequacy seemed to be critical for hospitals as hospital efficiency benefits greatly from process adequacy and positively influences hospital quality. The indicators of pain management, physician-patient communication and transition of care were all significant. All these indicators are a process of care attributes. This result indicates that an adequate process of care might eventually lead to structure complexity to positively affect hospital efficiency as well. The results show that when efficiency and quality are entered together in the model, the process does not mediate the hospital quality. This evidence suggests the critical role of utilization of hospital and human resources in increasing or decreasing the quality of the hospital, as it undermines the direct impact of the structure and the process.

In regard to determining the relationship between hospital efficiency and hospital quality, results showed a strongly positive influence of hospital efficiency on quality. The researcher proposes the hypothesis as a theory that a systematic improvement in efficiency enhances the quality of hospital whereas ambiguity in allocating resources in terms of reducing or increasing inputs to increase efficiency can be detrimental to hospital quality. The analysis of contextual variables in this study showed that the geographical location significantly influences on structural complexity. HIT has the ability to improve the quality and delivery of services in rural areas. HIT can increase the communication mechanisms in remote locations

to physicians in urban hospitals though there might be challenges to implement and maintain HIT in rural hospitals. Integrated care has the potential to increase the coordination across different services leading to best outcomes through an effective approach for serving people. The hospital’s teaching status affects process adequacy by changing the missions of hospitals.

The most significant contribution of this study was the measurement of process adequacy in an evaluation model based on indicators that are more relevant to the patient's satisfaction with the services offered during the treatment process and discharge. This concept addresses the mediating role of patient-physician communication and services available at the time of discharge, which confirms regardless of process adequacy, complex structures based on integrated technology and integrated care management have a small contribution to improving the efficiency and quality of the hospital.

Conclusion

The study established the structural relationships among concepts of structural complexity, process adequacy, hospital performance, and hospital quality. It is also discussed that the influence on variation in process adequacy that may directly affect hospital quality and efficiency. This study provided evidence-based information that can be used to classify and characterize different types of hospital measures and to compare hospital performance based on specific clinical outcomes of inpatient data. The results of the study identified characteristics of high-performing hospitals with respect to quality and efficiency indicators. The results of this study add to existing knowledge on measures of effectiveness of care and patient-centered measures by applying indicators of process adequacy and hospital performance.

Using covariance SEM suggested a strong relationship among process adequacy and hospital performance while this relationship affected by variations in structural complexity. The strong correlation between structural complexity and process adequacy influence hospital

efficiency which mediates the effect of the total model on hospital quality. This finding is in support of the first hypothesis that process adequacy is partially mediating hospital performance.

Using measures of hospital efficiency and effectiveness of care, this study addresses important aspects of inpatient care. The results of this study led to enrichment of evidence and empirical practices that are appropriately useful to provide analytical reports and hospital-grade reporting quality.

Results indicated that training system of teaching hospitals is associated with improved outcomes through affecting indicators of process adequacy. This result emphasizes the evidence in the impact of physicians' training on appropriate relationships with patient as well as patient preparation for transition and pain relief and control.

The location of hospital may affect the access to care by affecting the availability of HIT and integrated care at the structural level. Rural hospitals may encounter barriers to implement and stablish advanced HIT and integrated care that limit residents' ability to obtain the care they need. The application of appropriate and advanced healthcare services ensures for rural residents to have sufficient access to resources in a timely manner by minimizing the negative effect of distance and lack of transportation.

The study found a combination of direct and indirect effects of contextual and structural factors on the variation in hospital performance. Most notable fact is that efficiency positively influences hospitals' quality, whereas the reciprocal effect of quality on efficiency is not supported by the data. While reducing healthcare costs through achieving technical efficiency is possible in the operational sense, the implication is that there is no tradeoff relationship between efficiency and quality in hospital performance. This research contributed to the empirical analysis of national hospital data and to confirm Donabedian's SPO model.

Furthermore, the structural factors have both direct and indirect influences on hospital performance.

Implication

The healthcare industry and hospitals are moving towards the implementation and adoption of sophisticated and advanced technology systems, partly through coercion of the state and partly through the use of technological innovations. The impact of this system in hospitals may deviate from what is expected. This study attempts to address how integrated system of information technology and care management contribute to improving the quality of treatment and hospital efficacy. In addition to contextual factors of location and teaching status, this study showed that the role of process adequacy as a mediating variable is critical in the performance measurement of hospitals.

A local hospital is a vital resource for any community. Access to quality, comprehensive health services is essential for encouraging other businesses to invest in long-term economic growth. Structural features have an impact on the provision of services in determining the quality of hospital services. The provision of case management services makes it possible for health services to be tailored to the needs of the community and the amount of family support after discharge from the hospital. Also, getting information about nutrition after discharge or traveling for medical appointments is another aspect of case management.

The results of this study showed that structural complexity positively affects the improvement of service delivery, and this relationship is closely related to the rural or urban hospitals. The improvement of health information technology and care management, along with the improvement of physician-patient relationship and the support of discharge time and

pain management is very effective in improving patient's experience and in general, the performance of the treatment mechanism.

Limitations

This study uses a new conceptual model that introduces the process adequacy as a mediator between the structural complexity and performance. Although the SPO theory has been used in the compilation of this model, other organizational theories may use different logic in dealing with these variables.

The convenient sample of this study, instead of the random sampling, will result in the creation of a bias in the results. The generalization of results is not viable as the study used a convenient sample though the present sample size is about 40% of the number of acute care hospitals from all the core-based statistical areas and both rural and urban locations in US. The generalization in terms of time is not valid as the study used a cross sectional data and the influence of exogenous variable is likely to change over time.

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