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Variations in Quality Outcomes Among Hospitals in Different Types of Health Systems

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VARIATIONS IN QUALITY OUTCOMES AMONG HOSPITALS IN DIFFERENT TYPES OF HEALTH SYSTEMS, 1995 – 2000

A dissertation submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy at Virginia Commonwealth University.

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Abstract

VARIATIONS IN QUALITY OUTCOMES AMONG HOSPITALS
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Although prior research has found differences in costs and financial performance across different types of hospital systems, there has been no systematic study of variations in patient quality of care or safety indicators across different systems. Our study examines whether five main types of health systems – centralized (CHS), centralized physician/insurance (CPIHS), moderately centralized (MCHS), decentralized (DHS), and independent (IHS) - as well as other hospital characteristics are associated with differences in quality of patient care.

Data were assembled for 6 years (1995 – 2000) from multiple sources. We used 4 AHRQ risk adjusted inpatient quality indicators (IQIs) and 5 risk-adjusted patient safety

indicators (PSIs) as dependent variables. Random effects models were used in the analysis.

It was found that the IQI and PSI models have different patterns. In the IQI models, CHS hospitals have lower AMI, CHF, Stroke, and Pneumonia mortality rates than hospitals in other system types. The PSI models did not indicate any systems' effects on adverse event rates. It was also found that system hospitals' compliance with the JCAHO performance area indicator for availability of patient specific information was associated with lower rates of CHF, Stroke, Pneumonia, and Infection due to medical care.

The findings suggest that centralization of hospital structures may improve internal clinical processes by enhancing coordination of activities, communication between providers, timely adjustments of processes of care delivery and structures to external pressures. A lack of systems' effect on adverse events may be explained by a newness of the patient safety issues for hospitals and possible changes in reporting patterns of medical errors after the Institute of Medicine report of 1999. A system hospitals' compliance with the JCAHO performance area indicator may indicate improvements in information and clinical record systems.

Hospital systems hold much potential for hospitals in improving patient quality of care and safety because they provide a laboratory for studying the health care process and sharing lessons across multiple institutions. Based on our findings, we recommend that future studies use a combination of IQIs and PSIs when examining institutional quality of care because both provide different and complementary information.

CHAPTER 1: INTRODUCTION

The Study Problem

This study will examine how the organizational structures of hospital systems may affect quality of inpatient care. Contingency theory will be used to develop a conceptual framework and hypotheses. To test these hypotheses, panel data will be used on all general, acute hospitals in eleven states available for the 1995 – 2000 period combined from seven well-established data sets. Findings from panel fixed effects or random effects analyses will be compared with findings from cross-sectional three stage estimation models to avoid some data limitations and increase internal validity of the current study.

According to the Centers for Medicare and Medicaid Services (CMS) actuaries report, the United States spent an estimated $1.5 trillion on health care in 2003, or 14.9 percent of a Gross Domestic Product (GDP) of $10.9 trillion; it is also projected that $3.36 trillion, or 18.4 percent of a GDP of $18.24, the U.S. will spent by 2013 (Reinhardt, et al. 2004). Hospital inpatient spending increased at a rate of 4.1 percent in 2000, 8.7 percent in 2001, and 6.5 percent in 2003, down from 8.4 percent in 2002 (Strunk and Ginsburg, 2004). This new trend shows "a dramatic departure from the trend in 1994-1998, when hospital inpatient spending was actually declining year to year by as much as 5.3 percent (Strunk, Ginsburg and Gabel, 2001)."

Costs in the U.S. in comparison with other industrialized countries are believed to be driven by higher than projected per capita spending on health care, the wider distribution of compensation for health services, the highly fragmented health financing system, the higher capacity of health systems (i.e., technologies and professionals), administrative complexity and costs, and unwillingness to ration health care (Reinhardt, et al. 2004). High health expenditures generally and for hospital care, however, do not assure high standards of quality of care, which are defined as the degree to which health services for individuals and populations increase the likelihood of desired health outcomes and are consistent with current professional knowledge (Schuster et al. 1998). The World Health Organization Report (2000) evaluated the performance of the health care systems of the world, and the U.S. was ranked only 37th overall in 2000. The Institute of Medicine report (2000) has also revealed that between 44,000 and 98,000 inpatient deaths appeared due to preventable errors, occurring every year in the U.S. hospitals.

Efforts to address problems in health care must take into account the changing provider landscape in the U.S.A. In the mid-1990's, which is a timeframe relevant to this study, one of the suggested ways to improve quality of care, while containing health care costs, was to create integrated delivery systems (IDS) that consist of hospitals, physicians, other providers and auxiliary services, and possibly insurance products (Shortell, 1996). Clinical integration of IDS's processes was believed to help achieve the better quality at the lower costs due to more effective coordination of services in effective manner, shared incentives, standardization of care, improved continuity of care, and other factors (Shortell, 1996). Shortell et al. (2000) also mentioned that centralized health systems (CHS) may achieve clinical integration and better quality of care because CHS have common ownership and shared incentives, which allow them to communicate policies across and coordinate activities of sub-units in a unified manner.

During the mid-1990s (i.e., the timeframe for this study), a transformation of freestanding health providers into health systems was primarily stimulated by external forces, such as managed care, competition, reimbursement regulations (Lesser and Ginsburg, 2000, Kohn, 2000, Lake et al. 2003, Bazzoli et al., 1999). For example, the absolute number of health systems rose from 295 (2,836 affiliated hospitals) in 1994 to 365 systems (3,221 affiliated hospitals) in 1998 (Bazzoli et al., 2001).

Bazzoli et al. (1999), using cluster analyses, classified 90 percent of health system into five well-defined categories: centralized health system (CHS), centralized physician/insurance health systems (CPIHS), moderately centralized health systems (MCHS), decentralized health systems (DHS), and independent hospital systems (IHS). Prior research has found differences in costs across these system types (Bazzoli et al., 2000). Centralization of health systems may facilitate clinical integration of processes among system members due to diffusion of management and clinical information systems, quality and care management processes, which may results in differences in outcomes (Shortell et al., 2000). It is believed that this taxonomy could assist in advancing research on integration and outcomes in health care (Alexander et al., 1996).

However, there is only limited research on how structural integration of hospitals in systems may affect quality outcomes. Empirical studies demonstrate mixed results on how different organizational arrangements of health providers affect quality of care. Effects of clinical integration on hospital quality performance have also mixed results. Since no studies were performed on quality of care provided by different types of health systems, the current research is intended to compare quality outcomes in hospitals affiliated with various system types.

Purpose of the Study

Structural and process elements necessary for delivering high quality care will be assessed. Structural differences among hospital-led health systems may yield differences in care provision, resulting in differences in quality outcomes. Types of ownership, centralization of authority, and differentiation of services in health systems may result in different approaches to care delivery in various types of health systems. Internal processes of service delivery, in turn, may be associated with quality outcomes varying by system types. Therefore, structural and process characteristics of hospitals in different types of health systems may be associated with certain quality outcomes for these organizational arrangements, and differences in quality outcomes may occur between these types of health systems.

Research Questions

This research questions are as follows:

1. What types of health systems and their member hospitals are associated with the best quality outcomes, produced by hospitals in those systems?
2. What types of health systems and their member hospitals are associated with the worst quality outcomes, produced by hospitals in those systems?

3. Are there differences in care delivery processes associated with positive or negative quality outcomes in hospitals in various types of health systems?

Theoretical Framework

Contingency theory will be used in developing a conceptual framework for this study. Contingency theory states that there is no best way to organize that is highly effective for all organizations (Galbreith, 1973). Different environments present different challenges and opportunities for organizations (Lawrence and Lorsch, 1967). Lawrence and Lorsch (1967) proposed a conceptual perspective where organizations may restructure through differentiation and integration strategies in response to their environments. Thompson (1967) introduced a notion of task interdependence that can be used to predict the structural features of organizations. Environments (i.e., external conditions), organizational size, task interdependence, technology (i.e., internal conditions) were called contingency factors (Donaldson, 1995 and 2001; Lawrence and Lorsch, 1967; Thompson, 1967; Galbreith, 1973). External and internal contingency factors moderate organizational change of its structure in adapting to the environment and for improving organizational effectiveness and performance (Child, 1972; Donaldson, 1995). Contingency factors determine which organizational structural characteristics produce the highest levels of organizational performance, as there must be a good "fit" between environment conditions and the organizational structure designed to deal with that environment (Donaldson, 2001). Changes in contingency factors may possibly lead to changes in the organizational structures and processes through appropriate decision-making by capable organizational management (Figure 1).

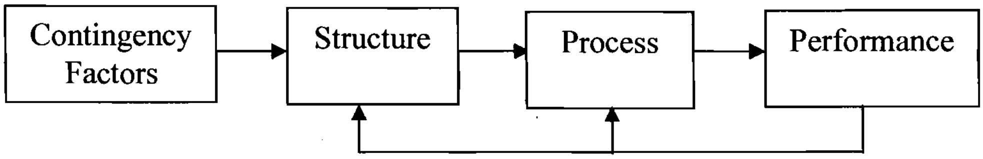

Figure 1: Schematic Depiction of Theoretical Constructs

Contingency theory provides plausible "scenarios" for evaluating hospital strategic responses to the dynamics of the health care environment in the 1995 – 2000 period. This conceptual model will theoretically identify strategies that may affect hospital structures and processes. This conceptual model will set up a structure–process–performance link for empirical evaluation. A set of testable hypotheses will be developed.

Conceptual Model and Propositions

The U.S. health care environment may be characterized as complex and dynamic (Kohn, 2000; Gaynor and Haas-Wilsion, 1999; Lake et al., 2003). Environmental forces, such as managed care, competition, reimbursement reforms (e.g., the BBA), and others, stimulated massive consolidation in the health care industry in the mid-1990s (Bazzoli et al., 1999, Gaynor and Haas-Wilsion, 1999, Lesser and Ginsburg, 2000, Dranove et al., 2002). Environmental and task uncertainty make organization performance unpredictable (Thompson, 1967). As the environmental dynamism and task uncertainty increase, health care organizations may change their structures to regain the fit with the changed environment in order to improve their quality. Contingency theory proposes two or possibly three scenarios of hospital systems responses to their external environment and internal contingency conditions.

According to the first scenario, external forces stimulate consolidation of health providers, which, in turn, increases interdependence (i.e., connectedness) among these providers (Donaldson, 2001). In this situation, leadership of integrated health care providers may view task interdependence as a leading or dominant contingency factor. Health systems may start using integration strategy to better align their structures in accordance with requirements of task interdependence.

A greater centralization of structures may allow managing effectively increasing connectedness of organizations in the systems. Contingency theory implies that as task interdependence and centralization increase, differentiation and divisionalization decrease, because organizational services, products, and tasks become related and require more integration and coordination at the systems' level and less delegation of authority to the hospital's level (Donaldson, 2001). Centralization of authority at the health system's level would allow the system leadership to better process information for making effective decisions and coordinating activities among sub-units in response to changing environments (Savage et al., 1997). Effective coordination of reciprocal interdependences may improve provision of care along the continuum and stimulate clinical integration of the system's sub-units. Centralization of health systems may also stimulate diffusion of administrative and care management practices within their systems (Shortell et al., 2000).

As a result, a hypothesis that better quality outcomes would be observed in more centralized health systems in comparison with more decentralized health systems will be proposed.

According to the second (contrasting) scenario, as consolidation among health providers has picked up in response to the dynamic environment in the mid-1990s, organizational size of health systems increased (Bazzoli 1999/2000). Child (1975) stated that organizational size defines the structure, and therefore, leadership may view a large size as a main contingency factor and need to manage it by restructuring.

Health system's leadership may use differentiation and divisionalization strategy to fit organizational size with their structures when organizational services, products, tasks are maintained at the hospital level and unrelated with each other at the system level (Thompson, 1967, Donaldson, 2001). As a result, a large health system to decentralize and rely more on indirect means of control over organizational processes, such as specialization (i.e., division of labor), formalization (i.e., pre-specified roles and relationships), and worker autonomy (i.e. technical competency of personnel) (Child, 1972; Scott, 2003).

Specialization, due to routinization of tasks, and formalization of care delivery may improve clinical processes and accountability of personnel at the hospital level, thus, reducing system errors and mistakes. Increased physician decision-making authority and clinical autonomy in decentralized health systems improve physician-hospital relationships when hospitals rely more on professionals to improve their performance (Alexander et al., 2001), which may result in better quality outcomes.

Thus, decentralization of health systems may improve adjustments of hospitals with contingency factors at the local submarkets by increasing service availability and accessibility through differentiation strategy, stimulating specialization in hospital services and physician clinical autonomy in the local submarkets as indirect means of control. In contrast to the first scenario, a hypothesis that better quality outcomes would be observed in more decentralized health systems in comparison with more centralized will be suggested.

The interplay of both scenarios provides that moderately centralized health systems can potentially become quality champions in comparison with other system types, because they may have found the "right" organizational structure and strategic balance between centralization and differentiation of their structures and services. On the other hand, independent health systems are hypothesized to have the worst quality outcomes in comparison with other system types, because their structures may be characterized as neither centralized nor differentiated.

Scope and Approach

Data are assembled for 6 years (1995 – 2000) from multiple sources: 1) Agency for Healthcare Research and Quality (AHRQ) Healthcare Cost and Utilization Project State Inpatient Database (HCUP SID) provides patient clinical and non-clinical information, including main quality indicators; 2) Joint Commission for Accreditation of Healthcare Organizations (JCAHO) performance area scores, assessing organizational dimensions of the quality of inpatient care (these data are available for 2 at most years for each study hospital), provide data on internal clinical processes and integration; 3) American Hospital Association (AHA) Annual Surveys provide data on hospital characteristics; 4) Area Resource File (ARF) provides market and socioeconomic variables at the Metropolitan Statistical Areas (MSA) and county levels; 5) HMO

InterStudy provides information on the number of HMOs and HMO penetration; 6) the 1995-2000 Medicare Case Mix Index Files provide data on hospital case-mix; and 7) the 1993-2000 Centers for Medicare and Medicaid Services (CMS) Medicare cost report data, which provide detailed hospital financial information.

A combination of panel and cross-sectional designs is proposed. The unit of analysis for this study is a hospital. Dependent variables are patient quality outcomes. Risk adjusted Inpatient Quality Indicators (IQIs) and Patient Safety Indicators (PSIs) are used. The exogenous constructs are presented by four sets of variables: (1) clinical integration; (2) hospital organizational characteristics, including the main explanatory variable – hospital affiliation with different types of health systems; (3) market characteristics; and (4) patient characteristics.

Through descriptive analysis, comparing hospitals in the empirical sample with hospitals in the nationwide sample, external validity and generalizability of findings will be assessed. In order to evaluate effects of structural designs of hospital systems on quality outcomes, performances of several models will be analyzed and compared: (1) panel models, estimated by fixed effects or random effects, assuming strict exogeneity; (2) cross-sectional three stage estimation models for separate years of 1997 and 2000; and (3) simplified models may be used if measures of clinical integration are weak. Using a combination of panel and cross-sectional models may help in accounting for possible feedback effects, avoiding data limitation, and reassuring internal validity of findings. The panel, cross-sectional three stage estimation, and simplified models for this study are defined and presented below.

Description of the Models

1) General Fixed Effects or Random Effects Model – Panel Study:

$$Y_{it} = \delta_1 + \delta_2 CI_{it} + \delta_3 S_{it} + \delta_4 X_{it} + \delta_5 M_{it} + \delta_6 P_{it} + \delta_7 Time_t + \mu_i + \varepsilon_{it}$$

2) Three Stage Estimation Models – Cross-sectional Study:

a) Multinomial Logit Model (first-stage) for Estimating Predicted Probabilities for Health Systems:

$$y_{Sys} = \alpha_0 + \alpha_1 X_1 + \alpha_2 M_2 + \alpha_3 P_3 + \theta_1 IVHS + \varepsilon$$

b) Negative Binomial Model (second-stage) for Estimating Predicted Sums of Scores for Internal Clinical Processes and Integration by System Types:

$$y_{CL} = \beta_0 + \beta_1 X_1 + \beta_2 M_2 + \beta_3 P_3 + \beta_4 \hat{y}_{Sys} + \theta_2 IVCI + \varepsilon$$

c) OLS (third-stage) Regression with Predicted Values of Internal Clinical Processes and Integration by System Type:

$$Y = \delta_0 + \delta_1 \hat{y}_{CL} + \delta_2 X_2 + \delta_3 M_3 + \delta_4 P_4 + \varepsilon$$

3) Simplified Model:

$$Y = \delta_1 + \delta_2 \hat{y}_{Sys} + \delta_3 X_3 + \delta_4 M_4 + \delta_5 P_5 + \varepsilon$$

Significance of the Study

This study differs from the previous empirical work on hospital systems and quality of care in several ways: the conceptual model presents two or possibly three scenarios on how structural variation in levels of centralization and differentiation between different types of health systems and their processes of care delivery may influence quality performances; HCUP SID quality and patient safety indicators are used as quality signals; JCAHO variables are proposed as measures of clinical integration; and extensive data sources and rigorous methodology may provide generalizable and reliable findings for this study.

Contingency theory is used in developing a contrasting and/or complementary set of hypotheses. The taxonomy of health systems is applied in assessing how different hospital structures may affect quality outcomes (Bazzoli et al., 1999). It has already been found that financial performance varies among hospitals in these types of health systems (Bazzoli et al., 2000). Therefore, it is expected that hospital structural characteristics may influence patient quality outcomes.

A combination of risk-adjusted Inpatient Quality Indicators (IQIs) and Patient Safety Indicators (PSIs) is proposed as dependent variables that has not been previously used in the panel data analyses in studying hospital structural characteristics and quality of care. Romano et al. (2003) in a descriptive study found that quality outcomes measured by 7 IQIs and PSIs got worse, outcomes for 10 IQIs and PSIs improved, and outcomes for 2 PSI and IQI remained unchanged from 1995 to 2000. Thus, there is variation in PSIs and IQIs over time; however, how much of this variation can be explained by hospitals' affiliation with different types of health systems still remains unanswered. This research will attempt to provide answers on which health system type may be the best or the worst quality performer. It is proposed to assess whether the JCAHO performance area scores can be used as measures of internal clinical processes and integration in hospitals in different types of health systems. Identification of clinical process measures may be beneficial for the future research, which will use a structure–

process–outcome framework. This study will be useful to health policymakers, hospital managers, and health services research community. Public (e.g., governments) and private (e.g., employers, health plans) would like to know if some types of systems produce better quality, so they can: a) get better hospital value when making purchasing decisions, weighing quality differences against cots; b) give hospital systems direct or indirect incentives to adopt such a structures. Similarly, hospital managers would find such information very useful for structural and process improvements. This study may contribute to a general knowledge on how hospital integration affects quality of care, which may facilitate further research efforts in this direction. Additional research may be needed to further pin point structural and procedural technical elements necessary for delivering high quality care.

Summary of Remaining Chapters

This chapter briefly overviews structural and clinical integration and quality of care, introduces theoretical and conceptual models, the purpose and significance of the proposed study. It also describes the forthcoming chapters: Chapter 2 reviews literature on quality of care and different types of structural integration that occurred the 1990s and the 2000s. Horizontal, physician-hospital, and vertical integration in the health care industry and their conceptual and empirical causes and effects will be described. A proposition of that Integrated Deliver Systems (IDS) are more likely achieve clinical integration, and therefore, reduce costs and improve quality outcomes will be reviewed. A discussion how external and internal forces and hospital structural characteristics may affect inpatient quality will be provided. This review will also reveal gaps in the existing empirical literature on quality of care and hospitals in IDS. Chapter 3 provides an overview of the mechanistic–organic approach to organization theory (Burns and Stalker, 1961), which became a conceptual basis for contingency theory. Contingency theory helps in developing several conceptual scenarios on health system structure effects on quality outcomes. A set of contrasting and/or complementary hypotheses is developed.

Chapter 4 describes the methodology used in this study. Panel and cross-sectional approaches to study designs are suggested. Multiple data sources, variables and measures, analytical models are discussed in this chapter.

Chapter 5 presents the empirical results of the current study. Descriptive statistics and results of fixed effects and three stage estimation models are presented. Performances of the models are compared.

Chapter 6 summarizes the empirical results, providing findings and conclusions. Limitations of the current study are discussed, and recommendations are suggested for the future research.

CHAPTER 2: LITERATURE REVIEW

Introduction

This literature review describes the status of quality of care and structural integration that occurred among hospitals and health care organizations during the 1990s and 2000s, which is a timeframe relevant to the current study. Horizontal, physician-hospital, and vertical integration in the hospital industry is reviewed in greater detail. A proposition that integrated delivery systems (IDS) are more likely than free standing hospitals to improve quality is discussed. Existing empirical research on how different types of integration affect hospital quality of care is also provided.

Secondly, the studies on external (i.e., managed care, competition, regulation) and internal (i.e., decision-making, organizational culture and others) forces that may have direct influence on integration and quality of care are reviewed. A description how hospital structural characteristics may affect inpatient quality is available in this literature review.

Thirdly, different taxonomies of health systems are presented in order to select one classification that can make this research more effective in terms of studying quality of care provided in hospitals that belong to different types of health systems. This review also reveals gaps in the existing empirical literature on hospitals and IDS structures and quality of care.

Quality in General Terms

According to the Institute of Medicine definition (2001), quality is "the degree to which health services for individuals and populations increase the likelihood of desired health outcomes and are consistent with current professional knowledge."

Good quality of care maximizes patient welfare, reflects excellence in the provision of medical care in a timely and continuous manner, with good communication, shared decision making, and cultural sensitivity (Donabedian, 1980, Laffel and Blumenthal, 1989 and Schuster et al. 1998). Poor quality is characterized by providing too much care (e.g., unnecessary medical services, tests, medications that can harm patients due to side effects or associated risks); too little care (a failure to provide necessary and needed medical care); or the wrong care (e.g., clinician-induced complications) (Schuster et al. 1998).

Donabedian (1980) proposed a structure–process–outcome approach for studying quality of care. "Structural quality evaluates health system characteristics, process quality assesses interactions between clinicians and patients, and outcomes offer evidence about changes in patients' health status" (p. 518, Schuster et al. 1998).

Stiles and Mick (1994) proposed a typology of quality dimensions presented below that was influenced by the Donabedian's work (Table1). Even though all dimensions of quality are important for measuring quality outcomes, literature reviews indicated that there are more studies available on technical process quality (Schuster et al. 1998). Technical process quality is characterized by whether provided clinical care is appropriate and necessary. The care is appropriate when the expected health benefits

Table 1: The Typology of Quality Dimensions

	Structure	Process	Outcome
Technical	Equipment available Staffing (numbers, qualifications, expertise) Training programs Teaching affiliation Size, volume, ownership Governing board	Accuracy of diagnosis Appropriateness of treatment Treatment skillfully applied Treatment plans, sequencing Practice guidelines	Morbidity, mortality Increments and decrements in health or functional status Palliation Frequency, distribution of adverse incidents Malpractice Donations (time, bequests)
Interpersonal	New technology's impact on roles and role relationships Building design, signage Presence of chaplains, patient advocates, social workers, translators, ethics committee	Collegiality Nature of communication Honest, forthcoming treatment of patients and families Sensitivity and compassion in delivery of care	Patient satisfaction Emotional, spiritual peace Family satisfaction Referrals Compliance Returns for future care Malpractice Donations (time, bequests)
Amenities	Cleanliness Presence of conveniences Ease of access, parking Appearance of staff	Efficiency in patient flow Short waiting periods	Patient satisfaction Family satisfaction Referrals Donations (time, bequests)

(p. 313, Stiles and Mick, 1994)

exceed health risks. The care is necessary if there is a reasonable chance that a patient would benefit from this care or it is improper not to provide the care.

Quality indictors are developed to measure technical process quality. Quality indicators are based on professional standards of care and allow a comparison of performance of health providers between each other and over time (Schuster et al. 1998). Quality indicators are constantly used to identify those structural and process characteristics of health providers that have the most influential effects on quality of care. Structural integration among health providers may affect quality of care. Thus, in the following sections, a review of literature on various aspects and effects of integration in the health care industry, including its effects on quality of care, is provided.

Integration in General Terms

Webster's dictionary (1990) defines integration as: "the act or process or an instance of forming, coordinating, or blending activities into a functioning or unified whole." "Integration is the extent to which functions and activities are appropriately coordinated across operating units that are parts of a system's delivery of care so as to maximize the value of services to patients (Giles et al., 1997, p. 230)." Functional integration, physician system integration, and eventually clinical integration are believed to be the key elements in creating the integrated organization (Shortell et al., 1996).

Shortell et al. (1996) defined functional integration as "the extent to which key support functions such as financial management, human resources, information systems, strategic planning, and total quality management are coordinated across the operating units....Physician-system integration is defined as the extent to which physicians are economically linked to the system, use its facilities and services, and are active participants in planning, management, and governance.....Clinical integration is defined as the extent to which patients care services are coordinated across people, functions, activities, processes, and operating units so as to maximize the value of services delivered" (p. 30). Clinical integration is achieved when a health care organization is able to horizontally and vertically integrate their structures and processes. Clinically integrated organized delivery systems may improve quality of care and reduce costs (Shortell et al., 1996).

Horizontal Integration

Horizontal integration is defined as the "combination of several organizations whose outputs are substitutes from the perspective of consumer demand" (p. 419, Snail and Robinsion, 1998). Horizontally integrated firms offer "similar (substitute) or compatible (complement) products" and "horizontal markets are comprised of conventional competitors (firms that offer similar goods and services to the same set of potential customers)" (p. 179, Robinson, 2001). Horizontal integration is also defined as "coordination of activities at the same stage of delivery of care" (Shortell et al., 1996). Horizontal integration takes place when two or more hospitals combine their structures (Dowling, 1995). There are two types of horizontal integrations in the hospital sector: (1) merger (one of the organizations retains its name and legal status) or consolidation (a new organization is formed from melding together a few separate organizations) and (2) multihospital systems (Mick et al., 1993).

Horizontal integration through merger started in the mid 1960s (Dowling, 1995). There were only 74 hospital mergers in the 1983–1988 period; 190 mergers occurred between 1989 and 1996 (Bazzoli et al., 2002). According to Sinay and Campbell (2002), 278 single hospitals merged or were consolidated from 1986 and 1992. Hospital mergers continued through the mid-1990s and slowed in the late 1990s. There were 31 mergers in 1998 and 22 hospital mergers in 1999. A seventeen percent increase in the merger activity was noted in 2000, which was the first increase in two years.

Once two or more hospitals merge, but maintain their separate identity, they become a part of local or regional multihospital system. Multihospital systems are defined as a system of "two or more acute care hospitals that are owned, leased, sponsored, or managed by a single corporate entity" (p. 100, Mick et al, 1993, Zuckerman, 1979). According to the American Hospital Association (AHA) definition, health systems are entities that owned and/or managed by health care provider facilities or health-related subsidiaries. Some demographic information on multihospital systems is presented below.

Bazzoli et al. (2004) reported that 56.2 percent of U.S. hospitals belonged to a health network or system; by 2000, this increased to 72.1 percent. Ermann and Gabel (1985) described the growth in multihospital systems and the number of hospitals affiliated with systems in their review of literature: there were 202 systems (1,405 affiliated hospitals) in 1975, 267 systems (1,796 affiliated hospitals) in 1980, 256 systems (1,924 affiliated hospitals) in 1982 identified in the AHA data sets. The number of health systems has increased from 295 (2,836 affiliated hospitals) in 1994 to 365 systems (3,221 affiliated hospitals) in 1998 (Bazzoli et al., 2001 and 2002).

Luke et al. (1995) studied local hospital systems (LHS) formation. They noted that the percentage of urban acute care general hospitals that were members of urban clusters (i.e., hospitals having one or more system partners in the same metropolitan area) grew from 19 to 28 percent from 1982 to 1989. The geographic dispersion of health systems was mainly limited to one geographic area, i.e. Metropolitan Statistical Area: "in 1990, 56.5 percent of systems owned hospitals [located] in just one MSA and this increased to 63.9 percent of systems in 2001 (Bazzoli, 2005)." Mergers and formation of multihospital systems have been extensively studied in the recent years. Conceptually and empirically grounded reasoning of horizontal integration was proposed by the number of researchers, which is going to be discussed in the following sections.

Causes of Horizontal Integration

Organization and economic theory perspectives were mainly used to describe pros and cons of horizontal integration in the health care industry. Organization theory suggests that organizations may get involved in horizontal integration in order to increase or improve: (1) organizational size, (2) chances of organizational survival, (3) access to resources, (4) market and political powers, (5) performance and outcomes, (6) reduce competition in local markets (Shortell et al., 1996, Mick et al., 1993, Morrisey and Alexander 1987).

Economic theory suggests that organizations may get involved in horizontal integration in order to experience: (1) economies of scale and/ or scope, (2) economies of management, purchasing, and marketing, (3) easier access to capital and manpower, (4) reduction in competitive pressures, (5) increased purchasing and bargaining powers (Bogue et al., 1995, Robinson 2001, Bazzoli et al., 2002).

It is obvious that many conceptual causes proposed by either theory are compatible and suggesting the same consequence: horizontal integration in health care should improve the end results, i.e. organizational performance and quality of care. Whether it is true or not can be learned from the empirical research findings. Horizontally integrated hospitals are believed to be systematically different from independent hospitals and, therefore, a comparison of these two forms is difficult (Snail and Robinson 1998). A discussion of empirical studies on determinants of horizontal integration that involved multivariate techniques and/or longitudinal data to reduce potential limitation of cross-sectional designs is provided below. However, there are only a few articles that used rigorous statistical techniques and panel data.

Bogue et al. (1995) studied 74 hospitals that merged between 1983 and 1988. They found that the acquiring hospitals were more likely to be large, general community, non-profit hospitals, with higher occupancy rates and lower Medicaid revenues than hospitals with which they merged. The Bogue's et al. (1995) longitudinal study compared hospital characteristics before and after a merger and whether merged hospitals retained or dropped acute care services. They identified three main reasons for merger: consolidation of services, improving market positioning, and gaining financial and operating stability.

Bazzoli et al. (2002) replicated the Bouge's study using newer data in order to compare their findings. Bazzoli's et al. study supported the earlier findings, i.e. merged hospitals tended to consolidate duplicating departments and programs, to reduce clinical (mainly nursing), non-clinical, and administrative FTEs, and to strengthen their financial position. However, urban hospitals in the later period (1989–1996) were less frequent in reducing excess capacity and closing duplicating facilities and services than hospitals in the earlier period (1983–1988).

Alexander and Morrisey (1988a) researched hospitals that joined with multihospital systems in the 1980s and found that weak hospitals merged with stronger hospitals to improve their market positioning. Alexander and Morrisey (1988b) also identified that hospitals' non-teaching status, low bed size, low occupancy rate and profit margin may increase their chances of being acquired in the 1980s. Brooks and Jones (1997) found that hospitals merged to gain opportunities in their unique local environments in the 1983–1992 period. Brooks and Jones (1997) also found that greater financial differences and closer geographic proximity between merging hospitals may result in greater benefits of their merger. However, Bazzoli et al. (2003) studied 1,016 urban hospitals in the later period of 1994 and 1998 and found that financially strong hospitals were more likely to join hospital systems as a defense strategy to managed care in the 1990s.

Luke et al. (1995) found that local health system formation was positively associated with the number of hospitals in the markets, the number of doctors per capita, and the percentage of the population enrolled in HMOs. Chernew et al. (1995) also found that a ten percent increase in HMO market shares lead to a four percent reduction in the number of hospitals and a five percent reduction in beds in 1982–1987, suggesting that consolidation and integration of providers possibly happen for efficiency reasons and for gaining market power. Thus, motivations for hospital horizontal integration were different for hospitals in the 1980s and the 1990s. Horizontal integration in the hospital sector may have been motivated by multiple factors:

(1) To increase market and political power, reducing competition in their markets;

(2) To carry out organizational change: consolidation of duplicating services and departments, reducing excess capacity and personnel;

(3) To improve hospitals' financial and operating positioning;

(4) Mergers between unequal hospitals were prevalent in the 1980s and managed care may have stimulated integration of strong providers in the 1990s.

Effects of Horizontal Integration

The following literatures look at horizontal integration's effects on quality of care and hospital financial performances. Only one study was identified that examined the effects of hospital mergers on quality of care. Ho and Hamilton (2000) looked at hospital mergers and acquisitions in California between 1992 and 1995 in terms of quality measures from 1 to 3 years before or after mergers. Measures of quality were inpatient mortality from heart attacks and strokes, 90-day readmission rates for heart attack patients, and early discharge of newborns (Ho and Hamilton, 2000). A self-selection problem of hospitals that chose to merge was controlled by the Heckman's selection technique. Controlling for patient, organizational, and market characteristics, Ho and Hamilton (2000) did not find differences in inpatient mortality before and after mergers and acquisitions, although the associated standard errors were large. Readmission rates and early discharge of newborns increased in some cases during the 1–3 year period after mergers.

Newhouse et al. (2003) recreated variables for integration within Maryland (MD) hospitals and differentiation across MD hospital systems and networks using a methodology developed by Bazzoli et al. (1999). They used these variables as the key explanatory variables in a retrospective cross-sectional study of integration and differentiation effects on readmission, in-hospital mortality, length of stay and costs.

They found no integration effects on outcomes; a higher likelihood of readmission was found as the level of community service differentiation increased. However, several limitations may be noted: 1) this study was limited to only one state; 2) the Bazzoli's et al. methodology was only partially applied leaving out physician and insurance products; 3) Newhouse's et al. (2003) measures of integration as the number of services at the hospital level and of differentiation as the number of services available within the hospital, system, network, community may be correlated.

The effects of horizontal integration on hospitals financial and operational performance were contradictory. On one hand, Connor et al. (1997) longitudinally compared costs and prices for 3,500 hospitals (122 mergers) in merging and non-merging categories between the 1986 to 1994 period in selected markets. They found that mergers were financially beneficial for consumers, providing average price reduction of 7.1 percent; and cost growth was 7.2 percent lower for hospitals in merging category. Spang et al. (2001) also studied the impact of mergers on hospital costs and prices for the 1989 to 1997 period. Spang et al. (2001) found that cost growth for merging hospitals was 10.1 percent lower than that of non-merging hospitals; price growth for merging hospitals was 7.9 percentage points less than it was for non-merging hospitals.

Menke (1997) found that system hospitals had two hundred – two hundred fifty dollars lower average and marginal costs per stay than independent hospitals. Hospital systems also reached economies of scope between inpatient and outpatient services, reducing mean costs by eleven percent for system and three percent for independent hospital (Menke, 1997).

On the other hand, Dranove and Shanley (1995) examined two reasons for the formation of horizontally merged local multihospital systems: cost reduction and reputation. Integrated hospitals may eliminate duplicating services and reduce administrative costs. Searching costs for consumers who look for higher quality of care may also decrease in integrated provider markets. Dranove and Shanley (1995) found that cost reduction was not a factor, but system hospitals enjoyed reputation benefits over non-system hospitals. Horizontal integration of hospitals may affect their pricing policy. Dranove et al. (2004) found that consolidation enabled hospitals to increase prices in three of the four markets studied. Earlier Dranove et al. (1996) concluded that horizontally merged hospitals did not generate production efficiency and did not limit duplication of expensive technologies, but system hospitals were able to raise price margins in comparison with non-system hospitals.

Clement et al. (1997) found that 2,500 urban hospitals that were members of strategic hospital alliances (SHAs) had higher net revenues per adjusted discharge than non-SHA hospitals in 1995, but their cash flow and operating expenses were not different. In another study, price increases were larger for region and national hospital systems (Young et al., 2000). Finally, Bazzoli et al. (2004), in reviewing literature on organizational change over two decades, concluded that horizontal integration among hospitals yields higher revenue or profit levels for consolidating hospitals versus independent hospitals.

However, possible price and cost effects of hospital mergers may decrease over time (Nauenberg et al., 1999, Spang et al. 2001). It is also unclear whether multihospital systems can gain substantial economies of scale. Hospitals with the 200–400 bed range were the most likely ones to achieve economies of scale; but many consolidated hospitals exceeded this range (Snail and Robinson, 1998).

Dranove and Shanley (1995) found that system hospitals were not better than non-system hospitals in exploiting economies of scale in managing service offerings and administrative costs. Dranove (1998) also stated that economies of scale were exhausted in hospitals with over 10,000 discharges annually; therefore, larger, merged hospitals and multihospital systems would have no or small efficiency gains. In summary:

(1) There is limited research on quality effects of horizontal integration. Only one study identified that there were very limited effects of mergers on quality outcomes;

(2) Empirical studies demonstrate mixed results of horizontal integration on hospital operational performance, i.e. hospital costs;

(3) Many empirical studies suggest that consolidating hospitals (merged and joined into multihospital systems) had higher price or profit levels than non-consolidating, but these effects may decrease over time;

(4) There are mixed findings on whether horizontally integrated hospitals would gain economies of scope and/or scale;

(5) More empirical work is necessary for assessing quality outcomes in different types of health systems and hospitals.

Horizontal integration has been a prevalent phenomenon in the hospital industry during the last decades. Effects of horizontal integration are mixed and the most literatures are dated. However, Bazzoli et al. (2004) suggested that studies on outcomes of horizontal integration are only measuring short-term effects (at most 3 years after a merger) of hospital consolidation, but not long-term effects. Thus, empirical studies that look at long-term effects of hospital integration are necessary to consider.

According to Shortell et al. (1996), health providers need to achieve physician-system integration before reaching clinical integration and resulting in cost reduction and improvement in quality of care. Therefore, a discussion of empirical literature on physician-hospital integration and vertical integration in the health care industry that took place in the recent time is important.

Physician–Hospital Integration

Robinson (2001) stated that physician-hospital integration differs from vertical integration of hospitals with other organizations, because some relationships between physicians and hospitals may be complementary, not vertical, in nature. These two parties "rarely sell or buy from each other....they combine their services in a complementary fashion to create a single product that is sold to the patient and insurer" (p. 181, Robinson, 2001).

Physician-hospital integration increased through the mid 1990s, but has since experienced a steady decline. "In 1994, 58.5 percent of health systems had contractual arrangements with physicians and this declined to 31.8 percent by 2001. The percentage of systems that owned physician practices declined from 29.1 percent to 18.2 percent.... around 20 percent of hospitals systems owned HMOs in the 1994 to 1998 period and this declined to 16 percent by 2001" (Bazzoli, 2005). In this sub-section, studies that looked at structures of physician–organization arrangements (POA), causes and effects of physician–hospital integration are reviewed.

Structural Organization of Physician–Hospital Arrangements

A variety of organizational models have been developed to link physicians and hospitals. American Hospital Association's Annual Survey of Hospitals describes them as follows: Group Practice Without Walls (GPWW) is a loosely coupled formation aimed at decreasing administrative expenses; and physicians remain independent. Independent Practice Association (IPA) is a legal entity that assists solo physicians and those in smaller practices to obtain managed care contracts. Physician-Hospital Organization (PHO) is a joint venture that assists physicians to obtaining managed care contracts; it may also own or operate a primary care clinic. Management Service Organization (MSO) is owned by a hospital or a physician organization and contracts with physicians to provide administrative services and management. Medical Foundation (MF) is a hospital subsidiary that acquires all physical assets of medical group practices; physicians sign a professional services agreement with the subsidiary corporation. Integrated Salary Model (ISM) is a hospital that employs physicians. Integrated Health Organization (IHO) owns one or more medical group practices and owns or joint ventures with an HMO.

Several researchers identified prevalence of Physician–Organization Arrangements (POAs) in different years. Morrisey et al. (1996) used 1993 Prospective Payment Assessment (ProPAC) data on 1,495 hospitals and reported that 23.3 percent of hospitals participated in at least in one form of physician-organization arrangements; 64

percent had a physician-hospital organization (PHO), 32.6 percent - a management service organization (MSO), 15.5 percent - a medical foundation (MF), and 11.2 percent - an integrated healthcare organization (IHO).

Dynan et al. (1998) studied 573 hospitals in a later period and found that the prevalence of POAs was as follows: 60.5 percent of PHOs, 38.3 percent MSOs, 31.7 percent ISMs, 22.1 percent MFs, 20.3 percent of IPAs, 10.4 percent IHOs, 9.5 percent of GPWW. According to the AHA, which may followed a greater number of hospitals, 27.6 percent of hospitals had PHOs in 1994, which increased to 33.2 percent in 1996, and then declined to 26.4 percent by 2000 (Bazzoli et al., 2004). The similar patterns of fluctuation in prevalence were discovered for other types of POAs (Bazzoli et al., 2001).

Burns and Thorpe (1993) suggested that physician-hospital arrangements develop from one model to the next. Cave (1995) lined up different POA models on dimensions of cost-efficient delivery of services and sustainability over the long run. GPWW model was on one extreme, i.e. low cost-efficient delivery of care and not sustainable in the long run. Efficiency and sustainability were increasing as: PHO→ MSO→ MF→ Staff models; and Equity model was on another extreme, i.e. high cost efficiency and sustainability. Cave (1995) suggested that IDS would benefit from having staff- and equity-based systems because these systems would provide operational stability, a strong primary care physician base, efficient delivery of medical care, and geographic accessibility under capitation payment. One governance structure in staff- and equity-based systems and strong physician bonds with these systems would also stimulate efficiency and sustainability. However, Burns and Thorpe (1993) and Cave (1995) suggestions were driven by theory and observations, not based on empirical findings, and were considered as rough typologies. Later studies by Alexander et al., (1996) and Dynan et al., (1998) did not find support for gradual staging from less to more integrated physician-hospital arrangements in response to managed care. Casalino and Robinson (2003) in their case study of four hospital systems noticed that systems chose to develop or maintain their affiliations with physicians even while the U.S. health industry is moving from tight to loose managed care.

Causes and Effects of Physician–Hospital Integration

The determinants of physician-hospital integration have rarely been studied. Empirical studies that demonstrate how hospital structure, environment, and strategy may stimulate physician-hospital integration are discussed below.

Certain physician characteristics may affect physician-organization integration. Burns et al. (2001) identified that older physicians were more likely to align with a system, possibly due to fewer available alternatives at the later stage of their careers. Tenure duration was associated with physician intent to continue working with a system and to admit patients to that system; and tenure was inversely related to physician's affective commitment to the hospital system. Burns et al. (2001) suggested that over time physicians "may come to resent their ties to a system even though they report being more likely to stay with the system and admit patients to its facilities" (p. I-5). Physician leadership in POAs' governance and decision-making was a positive factor in integrating physicians and hospital systems (Burns et al., 2001; Coddington et al. 2000; Gillies et al. 2001). Financial stimuli may also result in better physician-organization alignment.

Burns et al. (2001) at a physician and Alexander et al. (2001) at a physician organization level of analyses found that physician financial incentives, i.e. salary and stipend, and practice management support services resulted in greater alignment between physicians and hospital systems. The Alexander's et al. (2001) study also found that the individual physician risk assumption related to managed care contracts was negatively related to physician-system integration; but the group risk assumption exerted positive relationships with alignment. Joint risk-sharing arrangements had positive effects on physician–hospital integration (Burns, Morrisey, et al. 1998; Dynan, Bazzoli, et al. 1998). Mixed results were also found on physician competition effects on their integration with hospitals (Alexander et al., 1986; Gillies et al., 2001).

Hospitals structural characteristics, such as size (200-300+ beds), location in urban areas, affiliation with regionally based health systems, non-for-profit and teaching status were associated with physician-hospital integration (Morrisey et al. 1996, Alexander et al. 1996). Hospitals located in environments with higher managed care penetration (>15%) were more likely to integrate with physicians (Morrisey et al. 1996). A greater hospital competition was also associated with physician-hospital integration, i.e. hospitals were twice as likely to form POAs if a competing hospital also formed POAs (Alexander et al. 1996). However, there were mixed findings on whether hospitals received any financial benefits from forming POAs. On one hand, Mark et al. (1998) found that hospitals with POAs had higher costs and lower total margins when compared with hospitals without POAs. On the other hand, Goes and Zhan (1995) found hospital costs were lower for integrated physician–hospital organizations. Bazzoli et al. (2004)

concluded that hospitals were shedding there POAs since 1996, suggesting that "these organizations may not have returned the value for which hospitals had hoped (p. 318)." Managed care effects on physician-hospital integration were described as complex and different from its effects on integrative processes in the hospital industry (Morrisey et al. 1996, Burns et al. 2000).

On one hand, Morrisey et al. (1996) found that more extensive processes of physician-hospital integration, such as employing physicians and buying practices and entering into joint ventures and network, were not associated with HMO penetration. Burns et al. (2000) studied the effects of HMO market structure, measured as HMO penetration and the number of HMO in a market, on formation of physician-organization arrangements (POAs). The researchers found that a formation of hospital-physician alliances was induced by the number of HMOs in the market rather than by HMO penetration.

Threshold effects were identified: the number of HMOs exceeding four in the local market lead to a substantial increase in POAs formation; however, when the market consisted of one or two dominant HMOs, POAs' formation may be the lowest, i.e. discouraged by concentrated HMO markets. These findings raised doubts that HMO penetration triggered physician-hospital integration (Burns and Thorpe, 1995, Shortell et al., 1996).

Bazzoli, Dynan, et al. (2000) also found that global capitation of physician–hospital arrangements had more significant effects on their integration than managed care penetration. Global capitation motivated physicians and hospitals to integrate their administrative, management services and computer linkages, promote physician financial risk sharing, and create joint ventures to provide new services (Bazzoli, Dynan, et al., 2000).

On the other hand, Dranove et al. (2002) investigated whether managed care may lead to consolidation among hospitals and physicians. Managed care was associated with increase in the Herhindahl Index of hospital concentration from .096 in 1981 to .154 in the average market in 1994, which was comparable with a decrease from 10.4 equal-sized hospitals to 6.5 equal-sized hospitals. Researchers also found a 14-point decrease in the percentage of physicians in solo practice in the 1986–1995 period. Researchers concluded that higher levels of managed care penetration were positively associated with increases in concentration of hospital and physician markets.

Cuellar and Gertler (working paper, 2002) studied whether physician–hospital integration is motivated by (1) efficiency gains (e.g., reducing transaction costs and gaining economies of scope); or is achieved for (2) exerting power in negotiating higher prices with managed care plans (Gal-Or, 1999). They discovered that adoption of POAs (excluding fully integrated models) was more likely to occur in markets with high managed care presence, managed care growth, and managed care dependency. The authors also found that hospitals integrated with POAs were not different from unintegrated hospitals in terms of operating costs, i.e. did not have efficiency gains. However, the results supported the negotiation contracts' power conceptualization, i.e. hospitals integrated with open and closed POAs had positive and significant effects on managed care prices and payer volumes than unintegrated hospitals. Cuellar and Gertler

(2002) compared quality of care, measured by HCUP quality indicators, for different forms of POAs, which was important for both theoretical perspectives. They found that fully integrated organizations (medical foundations and salary POA) were associated with better quality outcomes in the HCUP's measures of surgical complication and ambulatory sensitive conditions and charge about the same in comparison with other less integrated physician–hospital models.

Strategic positioning of health care providers may also be effective in achieving physician-hospital integration. Alexander et al. (1996) studied whether the three strategic dimensions of POA formation–protecting hospital markets, expanding hospital markets, integrating/coordinating delivery–were likely causes of POA formation. Alexander et al. (1996) found that expansion of current markets and integration of clinical services were more likely to cause of POA formation. Also, health systems that placed high strategic importance on market expansion or clinical integration had a significantly greater number of physicians in POAs. However, use of purposeful sample and a cross-sectional study design were limitations of the study.

Dynan et al. (1998) studied strategies used by hospitals to form POAs. They classified hospitals as having: (1) a tight-only strategy if they had any combination of MSO, MF, ISM, and IHO; (2) a loose-only strategy if they had GPWW, IPA, or PHO combinations; (3) a hybrid strategy with a combination of both tight and loose organizational forms. The researchers found that a tight-only strategy exerted a significant, positive effect on three factors of functional integration (i.e., integration of administrative, practice management services, and organization of joint ventures to create new services) and a significant, negative effect on physician financial risk-sharing between hospitals and physicians. However, a hybrid strategy has a significant, positive effect on five factors (three mentioned above and also including computer linkages and salaried physician arrangements), indicating that the hybrid strategy achieves greater level of functional integration than the tight-only and loose-only strategies. Researchers concluded that hospitals and physicians integrate not only through involvement in governance, capital planning, and provision of practice management services, but also through clinical integration and economic involvement. Dynan et al. (1998) also mentioned the importance of studying both the structure and process elements, rather than relying on ownership and contractual elements, since their research showed that ownership may not be crucial for achieving tight integration between hospitals and physicians. In summary, several factors may influence physician–hospital integration:

(1) Physician characteristics, such as older age, tenure, and physician involvement in governance and decision-making process of health systems;

(2) Financial incentives for physicians, such as physician salary and stipend, and creative payment arrangements that balance individual and group risks;

(3) Hospital structural characteristics, such as hospital size, Medicare patient mix, location in urban areas, affiliation with health systems, non-for-profit and teaching status; and hospital competition;

(4) There are mixed findings on a managed care influence on integration of physicians and hospitals; however, global capitation payment system may be a more decisive factor in POAs' formation;

(5) POAs are more likely to form for gaining contract negotiation power, rather than for efficiency reasons;

(6) Hybrid POAs' strategy (combing loosely and tightly integrated models) may achieve a greater functional integration; however, fully integrated models (e.g. medical foundation and salary model) may have better quality outcomes than less integrated models.

Vertical Integration

"Vertical integration is the production by a single organizational entity of successive stages in the processing and distributing of goods and services" (p. 100, Mick, 1993). In health services research literature, commonly used terminology for vertical integration is defined as follows:

(1) Vertical "forward" integration is directed toward an organization's consumers such as patients, physicians, enrollees, and purchasers. Forward integration in the hospital industry includes linkages with physician group practices, outpatient clinics, skilled nursing facilities, home care agencies, because these are "sources of the hospital's patients and/or where patients go following hospitalization" (p. 141, Dowling, 1995; Grasso, 2000). Thompson (1967) also suggested stages of vertical integration "before" and "after" the core technology. If applied to health care, then inpatient care is the core technology, pre-hospital and post-hospital care are before and after stages, respectively.

(2) Vertical "backward" integration is aimed at the inputs of production, such as supplies, equipment, drugs, trained labor, etc. Backward integration may be characterized by hospital ownership of a medical equipment company, laboratory, or

group purchasing organization, affiliation with a nursing school or medical school, i.e. sources of inputs used for production of patient care (Dowling, 1995; Grasso, 2000).

Vertical forward integration among health providers increased through the mid-1990s, but then experienced a steady decline due to changes in the payment methods introduced by the Balanced Budget Act (BBA) for long-term and nursing care facilities "...the percent of community hospitals offering home health care increased between 1990 and 1998 (from 35.3 percent to 53.6 percent) but then declined in 2001 (to 44.2 percent). The percentage offering skilled nursing facility care followed a similar trajectory, increasing from 19.6 percent in 1990 to 33.3 percent in 1998, but declining, albeit slightly, in 2001 to 30.9 percent (Bazzoli, 2005)."

Causes and Effects of Vertical Integration

The concept of vertical integration is not new for the health care industry, and several reasons for vertical integration have been proposed and believed to improve performance of integrated health care providers (Ackerman, 1992, Robinson and Casalino, 1996, Robinson, 2001).

(1) Vertical integration may "occur when the gains to specialization (by keeping the productive states in separate firms) are offset by the costs of using market exchange – that is, when it is cheaper to "make" the input than to "buy" it" (p. 59, Conrad et al., 1990);

(2) Vertical integration may lower transaction costs through efficient negotiation, monitoring, and enforcement of restructuring in organizational units of the vertical systems (Conrad et al., 1990);

(3) Vertical integration may also result in modest economies of scope by sharing facilities, joint purchasing, and coordinating administrative services, i.e. if similar production processes are used along the value chain (Robinson and Casalino, 1996, Conrad et al., 1990);

(4) Physician-hospital and hospital - long-term care links may allow integrated providers to better control flows of patients (Cody, 1996);

(5) Financial risks may be better managed by vertically integrated providers (Robinson and Casalino, 1996).

Robinson (1996) researched vertical integration of Californian hospitals with skilled-nursing facilities (SNFs) over two periods: 1982-1986 and 1986-1990. He found that high Medicare patient mix and non-profit status were significant predictors of developing hospital-based subacute care in both periods. Economies of scope had a strong association with integration, and capacity utilization had less strong influence on integration in the later period. Market conditions did not influence the decision to integrate into subacute care. Other theoretically driven causes of vertical integration, i.e. decrease in transaction costs, did not explain hospital integration into subacute care. Banks et al. (2001) also suggested that the post-1984 system of prospective payment for hospital care and the Balanced Budget Act (BBA) financial incentives have possibly encouraged vertical integration. Hospitals have incentives to transfer patients along the continuum of care sooner; however, traditional providers of long-term care (i.e. skilled nursing facilities) have less incentives to accept complicated patients under the BBA prospective payment for SNFs,. Hospitals vertically integrated SNFs may have easier placement for these patients (Banks et al., 2001). Young (1998) suggested that Integrated Delivery Systems (IDS) would be more suited to sustain financial strains, due to the BBA, than non-IDS. IDS could use strategic planning, design clinical and non-clinical task forces and teams for integrated care delivery, select appropriate patient transfer pricing and methodology between system members in order to minimize the negative BBA effect on their systems.

However, many hospitals are now choosing to disintegrate with their nursing facilities (Bazzoli, 2005), because the costs associated with keeping SNF may exceed their benefits. Cody (1996) hypothesized that vertical integration of hospitals with outpatient and subacute/chronic care facilities were expected to substitute for inpatient volume and enhance revenues. Effects of seven vertical integration strategies on the change in total revenue from 1983 and 1990 were investigated. Cody (1996) found that adding more community-based physicians to the medical staff, providing more clinic care and outpatient surgery services had a positive and significant influence on the change in revenue from 1983 to 1990. On the other hand, Wan et al., (2001) found that profit margin was lower for health networks (IHNs) integrated into subacute and long-term care than for those with no integration. Researchers pointed out a possible selection problem because data had information on 100 top-ranked IHNs; a cross-sectional design may also be a draw back. In summary, it is concluded that:

(1) The empirical findings are mixed – one study identified that vertical integration had positive and significant influence on the change in revenue of integrated providers; however, another study showed opposite results;

(2) Economies of scope may be associated with hospital integration with subacute care facilities; however, the concept of decreasing transaction costs is not substantially researched;

(3) Organizational characteristics, such as high Medicare patient mix and non-profit status, are associated with vertical forward integration;

(4) Changes in the payer environment may confound organizations' incentives to pursue vertical integration.

Horizontal, physician–hospital, and vertical "forward" integration may facilitate a greater clinical integration among providers (Shortell, 1996). Therefore, in the next section, studies that may explain how structural integration of health providers is linked to clinical integration, and how clinical integration may affect hospital performance and quality of care are presented.

Integrated Delivery Systems and Clinical Integration

Vertically and horizontally integrated health providers may operate as Integrated Delivery Systems (IDS). "An organized [or integrated] delivery system is a network of organizations (e.g., ambulatory care clinics, physician groups, diagnostic centers, hospitals, nursing homes, home health care agencies) usually under common ownership which provides, or arranges to provide, a coordinated continuum of services to a defined population and is willing to be held clinically and fiscally responsible for the health status of that population (p. 8, Devers et al. 1994)." Gillies et al. (1993) defined clinical integration as "the extent to which patient care services are coordinated across the various functions, activities, and operating units of a system (p. 468)." Integrated Delivery

Systems (IDS) are more likely to be clinically integrated than freestanding health care providers. According to Shortell (1996), organized or integrated delivery systems may achieve clinical integration and, therefore, provide high quality care at lower costs.

In theory, clinical integration of providers in IDS may facilitate: (1) coordination of clinical and non-clinical services in effective manner; (2) standardization of care; (3) population-based health status/needs assessment; (4) provision of better management of chronic diseases; (5) specialization among different health providers within the system; (6) improved continuity of care, provision of easier access to care, and less paperwork (Gillies et al., 1993, Shortell et al., 1994, Charns 1997, Casalino et al., 2003).

Shortell et al. (1996) noted that “the key to successfully creating a clinically integrated continuum of care is the ability to achieve mass customization … that involves developing services to meet the unique needs of each patient but doing so in an efficient fashion, using relatively standardized support functions that can be applied to all patients and that can coordinate care for all patients across the continuum (p. 167).” Burns (1999) pointed out that standardization of clinical services through various care management processes (CMP) is the glue that could hold together the polarities in IDS. Burns (1999) defined CMP as use of clinical evidence-based practice guidelines and protocols, performance feed back to individual physicians, continuous quality improvement/ total quality management (CQI/TQM), clinical information systems, case management, use of medical registries, and team approach to provision of care. Care management processes may move IDS toward mass customization and clinical integration, allowing meeting needs of individual patients in an efficient manner.

In practice, IDS may achieve clinical integration when (1) there are clear mission and values, aimed at clinical integration, that all IDS sub-units should follow, (2) strategic planning activities involving all sub-units are in place, (3) availability of information systems, providing data across IDS, (4) coordination of activities is promoted through common budgeting policies and practices (Shortell, Gillies, and Anderson, 1994).

Causes and Effects of Clinical Integration

Organizational characteristics and financial incentives may influence clinical integration between providers. Shortell and colleagues (1996 and 2001) identified hospital characteristics that were related to clinical integration. Larger hospital size, close physician-system integration with large physician groups (25>), close geographic proximity between hospitals, physician administrative involvement, hospital strategic orientation to improve quality of care, and a greater degree of HMO market penetration were positively associated with clinical integration (Gillies et al., 1993, Devers et al., 1994, Shortell et al., 1996). Cohen et al. (2000) suggested that integration (mostly for educational activities) of clinical departments in merged hospitals depends on successful leadership and management models. They identified several factors necessary for integration of clinical departments: single chairpersons, constant communication, flexible leadership and management structures, centralization of and patience in decision making which was trusted and accepted by physicians.

Mark (1998) studied effects of change in hospital characteristics over two years on total margin and average Medicare costs as of 1993 in hospitals that either adopted or did not adopt physician – hospital organizations. They found that operating margins were higher when clinical departments heads were held accountable for profits and losses and when medical staff developed clinical guidelines. Whereas growth in average Medicare costs was lower when hospital boards had greater physician membership and when hospitals offered practice management services to physicians. Although direction of causality was a concern in this study, it suggested that greater levels of clinical integration and physician accountability may increase operating margins and lower hospital costs.

Shortell et al., (2001) and Waters et al., (2001) found that compensation incentives that reimbursed physicians based on cost containment, productivity, and quality were positively associated with development and comprehensiveness of clinical integration practices. Casalino et al., (2003) also found that external incentives (physician bonuses, public recognition and other financial and non-financial incentives to provide better quality of care) were strongly associated with use of care management practices (CMP) in providing care to chronically ill patients. In particular, public recognition and better managed care contract opportunities were the most strongly associated. These findings suggest that health care purchasers and insurers should provide external financial and non-financial incentives to health providers in order to improve quality of care.

Greater clinical integration and physician participation in health systems were associated with increased greater debt coverage (r=.54 to r=.58), availability of capital (r=.54 to r=.59), greater total net revenues (r=.47), operating margins (r=.51), and system's cash flow (r=.48) (Devers et al. 1994, Shortell et al. 1994). However, the researchers mentioned that these findings should be interpreted cautiously because of cross-sectional study design and the lack of statistical control for other factors that might have influenced the systems' performance (Shortell et al. 1994). Lee and Wan (2002) examined relationships among structural clinical integration, average total charge, and patient outcomes. Clinical integration was conceptualized and structured as a latent variable in the LISREL model, using several hospital structural components: integration across sites of care (forward and backward integration), integration across divisions of care (use of high tech services and case management), integration of physicians (use of different types of POAs), integration of the information technology (use of administrative, management, and clinical information systems). They found positive associations between structural clinical integration and average total charge, as well as between average total charge per admission and surgical complications and in-hospital death.

Lin and Wan (2002) concluded that clinical integration did not immediately improve financial performance of hospitals, and that structural clinical integration had only an indirect effect on patient outcomes. However, several limitations were noted by Lin and Wan (2002): the lack of random sampling of hospitals, a limitation in measuring clinical integration that reflected only hospital structural aspects, a questionable use of average total charge as a measure of efficiency, and limitations of risk adjustment models. Various studies demonstrate that different clinical management processes (CMP) may be more or less effective in improving quality of care. A number of randomized control trials found that efforts to implement evidence-based clinical guidelines were not very successful; only small-to-moderate improvements (not more than 5-10 percent) in the process of care have been found. Mixed and moderate effects of physician performance assessment and feedback on quality of care were also found in 8 systematic literature reviews (Grol, 2001). The most effective forms of feedback were those provided by a respected peer or opinion leader using credible guidelines and embedded in a comprehensive program of continuous monitoring and improvement (Grol, 2001).

Continuous Quality Improvement (CQI) may be described as a constant improvement of processes of providing goods and services that meets or exceeds customer expectations (Shortell et al. 1998). A national survey of U.S. hospitals in 1993 found that 69 percent of hospitals had adopted of some form of CQI (Shortell et al. 1998). A literature review by Shortell et al. (1998), assessing the impact of CQI on clinical practice, provides some interesting information. The majority of reviewed studies reported positive CQI effects on clinical practice. For example, CQI reduced length of stay and patient charges with no change in patient mortality, CQI lead to fewer adverse drug events, a lower mortality rate, and reduced costs. However, there were no studies that addressed quality issues across the continuum of acute, primary, and follow-up care. The weak study designs may have undermined the positive findings on CQI effects on quality of care (Shortell et al., 1998).

Effective internal processes of care provision, physician/unit specialization and team approach may positively affect quality of inpatient care. Aiken et al. (1994)

examined whether hospitals known to be good places for nursing ("magnet" hospitals, which are known for their team approach and integrative care delivery) have lower mortality than hospitals that are otherwise similar. They found that the magnet hospitals have a 4.6 percent lower mortality rate than matched control hospitals (Aiken et al., 1994). Decreased mortality was also associated with pediatric ICUs with intensivists, co-management among internists and surgeons, facility-led services, and a specialized stroke unit (Mitchell and Shortell, 1997). However, limited and inconsistent research was performed on other organizational processes of care, such as collaboration and coordination of care, and organizational culture effects on quality (Mitchell and Shortell, 1997).

Shortell et al., (1994) identified the lack of developed clinical information system one of the major barriers for clinical integration. Waters et al., (2001) found evidence indicating importance of management information systems in formation of clinical integration between physician and organization. Casalino et al., (2003) detected that IT was positively associated with physicians' use of CMP. Hospital information technology (IT) adoption was positively associated, among other factors, with hospital system membership (Burke et al., 2002). In 1996, the health care industry spent $11.6 billion on computerized information systems, supporting clinical areas such as outcome measurement, clinical decision support, disease and case management, telemedicine; it is also expected that IT costs will be rising in the future (Snyder-Halpern et al., 2000).

Even though the findings suggesting effectiveness of CMP were mixed, Grol (2001) identified 16 systematic reviews that showed effectiveness of multifaceted strategies for quality improvement, i.e. strategies that combined different approaches and targeted different barriers to improve care. These strategies were more effective than individual approaches in terms of quality of care.

Grol (2001) concluded that there is a need to integrated different CMP in a wider quality system. Bazzoli et al. (2004), in reviewing literatures on processes of hospital integration, suggested that administrative consolidation and integration of low-volume clinical services may have come quickly, but a wide-scale clinical service integration was limited and took longer time to achieve.

In summary, clinical integration may be a lengthy, resource and time intensive process:

(1) Clinical integration is not fully achieved by many providers and requires a clear IDS mission, centralized leadership, strategic planning, information systems, coordination of activities, capital investments, and time;

(2) Clinical integration is more likely to be achieved in large hospitals that were aligned with larger physician groups, strategically oriented to improve quality of care, located in competitive environments and in close geographic proximity with each other or reimbursed by global capitation;

(3) Clinical integration is strongly and consistently associated with physicians' financial and non-financial incentives and physicians' participation in leadership of IDS;

(4) Findings on whether increased financial performance associated with clinical integration are inconclusive;

(5) Effects of clinical integration practices on quality have also inconclusive results;

(6) Clinical integration may result in cost-effective and high quality care, when standardization of care through multifaceted strategies for quality improvement are achieved;

(7) There are no clear measures of clinical integration and those few are hard to find in existing data bases.

Effects of External and Internal Factors on Quality of Care

External forces may have stimulated transformation of freestanding health providers into integrated delivery systems (IDS) in the 1990s (Lesser and Ginsburg, 2000, Kohn, 2000, Lake et al. 2003, Bazzoli et al., 1999). Managed care, competition, reimbursement regulations and hospital financial status may also affect quality of care. Since this literature review was not so far focusing on external factors' direct effects on quality of care, it may be beneficial to describe studies that actually examined these direct effects.

Effects of Managed Care on Quality of Care

Only a few empirical longitudinal studies were found that research managed care effect on hospital quality of care. Shen (2003) examined the effect of financial pressure on hospital care between 1985 and 1994. One of the variables representing financial pressure was a change in health maintenance organization (HMO) penetration at the county level. Quality was measured by mortality and complication rates for acute myocardial infarction (AMI). HMO penetration doubled between 1985 and 1994. Shen

(2003) found that a 1 percent increase in HMO penetration was responsible for 0.20 percent and 0.70 percent increase in hospital 30-day mortality rates in 1985-1990 and 1990-1994, respectively. Adverse HMO effect was reduced in magnitude and significance for mortality rates beyond 1 year, suggesting that HMO penetration affected the short-term mortality.

However, Sari (2002) applied fixed, random effects, and instrumental variable fixed effects models, using hospital panel data for the 1992-1997 period from 16 states, and found that higher managed care penetration improved quality, when inappropriate utilization, wound infections and adverse/iatrogenic complications were used as quality indicators. Thus, findings on managed care effects on quality were mixed, which may be attributed to differences in quality measures that were used in the studies, i.e. AMI mortality versus patient safety indicators. Multiple empirical studies compared quality of care provided in managed care plans versus fee-for-services plans (FFS). Managed care cost-containment strategies, service access and use reduction strategies raised concerns about quality of care. Miller and Luft (1994, 1997, 2002), in their series of literature reviews, provided comprehensive analyses of several important empirical studies that compared managed care and FFS quality performances. They identified and assessed thirty-seven articles on quality of care provided by HMOs and non-HMOs plans for their 1997 and 2002 reviews. There were equal numbers of positive and negative results comparing quality of HMO and non-HMO plans. The main conclusion was that quality of care for HMO enrollees was roughly comparable to those for non-HMO enrollees (Miller and Luft, 1997, 2002).

Effects of Competition on Quality of Care

Competition in health markets differs from competition in the other industries. In this section, a description how the nature of competition has changed from "medical arms race" to price competition in the health care industry from the early 1980s until 2000 is provided (Devers et al., 2003). Also articles on price competition's influence on quality of care are discussed.

Health care competitive environment is affected by asymmetry of information between buyers and sellers, uncertain outcomes of care, the third party payment system, integration among health providers, cost reduction strategies, and other factors (Gaynor and Haas-Wilson, 1999; Miller, 1996). Thus, competition in health care may not function as predicted by the economic theory. In health care, providers compete not only based on price, but also based on quality of care, including access and style of care, reputation, and technical quality (Miller, 1996; Morrisey, 2001).

The presence of health insurance made patients and their agents–physicians to be less concerned about prices (Gaynor and Haas-Wilson, 1999). Hospitals added services and technologies when their competitors did the same, which led to duplication and excess capacity (Robinson and Luft, 1987; Salkever, 1978; Melnick and Zwanziger, 1988). Therefore, hospitals in more competitive markets had higher costs than hospitals in less competitive markets. This type of competition that increased hospital prices and costs was named "medical arms race".

During the 1990s, managed care attempted to introduce price competition through selective contracting. Melnick and Zwanziger (1988) and Zwanziger et al. (1994) found that rates of increase in costs were lower in more competitive markets after the introduction of selected contracting. Melnick et al. (1992), Gaskin and Hadley (1997), Bamezai et al. (1999) also showed that a traditional model of competition (i.e., more competition–lower prices and costs) worked in the hospital markets with higher levels of managed care penetration and selective contracting.

There was a concern that price competition among hospitals may negatively affect inpatient quality (Gaynor and Haas-Wilson, 1999). Only a handful of empirical studies looked at the impact of hospital price competition on quality of care and the results were mixed.

Mukamel et al. (2002) studied the effects of price competition on resource allocation and quality of care, suggesting that higher price competition may lead hospitals to allocate more resource into "hotel" rather than clinical services, which may result in worsening of quality outcomes. The researchers compared data for hospitals before and after selective contracting in California form 1982 to 1989. Mukamel and colleagues (2002) found evidence that clinical quality, measured by excess mortality, was associated with the amount of resources used in producing clinical services and that the increase in mortality (i.e., lowering of quality) was associated with a decrease of 1 standard deviation in clinical expenditures per adjusted discharge. Therefore, cost reduction through increased price competition and selective contracting in California may result in lower quality of care in hospitals. Volpp et al. (2003) also found similar results in New Jersey: after the introduction of hospital price competition, quality of care for Acute Myocardial Infarction (AMI) patients has deteriorated for the uninsured group.

Contrary, Kessler and McClellen (2000) examined the effects of hospital competition and HMO penetration on payments to hospital, mortality rates, and readmission rates for Medicare heart attack patients over the 1985–1994 period. They found that payments were lower, heart attack mortality was lower, and the complication rates were lower in high hospital competition and HMO penetration areas rather than in less competitive markets with lower HMO penetration levels. In other words, higher competition was associated with better quality outcomes. Sari (2002) also studied hospital panel data from 16 states in the 1992-1997 period and confirmed that higher hospital market share and market concentration, i.e. lower hospital competition, were associated with lower quality outcomes measured by in-hospital complications.

Effects of Reimbursement Regulations and Hospital Financial Status on Quality of Care

Several shifts have occurred in the federal government reimbursement policy over the last two decades. These shifts are described in this section. Before 1983, Medicare reimbursed hospitals on a reasonable costs basis for inpatient care patients. This time was referred as the "Golden Era" of health care, because the government covered virtually all health care costs. However, the escalation of costs resulted in adoption of the Medicare Prospective Payment System (PPS) in 1983 that paid hospitals a fixed amount per discharged case, determined by the Diagnostic Related Groups (DRGs). The Balanced Budget Act of 1997 lowered the rates of growth in payments and levels of supplemental payments for Medicare patient. It was suggested that the PPS and the BBA may negatively affect quality of care (Banks et al., 2001).

The PPS reduced the reimbursement for the average Medicare patients for a majority of hospitals (Hadley et al., 1989). Hospitals responded by implementing operational changes, which resulted in low increases in the Medicare inpatient hospital costs. Hospital admissions fall 11.3 percent and occupancy rates decreased by approximately 10 percent between 1983 and 1987 (Feinglass et al., 1991). Other effects included reductions in the Medicare patient length of stay, increases in outpatient service provision, and reduction of hospital staffing (Feder et al., 1987).

Hospitals had an incentive to shift provision of care from inpatient to skilled nursing settings, because these types of services were still reimbursed on retrospective, cost basis and were not affected by the PPS. Lee et al. (1996) found that post-acute care substituted for acute care; post-acute care costs grew rapidly from 7 percent in 1986 to 22 percent in 1993. Admissions to SNFs also grew from 9.6 to 11.8 in the 1981–1985 (Feinglass et al. 1991). Health expenditures continue to grow, but at a lower rate since 1983. Sager et al. (1989) also indicated a major shift in the location of death from hospitals to SNFs after the PPS of 1983.

There were no indications that quality of care suffered as a result of the PPS regulation (Feinglass et al. 1991). Kahn et al. (1990) evaluated effects of the PPS before and after its implementation and found no association between the introduction of the PPS and 30- or 180-day mortality. However, Cutler (1995) found the PPS was associated with increased short-term mortality in hospitals. Shen (2003) also studied the effects of the PPS on hospital quality using long-differences models for the period before and after the PPS. There was a short-term negative effect of the PPS on 30-day mortality rates from AMI. Thus, effects of the PPS on hospital quality are mixed. Hospital financial characteristics, as a possible reflection of cost-containment strategies, may also influence quality of care; but the empirical findings are also mixed (Fleming, 1990). Burstin et al., (1993) found that low inpatient operating costs per discharge increased the likelihood of negligent medical injuries. Bradbury et al., (1994) found positive and significant relationships between hospital resource expenditures and certain patient mortality and morbidity measures. They concluded that more care, i.e. a greater amount of services provided, does not mean better care.

The Balanced Budget Act (BBA) of 1997 addressed issues of the further rising costs by introducing a prospective payment system for outpatient care and skill nursing facility care, decreasing payments for home health care, and cutting DRG payments for selected DRGs when care load shift to SNFs.

Other cost cutting policies included elimination of the inflation update to hospital DRG payments in 1998, limiting inflation adjustments in subsequent years, cutting capital payments, reducing adjustments for indirect medical education (IME) and disproportional share hospital (DSH) payments. One hundred nineteen ($119) billion dollars of hospital payment savings due to the BBA were estimated (Bazzoli et al. 2002). However, the BBA revisions restored about $21 billion of hospital payment savings for the period 1998-2004. Bazzoli et al. (2002) found that hospitals experienced decreasing hospital margins. Hospital also reduced length-of-stay and limited staff increases.

Under the BBA provision, financial incentives to shift care to outpatient and skilled nursing facility settings were lost. Due to the BBA financial pressure and decreased hospital margins, health providers may cut back on quality of care. However, there are very limited empirical studies that evaluated the BBA effects on quality of care. Clement et al. (working paper, 2004), in a descriptive study over the 1995–2000 period, observed worsening of quality after 1997, measured by a few inpatient quality and patient safety indicators. Summarizing the effects of external factors on health provider integration and quality, it may be concluded that:

(1) Empirical studies convey mixed findings on managed care penetration effects on hospital quality of care. There were no substantial differences in quality of care provided by HMOs versus FFS plans.

(2) Price competition among hospitals was introduced as a result of managed care cost-cutting strategies, i.e. selective contracting and capitation payment. The quality effects of price competition were mixed.

(3) The PPS regulation's and hospital financial characteristics' influences on quality of care demonstrated mixed findings. Effects of the PPS and the BBA pressures on quality of care were not extensively researched. However, there is a concern that increasing financial pressure due to both the PPS and the BBA may worsen quality of care.

Effects of Hospitals' Structures and Processes on Quality of Care

Hospital internal factors may also affect quality of care. This section of the literature review discusses whether hospital system membership and hospital characteristics, such as professionalization of personnel and use of technology, hospital ownership and teaching status, and volume of services, influence quality of care.

Madison (2004) studied relationship between hospital system membership and the patient outcomes. She found that, even though the effect of hospital system membership on quality outcome was limited, patients, who were admitted to small rural system hospitals that were affiliated with big hospital partners within 100 miles, experienced lower mortality rates than patients initially admitted to independent hospitals.

Physician qualification, expertise, and higher level of training may be related to quality care. The greater percentage of board certified physicians was associated with lower mortality rates in hospitals (Hartz et al., 1989, Kelly and Hellinger, 1986).

The higher percentage of registered nurses (RNs) versus less qualified nurses and the greater number of RN hours were associated with statistically significant decreases in the likelihood of patient dying within 20 days of admission, the rates of failure to rescue and pneumonia, and the rates of urinary tract infection, gastrointestinal bleeding, and cardiac arrest (Aiken et al., 2003, Cho et al., 2003, Needleman et al., 2002).

However, Mark et al. (2004) found only "limited support for the prevailing notion that improving RN staffing unconditionally improves quality of care" (p.279).

For-profit ownership status was associated with increased inpatient mortality, preventable adverse events of any type and operative adverse events, and events due to delayed diagnosis and therapy (Devereaux et al., 2002, Thomas et al., 2000). However, teaching status effects on quality had mixed findings, but the most rigorous studies with large sample sizes and adequate risk adjustments found that for common conditions, particularly in elderly patients, major teaching hospitals offered better care than non-teaching hospitals (Ayanian and Weissman, 2002). Hospitals with greater number of high-tech services provided better quality care (Hartz et al., 1989, Silber et al., 1995). Systematic review of literature by Gandjour et al. (2003) showed evidence for a volume–mortality relationship, i.e. the greater the volume of services performed, the less mortality. In summary, it may be concluded that there are certain structural and process variables of hospitals, such as physician and nursing staff qualification, non-profit hospital ownership, provision of high-tech services technology, teaching status, high volume of services, may have positive effects on inpatient quality of care. In the next section, a review of existing taxonomies and how a use of taxonomy can benefit this research are provided.

Taxonomy

It is believed that taxonomy of health providers may assist in advancing research on integration in health care (Alexander et al., 1996). Taxonomy may be useful for identification of hospitals that belong to different types of systems and studying how hospital affiliation with systems may affect quality outcomes. Several taxonomies of integrated delivery systems were proposed by researchers.

Webster's (2004) dictionary defines taxonomy as "the study of the general principles of scientific classification." Alexander et al. (1996) suggested that taxonomy of health care organizations may clarify strategies and structures that organizations use to adapt to turbulent environments, and may identify dimensions that produce distinct internal structures among health care organizations. The organizational taxonomy may also be necessary for tracking changes in the health industry and studying performance of health providers.

Different researchers attempted to classify integrated delivery systems (Burns and Thorpe, 1993; Alexander, 1996; Succi et al., 2001; Bazzoli et al., 1999; Madison, 2004). Unlike plants and animals that can be classified by inherent genotypes, organizations do not have unique "genetic" codes. Therefore, it is essential to find classification principles that allow allocation of health care organizations in different categories. Several factors were used to classify organizations: structure, strategy, ownership, types of affiliation, and others. Pros and cons of these classifications are discussed.

Succi et al., (2001) looked at health system consolidation and formation of new health systems. Succi and colleagues (2001) classified systems by categories: (1) investor owned, (2) church affiliated not-for-profit (NFP), and (3) other private not-for-profit; and by size: (1) small: 2–5 member hospitals, (2) medium: 6–20 member hospitals, and (3) large: 21 or more member hospitals.

However, several limitations may be noticed. Succi et al., (2001) used a cross-sectional design in their study that did not capture temporal trends in the health industry that affected integration processes. This classification did not incorporate other providers, which could also belong to IDS, i.e. the payers, non-physician providers, and community health centers. This classification was also not validated or used in other empirical studies, suggesting either instability of their groupings or technical complexity.

These limitations were addressed in several ways by Bazzoli et al. (1999) in their taxonomy of hospital system and networks. Bazzoli and colleagues (1999) used existing industrial organization economic and organization theories in creating this taxonomy. Measures of differentiation, integration, and centralization were developed at the hospital, POA, and provider-owned insurance company level and used as the classification factors.

Bazzoli et al., (1999) found that differentiation and centralization were particularly important for the classification. They classified 90 percent of health systems as described below:

(1) Centralized Health Systems – systems with high degree of centralization in hospital services, physician arrangements, and insurance products; ownership-based and contractual-based physician and insurance arrangements were employed at the system level; moderate differentiation in hospital services and physician arrangements and low differentiation in insurance products; urban locations and hospitals in close proximity of one another were common; teaching hospitals were more common in this category.

(2) Centralized Physician/Insurance Health Systems – high levels of centralization for physician arrangements and insurance products at the health system level; hospital services were only moderately centralized; differentiation in all service/product dimensions was moderate; relatively small numbers of hospitals with low investor-owned representation; hospitals in close geographic proximity.

(3) Moderately Centralized Health Systems – moderate levels of centralization for all service/product dimensions; high differentiation in hospital services and moderate differentiation in physician arrangements and insurance products; higher prevalence of church-sponsored institutions.

(4) Decentralized Health Systems – high levels of decentralization in hospital services, physician arrangements, and insurance products, these were more predominant at the hospital level than at system level; high levels of differentiation on the hospital, physician, and insurance dimensions; large number of hospitals that are disproportionately church-affiliated and are spread over a broad geographic area.

(5) Independent Hospital Systems – little differentiation of hospital services, few physician arrangements, and little insurance product development; centralization on all of these dimensions is low to moderate; smaller, rural area systems; and investor-owned hospitals were predominant (Bazzoli et al., 1999).

The taxonomy captures structural dimensions of the health systems and their strategic activities. The taxonomy also incorporates vertical and horizontal integration among various types of health organizations. Large samples and use of panel data increased reliability and validity of taxonomic classification. Thus, this taxonomy is more comprehensive and is likely to be stable over time than other classifications. It has also been used to track changes in the health care industry (Bazzoli et al. 2001).

Bazzoli et al. (2001) found that the number of health systems rose from 295 (2,836 affiliated hospitals) in 1994 to 365 (2,512 affiliated hospitals) in 1998 in the U.S. The results of taxonomic analyses demonstrated no evidence “that providers’ efforts to develop organized delivery systems nationwide are on a pathway to disintegration” (p. 195, Bazzoli et al. 2001).

Shortell et al. (2000) suggested that higher levels of centralization of health systems may facilitate more clinical integration due to diffusion of management and clinical information systems, quality management and care management practices. It may be expected that hospitals in more centralized health systems are more likely to achieve greater levels of clinical integration and, in turn, improve quality of care. Therefore, it is beneficial to use this taxonomy in studying how structural and process elements of different types of systems may affect quality of care over time (1995-2000).

Summary

This literature review demonstrates that structural integration in the health care industry was influenced by the variety of external and internal factors. The literature also suggests that structural integration through horizontal, vertical and hospital-physician integration may lead to clinical integration among health providers. However, a limited number of empirical studies researched integrated delivery systems' (IDS) and clinical integration's effects on hospital performance and quality of care. Those studies that did yielded mixed findings. The taxonomy that classifies hospitals in five different health systems, ranging from centralized to independent, is identified for use in this research on quality of care provided in hospitals that belong to different types of health systems.

CHAPTER 3: THEORETICAL FRAMEWORK

Introduction

In this chapter, a mechanistic and organic approach to organization theory is reviewed. Contingency theory attempts to bridge the mechanistic-organic dichotomy, however, adding a level of complexity to this dichotomy. Contingency theory helps us develop at least two plausible scenarios evaluating hospital strategic responses to the dynamics of the health care environment in the 1995–2000 period. Relevant tenets of contingency theory are used to develop a conceptual model that predicts hospital system leadership's choice of strategies that assist in either centralization or decentralization of their structures.

General organizational behavior literature is discussed to set up a link between organizational structure fit with contingency factors and its effect on organizational performance. The conceptual model theoretically identifies strategies that may affect hospital structures. Hospitals affiliated with five types of health systems (i.e., having different structures) may develop and use different processes of care delivery, which, in turn, may result in varying quality performance across system types. The conceptual model is used in setting up a structure–process–performance link for empirical evaluation. As a result, a set of testable hypotheses is developed and is discussed the following sections of this chapter.

Mechanistic Versus Organic Approach to Organization Theory

Burns and Stalker (1961) distinguished between organic and mechanistic structures of organizations as representing two poles or extremes on a continuum of various organizational structures. The mechanistic structure is top-down, characterized by higher levels of centralization of decision making, specialization through job descriptions, and formalization by rules and regulations (Burns and Stalker, 1961). The organic structure is decentralized and low on functional specialization and formalization, where employees have a creative approach to decision-making. Mechanistic organizations administratively control their employees, while organic organizations rely on initiative and expertise of their employees. The mechanistic–organic approach may also be attributed to large, multidivisional (M-form) corporations. For example, organic structures were used in decentralized, semi-autonomous operating centers of M-form organizations and creative processes were employed through long-term research, investment, and innovation sub-units (Thompson et al., 1983).

The mechanistic–organic dichotomy can be used to examine how organizational structures may adapt to different environmental conditions. In stable and simple environments, where tasks and technology are relatively routine and require less flexibility, organizations employ relatively high percentage of nonprofessional workers, the mechanistic structure may provide better outcomes (Thompson, 1967).

In turbulent and complex environments, where tasks and technologies are non-routine, organizations innovate and employ a relatively high percentage of professionals, the organic structure may be suitable to maintain or improve organizational performance.

The organic organizations rely more on lateral communication and coordination, because these organizations are effective when they can process more information, and have greater expertise and flexibility in complex environment. An organization also can be situated in between these two extremes, having varying levels of centralization, specialization, and formalization (Donaldson, 2001).

Contingency theory uses the mechanistic–organic framework; however, adding increasing levels of sophistication and complexity to this approach. According to one scenario, contingency theory suggests that under unstable environmental conditions (e.g., turbulent and dynamic) with increasing task interdependence (i.e., connectedness of organizations with each other), large organizations do not necessarily use the organic approach, requiring decentralization.

Instead, centralization of decision-making is beneficial for organizations that chose to integrate and consolidate their structures. However, according to another scenario, large organizations may use differentiation and divisionalization strategy to manage large organizational size, which requires a greater decentralization of their structures. Therefore, organizations' leadership may choose one or another strategy to be used in order to respond to environmental conditions by either centralization or decentralization of structures.

In the following sections, a review of contingency theory is available; a discussion how one theory may lead to two different scenarios on how hospital systems under certain conditions may either chose greater centralization/decentralization and/or differentiation of their structures and services is provided. Testable hypotheses that may identify which system structures have a positive effect on hospitals performance measured by quality outcomes are proposed.

Contingency Theory – Overview

Contingency theory states that there is no single organizational structure that is highly effective for all organizations and that organizations can and must adapt to their environments (Galbreith, 1973; Donaldson, 1997). Contingency theory explains how changes in the environment affect organizational structures and organizational effectiveness and performance (Lawrence and Lorsch, 1967). Each element of organizational structure is dependent upon one or more conditions or contingency factors (Donaldson, 2001). These main conditions are organizational environment, task uncertainty, task interdependence, and size (Burns and Stalker, 1991; Child, 1975; Galbreith, 1973; Thompson, 1967; Scott, 2003; Chandler, 1962; Lawrence and Lorsch, 1967; Donaldson, 1995 and 2001).

The contingency factors are moderators (Donaldson, 2001). Effects of one variable, organizational structure, on the second variable, organizational performance, depends on the third variable, a contingency factor and variations in its levels, or a fit among contingency conditions and organizational structures (see Figure 2).

Contingency factors determine what organizational structural characteristics produce the highest levels of organizational performance. Changes in contingencies may lead to changes in organizational processes and structures through appropriate decision-making initiatives by organizational leadership, or the organization would perform poorly and possibly fail. There are two categories of contingency factors namely those that are

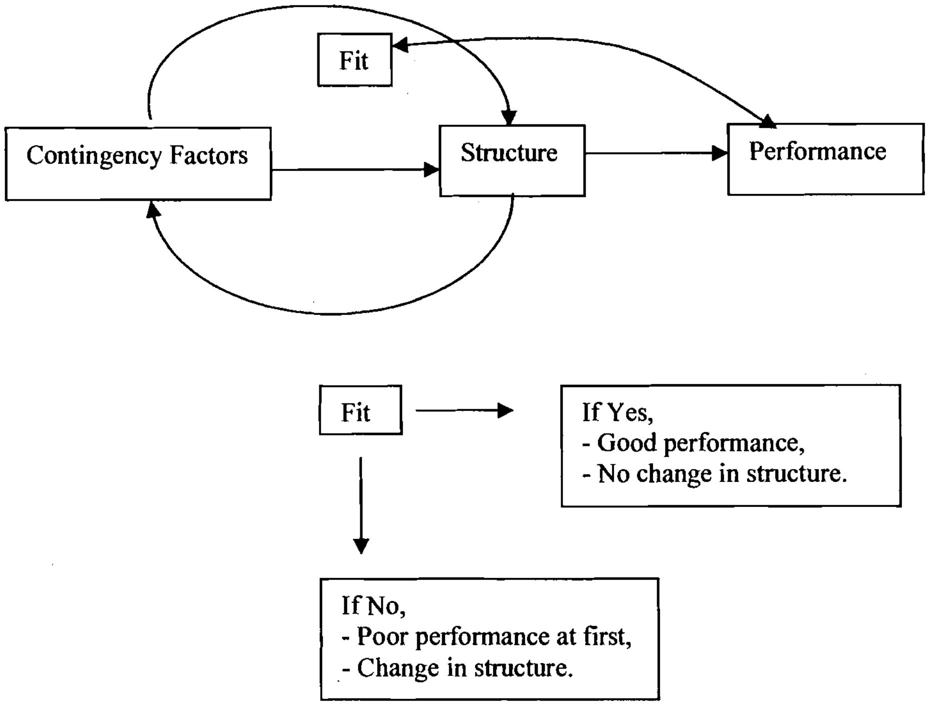

Figure 2: Tenants of Contingency Theory

external to the organization and those that are internal (Donaldson, 2001). Organizational environment is an external condition. Task uncertainty, task interdependence, and organizational size are internal conditions.

Environment reflects all elements and components outside the boundary of an organization, which may be defined by the organization and its actors (Scott, 2003). Donaldson (2001) proposed to reduce the environmental condition to three dimensions: "dynamism (which subsumes a notion of stability-instability and turbulence), complexity (which subsumes a notion of homogeneity-heterogeneity and concentration-dispersion), and munificence (which subsumes capacity) (p.20)." Dynamism is one of the major components of the environmental contingency (Thompson, 1967, Child, 1975, Donaldson, 2001). Dynamism may be characterized not only as a rate of change, but also as the degree of unpredictability or instability, i.e. shifting environment makes organization's successful performance unpredictable (Dess and Beard, 1984, Thompson, 1967).

Thompson (1967) characterized environments as homogeneous, i.e. simple, or heterogeneous, i.e. complex. As heterogeneity increases, the number of functional divisions within an organization would increase to cope with the increasing environmental uncertainty. Munificence is the quantity of slack resources (Dess and Beard, 1984), such as availability of inputs and markets for outputs, fewer competitors and a known regulatory filed (Scott, 2003). Economic stringency or lowering munificence fosters organizational change. Organizational performance becomes less certain, as the environment becomes more dynamic and complex, and the availability of resources decreases.

The internal contingency factors include task uncertainty, task interdependence and organizational size. Task uncertainty is closely related to the organic – mechanistic dichotomy. According to Donaldson's conceptualization (1997), low uncertainty tasks are most effectively performed by a centralized hierarchy, since this is a simple structure, which allows quick decision-making, close coordination, and it is inexpensive to implement. As task uncertainty increases, then the hierarchy needs to loosen control and to be overlaid by decentralized structures. However, when other contingency factors, e.g., task interdependence and organizational size, start playing a more significant role, the direction of organizational restructuring becomes less clear.

Task interdependence describes how organizational parts are connected with each other (Donaldson, 2001). Thompson (1967) defines organization's internal connections as pooled, sequential, and reciprocal interdependences. Pooled interdependence refers to overall coordination among organizational departments. If one branch of an organization does not perform well, the whole organizational performance is jeopardized. Standardization is used for coordination of pooled interdependence. Sequential is a serial interdependence, where the outputs of one branch become the inputs of another branch. It is coordinated by planning. Reciprocal interdependence refers to the cycle in which the outputs of one branch become inputs for the other branch, and the outputs of the last branch become the inputs for the first branch. Reciprocal interdependence is coordinated by mutual adjustment, i.e. feedback.

Size is another major contingency and an organizational characteristic, reflecting the number of people working in an organization. Organizational size affects structure of an organization. Mintzberg (1979) found that a small organization is more effective if it uses a simple organizational structure. As the organizational size increases, the organizational structure becomes more complex. For example, as size increases, the number of employees and/or hierarchical levels or branch offices may also increase (Scott, 2003). Size is positively associated with the number of organizational activities and functions (Scott, 2003). Environment affects internal contingencies of organizations, which, in turn, shapes organizational structure. Thus, internal contingency factors may become more immediate and direct causes of structure under conditions of achieving structural congruency with multiple contingency factors (Donaldson, 2001).

Interplay among the environment, internal contingencies, and managerial actions influences the organizational design and affects its performance (Donaldson, 2001). An organization has to gain a "fit" of its structure with contingency factors (see Figure 2 on p. 64). This fit results in a desirable organizational performance. A "misalignment or misfit" between the contingencies and the structure results in a poor performance, which drives structural changes in the organization in order to regain the fit with new levels of contingencies (Donaldson, 2001). As a result, structural adjustments in the right direction should improve organizational performance and lead to a new desirable fit between contingency factors and a new organizational structure. The fit-misfit parameter of contingency theory implies that an organization can adapt its structure to changing environments and contingencies, so that their effectiveness and performance are maintained at a desirable level (Donaldson 2001) or conversely, organizations can misjudge their environment and a type of structure that is needed to function effectively in this environment, and performance declines. Organizations must continuously monitor alignment of their structures and performance.

A number of researchers proposed a multicontingency approach to conceptualization of organizational fit and performance. Mintzberg (1979) suggested that size, technology, environment, and management would influence the choice of organizational structure. A viable configuration (i.e., a fit) of environment, leadership, strategy, and structure is necessary for good performance (Miller, 1987). Richard (1994) found that manufacturing firm leadership's judgment aimed at strategy-structure-environment alignment produced higher performance than did other judgments.

Therefore, organizational leadership may be able to strategically decide which structure is more appropriate in dealing with a particular external or internal contingency or a group of contingency factors.

Gresov (1989) simultaneously examined effects of task uncertainty and interdependence on unit structure and performance efficiency. There may be a conflict between contingency factors – the likelihood that structure would deviate from the demands of either task uncertainty, horizontal dependence (i.e., task interdependence), or both (Gresov, 1989). Organizations may adopt a mechanistic design to handle routine tasks and ignore the need to manage interdependence; or they may adopt an organic design to mange interdependence, thus, ignoring task requirements. Organizations may also adopt a hybrid structure to manage both contingencies. Gresov (1989) found that an organic design had fit with an uncertain environment, but mixed support for a performance decrease from misfit. He implied that different structures and not necessarily optimal ones may result in a performance level sufficient for organizational survival. Gresov (1989) concluded that "a multi-contingencies approach provided additional information about patterns of design….this approach isolated instances in which equifinality could be observe…the model provided insight into both the phenomenon of misfit and the difficulties of observing it." Therefore, an organizational management may respond to one or another contingency factor based on a perceived importance of these factors.

On the other hand, Burton, Lauridsen, and Obel (2002) tested the multicontingency fit model for strategic organizational structures, operationalizing misfit by organizational performance. They found that firms with situational, or contingency misfits, or both, result in performance losses compared with firms with no misfits. They also found that one misfit of any kind may significantly compromise performance. However, a definition and measurement of a fit or a misfit is a difficult task and requires solid theoretical conceptualization (Gresov, 1989; Burton et al., 2002)

A poor organizational performance may be used as a proxy for measuring a misfit, and a good organizational performance – as a fit proxy. Organizational performance may be measured in many ways. Total outputs, quality, productivity, efficiency, survival, adoption of innovations, employee satisfaction are often used as measures of organizational performance and effectiveness (Scott, 2003; Child, 1975, Dewar and Werbel, 1979, Hage and Dewar, 1973). Time is also an important component in measuring organizational performance (for example, how quick is a return on investment); and also researchers need to be aware of a passage of time in studying organizational performance. Some performance effects need to be studied in a short-run, others – in a long-run; or an organizational stage of development (i.e., newly formed versus developed organizations) may also influence performance (Scott, 2003).

Different performance measures may also yield different results for different structures. For example, Kim and Burton (2002) studied the effect of task uncertainty and decentralization on project team performance, measured in three dimensions: cost, time, and quality. They found that, "under high task uncertainty, a decentralized team performs better in terms of cost and time, but a centralized team performs better in terms of quality. Under low task uncertainty, there is no performance difference between a centralized team and a decentralized team in terms of cost and time, but a centralized team performs better in terms of quality (p. 365)." Their findings suggest a task uncertainty-structure fit's effect on performance is multidimensional and that organizations may chose their structure depending on their strategic goals, i.e. whether to improve quality or to reduce cost in this particular example.

Juran (1989) also used quality as a measure of organizational performance. He referred to quality not only as a quality of the end product, but also quality that is built into organizational design, production processes, and employees' job descriptions. Quality of care may measure performance of health care organizations. Alexander and Randolph (1985), for example, researched separate effects of technology, structure, and the fit between them on quality of care. They collected primary data on performance of nursing units which was measured by patient evaluations of quality of care, reviews of patient records, interviews with nurses and patients, and observations of processes of nursing care. Alexander and Randolph (1985) found that the fit between technology and structure was an important predictor of nursing subunit quality.

In this study, patient outcomes are used to measure how hospitals structural characteristics, such as affiliation with different types of systems, may affect hospital performance in terms of quality of care in responding to contingencies of task interdependence and size. Data over a six-year period are used, and measures of external shifts in the environment that may had an effect on system restructuring over time are constructed. However, due to data (i.e., availability of only secondary data) and methodological constraints, it is unattainable to observe and to measure a fit between the external environment and organizational structures and their direct and combined influence on quality outcomes.

The following sections review how contingency theory may explain two different scenarios for hospital system restructuring. Specifically, (1) hospital system leadership might assess task interdependence as the main contingency factor affecting performance, requiring centralization of structures; or (2) hospital system leadership might react to increasing organizational size as systems are formed, requiring decentralization of structures.

Scenario 1 for Centralization of Organizational Structures

According to Donaldson (2001), task interdependence incorporates integration as a strategy that is used by an organization to set itself apart form competitors. Integration across specialized tasks and services is necessary in order to achieve unity of effort. Integration is related and achieved through various types of coordination. The overall managerial challenge is to strategically integrate various tasks, services, and production lines, using effective types of coordination in order to meet demands of the external and internal pressures (Lawrence and Lorsch, 1967). Therefore, organization leadership may pursue centralization of structures in order to effectively integrate their task, services, and production lines. In other words, centralization may improve effectiveness of coordination in integrated organizations where there is a high degree of task interdependence. A schematic depiction for Scenario 1 is presented in Figure 3.

Structural integration between organizations increases their task interdependence, and therefore, requires more coordination in order to improve an overall organizational

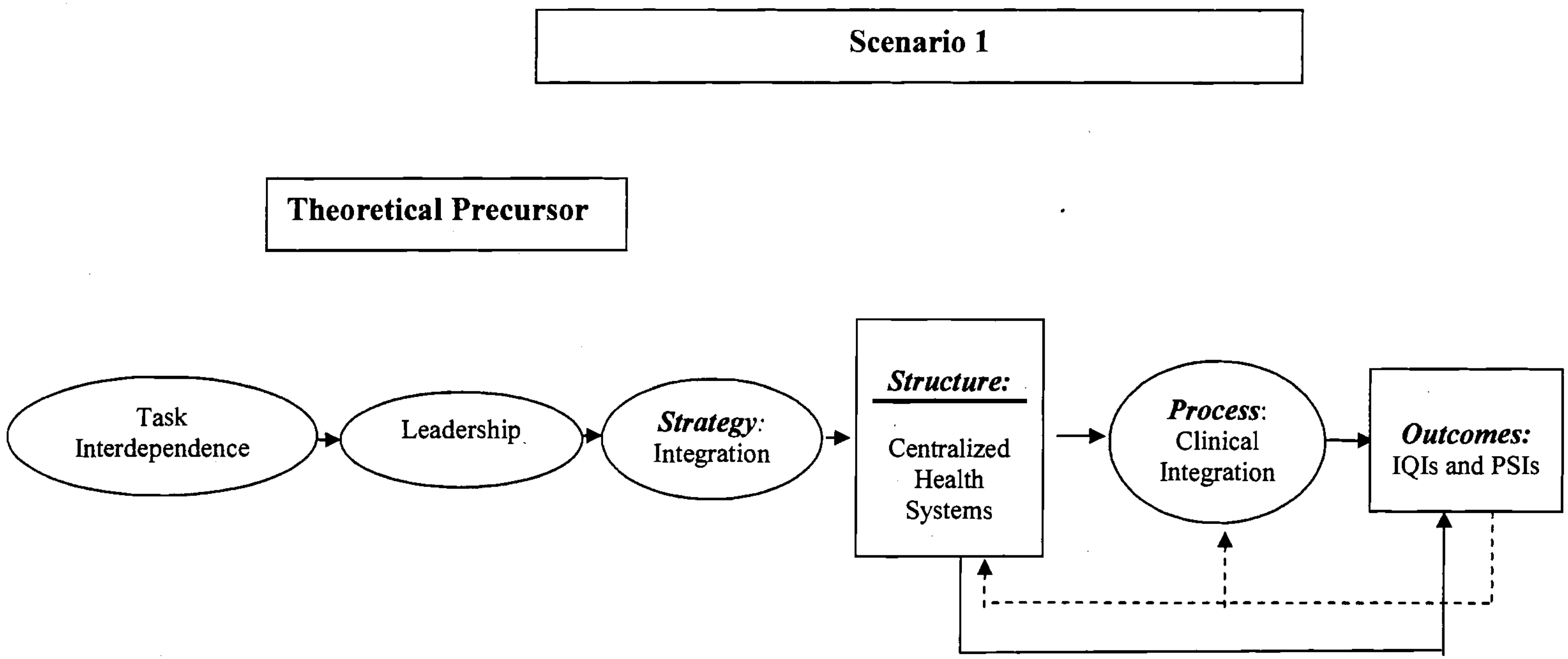

Figure 3: Conceptual Model for Scenario 1

effectiveness and performance. Sequential and pooled interdependences among integrated organizations require complex coordination of activities. For example, vertical integration between organizations results in increased sequential interdependence between organizational branches (Thompson, 1967). Sequential interdependence is managed by planning. Implementation of innovation is an example where reciprocal interdependence between organizational sub-units is needed; thus, coordination by feedback is used. Coordination in integrated organizations is improved, when centralization fits and enhances the requirements (e.g., planning or feedback) of increasing levels of task interdependence. Therefore, organizational leadership may effectively deal with task interdependence by using the strategy of integration, which also requires a centralized means of coordination (Rumelt, 1974, Lawrence and Lorsch, 1967).

The U.S. health care environment may be characterized as complex and dynamic due to various financial, structural, regulatory, and other forces affecting the industry in the last several decades (e.g., Kohn, 2000, Gaynor and Haas-Wilsion, 1999, Lake et al., 2003). Environmental and task uncertainty make organization performance unpredictable (Thompson, 1967). As the environmental dynamism and task uncertainty increase, health care organizations may change their structures to regain the fit with the changed environment.

According to contingency theory, turbulent environment and task uncertainty should force hospital structures to decentralize and decrease levels of specialization and formalization. However, the environmental forces, e.g. managed care, competition, reimbursement reforms (e.g., the BBA), and others, stimulated massive consolidation in the health care industry in 1990s (Bazzoli et al., 1999, Gaynor and Haas-Wilsion, 1999, Lesser and Ginsburg, 2000, Dranove et al., 2002). This consolidation increases interdependence among health care providers (Donaldson, 2001). For example, task interdependence that was achieved through physician-hospital alignments has increased under the global capitation payment system in the mid-1990s (Bazzoli et al., (1999/2000), which occurred in a timeframe relevant to this study. Task interdependence may increase when integrated delivery systems (IDS) are held accountable for the health status of the enrolled population and is reimbursed on a capitated basis.

Hospitals consolidated into multihospital systems, formed physician-hospital organizations, and participate in other forms of IDS (Shortell et al., 1998; Bazzoli et al. 1999). Different types of consolidation – horizontal and vertical – and different types of vertical integration – physician-hospital versus insurance-hospital – results in different types of task interdependence. Consolidation became a hospital strategy to respond to the turbulent health care environment (Gaynor and Haas-Wilsion, 1999). Consolidation increases reciprocal interdependence between organizations in the integrated delivery system systems, where performance of one organization is interconnected with the performance of the overall IDS (Thompson, 1967, Donaldson, 2001); therefore, IDS's leadership may view task interdependence as a leading or dominant contingency factor in this situation. Task interdependence may stimulate IDS readjusting their structures towards greater centralization in order to manage effectively increasing connectedness of organizations in the systems.

Effective management of consolidation and integration processes may allow IDS to achieve desired performance outcomes. Contingency theory implies that as task interdependence and centralization increase, differentiation and divisionalization decrease, because organizational services, products, and tasks become related and require more coordination at the systems' level and less delegation of authority to the hospital's level (Donaldson, 2001). Centralization of authority at the IDS level would allow the system leadership to use better processing of information for making effective decisions for and coordinating activities among sub-units in response to changing environments (Savage et al., 1997). The leadership may project that centralization of IDS would improve coordination and communication process among organizational sub-unites (i.e., various health providers) in the system. IDS's centralization and coordination of processes would help achieve a tighter integration. Effective coordination of reciprocal interdependences may improve provision of care along the continuum of IDS and stimulate clinical integration within the system. These strategic decisions, structural tune-ups, and intraorganizational processes may improve organizational performance and result in better quality outcomes for health providers in centralized IDS.

Hypotheses for Scenario 1

Using the first scenario, hospitals in more centralized health systems have complex structures and resemble the IDS that was proposed by Shortell et al. (1996). In the highest stage, affiliates of the IDS are reciprocally interdependent, coordinating activities by feedback and achieving clinical integration; thus effectively responding to task interdependence (Charns, 1997).

Governance of Centralized Health Systems (CHS) is characterized as having high levels of administrative intensity (i.e., administrative staffing at the system level) and decision-making authority over policies related to the system. CHSs also have slightly higher representation of affiliates' members on the system board (Alexander et al., 2003). Centralized governance in health systems allows boards to make decisions quickly, which is important for IDS in operating in the turbulent environments (Savage et al., 1997). The leadership of Centralized Health Systems (CHS), due to high level of centralization of hospital services, physician arrangements, and insurance products, are more likely to develop and diffuse management and clinical information systems, quality management, and care management practices (Shortell et al., 2000). Hospitals in CHS are also more likely to be located in close geographical proximity (Bazzoli et al., 1999), which is also important for achieving clinical integration.

Centralized Physician/Insurance Health Systems (CPIHS) are characterized as those that have high centralization for physician arrangements and insurance products and moderate centralization for hospital services (Bazzoli et al., 1999). In all other aspects, CPIHS are similar to CHS, and therefore, it is proposed to collapse both in one category, i.e. hospitals in more centralized systems.

Hospitals in more centralized systems may have a better fit with the contingency of task interdependence than hospitals in decentralized systems (DHS). This effective alignment may result in the overall improvement of hospital performance manifested in improved quality outcomes in CHS and CPIHS. Young et al. (1998) found that surgical units which used a combination of coordination by feedback and by programming, had best perceived quality, lowest mortality and morbidity. Coordination, continuity of care and clinical integration may positively affect clinical performance and improve quality outcomes for hospitals in centralized health systems and centralized physician/insurance health systems. Also, the leadership of centralized health systems may have more power and authority to consolidate certain administrative and clinical departments in their member hospitals. A volume of services provided in consolidated clinical departments should increase and positively affect the processes of care delivery (i.e., "the practice makes perfect"), and, as a result, improve quality performance of hospitals in more centralized health systems. Therefore, the following hypothesis is proposed:

H1: Hospitals in more centralized health systems (CHS and CPIHS) would produce better quality outcomes than hospitals in Decentralized Health Systems, all other things being equal.

Clinical integration is highly correlated with physician-hospital integration (Shortell et al., 1996). Centralized Physician/Insurance Health Systems may have a greater arsenal of tools and means than other system types in providing financial and other incentives to their physicians in order to increase physician-organization alignment and to improve physicians' quality performance (for example, through following evidence-based clinical protocols and guidelines, monitoring physicians' clinical practices and activities, etc.). Therefore, hospitals in CPIHS may achieve greater integration of clinical processes, due to tighter physician-hospital alignment and potentially better incentives, and therefore, improve their quality performance in comparison with hospitals in CHS. The hypothesis is as follows:

H2: Hospitals in Centralized Physician/Insurance Health Systems would produce better quality outcomes than hospitals in Centralized Health Systems, all other things being equal.

Scenario 2 for Decentralization of Organizational Structures

On one hand, task interdependence may require centralization of structures. On the other hand, a decision on whether to centralize or to decentralize organizational structures may be made by leadership depending on other factors. The main factor for decentralization is organizational size (Donaldson, 2001). Child (1975) stated that organizational size defines the structure. Smaller organizations can control their employees directly through centralized authority.

As organizational size increases, an organization needs to decentralize and rely more on indirect means of control over organizational processes, such as specialization (i.e., division of labor), formalization (i.e., pre-specified roles and relationships), and worker autonomy (i.e. technical competency of personnel) (Child, 1972; Scott, 2003). With an increase in size, the span of control of managers increases, because the number of managers and administrators stays unchanged or increases at a lower rate in comparison with greater increases in the number of workers (Blau, 1970). Thus, large organizations avoid being top heavy with high overhead costs, which may also improve their effectiveness and efficiency, resulting in better performance. Therefore, organization leadership may decide to manage the increasing organizational size by decentralization of organizational structures. A schematic depiction for Scenario 2 is presented in Figure 4.

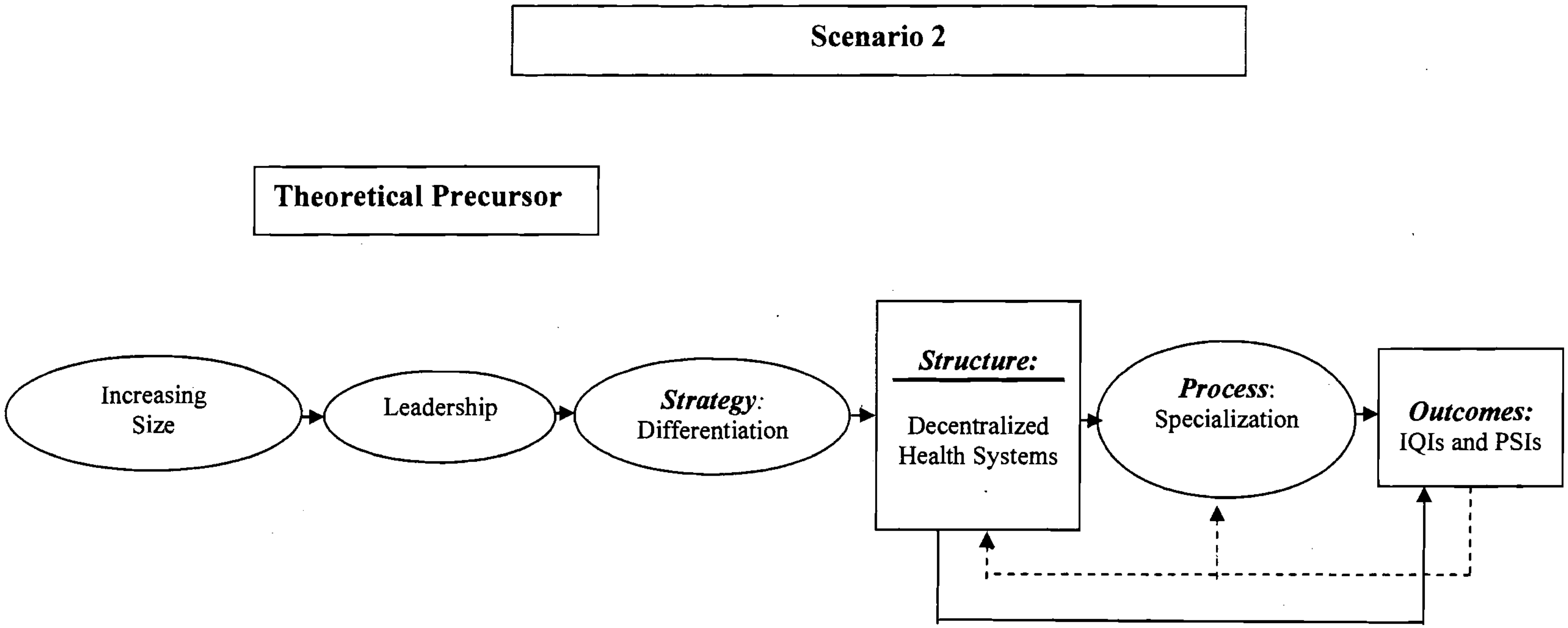

Figure 4: Conceptual Model for Scenario 2

Organizational leadership may use differentiation and divisionalization strategy to fit organizational size with the structure when organizational services, products, tasks are unrelated and require decentralization of decision-making authority (Thompson, 1967, Donaldson, 2001). Lawrence and Lorsch (1967) described differentiation as differences between organizational sub-units in goal orientations, time orientations, formality of structure, and interpersonal orientations. Structural differentiation is also defined as how an organization is split horizontally – the number of sub-units, job titles, span of control of top management – and vertically – the number of levels of hierarchy (Donaldson, 2001).

Divisionalization is also related to decentralization (Donaldson, 2001, Chenhall, 1979). Divisionalization of organizations requires decentralization of authority because various divisions of large organizations become only loosely interdependent. Therefore, large organizations coordinate their activities by rules, procedures, and planning, which further emphasize decentralization of the structures. Therefore, decentralization is achieved through differentiation and divisionalization strategy.

Specialization, formalization, and worker autonomy are positively correlated with decentralization of structures (Child, 1972; Scott, 2003). Decentralized organization may use specialization, formalization, and autonomy to improve effectiveness of organizational processes and, as a result, organizational performance. Specialization is the division of labor in the organization; it is measured by a scale of functional specialization that assesses the degree to which administrative (and possibly clinical) work has been specialized by functions (Donaldson, 2001). Specialization of tasks is necessitated by and occurs as a result of structural complexity of large organizations. Specialization makes processes of production more effective in these organizations. Formalization is the extent to which pre-specified procedures and processes for doing work are articulated and written down as well as used and enforced for defining procedures and jobs, recording performance, and passing information (Scott, 2003; Donaldson, 2001).

The need for autonomy may result from increasing decentralization. The middle management and technical experts need less direct control within defined and formalized organizational frames, because they have sufficient technical knowledge of how to manage increasing volume of information, specific tasks and how to deal with their immediate contingencies, as the size grows. Technical personnel also develop professional autonomy, due to specialization (Lawrence and Lorsch, 1967). Therefore, decentralization improves predictability of organizational performance by making middle management and technical experts comply with formalized procedures and tasks as indirect means of control while giving them some freedom to utilize their skills and creativity (Child, 1975).

The organizational structure becomes complex as organizational size increases, therefore, differentiation and divisionalization strategy is used by large organizations to fit their size with their structures. This strategy requires more delegation of decision-making authority from the top to the middle management, greater specialization of personnel, formalization of procedures, and worker autonomy, which may improve organizational processes and further stimulate decentralization of structures. As a result, decentralization may increase effectiveness and predictability of organizational performance.

In the health care industry, the large size of many integrated delivery systems (IDS) may reduce effective coordination and information exchanges between the top IDS management and the local hospital sub-units. Consolidation of health providers into systems vertically and horizontally increases the hierarchy of IDS (Arndt and Bigelow, 1996, Meighan, 1994). Therefore, IDS need to decentralize their structures by delegating authority to the middle management, i.e. to the hospital level and local submarkets.

Hospitals affiliated with decentralized systems maintain or further increase differentiation and divisionalization of IDS's structures, provide more clinical autonomy to professionals (i.e., clinicians), and increase specialization of other hospital personnel. Differentiation and divisionalization strategy makes hospitals less dependent on the systems' center. Thus, differentiation and divisionalization may decrease hospitals' need for sequential and reciprocal coordination with other system members, and therefore, reduce hospitals' burden to improve the overall IDS performance, which makes a hospital wholly responsible for its own submarket and reduces some of hospital's task uncertainty.

High differentiation and divisionalization of hospitals in the decentralized IDS may result in hospitals maintaining the full range of services, improving availability and accessibility and competitiveness of care in local submarkets. Indirect means of control, (i.e., managerial, financial, and clinical procedures and rules) may be used to formalize provision of care and maintain the overall control of the IDS over its local units or branches. Specialization, due to routinization of tasks, may improve performance of clinical personnel (e.g., nursing staff) at the lower levels of hospital hierarchy, thus, reducing system errors and mistakes. Therefore, decentralization of authority in IDS may improve adjustments of hospitals to their local submarkets, enhance clinical performance and autonomy of personnel, reduce system errors, due to specialization of hospital personnel and formalization of processes, and increase service availability and accessibility in the local submarkets; thus, improving quality outcomes for hospitals in decentralized IDS.

Hypotheses for Scenario 2

According to *the second scenario*, as hospitals and health systems consolidate, their size increases and decisions have to be communicated vertically and horizontally across tall hierarchical structures. Top management of Centralized Health Systems (CHS) and Centralized Physician/Insurance Health Systems (CPIHS) may lose their ability to influence processes at the lower levels of their organizations, because centralized decision-making and means of control become less effective in managing increasing volumes of information, as size grows (Donaldson, 2001). Thus, centralized structures of CHS and CPIHS may be more dysfunctional under the contingency of size, and therefore, suffer from poor organizational performance, resulting in decreasing quality outcomes. However, Decentralized Health Systems may respond differently to the contingency of size because of their differentiation and divisionalization strategy, and organizational characteristics and processes. Decentralized Health Systems are large organizations and characterized by having high levels of differentiation of hospital services, physician arrangements, and insurance products that are more predominant at the hospital level. The governance of DHS is characterized by low administrative intensity and low levels of centralization for both system and affiliate policies; and boards are dominated by nonaffiliated representatives (Alexander et al., 2003). Hospitals in DHS also tend to be spread over a broad geographic area (Bazzoli et al., 1999). The leadership of DHS decentralizes decision-making authority to implement strategies that are targeted to their local submarkets and to adjust structures to their immediate contingencies (Pointer et al., 1995).

Due to differentiation and divisionalization, DHS maintain substantial infrastructure, physician arrangements, and resource base in each submarket (Shortell et al., 2000). "Management and clinical information systems and quality and care management practices may be well organized within these submarkets (p. 15, Shortell et al., 2000)." Divisionalizaiton of hospitals in submarkets may increase hospital system's competitive advantages in the local markets (Luke et al., 1995). Therefore, hospitals in DHS may achieve desirable levels of performance and positive quality outcomes.

Consequently, Decentralized Health Systems, because their decision making processes are decentralized at the hospital level, rely on specialization of hospital personnel, formalization and some degree of physician clinical autonomy as possible means of indirect control over hospital internal processes. This indirect control strategy may be more effective in managing large organizational size. Gupta et al. (1994) studied how professionals in institutionalized environment are coordinated and controlled and what forces shape organizational structures. Their results show that the more institutionalized the environment, the more organizations rely on professionals to improve performance. Decentralized decision-making and more clinical autonomy improve physician-IDS relationships (Alexander et al., 2001), which may be important for improving quality outcomes. Differentiation and divisionalization may promote increasing professionalizaiton and specialization of hospital personnel in DHS. Professionalization and specialization, in turn, may improve quality outcomes and reduce patient safety errors in hospitals that belong to DHS.

As a result, hospitals in DHS may use differentiation strategy to manage their increasing size and set up indirect means of control over organizational processes through specialization of hospital personnel, their greater clinical autonomy, and formalization of procedures, which, in turn, may lead to improved quality of care. Therefore, the following hypothesis is proposed:

H3: Hospitals in Decentralized Health Systems would produce better quality outcomes than hospitals in more centralized health systems (CHS and CPIHS), all other things being equal.

Interplay of Both Scenarios

Moderately Centralized Health Systems (MCHS) and Independent Hospital Systems (IHS) have varying levels of centralization and differentiation. Thus, MCHS and IHS may be differently situated than the other types of systems. MCHS may use a combination of both centralization and differentiation to propel their performance. However, the structure of IHS, being low on centralization and differentiation, may not be well-fitted to respond effectively to the environmental challenges.

Moderately Centralized Health Systems (MCHS) are described as having moderate levels of centralization for hospital services, physician arrangements, and insurance product dimensions and exhibiting relatively high differentiation in hospital services and moderate differentiation in physician arrangements and insurance products (Bazzoli et al., 1999). The MCHS's governance also has moderate administrative intensity and moderate levels of centralization for system-level policy decisions; however, MCHS have the highest level of centralization for affiliate-level policy-making and one of the highest percentage of affiliate representatives on system board (Alexander et al., 2003).

The leadership of MCHS may decide that both task interdependence and large size contingencies are equally important. Moderate centralization for all categories may be used by the system's leadership to integrate the overarching system's activities with hospital's contingencies at the local submarkets. High differentiation of hospital services and moderate differentiation of physician arrangements and insurance products may also demonstrate that the MCHS' leadership tries to introduce some decentralization of structures. The leadership of MCHS may attempt to balance both contingencies, i.e. task interdependence by moderate centralization and increasing size by high-to-moderate differentiation and divisionalization. A combination of both strategies may improve the system's quality performance. The system center and local hospital sub-units may be smoothly integrated, achieving effective coordination and continuity of care, while the size is managed by some degree of differentiation and divisionalization. Bazzoli et al. (2001) found that more hospitals have joined into the moderately centralized systems and the number of hospitals in this category has increased over time. These factors provide some evidence that moderately centralized system may become "a system of choice and preference" for hospitals because of its effectiveness. Empirical research also showed that hospitals in MCHS have highest profitability and low average age of plant, while having comparable costs with hospitals in more centralized systems (Bazzoli et al., 2000). Effective hospitals may provide better quality of care (Donabedian, 1980 and 1982). Thus, the following hypothesis is proposed:

H4: Hospitals in Moderately Centralized Health Systems would produce better quality outcomes than hospitals in all other types of health systems (CHS, DHS, and CIPHS), all other things being equal.

Hospitals in Independent Hospital Systems have low levels of centralization of hospital services, fewer physician arrangements, and little insurance development; they are also low on differentiation for the same categories (Bazzoli et al., 1999). Independent Hospital Systems (IHS) have "the smallest average board size, the highest average percentage of affiliate representatives on the board, and the lowest level of centralization for both system- and affiliate-level policy decisions" (Alexander et al., 2003, p. 238).

Bazzoli et al. (2000) also found that hospitals affiliated with independent systems had the highest costs and lowest profits in comparison with hospitals affiliated with other types of systems. Hospitals in IHS are smaller organizations that are predominantly located in rural areas (Bazzoli et al., 1999). Having low levels of centralization does not allow hospitals in IHS to be effective in managing task interdependence. Also, hospitals in IHS lack the size to implement to differentiation and divisionalization strategy in order to improve their performance. Having low levels of differentiation may preclude these hospitals from maintaining substantial infrastructure, physician arrangements, and resource base in their submarkets. This type of hospital system is only loosely integrated (Bazzoli et al., 2001). Thus, hospitals in Independent Hospital Systems may be disadvantaged in dealing with the turbulent health care environment. The following hypothesis is proposed:

H5: Hospitals in Independent Hospital System would produce worse quality outcomes than hospitals in all other types of health systems (CHS, DHS, and CIPHS), all other things being equal.

Summary

Contingency theory provides at least two and possibly three general scenarios that may explain how hospitals affiliated with various types of health systems may differ in terms of their internal processes and quality performance. As a result, a set of competing and/or complementary testable hypotheses is proposed. The following Chapter 4 discusses the methods that allow answering the research question and testing the proposed hypotheses.

CHAPTER 4: RESEARCH METHODS

Introduction

Two research designs are proposed – a panel design, using fixed effects or random effects models, and a cross-sectional design for two separate years of 1997 and 2000, using three stage estimation models – in order to account for possible feedback effects and to increase internal validity of results. Seven well-established data bases are used for the analyses. It is planned to assemble data from short-term, general, nonfederal hospitals from 11 states for 6 years from 1995 to 2000. Two years of data from Joint Commission on Accreditation of Healthcare Organization (JCAHO) are available for hospitals in this study. Dependent variables are measures of patient quality outcomes, i.e. Inpatient Quality Indicators (IQIs) and Patient Safety Indicators (PSIs). Several sets of variables are suggested to measure: (1) hospital organizational characteristics, including the main explanatory variable – hospital affiliation with different types of health systems; (2) market characteristics; (3) patient characteristics; (4) clinical integration, using JCAHO data; (5) variables for cross-sectional studies, reflecting a choice of a health system and a choice of integration of internal clinical processes. In order to evaluate effects of structural designs of hospital systems and internal clinical processes and integration on quality outcomes, rigorous analytical methods are used. The research design and methods are discussed in the following sections.

Study Design

A research design should meet two criteria: (1) answer research questions and (2) adequately test hypotheses (Kerlinger, 1986). Experimental design with randomization of subjects to experimental and control groups and with a follow up over time – "the gold standard"– is the strongest design in identifying causation in studied relationships. Cook and Campbell (1979) noted three conditions for inferring cause: "(a) contiguity between the presumed cause and effect; (b) temporal precedence, in that the cause had to precede the effect in time; and (c) constant conjunction, in that the cause had to be present whenever the effect was obtained" (p. 10). Wooldridge (1999) stated that economic theory uses a notion of ceteris paribus in estimating a causal effect of one variable on another variable, holding other factors fixed in evaluating public policy. Econometric methods are often applied to simulate a ceteris paribus experiment. Experimental design is not feasible in studying hospitals in various types of health system and their effects on quality of care. Thus, econometric models are used instead. One of which is a panel model. Strengths and weaknesses of a panel design are discussed below.

Strengths of Panel Design

(1) A panel design controls for heterogeneity in a cross-sectional unit. Hospitals in various health systems are heterogeneous. Variation in quality of care may be attributed to time invariant variables related to some unobserved characteristics of hospitals, systems, and states. Panel data allow controlling for these time-invariant, unobserved variables, otherwise omitted from an econometric model, which results in biased parameter estimates.

(2) Panel data provide “more informative data, more variability, less collinearity among the variables, more degrees of freedom and more efficiency” (p. 4, Baltagi, 1995). Panel data for multiple years add more variability and information on patient, hospital, market, and other characteristics.

(3) “Panel data are better able to study the dynamics of adjustment” (p.4, Baltagi, 1995). Panel data allow studying trends over time, duration of effects of interest, intertemporal relations, and life-cycles. Hospitals that join health systems may improve their quality performance, however, over a longer time period. Only panel data allow capturing this improvement over time; cross-sectional design can miss this temporal trend.

(4) Panel data are better able to identify and measure effects that are not detectable in pure cross-sections or pure time-series data. Also, many variables can be more accurately measured at the micro level, and biases resulting from aggregation over firms and individuals are eliminated (Baltagi, 1995). Panel data are usually gathered on micro units, like patients and hospitals. Panel data allow making stronger causal inferences than cross-sectional data

Limitations of Panel Design

(1) Design and data collection problem, including nonresponse, recall, and reference period (Baltagi, 1995). This study relies on well-established sources of data, e.g. AHA survey, these data are collected on annual basis and the format of questionnaires rarely changes. It is believed that hospitals’

familiarity with the AHA survey may reduce some of the aforementioned biases. Missing records or outliers on key variables may be a problem; however, appropriate cleaning methods are used to reduce the effects of missing data and outliers. It is also believed that missing records are random and, thus, not a source of bias.

(2) Even though there is an assumption that the proposed panel model is strictly exogenous, a feedback effect may become a serious concern. In this study, for example, a feedback effect may occur if quality of care in an earlier study period may motivate a hospital to join with a certain system type, which is perceived as the system to improve quality outcomes, in a later study period.

Due to data limitation (i.e., JCAHO data are only available for two years), it is impossible to use lagged hospital quality performance variables to address for the feedback issue. It is a major limitation of the study. Thus, results form panel models are compared with results from cross-sectional models, i.e. three stage estimation models that may address the feedback problem. Three stage estimation model for studying quality outcomes by hospital system types is discussed below.

Three Stage Estimation Model

According to the conceptual model, a structure (e.g., a system type) would influence a process (e.g., a level of clinical integration) and a process would influence organizational performance (e.g., quality outcomes). However, a feedback or selection effect may be present. There is a notion that hospitals may select a specific health system type in order to improve their financial performance (Menke, 1997, Bazzoli et al., 2000).

Quality performance may also influence hospitals to join with a certain system type and to alter their process of care delivery in order to achieve better quality outcomes. For example, it is expected that centralized health systems are more likely to achieve clinical integration, which may improve quality outcomes (Shortell et al., 2000).

Three stage estimation model may address the feedback effect. Lagged financial and quality performance variables measure a previous hospital performance effect on a hospital's choice of a system type. Alexander and Morrisey (1988) and Bazzoli et al. (2000) also conceptualized that hospitals' affiliation with health systems, among others, depend upon favorable market conditions. These market factors may also be used to account for a hospital choice of a system type. Different health systems may put in place different processes of care delivery. Some types of health systems may be more effective in achieving greater clinical integration, due to higher levels of centralization (Shortell et al., 2000). Therefore, some hospitals may choose to select more centralized health systems in order to improve their process of care delivery through clinical integration. It is proposed to use two variables that reflect alignments and relationships between physicians and hospitals as variables for addressing a selection issue of a hospital choice of a level of integration of internal clinical processes in different types of health systems.

Data Bases and Sources

The data are assembled from multiple sources. Seven data bases are put together to provide sufficient measures of quality outcomes, hospital, patient, market and other characteristics for the current study. The data sources include and are described as follows:

(1) the 1995-2000 hospital discharge data for 11 states that participate in Agency for Healthcare Research and Quality (AHRQ) Healthcare Cost and Utilization Project State Inpatient Database (HCUP SID) provide patient clinical and nonclincal information, which are used to construct quality and patient safety indicators;

(2) the 1995-2000 Joint Commission for Accreditation of Healthcare Organizations (JCAHO) performance area scores assess organizational dimensions of the quality of hospital care and serve as measures of internal clinical processes and integration;

(3) the 1995-2000 American Hospital Association (AHA) Annual Surveys provide data on hospital characteristics and structure;

(4) the Area Resource Files (ARF) provide market and socioeconomic variables at the county and Metropolitan Statistical Areas (MSA) levels;

(5) HMO InterStudy provides information on the number of HMOs and HMO penetration;

(6) the 1995-2000 Medicare Case Mix Index Files;

(7) the 1993-2000 Centers for Medicare and Medicaid Services (CMS) Medicare cost report data, which provide detailed hospital financial information.

AHRQ's HCUP SID data base is used in the study. There were 13 states that participated in HCUP SID in 1995; 16 states joined in 2000, so there was a total of 29 states in 2000. HCUP SID is the largest collection of all-payer, uniform, state-based, inpatient administrative data. HCUP SID contains information on patient demographics (age, gender, and race for some states), patient clinical data (principal and secondary diagnoses and procedures, and length of stay), location of admission and discharge, expected payment source (Medicare, Medicaid, private insurance, self-pay, managed care for some states), and total charges. The HCUP SID data are on 11 states – Arizona, California, Colorado, Florida, Iowa, Maryland, Massachusetts, New Jersey, New York, Washington, and Wisconsin. These states were chosen based on several characteristics: (1) participation in HCUP SID throughout the entire 1995–2000 period; (2) mandatory (rather than voluntary) hospital participation in data collection; (3) inclusion of hospitals specific identifiers for merging with other data bases, e.g. AHA, CMS, and others. Being a convenience sample, it still represents wide geographic areas in the U.S., covering 7 of the 9 census divisions. Thirty six percent (36%) of all community hospitals nationwide are located in these 11 states.

The Joint Commission for Accreditation of Healthcare Organizations (JCAHO) performance area scores for hospitals that have undergone accreditation between 1995 and 2000 are used. Around 80 percent of hospitals nationwide participate in the JCAHO accreditation program, where system hospitals are more likely to be accredited. JCAHO reviews the member hospitals every three years. Since the study period covers years from 1995 to 2000, JCAHO data are available for two triennial periods, in which the majority of hospitals have two sets of JCAHO performance scores within a 3-year interval period. The year of 1997 instead of 1995 is chosen for the cross-sectional analysis, because the JCAHO data base for 1995 includes only 550 hospitals, which is substantially less than 1,300 hospitals available for 1997. Some hospitals may have missing data because they closed, merged, or had some other change, which makes this sample of hospitals unbalanced.

The AHA Annual Survey is a recognized source of hospital data. AHA data have been extensively used in health services research. Hospital-specific, nationwide data are annually collected, which usually achieves an overall response rate of 85 percent or higher each year; however, single item's response rates may vary. AHA data include information on various hospital organizational characteristics and their geographic location.

Other data sets are described below. Area Resource File (ARF) contains extensive, county-level data on market and economic conditions, socio-demographic characteristics, health resources, and other variables that may affect quality of care. ARF collects data from multiple sources, including census files, Physician Master File from the American Medical Association, and mortality and natality data from the National Center for Health Statistics.

HMO InterStudy file contains data on approximately 650 HMOs in the country, including information on HMO enrollment and county service data and can be used for calculation of HMO market share and the number of HMOs in a particular market area. The Centers for Medicare and Medicaid Services (CMS) data are also used to obtain the Medicare case-mix indexes. Medicare cost reports provide substantial financial data on hospitals that receiving Medicare payments. Medicare cost report data can help to identify underlying financial performance of hospitals. Approximately 87 percent of general acute care hospitals nationwide file Medicare cost reports.

Unit of Analysis

The unit of analysis for this study is short-term, general, nonfederal hospitals that belong to different types of health systems: Centralized Health Systems (CHS), Centralized Physician/Insurance Health Systems (CPIHS), Moderately Centralized Health Systems (MCHS), Decentralized Health Systems (DHS), and Independent Hospital Systems (IHS).

Sampling

Complete data on approximately 3,050 hospitals for each year are merged from HCUP SID, AHA, ARF, and other data sources. The average number of hospitals in various types of health systems over the 1995 – 2000 period is as follows: (1) 170 hospitals in CHS; (2) 297 hospitals in CPIHS; (3) 870 hospitals in MCHS; (4) 1,350 hospitals in DHS; and (5) 360 hospitals in IHS.

JCAHO data are available for about 1,298 hospitals in eleven states over the study period, 1995 – 2000. It is identified that around 714 hospitals belong to various types of health systems in 11 states: (1) 38 hospitals in CHS; (2) 52 hospitals in CPIHS; (3) 254 hospitals in MCHS; (4) 337 hospitals in DHS; and (5) 33 hospitals in IHS. As a result, this sample includes about 740 hospitals in eleven states with complete records from all seven data sources. Since the sample is reduced from 2,647 hospitals to approximately 1,298 hospitals in eleven states and 714 hospitals in different types of health systems, it may potentially introduce a threat to external validity.

In order to increase reliability and generalizability of findings, descriptive statistics for hospitals in this sample for eleven states and those ones in the national sample are compared. The statistics for hospitals that belong to health systems in the empirical sample with those in the national sample are also compared.

Analytical Model

In order to evaluate effects of hospital affiliation with systems on quality outcomes, rigorous research methods are necessary. A strict exogeneity assumption allows using fixed effects or random effects models with panel data. However, a feedback or selection effect may still be a problem. Since these data are limited to only two time periods (due to a JCAHO data limitation), it is impossible to use lagged quality outcomes and hospital financial performance to address the feedback issue in the panel model.

Thus, the cross-sectional design, using three stage estimation models, which is evaluated separately for two years of 1997 (this year is chosen, because the 1997 JCAHO's data set has substantially more hospitals than the 1995 data set) and 2000, is proposed to reassure validity of empirical findings and to address the feedback issue.

Variables that reflect three-year shifts in the external environment are constructed and measured by the market-level variables, such as HMO penetration, competition among systems, and the number of HMOs. Changes over time (three years before the study years of 1997 and 2000) in levels of these variables may assess a fit-misfit relationship between external environmental shifts and hospital system structures. An analytical plan below provides a step-by-step procedure for empirical analyses. Empirical models are also described in greater detail and expressed mathematically in the following section.

Plan for Empirical Analyses

(1) Panel study:

a) A strict exogeneity assumption allows us to set up fixed effects (FE) or random effects (RE) models (if assumptions for RE are met and supported by the Hausman specification test), where quality outcomes are directly associated with process (i.e., clinical integration) and structure (i.e., health system types) measures. A sensitivity analysis estimates the most appropriate way of combining internal clinical processes and integration variables (which is discussed later in this section).

(2) Cross-sectional study:

a) Conduct the Hausman test for endogeneity for a hospital's choice of a system type. If this test demonstrates endogenity problem, then cross-sectional three stage estimation models for separate years of 1997 and 2000 are used. Lagged quality outcomes and hospital financial performance and other variables reflective of preferable market conditions are used at this stage to account for the feedback or selection effect of a system type choice.

b) A multinomial logit model for estimating predicted probabilities of a strategic choice of a system type is calculated for each hospital observation, using maximum likelihood estimation (MLE) method. A dependent variable in this model is a system type or a grouping of health systems (e.g., hospitals grouped into more centralized health systems (CHS + CPIHS)); and it is a categorical variable. The multinomial logit model can be presented schematically:

System* = f (Hospital, Market, and Patient Characteristics of Quality of Care, Lagged Quality and Financial Performance and Other Market-Type Variables for a Choice of a System Type)

c) At this stage, the Hausman test for endogeneity is conducted for a hospital's choice of a level of integration of internal clinical processes. If endogeneity is present, variables reflective of a selection of a level of integration of internal clinical processes are used.

d) A negative binomial model for estimating predicted sums of scores of internal clinical processes and integration levels by different types of health systems is calculated for all hospital observations. A construction of internal clinical processes and integration scores is discussed later in the variable measurement section. The model can be presented schematically:

CI* = f (Hospital, Market, and Patient Characteristics of Quality of Care, System*(predicted probability), Variables for a Choice of Internal Clinical Processes and Integration Level)

e) Predicted scores of internal clinical processes and integration (CI*) are compared for different types of health systems or groupings of health systems by comparing estimated coefficients for different system types. The robust variance estimator for two-stage models is used to calculate correct error terms (Hardin, 2002). Conclusions are made on which types of health systems are more likely to have higher or lower levels of clinical integration based on the values of predicted probabilities.

(f) Predicted sums of scores of internal clinical processes and integration by different types of systems (from point D) are used in OLS linear models, estimating quality outcomes for hospitals in various types of health systems. It can be presented schematically:

Quality Outcomes = f (CI* (predicted score), Hospital, Market, and Patient Characteristics of Quality of Care)

g) Analysis of variance (ANOVA) is conducted on predicted values of quality outcomes, comparing outcomes across different types of health systems or groupings of health systems, depending on the hypotheses. Conclusions are made on which types of health systems are more likely to have better quality outcomes.

(3) Simplified Model:

a) It is possible that a measure of clinical integration, which is constructed using JCAHO variables, is a weak measure of clinical integration. In this case, a simplified model is proposed, where predicted probabilities for health systems are directly put into the final OLS model for estimating quality outcomes, and the internal clinical processes and integration stage is not analyzed.

Description of Models

Fixed effects (FE) model controls for unobserved hospital and market characteristics that, otherwise, may affect parameter estimates due to omitted variable bias. FE model introduces a separate intercept for each hospital and, as a result, takes time-invariant, unmeasured components out of the equation. FE model provides consistent estimates of β, regardless of whether or not unobserved time-invariant factors are correlated with explanatory variables.

Information from those hospitals that switched their affiliation from one type of system to another over a course of this study period is used; only these hospitals are selected out in the FE analysis. FE model identifies types of hospital systems and internal clinical processes and integration that have significant effects on patient outcomes.

Random effects (RE) model provides additional strengths. RE model reduces a loss of degrees of freedom, controls for unobserved unmeasured characteristics, making parameters consistent, and also provides estimates for individual, time-invariant variables (such as gender), which get differenced out in FE model. However, it is quite difficult to meet all assumptions, specifically assuring that explanatory variables are not correlated with hospital specific component of the error term, for proposing RE model that provides consistent and efficient parameter estimates.

Thus, the Hausman specification test is used to evaluate whether assumptions for random effects model are met. If this test demonstrates that RE assumptions are met, this model would become "the best choice" model in the analyses of hospital affiliation with various systems types and quality outcomes. The empirical models are mathematically represented and described in the following section.

(1) General Fixed Effects or Random Effects Models – Panel Design:

$$Y_{it} = \delta_1 + \delta_2 CI_{it} + \delta_3 S_{it} + \delta_4 X_{it} + \delta_5 M_{it} + \delta_6 P_{it} + \delta_7 Time_t + \mu_i + \varepsilon_{it}$$

Y_{jt} is a vector defining quality outcomes;

CI_{jt} is a vector representing clinical integration, measured by the sum of JCAHO variables;

S_{jt} is a vector representing dummy variables for different types of health systems;

X_{jt} is a vector representing hospital control variables;

M_{jt} is a vector representing market control variables;

P_{jt} is a vector representing patient control variables;

μ_i is represents hospital specific, time-invariant, unobserved component;

$Time_t$ is a vector of dummy variables, indicating the year when the dependent variable is observed;

$\delta_1 \delta_2 \delta_3 \delta_4 \delta_5 \delta_6 \delta_7$ are vectors of parameters to be estimated;

ε_{jt} represents a random error term;

i and t indexes hospitals and time.

(2) Three Stage Estimation Model – Cross-Sectional Design:

a) Multinomial Logit Model for Estimating Predicted Probabilities for Different Types of Health Systems:

$$y_{Sys} = \alpha_0 + \alpha_1 X_1 + \alpha_2 M_2 + \alpha_3 P_3 + \alpha_4 L_4 + \alpha_5 O_5 + \varepsilon$$

b) Negative Binomial Model for Estimating Predicted Sums of Scores for Internal Clinical Processes and Integration Levels by System Types:

$$y_{CL} = \beta_0 + \beta_1 X_1 + \beta_2 M_2 + \beta_3 P_3 + \beta_4 \hat{y}_{Sys} + \beta_5 MD_5 + \varepsilon$$

c) OLS Regressions with Predicted Sums of Scores of Internal Clinical Processes and Integration by System Type:

$$Y = \delta_0 + \delta_1 \hat{y}_{CL} + \delta_2 X_2 + \delta_3 M_3 + \delta_4 P_4 + \varepsilon$$

The vectors are described as follows:

Y is a vector representing quality outcomes;

$\hat{y}_{Sys}$ is an estimated predicted probability for each hospital being selected into a health system or a grouping of health systems;

$\hat{y}_{CL}$ is an estimated predicted score of an internal clinical processes and integration level for each hospital in a health system or a grouping of health systems;

L is a vector representing lagged values of hospital quality and financial performance and accounting for the system type feedback effect;

O is a vector representing other variables reflective of favorable market conditions and accounting for the system type selection effect;

MD is a vector representing alignments and relationships between physicians and hospitals and accounting for the internal clinical processes and integration selection effect;

$\alpha_1 \alpha_2 \alpha_3 \alpha_4 \alpha_5 \beta_1 \beta_2 \beta_3 \beta_4 \beta_5 \delta_1 \delta_2 \delta_3 \delta_4$ are vectors of parameters to be estimated;

ε represents error term.

(3) Simplified Model:

$$Y = \delta_1 + \delta_2 \hat{y}_{Sys} + \delta_3 X_3 + \delta_4 M_4 + \delta_5 P_5 + \varepsilon$$

Since measures of internal clinical processes and integration may be weak, a simplified model differs from the three stage estimation model by excluding predicted scores of internal clinical processes and integration and ANOVA steps from the analyses.

All other components and descriptions of elements are similar with the three stage estimation model.

Measurement of Variables

In this section, measurements of this study's constructs and variables are discussed. Variables for this study are selected based upon the literature review, organizational theory, and a previous use of these variables in related empirical studies. Patients' quality outcomes are represented by the Inpatient Quality Indicators (IQIs) and Patient Safety Indicators (PSIs). A measure of internal clinical processes and integration is represented by a sum of JCAHO variables. Hospital characteristics include the main explanatory variable – hospitals' affiliation with different types of health systems – and other variables. Market characteristics are represented by hospital competition and managed care constructs as well as changes in these variables over time reflective of environmental shifts. Patient characteristics and other variables are represented by demographic variables and used as statistical controls. Lagged hospital quality and financial performance, variables reflective of favorable market conditions, and physician-hospital alignment and relationship variables are needed to account for the feedback or selection effect in cross-sectional analyses. Inpatient Quality Indicators (IQIs) and Patient Safety Indicators (PSIs) are described in greater detail in the following sections and grouped together based on their clinical characteristics.

Quality Outcomes

Quality indicators are generated from the HCUP SID for the 1995–2000 period. Quality of care is multifaceted category that requires multiple measures. Inpatient

Quality Indicators (IQIs) and Patient Safety Indicators (PSIs) are mortality rates and adverse events, respectively. IQIs and PSIs may serve as flags for potential quality problems rather than definitive measures of quality (AHRQ Pub.03-R204, 2003). These measures are aggregated at the hospital level. In this study, a combination of quality indicators is used. Four IQIs from available 15 mortality indicators and 5 PSIs from available 20 adverse events indicators are selected. Risk-adjusted rates of IQIs and PSIs are applied to represent patient quality outcomes.

One of the concerns here is that the better quality hospitals may have a more effective process of identification, coding, and reporting of inpatient deaths and adverse events than the worse quality hospitals. This is a limitation of using secondary data bases and a researcher has to keep this limitation in his/her mind. However, hospitals in those states that have a mandatory hospital participation in data collection for the HCUP SID project were chosen. It is believed that the HCUP SID project provided similar guidelines for data collection in these hospitals, which may have assured a higher level of data collection quality. In the following section, IQIs and PSIs are described in greater details, as well as, the rational for selecting these particular indicators.

Inpatient Quality Indicators (IQIs) are risk-adjusted mortality rates. Four IQIs for the current study are selected because of their clinical significance, i.e. leading causes of deaths in the U.S. These IQIs are also selected for common reasons: 75 percent or more hospitals treat patients with relevant IQIs for the majority of years; and there are a large number of patients at risk for these IQIs in the empirical sample. Precision of measurement is high for these 4 IQIs (AHRQ Pub.02-RO204, 2002).

IQI 15: Acute Myocardial Infarction (AMI). According to the American Heart Association, approximately 1.5 million people suffer from AMI each year; one-third of them die from heart attacks. AMI indicator is precise, measuring substantial amount of provider level variation that is not attributable to random variation (AHRQ Pub.02-RO204, 2002). McClellan and Staiger (working paper, 1999) stated that short-term AMI mortality is an excellent indictor of quality of care. McCarthy et al. (2000) studied the reliability of using administrative data in quality outcome research by comparing results from secondary sources with data gathered through primary data collection (e.g. medical records).

IQI 16: Congestive Heart Failure (CHF) is a common disease, about 2 million people suffer from CHF each year; elderly patients have a greater risk of death from CHF; there is empirical evidence that hospitals at least in some states were able to decrease CHF mortality during 1990s (AHRQ Pub.02-RO204, 2002).

IQI 17: Stroke is the third leading cause of death in the U.S.; 10 – 15 percent of stroke patients die during the hospitalization (AHRQ Pub.02-RO204, 2002).

IQI 20: Pneumonia is the sixth leading cause of death in the country. McCarthy et al. (2000) found that 50 percent of pneumonia cases had at least one objective clinical evidence to confirm the complication (AHRQ Pub.02-RO204, 2002).

"Patient safety is defined as freedom from accidental injury due to medical care, or absence of medical errors, or absence of misuse of services" (p. 131, National Healthcare Quality Report, AHRQ, 2003). Institute of Medicine report (2000) estimated that 44,000 to 98,000 deaths occurs every year as a result of medical errors, making it the eighth leading cause of death; estimated cost of medical errors is reported as $29 billion annually in lost income, disability, and health care costs.

Patient Safety Indicators (PSIs) are risk-adjusted rates of adverse events for a particular condition or procedure. Five PSIs are selected. These indicators perform well in terms of reliability, bias, relatedness of indicators, and persistence over time (AHRQ Pub.03-R203, 2003). There is also one common reason for inclusion of these PSIs – a large number of patients were at risk for developing these complications during the 1995–2000 period. In this study, PSIs may be subdivided into three categories: (1) adverse iatrogenic events; (2) adverse nursing events; (3) adverse events due to errors in post-operative process of care.

Adverse iatrogenic events.

PSI 15: Accidental puncture and laceration was proposed to capture complications due to technical difficulties in medical care. For example, Taylor et al. (1998) found that 95 percent of patients, who had laparoscopic cholecystectomy, with an ICD-9 code of accidental puncture and laceration had a confirmed injury of the bile duct or gallbladder. Iezzoni et al. (1994) and Johantgen et al. (1998) proposed to use this indicator and categorized it as an iatrogenic complication. McCarthy et al. (2000) found that 83.3 percent patients with this complication had at least one objective clinical evidence to confirm the complication. Romano et al. (2003) reported 7 percent increase in accidental puncture or laceration during the 1995-2000 period. PSI 15 attributes for 1.34 days in excess LOS, $8,271 in excess charge, and 2.16 percent of excess mortality (Zhan and Miller, 2003).

Adverse nursing events.

PSI 3: Decubitus ulcer is limited to secondary diagnosis for screening out cases of ulcers present due to objective clinical reasons. This indicator was identified as very favorable in indicating errors in nursing and process of care (AHRQ Pub.03-R203, 2003). Empirical studies found that nursing staffing, skill mix, and nursing hours were associated with occurrence of decubitus ulcer in hospitals (Needleman et al., 2002). Romano et al. (2003) reported 19 percent increase in the 1995-2000 period. PSI 3 attributes for 3.98 days in excess LOS, $10,845 in excess charge, and 7.23 percent of excess mortality (Zhan and Miller, 2003).

PSI 7: Infection due to medical care is primary related to intravenous lines and catheters. According to American Nurses Association, this indicator is nursing-sensitive for acute care settings. Iezzoni et al. (1994) also included this indicator in their set of inpatient quality indicators suggested for use with administrative data. Nursing staff is mainly responsible for monitoring patients with central lines and catheters and making sure that they are removed on time. Romano et al. (2003) found a 14 percent increase in the infection rate over the 1995–2000 period. PSI 7 attributes for 9.58 days in excess LOS, $38,656 in excess charge, and 4.31 percent of excess mortality (Zhan and Miller, 2003).

Adverse events due to errors in post-operative process of care.

PSI 12: Post-operative pulmonary embolism (PE) or deep vein thrombosis (DVT) cases are limited to secondary diagnosis to eliminate complications that were present on admission. This PSI is characterized as useful estimator of adverse events, because preventive techniques (e.g., anticoagulant therapy) should decrease the rate of this complication (AHRQ Pub.03-R203, 2003). There are mixed findings on whether nursing is associated with post-operative PE or DVT.

McCarthy et al. (2000) noted that detection of 66.7 percent of surgical cases had at least one objective clinical evidence to confirm the complication. Romano et al. (2003) found a 42 percent increase in post-operative PE or DVT during the 1995-2000 period. PSI 12 attributes for 5.36 days in excess LOS, $21,709 in excess charge, and 6.56 percent of excess mortality (Zhan and Miller, 2003).

PSI 13: Post-operative sepsis is limited to secondary diagnosis to select out cases of sepsis present on admission (AHRQ Pub.03-R203, 2003). Iezzoni et al. (1994) included this indicator in their list of quality measures detectible in the administrative data bases. McCarthy et al. (2000) identified that 81.5 percent of post-operative infection cases had at least one objective clinical evidence to confirm the complication. A forty-one percent (41%) increase in septicemia was reported in the 1995-2000 period (Romano et al., 2003). PSI 13 attributes for 10.89 days in excess LOS, $57,727 in excess charge, and 21.92 percent of excess mortality (Zhan and Miller, 2003).

IQI and PSI Processing Steps

The software, which was developed by the AHRQ and researchers from Stanford University, generates observed and risk adjusted IQIs and PSIs. Observed rates are generated in three steps.

First, identification of outcomes of interest (numerators, i.e. deaths or adverse events) in inpatient records is achieved by setting a series of flag variables that select out necessary outcomes from the raw inpatient data. Second, identification of population at risk (denominator) is also done by the similar process of running the hospital discharge records. Third, observed or raw IQIs and PSIs are calculated by simple division of outcomes of interests by the populations at risk. At this point, the software allows stratification of data by different categories, such as hospitals, age groups, race/ethnicity, gender, and payer categories.

Risk adjustment for IQIs and PSIs slightly varies. IQIs and PSIs adjustment for age and gender are applied to the observed rates. The software provides the baseline file means and regression coefficients for age and sex derived from AHRQ's SID for 29 states, i.e. the average case-mix. These means and coefficient are then applied to the sample of interest, which allows comparability of rates across different hospitals. IQIs are adjusted in a linear model by APR-DRGs. It is recommended to run version 15 of 3M's All Patient Refined – Diagnoses Related Groups (APR-DRG) software on raw patient data before running the IQI's software in order to create APR-DRG categories, and severity and mortality indicators. PSIs are adjusted by modified DRGs and co-morbidities using logistic regression to account for differences among hospitals.

Internal Clinical Processes and Integration

Joint Commission for Accreditation of Healthcare Organizations (JCAHO) performance area scores are used to assess internal clinical processes and integration. Devers et al. (2004) evaluated the role of JCAHO in promoting patient safety. They found that hospitals try to meet JCAHO recommendations mainly in three areas: "(1) developing better process for reporting, analyzing, and preventing sentinel events (e.g., patients falls and use of patient restraints); (2) meeting patient safety standards …(3) meeting all or specific JCAHO patient goals, particularly improving communication and the accuracy of patient identification" (p. 104, Devers et al., 2004).

JCAHO data are generated from on-site hospital surveys done by JCAHO accreditation teams on a triennial basis. More than 500 human, organizational, and facility standards of quality of hospital care are assessed for accreditation purposes. A five-point scale is used to score hospital's compliance with each standard: (1) score 1 – substantial compliance – the organization meets all major provisions of the standard and intent; (2) score 2 – significant compliance – the organization meets most of the provisions of the standard and intent; (3) score 3 – partial compliance – the organization meets some provisions of the standard and intent ; (4) score 4 – minimal compliance – the organization meets few provisions of the standard and intent; (5) score 5 – noncompliance – the organization fails to meet the provisions of the standard and intent (JCAHO, 2001).

Individual scores are then aggregated into 44 performance area scores. Performance area scores are also measured by the five-point scale noted above. For example, if the worst score (5) is present for any standard associated within a particular performance area is identified, then this value (5) is assigned to the performance area. Five performance area scores measure internal clinical processes and integration:

(1) Initial Assessment Procedures standards include procedures used to determine patients needs, e.g. a physical examination and health history, appropriate diagnostic tests and screening.

(2) Anesthesia Care refers to the set of standards that address the planning and delivery of anesthesia including assessment of patients' conditions prior to anesthesia, informing patients of risks, options, and monitoring.

(3) Medication Use refers to the processes used to prescribe, prepare, dispense, and administer medication, including specific issues such as preparation of medication in accordance with all laws and regulations, safety, and availability of emergency medication.

(4) Operative Procedures refers to the grouping of standards, which address the processes used in the determination of appropriate operative procedures, appropriateness of preoperative preparation and monitoring, and safety of procedures.

(5) Availability of Patient Specific Information are aimed at ensuring that the necessary information that supports and documents the care provided to patients is obtained and maintained in the medical record in a timely manner.

These JCAHO standards may be reflective of areas related to clinical integration, such as use of clinical information systems and clinical evidence-based practices, guidelines, protocols, and medical registries (Burns, 1999). For example, medication use standard demonstrate whether a hospital is in compliance with pharmaceutical guidelines and protocols. Availability of patient specific information and initial patient assessment procedures may be building blocks of a system-wide clinical information system. Anesthesia care and operative procedures represent the sets of standards that may be used across all system members, thus, easing quality monitoring and promoting clinical integration. Therefore, Joint Commission for Accreditation of Healthcare Organizations (JCAHO) standards may capture aspects of clinical integration. However, only the empirical analyses would demonstrate whether JCAHO variables can or cannot hold as "good" measures of clinical integration. JCAHO's scores (1–5) are consolidated into a single measure of compliance. Scores 1 and 2 are given a value of 1, i.e. compliance with JCAHO standards, and scores 3, 4, and 5 are given a value of 0, i.e. not in compliance with JCAHO standards.

A sensitivity analysis to find out a way of summing these compliance measures across five variables (Initial Assessment Procedures, Anesthesia Care, Medication Use, Operative Procedures, and Availability of Patient Specific Information) is used. For example, if there are no differences in marginal effects across all five JCAHO variables on quality outcomes, a summation of all five JCAHO variables into a single measure of clinical integration is possible. Thus, zero is the minimum score, representing no clinical integration, and five becomes the maximum score, representing a greater level of clinical integration.

If some JCAHO variables have significant marginal effects but other variables do not, a summation only significant ones into a single measure of internal clinical processes and integration is attainable, and insignificant JCAHO variables are discarded. Other combinations may also occur and can be considered. The summation of JCAHO variables into a single construct would help to create a more comprehensive measure of clinical integration, to increase variability, and to make the analyses more focused on the research questions.

Hospital Organizational Characteristics

Hospitals affiliated with different types of health systems – centralized health system (CHS), centralized physician/insurance health system (CPIHS), moderately centralized health system (MCHS), decentralized health system (DHS), and independent hospital system (IHS) – is a set of dummy variables and the main explanatory variables. These variables are constructed from and available in the AHA data files.

Hospital size is measured by the total beds staffed and set up; it is a continuous variable. Hospital ownership is measured by three dummy variables, distinguishing between for-profit, non-profit (including other non-profit and church-affiliated), and public hospitals (i.e., omitted category). Hospital teaching status is also represented by dummy variables, having major-, minor-, and non-teaching status (i.e., omitted category).

Service mix and scope measures the number of tertiary hospital services, categorized into 3 groups: (1) 0–10 (i.e., omitted category), (2) 10–20, and (3) 20–30 services.

Geographic locations – urban and rural (i.e., omitted category) locations – are dummy variables. These variables control for organizational and environmental features that may affect health system formation and quality of care.

Total nursing staff per staffed bed is a ratio of RNs and LPNs to staffed patient bed. Ratio of registered nurses (RNs) to License Practical Nurses (LPNs) is a measure of nursing skill-mix. These variables control for nursing related features that may affect quality of care. Other control variables are described in the following sections of this chapter.

Market Characteristics

Hirschman Herfindahl Index ranges between zero and one and is measured at a hospital system level; a low HHI represents a greater competition in a particular MSA or county. HMO penetration also ranges between zero and one. The number of HMOs is a count of HMOs operating in a county or MSA. Previous research demonstrated mixed results on the effects of hospital competition and managed care penetration on quality outcomes (Sari, 2002; Shen, 2003); thus, it is necessary to control for market characteristics in the model.

Three-year change variables are constructed for these market characteristics and used in the cross-sectional study, accounting for possible relationships between the environmental shifts and systems' structures and indirect effects on hospital performance. Changes in levels of market variables from 1997 to 1994 prior the 1997 cross-sectional analysis and changes in levels of market variables from 2000 to 1998 prior the 2000 cross-sectional analysis are used.

Patient Characteristics

Patient characteristics are measured at the hospital level. Patient age is a categorical variable, having three groups: (1) the percentage of patients whose age is < 19 years (i.e., omitted category); (2) the percentage of patients whose age lies between 19 and 64 years; and (3) the percentage of patients whose age is over 64. Gender is measured as the percentage of patients who are female (percent of males is an omitted category). Race is measured as the percentage of white and non-white (percent of non-white is an omitted category). Volume captures the total number of patients at risk for this study's diseases or patient safety issues (i.e., denominators in calculating mortality rates and patient adverse events).

Patient acuity (mortality34 and severity34) is measured by the percentage of patients with 3 or 4 stages of risk of mortality and by the percentage of patients with 3 or 4 stages of severity of illness (3M mortality and severity scores). These variables control for patient features that may affect quality of care. Since mortality34 and severity34 are highly correlated, mortality34 is used for models estimating IQIs, and severity34 is used for models estimating PSIs. Case-mix severity index is a numeric variable, representing severity of Medicare cases. This variable comes from the CMS data files and is not correlated with patient acuity variables. Case-mix index averages around 1; values less than 1 represent hospitals with Medicare case-mixes that have lower severity than the average, and vice versa. It is important to control for hospital case-mix because hospitals that provide care to more severely ill patients may need more staffing and organizational inputs to produce the desired quality outcomes.

Cross-Sectional Analyses

Variables addressing a choice of a health system type.

Lagged quality outcomes and lagged operating margin and days cash on hand measure how a previous financial and quality performance may affect a current hospital's choice of a system type, addressing the feedback issue. Lagged operating margin is a numeric variable, measuring net income for hospital services in the year of 1995 and the year of 1998, i.e., two years before the 1997 and the 2000 three stage estimation models. Lagged days cash on hand indicate that the number of days that a hospital could cover its operating expenses (excluding depreciation and interest) with its unrestricted cash and investments in the years of 1995 and 1998. Lagged IQIs and lagged PSIs are measured as IQI and PSI quality signal factors that are summed over 4 IQIs and 5 PSIs in 1995 and 1998 for the 1997 and 2000 three stage estimation models.

Proportion of other hospitals that belong to more centralized health systems in a market in the prior time period (two years prior) is calculated by dividing the number of short-term general hospitals in a county for rural hospitals and a MSA for urban hospitals, other then hospital in question (target hospital), that belong to more centralized health systems (CHS and CPIHS) by the total number of short-term general hospitals in that county and MSA, excluding the target hospital. Some markets may only have one or two hospitals, thus, excluding target hospitals from the numerator and denominator is important to avoid spurious correlation.

Proportion of other hospitals that belong to more decentralized health systems in a market in the prior time period (two years prior) is derived by dividing the number of general hospitals in a county for rural hospitals and a MSA for urban hospitals, other then target hospital, that are affiliate with more decentralized health systems (DHS and MCHS) by the total number of short-term general hospitals in that county and MSA, excluding target hospitals.

A hospital's decision to conform to its environment may lead this hospital to join into a more predominant form of a health system in a market. Since a predominant system type is an environmental construct, which is external to an organization, it should not have a direct influence on quality of care provided in a particular hospital. Quality of care is more likely to be influenced by internal organizational factors, such as its structure and/or process.

Following Alexander and Morrisey (1988) and Bazzoli et al. (2000), measures of favorable market conditions (i.e., hospitals affiliated with systems were more likely to be located in favorable markets) to address the system type selection issue are presented.

Total population is the number of people living in a county or a MSA and possibly measures a resource base for hospitals. Per capita income is average income for a county or a MSA and may capture purchasing power of population and demand for health services. Proportion of population over 65 years old and eligible for Medicare is a numeric variable; and the CMS represents one of the major health care purchasers in the health market. Higher population, higher per capita income and greater proportion of the population that is 65+ represent a broad resource base and may motivate hospitals to join into systems to be able to take better advantage of favorable markets when compared to freestanding hospitals (Alexander and Morrisey, 1998, Bazzoli et al., 2000). Favorable market conditions may be related to a greater centralization of health systems. Centralized health systems may be more effective in providing services to large groups of people and navigating them through a continuum of care, because centralization may improve the system coordinating and communicating abilities (Shortell et al., 2000).

MDs per 1000 population is a ratio of practicing MDs by 1,000 population in a county or a MSA. Physicians may try to secure their inpatient practices in more competitive markets, i.e. areas with the greater number of MDs, by affiliating with health systems. Centralized health systems may be better suited to hire and retain physicians on staff because of their strategic and organizational predispositions. For example, the Kaiser Permanente health system is a good example of a highly centralized health system that employs physicians in a highly competitive physician market such as California. Therefore, physicians in highly competitive markets may prefer to work or to be affiliated with more centralized health systems, since centralized health systems may provide physicians with better job opportunities and job security.

Market conditions may directly affect structures, i.e. formation of various types of health systems, and, indirectly, processes of care provision, i.e. clinical integration. However, it is believed that preferable market conditions do not directly affect quality of care. Hospitals provide care to individual patients on a case-by-case basis and not discriminating by whether or not a patient comes from a market with greater number of people, per capita income, and proportion of the population that is 65+.

The number of physicians in a market may also not be directly related to quality of care, because other individual physicians' characteristics (i.e., physician qualification, expertise, and higher level of training) are more likely to be related to a physician component of quality (Hartz et al., 1989, Kelly and Hellinger, 1986) and are independent of the number of physicians in a market. However, data on physician professional characteristics are not available, which is a limitation of the current study.

Variables addressing a choice of a internal clinical processes and integration level. Proportion of area physicians aged 45–54 is the number of physicians in this age group in a country or a MSA divided by the total number of physicians in that market. Previous research demonstrates that physician–hospital integration is one of characteristics of clinical integration (Devers et al. 1994, Shortell et al. 1994). Older physicians may have a stronger alignment with hospitals in health systems, because physicians in this age category are more likely to assume leadership and decision-making positions in their health systems. It assumed that centralized health systems are more likely to grant physicians with greater decision making authority than other types of systems.

Therefore, physicians of older age may be more likely to pursue and to implement clinically integration policies and strategies promoted in more centralized systems. A level of internal clinical processes and integration should not directly correlate with physician age, since it is more likely to be correlated with other system characteristics – centralization, coordination, communication (Shortell, 2000) – independent of physician age.

Physicians and hospitals have formed various physician-organization arrangements (POAs) (Cave, 1995, Morrisey et al., 1996, Burns and Thorpe, 1993). POAs are associated with functional integration (Dynan et al., 1998). Dynan et al. (1998) classified hospitals as having: (1) tight-only hospital-physician arrangements if they had any combination of Management Service Organization (MSO), Integrated Salary Model (ISM), Model Medical Foundation (MF), Integrated Health Organization (IHO); (2) loose-only arrangements if they had Group Practice Without Walls (GPWW), Independent Practice Association (IPA), Physician-Hospital Organization (PHO) combinations; (3) hybrid arrangements with a combination of both tight and loose organizational forms. Dynan et al. (1998) suggested that hospitals with tight-only and hybrid POAs are more likely to facilitate process integration than loose-only arrangements due to differences in their strategic, structural, and financial characteristics. Madison (2004) and Cuellar and Gertler (working paper, 2002) identified several pathways through which POAs may influence quality outcomes.

For example, POAs provide a greater incentive for quality monitoring, improve cooperation and coordination in care delivery, overcome informational problems (providing incentives to remove agency problems), and may reduce transaction costs, and thus, improving patient treatment patterns and outcomes. Tight-only POAs strategy may achieve a greater level of clinical integration than other types of POAs, thus, having a direct effect on internal clinical processes and integration. However, POAs do not have a direct affect on quality, but through certain pathways (Madison, 2004; Cuellar and Gertler, working paper, 2002). Madison (2004) found that POAs did not have any measurable impact on patient treatment and outcome. Cuellar and Gertler (working paper, 2002) found that MF and ISM (i.e., tightly integrated models) provided better quality care than the other types of POAs.

Following Madison's (2004) and Cuellar and Gertler's (working paper, 2002) logic, it is suggested that tight-only POAs may improve process of care delivery, through greater levels of integration of internal clinical processes and indirectly affecting quality of care. It is proposed using types of POAs to account for a choice of an internal clinical processes and integration level, omitting a loose-only category. The description of the study variables, their construction and data sources are also presented in Table 2.

Table 2: Variables, Definitions, and Sources

Variable	Definition	Treatment in Analysis	Source of Data
Dependent Variables:			
Clinical Outcomes:			
IQI 15: AMI	IQI risk adjusted rates	Continuous variable	HCUP SID:
IQI 16: CHF	IQI risk adjusted rates	Continuous variable	1995–2000
IQI 17: Stroke	IQI risk adjusted rates	Continuous variable	HCUP SID:
IQI 20: Pneumonia	IQI risk adjusted rates	Continuous variable	1995–2000
PSI 15: Accidental puncture and laceration	PSI risk adjusted rates	Continuous variable	HCUP SID: 1995–2000
PSI 3: Decubitus ulcer	PSI risk adjusted rates	Continuous variable	HCUP SID:
PSI 7: Infection due to medical care	PSI risk adjusted rates	Continuous variable	1995–2000
PSI 12: Post-operative PE or DVT	PSI risk adjusted rates	Continuous variable	HCUP SID: 1995–2000
PSI 13: Post-operative sepsis	PSI risk adjusted rates	Continuous variable	HCUP SID: 1995–2000
Key Independent Variable:			
Hospital Affiliation with Various Health Systems or Groupings of Health Systems (CHS+CPIHS)	1 – hospitals in CHS; 2 – hospitals in CPIHS; 3 – hospitals in MCHS; 4 – hospitals in DHS; 5 – hospitals in IHS (omitted category)	Dummy variables	AHA:1995-2000
Internal Clinical Processes and Integration Variable:			
Initial assessment procedures: 1) Initial Assessment Procedures 2) Anesthesia care 3) Medication use 4) Operative procedures 5) Availability of patient specific information	Summed 5 JCAHO hospital compliance scores for hospital clinical process standards, ranging from 0 - no clinical integration - to 5 - fuller clinical integration	Categorical variable	JCAHO: 1995–2000
Hospital Characteristics:			
Hospital size	Total number of beds staffed and set up	Continuous variable	AHA:1995-2000
Hospital ownership	(1) Non-profit (2) For-profit (3) Public (omitted category)	Dummy variables	AHA:1995-2000
Service mix and scope	(1) 0 – 10 services (omitted category) (2) 10 – 20 services and (3) 20 – 30 services	Dummy variables	AHA:1995-2000
Hospital teaching status	(1) Major-teaching (2) Minor-teaching	Dummy variables	AHA:1995-2000

	(3) Non-teaching status (omitted category)		
Geographic location	(1) Urban (2) Rural (omitted category)	Dummy variables	AHA:1995-2000
Total nursing staff per staffed bed	Ratio of RNs and LPNs to staffed patient bed.	Continuous variable	AHA:1995-2000
RNs to LPNs ratio	Ratio of RNs to LPNs	Continuous variable	AHA:1995-2000
Operating margin for 1995 and 1998	Operating income/net patient revenue	Continuous variable	CMS:1993-2000
Days cash on hand for 1995 and 1998	(Cash + ST investments + unrestricted LT investments) / ((total expenses – depreciation) /)	Continuous variable	CMS:1993–2000
Market characteristics:			
Hirschman Herfindahl Index	Sum of squared market shares of inpatient days – a low HHI score represents a greater hospital competition.	Categorical variable: ranges between 0 and 1	AHA:1995-2000
HMO market share	Percentage of population covered by HMOs in a county or MSA – a low score means low HMO penetration.	Categorical variable: ranges between 0 and 1	InterStudy: 1995–2000
Number of HMOs	Count of HMOs operating in a county or MSA.	Continuous variable	InterStudy: 1995-2000
HHI change 1st period HHI change 2nd period	HHI (1997) – HHI (1994) HHI (2000) – HHI (1998)	Categorical variable	AHA:1995-2000
HMO share 1st period HMO share 2nd period	HMO share (1997) – HMO share (1994) HMO share (2000) – HMO share (1998)	Categorical variable	InterStudy: 1995-2000
# of HMO 1st period # of HMO 2nd period	# of HMO (1997) - # of HMO (1994) # of HMO (2000) - # of HMO (1998)	Continuous variable	InterStudy: 1995-2000
Patient characteristics:			
Patient age	(1) the % of patients whose age is < 19 years (omitted category) (2) the % of patients whose age lies between 19 and 64 years (3) the % of patients whose age is over 64	Categorical variable	HCUP SID: 1995-2000
Gender	The % of a hospital's patients who are female The % of a hospital's patients who are male (omitted category)	Categorical variable	HCUP SID: 1995-2000
Race	(1) the % of hospital's patients who are white (2) the % of non-white (omitted category)	Categorical variable	HCUP SID: 1995-2000
Volume	Number patients at risk for a certain IQI	Continuous variable	HCUP SID: 1995-

	and PSI		2000
Patient acuity (mortality34 and severity34)	- the % of a hospital's patients with mortality risk of stage 3 or 4 (IQI related) - the % of a hospital's patient mix with severity of illnesses risk of stage 3 or 4 (PSI related)	Continuous variables	HCUP SID: 1995-2000
Case-mix severity index	Averages around 1; values lesser than 1 represent cases with lower severity	Continuous variable	CMS case-mix files: 1995-2000
Cross-Sectional Analyses			
(a) Health System Choice			
Proportion of other hospitals that belong to more centralized health systems in a market	The total number of other general hospitals in more centralized health systems (CHS and CPIHS) by the total number of short-term general hospitals in that county or MSA, excluding a target hospital	Continuous variable	AHA:1995-2000
Proportion of other hospitals that belong to more decentralized health systems in a market	The total number of other general hospitals in more decentralized health systems (DHS and MCHS) by the total number of short-term general hospitals in that county or MSA, excluding a target hospital	Continuous variable	AHA:1995-2000
Total population	Number of population in 1000s living in a county or MSA	Continuous variable	ARF: 1995-2000
Per capita income	Per capita income in 1000s in a county or MSA	Continuous variable	ARF: 1995-2000
Population over 65 years old	Percent of population 65 and over years old in county and MSA	Continuous variable	ARF: 1995-2000
MDs per 1000 population	Ratio of practicing MDs by 1,000 population in a county or MSA	Continuous variable	ARF: 1995-2000
Lagged operating margin for 1995 and 1998	Operating income/net patient revenue	Continuous variable	CMS:1993–2000
Lagged days cash on hand for 1995 and 1998	(Cash + ST investments + unrestricted LT investments) / ((total expenses – depreciation) /)	Continuous variable	CMS:1993–2000
Lagged IQIs for 1995 and 1998	Summed over 4 IQIs	Continuous variables	HCUP SID: 1995–2000
Lagged PSIs for 1995 and 1998	Summed over 5 PSIs	Continuous variables	
(b) Choice of a Clinical Processes and Integration Level			
Proportion of area physicians aged 45–54	The number of physicians in this age group in a country or MSA divided by the total number of physicians in that market	Continuous variable	ARF: 1995-2000

Types of POAs	(1) tight-only POAs, combining MSO, ISM, MF, IHO (2) loose-only POAs, combining GPWW, IPA, PHO (omitted category) (3) hybrid POAs, combing different types	Categorical variable	AHA:1995-2000

Note: AHA—American Hospital Association; HCUP SID—Healthcare Cost and Utilization Project State Inpatient data bases; ARF—Area Resource Files; JCAHO—Joint Commission on Accreditation of Healthcare Organizations

Summary

This chapter described the research design, data sources, analytical plan, empirical models, and variable measurements to be used in the current study. Panel and cross-sectional models are proposed to identify relationships among hospital system types, clinical integration, and quality outcomes; and to determine which health system type or a grouping of health systems are more likely to achieve greater levels of integration of internal clinical processes and better quality performance. The data are assembled from multiple sources for the 1995–2000 period. Seven data bases are put together to provide sufficient measures of quality, hospital, patient, market characteristics for the current study. Patient risk-adjusted indicators (IQIs and PSIs) are generated from the HCUP SID, using the software provided by AHRQ. Four IQIs and five PSIs flag potential quality problems present in hospitals affiliated with various types of health systems. Performances of three models are compared: (1) the panel model, estimated by fixed effects or random effects; (2) the cross-sectional models for the separate years of 1997 and 2000, estimated by three stage estimation models; and (3) the cross-sectional, simplified model, if the measure of internal clinical processes and integration is weak.

CHAPTER 5: RESULTS

Introduction

First, descriptive statistics, such as system hospitals' organizational characteristics and compliance with JCAHO requirements, quality outcomes and trends in outcomes for the national sample and the empirical 11 states sample of system hospitals, are presented and discussed. Second, findings from the panel, longitudinal models evaluating the effects of system structures and internal processes on quality outcomes are reported and discussed. Finally, results from the cross-sectional analyses are reported and discussed.

Descriptive Analyses

The empirical sample is reduced from about 2,647 system hospitals in the national sample to approximately 857 system hospitals in the eleven states (i.e., HCUP SID data were only available for these states). There were 714 hospitals on average in different types of health systems per year in the empirical sample. The sample declined even further when the JCAHO data were merged in. There were 119 observations with complete data in 1995, 229 observations in 1996, 246 observations in 1997, 267 observations in 1998, 203 observations in 1999, and 234 observations in 2000.

Since JCAHO accredits the same panel of hospitals on the triennial basis, a decision was made to reorganize and reconstruct data into two panels: 1995–1997, representing the first JCAHO review year, and 1998–2000, representing the second

JCAHO review year. The number of observations was 600 on average in different panel, longitudinal models. Due to significant variations in the sample size, a careful descriptive analysis is necessary to identify differences in system hospitals' organizational characteristics between the national and empirical samples.

Organizational characteristics for hospitals and different types of health systems in the national and the 11 state empirical samples are presented and discussed at first. Next, adjusted least squared means (ALSM) approach are examined to identify trends in quality indicators for hospitals in different system types and over the study period for the empirical sample, adjusting for residual variation in patients' age, gender, acuity of illnesses, and case-mix index (CMI) at the hospital level.

System Hospitals' Organizational Characteristics

The descriptive results of hospital and system characteristics and trends in system hospitals are discussed for the national and empirical samples. Results of t-tests and Chi-squared tests of organizational characteristics between the national and the empirical samples are compared. Then hospital characteristics by five system types averaged over six years of data and Chi-squared tests of differences in organizational characteristics for these hospitals in five system types are evaluated. Hospital compliance-noncompliance with JCAHO requirements (i.e., clinical process and integration measures) is presented in a series of tables and graphs and compared for the national and empirical samples. Trends in mortality (IQI) and patient safety (PSI) rates adjusted for several hospital characteristics for the empirical sample hospitals over the study period are also reported. The following sections separately discuss descriptive tables and graphs.

Tables 3 and 4 present organizational characteristics of system hospitals in the national and the empirical (11 states) samples over the study period from 1995 to 2000. Some differences may be visually detected in these characteristics for the national and empirical samples. For example, the percentages of hospitals in different system types did not vary in the national sample (Table 3) in comparison with the empirical sample that varied at a higher rate for system hospitals (Table 4). However, the trends over time were similar in both samples, though changes were less dramatic for the national sample. In the following paragraphs, changes in hospital affiliation with different types of health systems over time are described in a greater detail, because these are main structural characteristics in this study.

In the national sample, the percent of hospitals in Centralized Health Systems (CHS) fluctuated around 5.25–5.75 percent during the 1995-1996 period (Table 3). The percent then declined to 3.92 percent in 1998 and increased to 7.87 percent in 2000 (Table 3). In the empirical sample, the percent of CHS hospitals ranged between 5.28 percent-7.55 percent over the 1995–1996 period, then sharply dropped to 1.31 percent in 1998 and climbed to 9.33 in 2000 (Table 4). The representation of hospitals in Centralized Physician Insurance Health Systems (CPIHS) decreased from 11.40 percent in 1995 to 7.93 percent in 1997, increased to about 10 percent in 1998 and 1999, and then declined to 7.64 percent in 2000 in the national sample (Table 3). In the eleven state sample, the percent of hospitals in CPIHS decreased steadily from 13.88 percent in 1995 to 6.02 percent in 1998, increased to 7.23 percent in 1999, and then experienced a sharp decline to 2.76 percent in 2000 (Table 4).

Table 3: System Hospitals' Organizational Characteristics in the National Sample Over the Study Period

Categories	1995	1996	1997	1998	1999	2000
Number of beds	176.56	175.71	176.68	173.90	174.70	176.17
Centralized Health Systems (%)	5.25	5.75	5.29	3.92	4.11	7.87
Centralized Physician Insurance Health Systems (%)	11.40	8.63	7.93	10.28	10.70	7.64
Moderately Centralized Health Systems (%)	20.36	26.88	27.14	31.24	32.32	33.16
Decentralized Health Systems (%)	52.40	45.30	47.23	39.99	39.23	41.35
Independent Hospital Systems (%)	10.60	13.44	12.41	14.57	13.63	9.97
Public (%)	17.22	16.64	15.48	15.07	14.76	14.05
For-profit (%)	20.96	21.55	23.13	22.52	21.80	22.08
Voluntary (%)	61.83	61.81	61.39	62.41	63.44	63.86
Major teaching (%)	6.32	6.58	6.67	6.67	6.62	6.76
Minor teaching (%)	14.11	14.49	14.88	14.65	14.53	12.12
Non-teaching (%)	79.57	78.94	78.45	78.68	78.85	81.12
Service Mix and Scope:						
0 - 10 (%)	55.02	54.21	54.00	56.50	54.91	54.32
10 - 20 (%)	32.93	32.53	32.47	30.45	32.07	31.99
20 - 30 (%)	12.05	13.26	13.53	13.05	13.02	13.69
Urban (%)	72.99	72.85	73.04	73.04	73.23	73.20
Rural (%)	27.01	27.15	26.96	26.96	26.77	26.80
Cash Flow to Total Revenue (%)	10.28	10.42	10.47	8.88	8.20	8.81
RN Percent of Licensed Nursing (%)	81.47	82.43	82.32	83.32	83.66	84.14
Sample Size	2,672	2,692	2,667	2,654	2,613	2,588

Table 4: System Hospitals' Organizational Characteristics in the Empirical Sample (11 states) Over the Study Period

Categories	1995	1996	1997	1998	1999	2000
Number of beds	205.10	204.47	205.72	205.01	207.14	208.43
Centralized Health Systems (%)	5.28	7.55	6.68	1.31	1.30	9.33
Centralized Physician Insurance Health Systems (%)	13.88	7.69	6.02	6.96	7.23	2.76
Moderately Centralized Health Systems (%)	26.55	33.57	33.69	36.27	39.88	42.84
Decentralized Health Systems (%)	50.53	47.27	50.00	48.49	44.65	41.79
Independent Hospital Systems (%)	3.77	3.92	3.61	6.96	6.94	3.29
Public (%)	12.82	12.40	11.64	11.37	11.47	10.55
For-profit (%)	20.21	20.67	22.35	21.23	21.51	21.82
Voluntary (%)	66.97	66.93	66.01	67.40	67.02	67.63
Major teaching (%)	7.27	7.58	7.60	7.66	7.80	7.91
Minor teaching (%)	17.44	17.91	18.43	18.79	18.79	14.75
Non-teaching (%)	75.29	74.51	73.96	73.55	73.40	77.34
Service Mix and Scope:						
0 - 10 (%)	37.02	36.69	38.14	43.29	41.39	39.60
10 - 20 (%)	46.20	44.52	43.06	38.93	40.94	41.83
20 - 30 (%)	16.78	18.79	18.79	17.79	17.67	18.57
Urban (%)	81.32	81.10	81.21	80.87	80.87	80.98
Rural (%)	18.68	18.90	18.79	19.13	19.13	19.02
Cash Flow to Total Revenue (%)	9.83	10.50	9.97	8.49	8.71	9.23
RN Percent of Licensed Nursing (%)	86.04	86.56	86.66	87.51	87.65	88.12
Sample Size	855	862	859	853	837	825

The percent of hospitals in Moderately Centralized Health Systems (MCHS) has been steadily growing from 20.36 percent to 33.16 percent over the study period in the national sample (Table 3). A similar trend was also found in the empirical sample, i.e. increasing from 26.55 percent to 42.88 percent. For hospitals in the Decentralized Health Systems (DHS), a decreasing trend from 52.40 percent in 1995 to 39.23 percent was observed in 1999, which increased up to 41.35 percent by 2000 in the national sample. A decreasing trend was also observed in the 11 state sample for the same system type, i.e. from 50.53 percent in 1995 to 41.79 percent in 2000 (Table 4). The percentage of hospitals in Independent Hospital Systems (IHS) has been increasing up to 14.57 percent in 1998, but then declined to 9.97 percent in 2000 in the national sample. In the empirical sample, the percentage of hospitals in IHS has increased from around 3.6 percent in the beginning for the study period to 6.95 percent in 1998 and 1999, but then sharply declined to 3.29 percent in 2000.

Other characteristics are described as follows. Overall, hospital organizational characteristics were fairly stable from one year to another in both samples. For example, in the national sample, the average number of hospital beds has been steadily and slightly decreasing from 176.56 in 1995 to 173.90 in 1998, and then increased up to 176.17 in 2000. The average number of hospital beds in the empirical sample was greater then in the national sample by approximately 30 beds. During the 1995–1998 period, the average number of beds had change little, hovering around 205 beds. System hospitals in the empirical sample had a smaller percent of public hospitals and larger percentages of voluntary hospitals in comparison with the national sample (Table 3 and 4). A greater percentage of hospitals in the empirical sample were in major- or minor-teaching categories, provided a greater mix and scope of services, located in urban areas, and had more nursing staff. The results of t-tests and Chi-squared tests comparing system hospitals' characteristics for the empirical and the national samples are provided later in the text.

Figure 5 provides a visual depiction of the trends in hospitals by system type over the study period for the empirical sample. A decreasing trend for hospitals in CHS from 1995 to 1998 is consistent finding with the previous research (Bazzoli et al., 2001). However, an increase in hospitals in the CHS category after 1998 has not yet been studied. A steady increase in the percent of hospitals in MCHS and a decrease in the percent of hospitals that are DHS over the study period can be observed.

In addition, t and Chi-squared tests were conducted on data pooled across six years for both the national and the 11 state empirical samples to assess whether the findings of this study can be generalizable to system hospitals in the entire country. These tests reveal that hospitals in the empirical sample have a larger mean number of beds than in the national sample (205.96 vs. 175.65, respectively) (Table 5). The distribution of hospitals by system types in the 11 state and the national samples are also significantly different with the exception of hospitals in Centralized Health Systems (CHS).

The percentage of CHS hospitals is similar in both samples (5.37 percent vs. 5.28 percent). However, the national sample has larger percentage of hospitals in Centralized Physician Insurance Health Systems (CPIHS) and in Independent Hospital Systems (IHS)

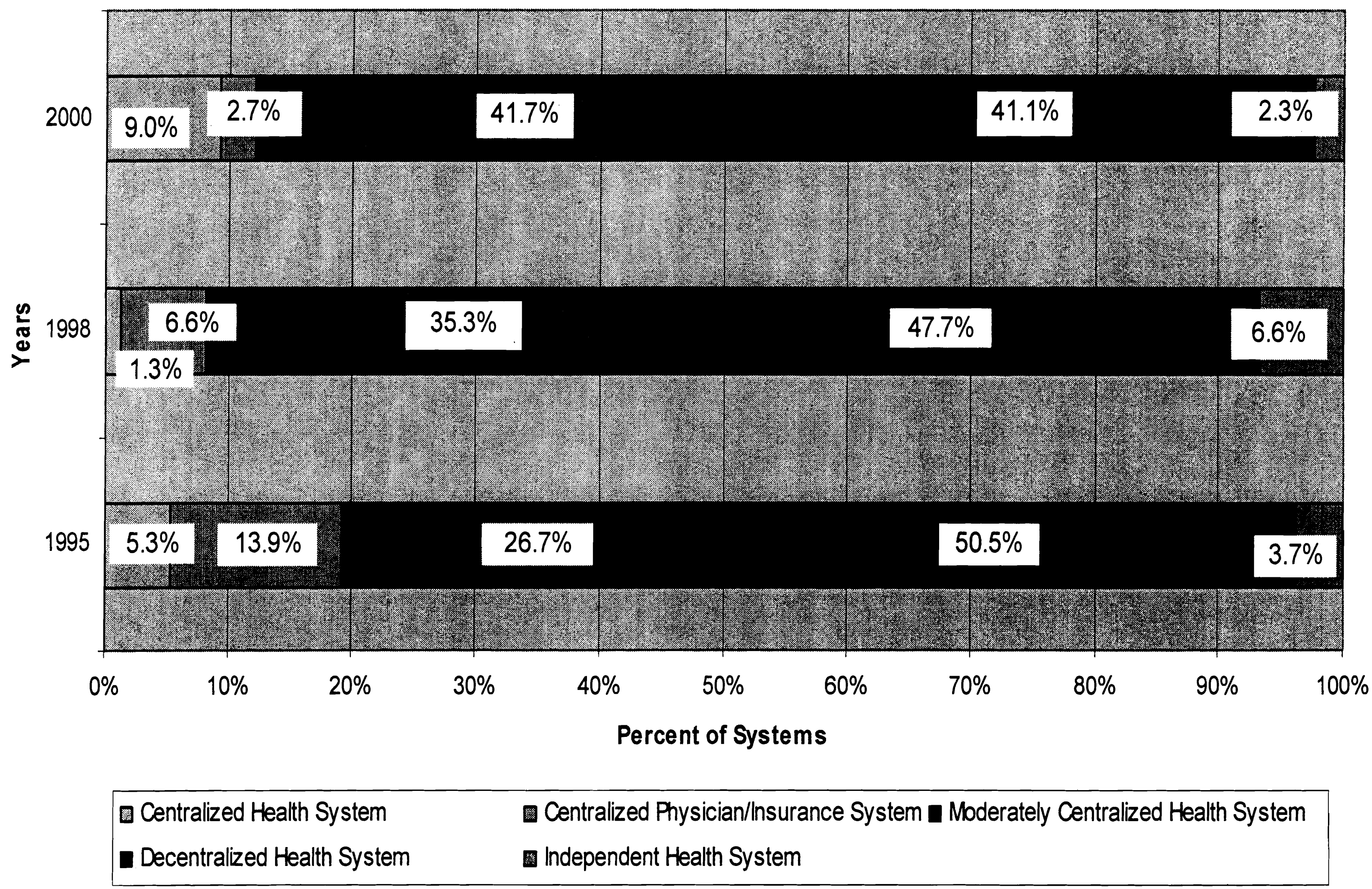

Figure 5: Trends in Hospitals in Different Types of Health Systems for the Empirical Sample

Table 5: Comparison of the National Sample and the Empirical Sample – System Hospitals' Characteristics Pooled Over the Study Period

	National Sample		11 State Sample			
	Mean	Std Dev	Mean	Std Dev	Chi-squared (or t-) value	Pr>|t|
Number of Beds	175.65	174.89	205.96	187.76	10.24	<.0001
Centralized Health Systems (%)	5.37	20.42	5.28	20.22	0.08	0.7736
Centralized Physician Insurance Health Systems (%)	9.40	23.55	7.28	23.55	19.28	<.0001
Moderately Centralized Health Systems (%)	28.60	26.54	35.62	45.30	74.07	<.0001
Decentralized Health Systems (%)	44.18	42.83	47.07	48.56	9.33	0.0022
Independent Hospital Systems (%)	12.45	30.14	4.75	19.22	209.57	<.0001
Public (%)	15.55	36.24	11.72	32.16	45.79	<.0001
For-profit (%)	22.00	41.43	21.29	40.94	1.15	0.2833
Voluntary (%)	62.45	48.43	66.99	47.03	34.66	<.0001
Major Teaching (%)	6.60	24.83	7.64	26.56	6.52	0.0107
Minor Teaching (%)	14.14	34.84	17.70	38.17	38.63	<.0001
Non-teaching (%)	79.26	40.55	74.66	43.50	48.05	<.0001
Service Mix and Scope:						
0 - 10 (%)	54.82	49.77	39.35.	48.86	414.47	<.0001
10 - 20 (%)	32.07	46.68	42.58	49.45	212.38	<.0001
20 - 30 (%)	13.10	33.74	18.06	38.48	88.11	<.0001
Urban (%)	73.06	44.37	81.06	39.19	146.02	<.0001
Rural (%)	26.94	44.37	18.64	39.94	146.03	<.0001
Cash Flow to Total Revenue (%)	9.53	8.89	9.47	8.62	-0.36	0.7206
RN Percent of Licensed Nursing (%)	82.88	11.94	87.08	8.76	20.94	<.0001
Sample Size	15,886		5,147			

than the national sample (9.40 percent vs. 7.28 percent and 12.45 percent vs. 4.75 percent, respectively). The percentage of hospitals in Moderately Centralized Health Systems (MCHS) and Decentralized Health Systems (DHS) is greater in the empirical sample (35.62 percent vs. 28.6 percent and 47.07 percent vs. 44.18 percent, respectively).

A smaller percentage of system hospitals has public ownership in the empirical sample than in the national sample (11.72 percent vs. 15.55 percent). The eleven state sample has a similar percentage of investor-owned hospitals (21.29 percent vs. 22.00 percent) and a larger percent of voluntary hospitals (and 66.99 percent vs. 62.45 percent) in comparison with the national sample (Table 3). Relatively more system hospitals were in major and minor teaching categories in the empirical sample than in the national sample (7.64 percent vs. 6.60 percent and 17.70 percent vs. 14.14 percent, respectively).

Hospitals in the empirical samples provide a greater mix and number of services (18.06 percent vs. 13.10 percent for the 20–30 service category and 42.58 percent vs. 32.07 percent for the 10–20 service category) and less likely to be in the 0–10 service category (39.35 percent vs. 57.82 percent) than hospitals nationally. Hospitals in the empirical sample are more likely to be located in urban areas (81.06 percent vs. 73.06 percent) and less likely in rural areas (18.64 percent vs. 26.94 percent). The eleven state sample hospitals have a greater percentage of total nursing staff that are RNs (87.08 percent vs. 82.88 percent). There is no difference in the ratio of cash flow to total revenue between the two samples (Table 5).

Based on the t and Chi-squared tests, it is concluded that the empirical (11 state) sample of system hospitals significantly differs from the national sample of system hospitals. The findings of the current study cannot be generalized to an average system hospital. Hospitals in the empirical sample are more likely to be disproportionately urban, larger in size, voluntary, nonpublic, and having a higher level teaching status and greater service complexity and nurses that are RNs. Thus, the findings are limited to system hospitals in these eleven states.

Table 6 presents organizational characteristics for hospitals in the different types of health systems, averaged over six years of data in the eleven state empirical sample. Chi-squared tests were conducted to compare organizational characteristics of hospitals by system types to assess similarities and differences in different system hospitals. Hospitals in CHS and CPIHS are on average larger in size (276 and 262 number of beds), followed by MCHS with 212, DHS with 189, and IHS with 164 beds (Table 6). Although most of hospitals in these five system types are voluntary, non-profit hospitals, a greater percentage of DHS and IHS hospitals have for-profit status (39.85 percent and 25.80 percent, respectively); and 23.49 percent of CHS hospitals are publicly owned.

There is a descending progression in the percentages of system hospitals that are major teaching hospitals – 15.86 percent (highest) of CHS hospitals are major teaching institutions versus 3.5 percent (lowest) of IHS hospitals are major teaching. A similar dynamic is observed in terms of the service mix and scope: hospitals in CHS offer a greater number and scope of services than hospitals in other types of systems. Hospitals in all system types in the empirical sample tend to be located in urban areas, though more hospitals in MCHS and DHS are more likely to be located in rural areas (19.61 percent and 23.75 percent, respectively). There are no differences in hospital cash flow (all

Tables 6: Hospital Characteristics by System Type and Averaged Over the Study Period in the Empirical Sample (1995–2000)

	CHS	CPIHS	MCHS	DHS	IHS	Chi-squared (or t-) value	Pr>|t|
Number of Beds	276.97	262.78	211.62	189.43	164.31	4142.70	<.0001
Public (%)	23.49	13.98	7.04	13.92	9.63	53.25	<.0001
For-profit (%)	1.37	2.34	8.72	39.85	25.80	617.64	<.0001
Voluntary (%)	75.14	83.68	84.24	46.23	64.57	627.71	<.0001
Major Teaching (%)	15.86	14.61	10.52	2.95	3.50	137.52	<.0001
Minor Teaching (%)	33.73	24.41	20.28	15.45	17.85	29.38	<.0001
Non-teaching (%)	50.42	60.98	69.20	81.60	78.65	136.99	<.0001
Service Mix and Scope:							
0 - 10 (%)	19.58	26.83	35.01	36.68	54.92	67.68	<.0001
10 - 20 (%)	54.91	39.05	43.55	46.96	40.19	14.93	<.0001
20 - 30 (%)	25.51	34.12	21.44	16.36	4.89	86.12	<.0001
Urban (%)	96.16	90.33	80.39	76.25	91.19	84.23	<.0001
Rural (%)	3.84	9.67	19.61	23.75	8.81	84.23	<.0001
Cash Flow to Total Revenue (%)	9.00	8.16	9.32	10.81	10.00	11278.82	.198
RN Percent of Licensed Nursing (%)	90.20	89.61	87.40	86.32	85.99	11247.04	.005
Sample Size	38	52	254	337	33		

around 8–10 percent) for different system types. Hospitals in centralized health systems tend to have a greater percentage of RNs of licensed nursing staff when compared with other system types. In conclusion, there are clear and statistically significant organizational differences in hospitals in different types of health systems in almost all system and hospital characteristics (except for the cash flow to total revenue), and it is important to control for these differences in the multivariate settings.

System Hospitals' Compliance with JCAHO Requirements

As discussed earlier – the JCAHO data were reorganized into 2 panels: 1995–1997, representing the first JCAHO review year, and 1998–2000, representing the second JCAHO review year. Table 5 presents descriptive statistics on the hospitals' compliance/noncompliance with the five JCAHO performance area variables used as clinical process measures for the current study, comparing hospitals' JCAHO scores in the national and the eleven state samples.

Big differences in Joint Commission for Accreditation of Health care Organization's compliance in three out of five performance areas from the first to the second review period are observed in both samples and presented in Table 7. An increase in non-compliance in initial patient assessment procedures was present (24.73 percent versus 36.29 percent for the national sample and 23.60 percent versus 33.33 percent for the eleven state sample), and decreases in non-compliance in medication use (35.11 percent versus 29.71 percent and 36.01 percent versus 28.03 percent, respectively) and availability of patient specific information (44.37 percent versus 37.56 percent and 42.83 percent versus 38.38, respectively) were also notable.

Table 7: System Hospitals Not in Compliance with JCAHO Performance Area Requirements in the National and Empirical Samples in Two Study Periods

	1st Study Period (95-97)					
	National Sample		11 State Sample			
	N	% not in compliance	N	% not in compliance	Chi-squared	$Pr>\lvert t\rvert$
Initial Assessment Procedures	3,312	24.73	572	23.60	0.33	0.56
Anesthesia Care	3,047	4.30	571	6.30	4.39	0.04**
Medication Use	3,312	35.11	572	36.01	0.17	0.68
Operative Procedures	3,050	5.54	571	4.90	0.38	0.53
Availability of Patient Specific Information	3,311	44.37	572	42.83	0.47	0.49
	2nd Study Period (98-00)					
	National Sample		11 State Sample			
	N	% not in compliance		% not in compliance	Chi-squared	$Pr>\lvert t\rvert$
Initial Assessment Procedures	3,703	36.29	693	33.33	2.23	0.14
Anesthesia Care	3,493	3.75	689	3.19	0.51	0.48
Medication Use	3,702	29.71	692	28.03	0.79	0.37
Operative Procedures	3,504	5.99	690	6.38	0.15	0.67
Availability of Patient Specific Information	3,703	37.56	693	38.38	0.17	0.68

Note: * means significance at .10 level, ** at .05 level, *** at .01 level

In the first study period, about a quarter of hospitals in the national and the empirical samples (24.73 percent and 23.60 percent, respectively) were not in compliance for initial assessment procedures; about one third (35.11 percent and 36.01 percent) – for medication use, and about a half (44.37 percent and 42.83 percent) – for availability of patient specific information in both samples. Hospitals compliance with JCAHO performance areas for anesthesia care and operative procedures was high in both the national and eleven state samples (95.70 percent and 93.70 percent for anesthesia care and 94.46 percent and 95.10 percent for operative procedures) (Table 7). Chi-squared test detected that hospitals in the national and empirical samples were different from each other on the anesthesia care compliance in the first review year, with fewer hospital in the eleven state sample in compliance.

In the eleven state sample, Table 8 and Figure 6 demonstrate a visible decrease in noncompliance in three (anesthesia care, medication use, availability of patient specific information) out of five JCAHO performance areas in the balanced sample of hospitals that have JCAHO data in both study periods. Noncompliance with JCAHO performance areas requirements for initial assessment procedures increased from 23.28 percent in the first study period to 35.83 percent in the second study period. Noncompliance with JCAHO performance areas requirements for operative procedures has just slightly increased from 4.46 percent to 6.29 percent of study hospitals (Table 8). In conclusion, the national and empirical eleven state samples were not different from each other on compliance with JCAHO requirements with the exception of anesthesia use in the first

Table 8: Percent of System Hospitals Not in Compliance with JCAHO Performance Area Requirements in the Empirical Sample in Two Study Periods

	11 State Sample			
	1st study period (95-97)		2nd study period (98-00)	
	N	% not in compliance	N	% not in compliance
Initial Assessment Procedures	494	23.28	494	35.83
Anesthesia Care	494	6.71	494	3.25
Medication Use	493	36.51	493	26.57
Operative Procedures	493	4.46	493	6.29
Availability of Patient Specific Information	492	42.31	492	40.89

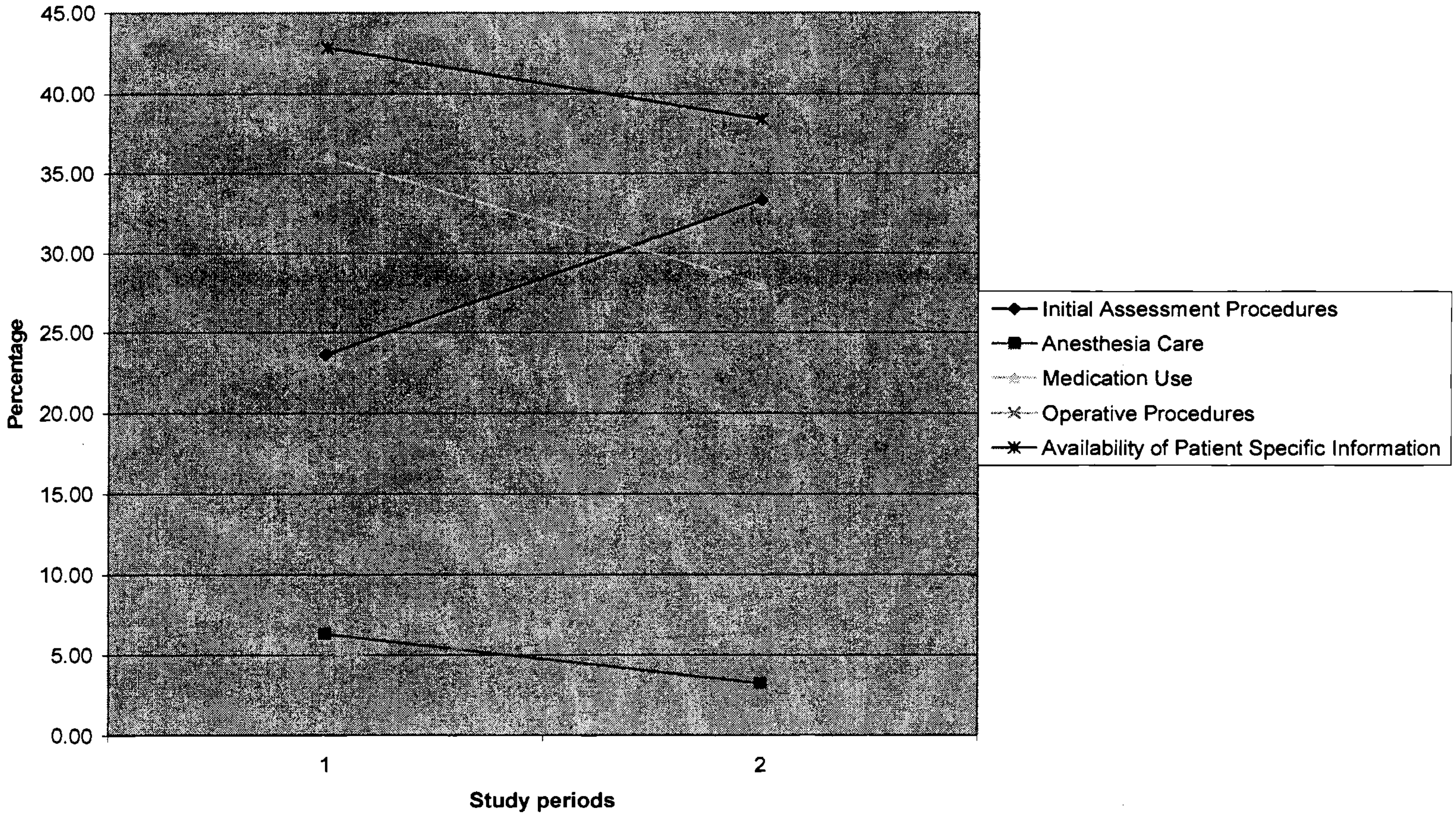

Figure 6: Trends in System Hospitals Not in Compliance with JCAHO Performance Areas in the Empirical Sample

review year. Thus, multivariate findings in terms of hospital compliance with JCAHO requirements may be nationally generalizable to an average hospital. A significant variation in compliance with JCAHO requirements among the study hospitals was observed. In general, the hospital compliance with JCAHO requirements has been improving over the study period for three out of five JCHAO performance areas, which may be showing the impact of the Institute of Medicine reports in 1999 and 2000 on medical errors and quality and also increased pressure on JCAHO to be more stringent and force hospitals to improve these performance areas.

Adjusted Least Squared Means

Adjusted Least Squared Means (ALSM) were calculated separately for each IQI and PSI and for 1995, 1998, and 2000 years. The ALSM procedure removes residual differences in hospital level patient characteristics, severity and complication that had measurable and significant effects on IQI mortality and PSI adverse event rates.

$$y = \alpha_0 + \alpha_1 S_1 + \alpha_2 P_2 + \varepsilon$$

where y is a vector defining quality outcomes (i.e., IQIs and PSIs);

S is a vector representing dummy variables for different system types, i.e. Centralized Health Systems (CHS),

Centralized Physician/Insurance Health Systems (CPIHS),

Moderately Centralized Health Systems (MCHS),

Decentralized Health Systems (DHS),

Independent Health System (IHS – a reference category);

P represents patient characteristics, i.e. age, gender, patient acuity, and CMI.

The estimated regressions were run with the system type variables and the key patient characteristics, holding these characteristics at their mean values. By doing that, the ALSM procedure isolates the hospital systems' effects on mortality and adverse events. Tables 9 and 10 demonstrate IQI mortality rates and PSI adverse event rates for the Adjusted Least Squared Means Models in 1995, 1998, and 2000. Mortality and adverse event rates are presented by the system type, where Independent Hospital System (IHS) is a reference category. Regression coefficients and standard errors represent differences (some of which were statistically significant at varying levels of significance) in the mortality and adverse event rates by system types in comparison with the IHS.

A comparison of the adjusted least squared means for the IQI mortality rates for AMI, CHF, Stroke, and Pneumonia revealed that the "best performers" (i.e. system hospitals with the lowest mortality rate) were hospitals in DHS, CHS, and CPIHS when compared to IHS hospitals during the 1995–2000 period. The ALSM mortality rates were significantly lower for these latter system types relative to IHS (Table 9). This relationship held over time for hospitals in DHS, but it was less stable for hospitals in CHS and CPIHS as shown in Table 9 and Figure 7 (the graph with AMI and CHF was chosen because this conditions were most illustrative of the differences among hospital systems).

The descriptive ALSM findings suggest that both decentralization and centralization of hospital structures may decrease mortality rates for AMI, CHF, Stroke, and Pneumonia. This finding is in disagreement with the conceptual model and opposing Scenarios 1 and 2, where only one, either centralized or decentralized, health system

Table 9: IQI Mortality Rates for the Adjusted Least Squared Means Models in 1995, 1998, and 2000

System Type	IQI 15: AMI - 1995			IQI 15: AMI - 1998			IQI 15: AMI - 200		
	Rate	Coef.	Std. Err.	Rate	Coef.	Std. Err.	Rate	Coef.	Std. Err.
IHS	13.37			9.96			12.44		
CHS	11.88	-1.49	0.94	6.84	-3.12*	1.84	11.86	-0.59	1.15
CPIHS	12.94	-0.43	0.64	8.65	-1.30	1.01	9.72	-2.72	1.75
MCHS	12.48	-0.90	0.56	10.11	0.16	0.68	13.66	1.21	0.92
DHS	12.54	-0.83*	0.48	8.27	-1.69***	0.65	10.97	-1.48	0.93
Sample Size		629			606			577	
System Type	IQI 16: CHF - 1995			IQI 16: CHF - 1998			IQI 16: CHF - 2000		
	Rate	Coef.	Std. Err.	Rate	Coef.	Std. Err.	Rate	Coef.	Std. Err.
IHS	5.39			4.46			5.34		
CHS	4.60	-0.79	0.48	3.09	-1.36	1.00	5.58	0.24**	0.39
CPIHS	5.86	0.47	0.33	3.74	-0.72	0.51	4.07	-1.27	0.61
MCHS	5.61	0.22	0.27	4.49	0.04	0.32	5.49	0.15	0.29
DHS	4.37	-1.01***	0.23	3.96	-0.50	0.30	4.57	-0.77***	0.29
Sample Size		756			812			730	
System Type	IQI 17: Stroke - 1995			IQI 17: Stroke - 1998			IQI 17: Stroke - 2000		
	Rate	Coef.	Std. Err.	Rate	Coef.	Std. Err.	Rate	Coef.	Std. Err.
IHS	12.99			11.19			14.24		
CHS	10.40	-2.59***	0.84	9.23	-1.96	1.73	13.63	-0.61	0.92
CPIHS	12.73	-0.26	0.57	9.66	-1.54	0.94	10.27	-3.97***	1.43
MCHS	12.72	-0.27	0.49	11.11	-0.09	0.60	14.02	-0.21	0.71

Continued

Table 9: IQI Mortality Rates for the Adjusted Least Squared Means Models in 1995, 1998, and 2000 (Continued)

System Type	IQI 15: AMI - 1995			IQI 15: AMI - 1998			IQI 15: AMI - 200		
	Rate	Coef.	Std. Err.	Rate	Coef.	Std. Err.	Rate	Coef.	Std. Err.
DHS	10.69	-2.30***	0.41	9.39	-1.80***	0.57	12.35	-1.89***	0.72
Sample Size		685			684			653	
System Type	IQI 20: Pneumonia - 1995			IQI 20: Pneumonia - 1998			IQI 20: Pneumonia - 2000		
	Rate	Coef.	Std. Err.	Rate	Coef.	Std. Err.	Rate	Coef.	Std. Err.
IHS	8.59			8.05			9.48		
CHS	6.43	-2.17***	0.62	6.44	-1.61	1.27	9.71	0.23	0.63
CPIHS	8.78	0.18	0.42	7.25	-0.80	0.66	6.66	-2.82***	0.98
MCHS	8.59	0.00	0.35	7.80	-0.25	0.41	9.78	0.31	0.48
DHS	7.17	-1.42***	0.30	6.41	-1.64***	0.39	8.41	-1.07**	0.48
Sample Size		792			787			761	

Note: * means significance at .10 level, ** at .05 level, *** at .01 level

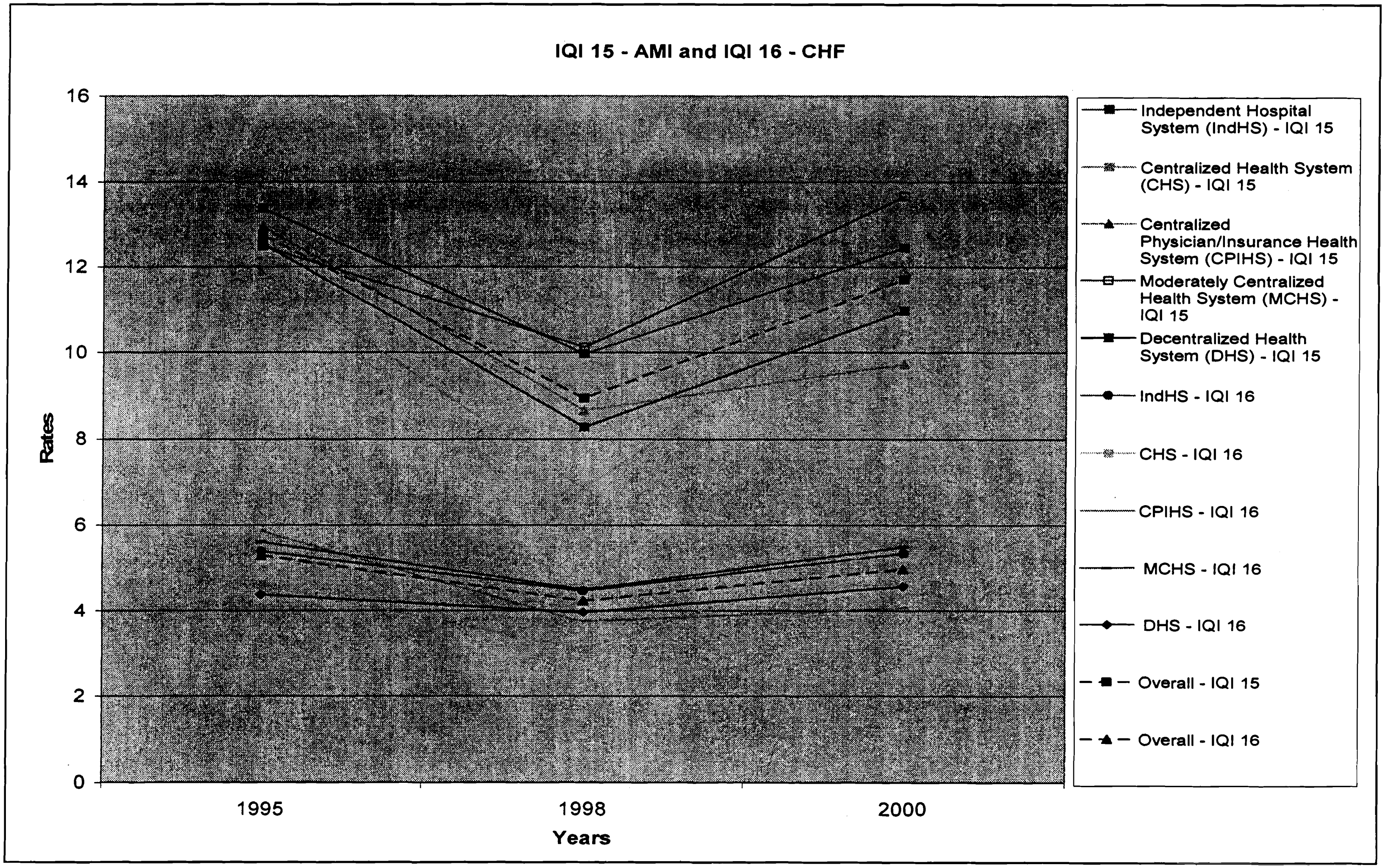

Figure 7: Trends in Acute Myocardial Infarction (AMI) and Congestive Heart Failure (CHF), 1995–2000

structure was predicted to have better quality outcomes. However, the ALSM findings for IQIs suggested a possible system effect on mortality rates in system hospitals, which is the most valuable finding at this stage. Multivariate analyses are going to be conducted that would provide statistical control for other factors that may affect quality outcomes.

In terms of PSI adverse event rates, no clear patterns exist across system types (Table 10 and Figure 8). Mortality rates and patient safety adverse events increased or leveled after 1998 (Figures 7 and 8) which may be suggestive of the BBA effect or possible changes in the hospital reporting patterns of medical errors after the Institute of Medicine (IOM) reports in 1999 and 2000. The longitudinal study needs to look for potential adverse quality effects from the BBA, and/or potentially other market/policy factors, and/or reporting of adverse events post the IOM report (1999), since historically there was a substantial under-reporting of adverse events in hospitals.

In conclusion, the ALSM demonstrates that there are statistically significant differences in mortality rates between various types of health systems, although patterns are less clear for the patient safety indicators. Multivariate analyses are need to examine how the system characteristics and internal clinical processes adopted by different system types may affect quality performance as measured as IQI and PSI and holding other factors constant. The following sections describe correlation analysis and the results of the panel, multivariate models.

Correlation Analysis

Prior to performing a correlation analysis, outliers on dependent and independent variables were identified and set to missing. These outliers could significantly skew the

Table 10: PSI Adverse Event Rates for the Adjusted Least Squared Means Models in 1995, 1998, and 2000

System Type	PSI 3: Decubitus ulcer - 1995			PSI 3: Decubitus ulcer - 1998			PSI 3: Decubitus ulcer - 2000		
	Rate	Coef.	Std. Err.	Rate	Coef.	Std. Err.	Rate	Coef.	Std. Err.
IHS	2.07			1.95			1.72		
CHS	1.81	-0.26	0.28	2.36	0.41	0.42	2.41	0.68***	0.22
CPIHS	1.88	-0.18	0.19	1.98	0.02	0.22	1.82	0.09	0.35
MCHS	1.59	-0.48***	0.16	1.79	-0.16	0.14	2.07	0.35**	0.16
DHS	1.96	-0.11	0.13	2.02	0.07	0.13	1.97	0.24	0.17
Sample size	810			808			774		
System Type	PSI 7: Infection due to medical care - 1995			PSI 7: Infection due to medical care - 1998			PSI 7: Infection due to medical care - 2000		
	Rate	Coef.	Std. Err.	Rate	Coef.	Std. Err.	Rate	Coef.	Std. Err.
IHS	0.13			0.17			0.18		
CHS	0.14	0.01	0.02	0.23	0.06*	0.04	0.19	0.01	0.02
CPIHS	0.12	-0.01	0.01	0.17	0.01	0.02	0.20	0.02	0.03
MCHS	0.13	-0.01	0.01	0.17	0.00	0.01	0.19	0.01	0.02
DHS	0.12	-0.01	0.01	0.17	0.00	0.01	0.16	-0.02	0.02
Sample size	817			819			894		
System Type	PSI 12: Post-operative PE or DVT - 1995			PSI 12: Post-operative PE or DVT - 1998			PSI 12: Post-operative PE or DVT - 2000		
	Rate	Coef.	Std. Err.	Rate	Coef.	Std. Err.	Rate	Coef.	Std. Err.
IHS	0.55			0.74			0.80		
CHS	0.61	0.06	0.08	0.92	0.17	0.16	1.0	0.20**	0.08
CPIHS	0.53	-0.02	0.05	0.79	0.05	0.08	0.84	0.03	0.12
MCHS	0.58	0.03	0.05	0.68	-0.07	0.05	0.83	0.03	0.06

Continued

Table 10: PSI Adverse Event Rates for the Adjusted Least Squared Means Models in 1995, 1998, and 2000 (Continued)

System Type	PSI 3: Decubitus ulcer - 1995			PSI 3: Decubitus ulcer - 1998			PSI 3: Decubitus ulcer - 2000		
	Rate	Coef.	Std. Err.	Rate	Coef.	Std. Err.	Rate	Coef.	Std. Err.
DHS	0.57	0.02	0.04	0.76	0.02	0.05	0.86	0.06	0.06
Sample Size	789			782			759		
System Type	PSI 13: Post-operative sepsis - 1995			PSI 13: Post-operative sepsis - 1998			PSI 13: Post-operative sepsis - 2000		
	Rate	Coef.	Std. Err.	Rate	Coef.	Std. Err.	Rate	Coef.	Std. Err.
IHS	0.47			0.98			0.99		
CHS	0.45	-0.02	0.13	1.03	0.05	0.30	0.94	-0.05	0.17
CPIHS	0.37	-0.10	0.09	1.01	0.03	0.17	0.70	-0.29	0.27
MCHS	0.39	-0.09	0.08	0.91	-0.07	0.10	0.88	-0.11	0.13
DHS	0.49	0.02	0.06	0.90	-0.08	0.10	1.15	0.16	0.14
Sample Size	651			662			646		
System Type	PSI 15: Accidental puncture and laceration – 1995			PSI 15: Accidental puncture and laceration – 1998			PSI 15: Accidental puncture and laceration – 2000		
	Rate	Coef.	Std. Err.	Rate	Coef.	Std. Err.	Rate	Coef.	Std. Err.
IHS	0.26			0.27			0.32		
CHS	0.26	0.00	0.04	0.30	0.02	0.06	0.26	-0.05*	0.03
CPIHS	0.26	0.00	0.03	0.30	0.03	0.03	0.40	0.09**	0.04
MCHS	0.32	0.06***	0.02	0.30	0.03	0.02	0.34	0.03	0.02
DHS	0.27	0.01	0.02	0.30	0.02	0.02	0.33	0.01	0.02
Sample Size	817			819			790		

Note: * means significance at .10 level, ** at .05 level, *** at .01 level

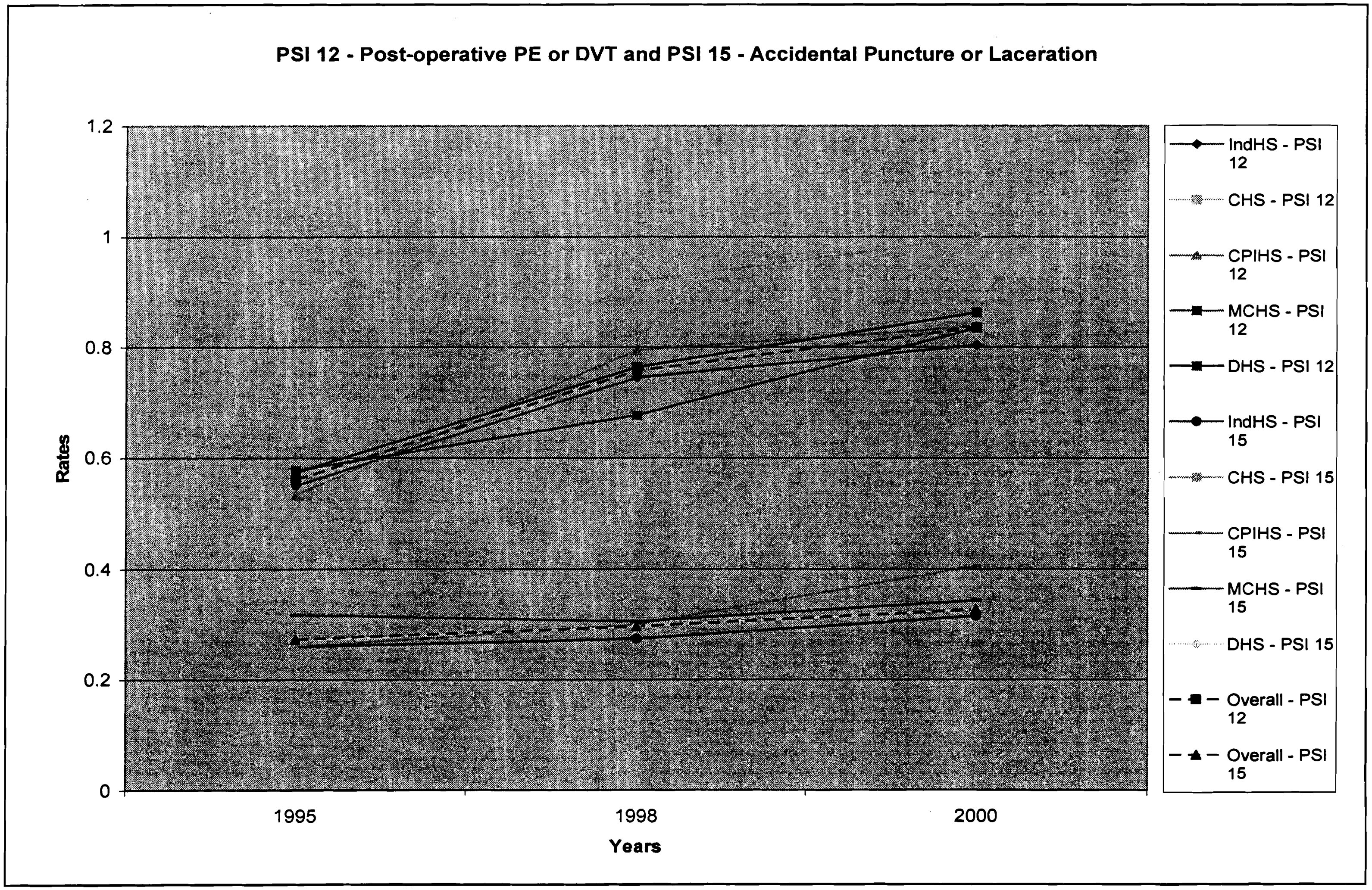

Figure 8: Trends in Post-Operative Pulmonary Embolism (PE) and Deep Vein Thrombosis (DVT) and Accidental Puncture or Laceration, 1995 – 2000

data and/or be due to reporting errors. A rule – being three standard deviations away from the mean – was used to identify outliers and applied to all continuous variables.

The correlation analysis of pooled cross-sectional data was conducted to evaluate which variables can enter into the multivariate models. It was discovered that several variables were highly correlated. It was found that total number of beds (a measure of hospital size) was correlated with the number of patients at risk for PSI adverse events (a measure of patient volume) at a level greater than the standard cut off point (r=0.75) (Appendix 1).

Once a hospital size and volume relationship was analyzed after first-differencing these measures over two time periods, it was found that they were not correlated. These two variables may be measuring different phenomena – the size is a common measure of power and a resource base in organizational research; and the volume is a measure of clinical proficiency (i.e., "practice makes perfect"). A simple statistical explanation is also viable – the number of beds is stable over time, but the volume of patients may vary from year to year, and therefore, these two measures are not correlated when analyzed over time. The decision was made to keep both variables in the empirical models since they may be capturing two different phenomena and not correlated over time.

The measures of hospital financial performance, i.e. operating margin and the ratio of cash flow to total revenues were highly correlated (r=0.77); thus, only one measure of hospital financial performance (the ratio of cash flow to total revenue) enters into the multivariate models. Hospital mortality and severity levels 3 and 4 had an expected r=0.94 correlation. Thus, mortality levels 3 and 4 are used in the IQI models and severity levels 3 and 4 are used in the PSI models. These measures were also highly correlated after first differencing.

The ratio of the number of physicians in the 45–54 age category by the total population in the market was constructed. This new measure of physicians per population was highly correlated with the total number of physicians (r=0.94) in the cross-sectional correlation analysis and (r=0.82) after first-differencing them over two time periods; therefore, the total number of physicians and population in the market area were excluded from the models, and the physicians in 45–54 age category per population stayed in the multivariate models.

The other highly correlated, mutually exclusive variables were as follows. Hospital investor and nonprofit ownership types were correlated at r= -0.82. The services mix and scope categories 10–20 and 20–30 were also highly correlated at r= -0.89. Two patients age categories (<19 and 19–64) were highly correlated with the older age (64+) category (r= -0.86 and r= -0.81, respectively). Hospital minor teaching and nonteaching status were correlated at r= -0.79. Hospital rural or urban location were correlated at r= -1. In these mutually exclusive categories of dummy variables, one of the categories is excluded from and becomes a reference category in the multivariate models. Appendix 1 presents the cross-sectional correlation matrix.

Panel, Longitudinal Analyses

Fixed and random effects models were estimated. The Hausman specification test was conducted (for details see Chapter 4, pp. 104-105). Firstly, the less efficient but consistent models – the fixed effects models – were estimated. Secondly, the efficient models – the random effects models – were estimated. Thirdly, the Hausman specification tests were used to compare differences in the coefficients between fixed and random effects models (pp. 104-105). The Hausman specification test indicated that there was no difference between fixed and random effects models (could not reject the null hypothesis of no systematic difference in the coefficients at the 0.05 level), suggesting that the random effects models were preferable given that they are consistent and efficient (Table 11).

Random Effects Models with Inpatient Quality Indicators

Random effects models (coefficients and standard errors) with IQIs – AMI, CHF, Stroke, and Pneumonia risk-adjusted mortality rates – as dependent variables are presented and discussed in this section. The description of the main system's structure and internal clinical process and integration effects on IQIs follows.

As suggested by the hypothesis 1, a greater level of systems' centralization may lead to lower mortality rates. Hospital affiliation with the centralized health system (CHS) had a significant, quality improving effect for all four risk-adjusted mortality rates: AMI, CHF, Stroke and Pneumonia. Hospital affiliation with independent health systems (IHS) was a reference category in the models. The AMI risk-adjusted mortality rate is 3.332 lower for CHS hospitals than for IHS hospitals. The similar trend was observed for the CHF, Stroke, and Pneumonia risk adjusted rates that were 1.519, 3.10, and 2.108 lower in CHS rather than IHS hospitals, holding all other factors constant. The regression coefficients and standard errors for these findings are presented in the following Table 12.

Table 11: Chi-squared Tests and p-values for the Hausman Specification Tests of Model Selection Comparing Consistent FE Estimators With More Efficient RE Estimators

	Chi-squared	p-value	Degrees of Freedom
AMI	32.43	0.50	33
CHF	35.44	0.35	33
Stroke	22.45	0.92	33
Pneumonia	30.93	0.57	33
Decubitus Ulcer	32.11	0.51	33
Infection Due to Medical Care	39.56	0.20	33
Post-operative PE or DVT	34.53	0.39	33
Post-operative Sepsis	41.70	0.14	33
Accidental Puncture or Laceration	45.58	0.07	33

Table 12: Random Effects Models of Different Health System Types and Internal Clinical Process Effects on IQI Mortality Rates

Variable	AMI		CHF		Stroke		Pneumonia	
	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.
CHS	-3.332***	1.438	-1.519**	0.764	-3.100**	1.522	-2.108*	1.138
CPIHS	-1.655	1.383	-0.313	0.738	-1.746	1.484	-1.189	1.105
MCHS	-1.723	1.278	-0.018	0.686	-1.244	1.364	-0.090	1.031
DHS	-1.712	1.299	-0.210	0.696	-1.606	1.389	-0.739	1.043
Patient Specific Information	-0.372	0.421	-0.439**	0.213	-0.753*	0.453	-0.981***	0.313
Medication Use	0.392	0.448	0.129	0.230	-0.104	0.496	-0.295	0.338
Initial Assessment Procedures	0.708	0.451	0.005	0.236	1.077**	0.497	0.332	0.345
Operative Procedures	-1.263	0.791	-0.139	0.440	-0.045	0.919	-0.780	0.650
Anesthesia Care	0.508	0.835	-0.140	0.427	-0.716	0.876	0.060	0.621
Total Beds	0.012***	0.002	0.001	0.001	0.008***	0.003	0.005***	0.002
For-profit	-1.951*	1.122	-1.357***	0.492	-0.057	1.049	-0.983	0.738
Nonprofit	0.990	0.966	-0.328	0.409	1.980**	0.882	0.440	0.614
Service Scope and Mix (20 - 30)	2.451***	1.028	0.785	0.532	2.479**	1.145	0.977	0.773
Service Scope and Mix (10 - 20)	2.112***	0.879	0.866**	0.434	2.024**	0.984	1.168*	0.623
Major Teaching	-1.561	1.078	-0.337	0.582	-0.650	1.156	-0.713	0.867
Minor Teaching	0.584	0.620	-0.194	0.315	0.109	0.621	-0.184	0.474
Urban	1.089	0.993	-0.620	0.426	0.306	0.908	-0.012	0.636
Total Nursing Staff Per Staffed Bed	0.304	0.588	-0.129	0.275	0.538	0.588	0.193	0.410
RNs to LPNs Ratio	-0.021	0.037	-0.008	0.015	-0.050	0.035	-0.008	0.023
Cash Flow to Total Revenue	0.067***	0.026	0.021	0.013	0.009	0.027	0.012	0.020
Age 19 - 64 (%)	-0.011	0.063	0.040	0.029	0.027	0.061	0.025	0.043
Age > 64 (%)	0.134***	0.047	0.077***	0.022	0.115**	0.046	0.061*	0.032

Continued

Table 12: Random Effects Models of Different Health System Types and Internal Clinical Process Effects on IQI Mortality Rates (Continued)

Variable	AMI		CHF		Stroke		Pneumonia	
	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.
Female (%)	0.060	0.078	0.011	0.037	0.001	0.082	0.006	0.056
Black (%)	0.006	0.019	-0.018*	0.010	-0.002	0.018	-0.007	0.014
Mortality Score 3 & 4 (%)	-0.201***	0.071	-0.114***	0.034	-0.191***	0.071	-0.104**	0.051
Case Mix Index	-1.752	2.179	-1.994**	1.016	-2.190	2.142	-3.410**	1.518
Log of Volume (Total Patients at Risk)	-2.727***	0.439	0.146	0.231	-2.025***	0.545	-0.633*	0.374
Hirschman Herfindahl Index	0.557	1.105	0.091	0.516	1.317	1.093	0.394	0.771
HMO Penetration	-1.231	1.540	-0.701	0.795	-2.143	1.617	0.407	1.181
Log of Per Capita Income (1000s)	0.959	1.277	0.207	0.615	2.072*	1.243	0.645	0.932
Population Over 65 (%)	-24.852***	5.897	-14.646***	2.937	-28.249***	5.944	-20.498***	4.409
MDs 45 - 54 Years Old Per Population	-0.587	0.784	0.582	0.397	0.156	0.819	0.541	0.598
Tight Physician-Hospital Arrangements	-0.216	0.543	-0.171	0.282	-0.406	0.592	-0.509	0.418
Hybrid Physician-Hospital Arrangements	0.421	0.535	-0.078	0.281	-0.398	0.581	-0.126	0.418
Second Time Period (1998 - 2000)	-0.143	0.422	0.250	0.227	0.276	0.486	0.284	0.333
Constant	17.628	9.422	4.871	4.345	18.521	9.197	13.194	6.578
Sample Size	492		472		432		475	
Number of Groups	365		318		292		321	

Note: * means significance at .10 level, ** at .05 level, *** at .01 level

Findings of t-tests derived through tests of linear restrictions demonstrated that CHS hospitals had better quality performance than hospitals in moderately centralized (MCHS) and decentralized health systems (DHS) in all four IQI models at varying significance levels (Table 13).

AMI mortality rates were lower at a rate of 1.609 and 1.62 in CHS hospitals compared with MCHS and DHS hospitals at the 0.1 significance level[1]. Hospitals in CHS had 1.501 and 1.309 lower CHF mortality rates than hospitals in MCHS and DHS, respectively, at the 0.01 significance level. Stroke mortality rates were 1.856 and 1.494 lower in CHS hospitals than in MCHS and DHS. Also, Pneumonia mortality rates were 2.018 and 1.369 lower in CHS hospitals rather than in MCHS and DHS hospitals (Tables 12 and 13). These findings may suggest that a higher level of centralization of hospital services may be an important structural factor that could also improve the process of care delivery and quality outcomes for AMI, CHF, Stroke and Pneumonia patients in CHS hospitals. In addition, t-tests for differences in coefficients for CHS and CPIHS showed no difference in 2 out of 4 models: Stroke and Pneumonia risk-adjusted mortality rates (Table 13).

In terms of AMI and CHF mortality rate, hospitals in CHS had 1.677 (at the 0.1 significance level) and 1.206 (at the 0.05 significance level) lower rates than hospitals in CPIHS. These findings do not support Hypothesis 2, which postulated that quality of care may be better (i.e., lower mortality rates) in CPIHS hospitals due to their tighter

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[1] The differences in rates by system types were calculated as follows: 1.609 = -3.332-(-1.723), where (-3.332) is a coefficient for the CHS category, (-1.723) is a coefficient for the MCHS category (Table 11). P-values for these differences are provided in Table 12.

Table 13: P-values of Tests of Linear Restriction Comparing Centralized Health Systems to the Other System Types in IQI Random Effects Models

Health System Type	AMI	CHF	Stroke	Pneumonia
Centralized Physician Insurance	0.091*	0.017**	0.191	0.215
Moderately Centralized	0.051*	0.001***	0.034**	0.001***
Decentralized	0.057*	0.003***	0.092*	0.032**

Note: * means significance at .10 level, ** at .05 level, *** at .01 level

physician-hospital integration. Centralization of hospital services at the system level (which is a main structural characteristic of centralized health systems) may have a positive effect on how these services are provided through possibly improved process of communication and coordination, and an effective use of clinical expertise along the continuum of care delivery in the centralized health systems. A discussion of these findings is provided in greater detail in Chapter 6.

Hospital affiliation with CHS and CPIHS were recoded into one variable representing a system with more centralized structure. This aggregation of systems into more centralized category was proposed in the conceptual model because CPIHS were different from CHS structures by having highly centralized physician arrangements and insurance products and moderately centralized hospital service. In all other aspects, CPIHS were similar to CHS. Hospital affiliation with MCHS and DHS were also recoded into a single variable representing a system with more decentralized structure as their structural characteristics were also thought to be compatible. Hospitals in independent hospital systems (IHS) remained a reference category. However, once empirical analyses were performed, the significant centralization effect become weaker when models were run with these aggregated system types. Hospitals in more centralized systems have 2.698 lower AMI mortality rate than hospitals in IHS, however, significant only at the 0.1 significance level (Table 14). The rest of the IQI models showed no difference in mortality rates for hospitals in more centralized versus independent hospital systems.

Table 14: Random Effects Models of Aggregated Health System Types on IQI Mortality Rates

Variable	AMI		CHF		Stroke		Pneumonia	
	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.
More Centralized	-2.698*	1.558	-0.813	0.710	-2.325	1.408	-1.553	1.089
More Decentralized	-1.591	1.510	-0.103	0.682	-1.416	1.346	-0.277	1.045

Note: * means significance at .10 level, ** at .05 level, *** at .01 level

Tests of linear restrictions (t-tests) demonstrated that more centralized health system may still have lower mortality rates than more decentralized health systems, supporting hypothesis 1. However, these findings were less representative (significant in 3 out of 4 models) than findings with single system types (significant in all 4 models) (Tables 13 and 15). Thus, there may be structural or process characteristics that are specific to each system type (e.g., high level of centralization of hospitals services in CHS) and aggregation of systems may not be appropriate in this case. Only one process of care delivery measure had a statistically significant trend shown in IQI models[2].

[2] Sensitivity analyses (tests of linear restrictions) were conducted to estimate whether there are differences in marginal effects and direction across all five JCAHO variables on quality outcomes. We found that the differences are quite large, and therefore, summation of all five JCAHO variables into a single measure of clinical integration was not attainable. All five single JCAHO variable retained in the models as separate measures.

Table 15: p-values of Tests of Linear Restriction Comparing More Centralized to More Decentralized Health Systems in IQI Random Effects Models

Health System Type	AMI	CHF	Stroke	Pneumonia
More Decentralized	0.081*	0.014**	0.1224	0.004***

Note: * means significance at .10 level, ** at .05 level, *** at .01 level

As system hospital compliance with JCAHO requirement for availability of patient specific information improves, CHF, Stroke, and Pneumonia risk-adjusted mortality rates decrease by 0.439, 0.752, and 0.981, respectively (Table 12). System hospitals in compliance with JCAHO requirement for availability of patient specific performance area may have attempted to improve their clinical information systems that may resulted in reduction of inpatient mortality.

The rest of JCAHO variables did not demonstrate any significant trends in the IQI models. However, in only one model, hospital compliance with JCAHO requirement for initial assessment procedures may be associated with an increase in the Stroke mortality rates by 1.077, which may appear due to random variation. A discussion of these findings is provided in greater detail in Chapter 6.

The other interesting hospital characteristics that were statistically significant in the IQI models are discussed below. Investor owned hospitals had 1.951 and 1.357 lower AMI and CHF risk-adjusted mortality rates than publicly owned hospitals (Table 12). Investor owned hospitals may locate in or relocate their facilities in markets with a healthier and wealthier population base in comparison to publicly owned hospitals that are more likely to have an inner city location. Nonprofit hospital ownership status is associated with significantly higher Stroke mortality rate (1.980) than in publicly owned hospitals (Table 12). As the total number of beds increases by one, the mortality rates for AMI, Stroke, and Pneumonia increase by 0.012, 0.008, and 0.005, respectively at the 0.01 significance level (Table 12). Hospitals in a 10–20 service mix and scope category have higher mortality rates that are highly significant in 3 IQI models for AMI, CHF, and Stroke and moderately significant in Pneumonia model in comparison to the reference group (the 0–10 service scope and mix category). Hospitals in a 20–30 service category have higher mortality rates for AMI and Stroke than in the reference category (Table 12). These findings may suggest a possible explanation – as the hospital size, complexity, and the number and scope of services grow, the possibility of making a clinical mistake and/or not being able to identify and correct it in time may also increase.

The models did not show any significant hospital financial performance trends on quality outcomes. The only finding that was significant suggested that one percentage point increase in the cash flow to total revenue ratio may lead to a 0.067 increase in the AMI risk-adjusted mortality rate (Table 12). This finding is somewhat counterintuitive, is not observed in the rest of IQI models, and may be attributed to random variation and noise.

Some interesting patient specific effects are discussed below. Hospitals with a higher level of patient acuity (measured by the percentage of patients with 3 or 4 stages of risk of mortality) managed to lower their AMI, CHF, Stroke, Pneumonia mortality rates by 0.201, 0.114, 0.191, and 0.104, respectively. In the similar manner, as the complexity of cases measured by CMI grows, the mortality rates for CHF patients decrease by 1.994 and for Pneumonia patients – by 3.410. Also, AMI, Stroke, and

Pneumonia mortality rates go down by 2.727, 2.025, and 0.633 as the volume of patient for these condition increases (Table 12). On one hand, having cared for more severe and complex patients and having a greater volume of patients, hospitals may increase their clinical expertise in providing better care for these types of patients. On the other hand, the location of death for sicker patients may be shifting outside the hospital, i.e. hospices, skilled nursing facilities. It was also found that having a greater percent of elderly patients (over 64 years old) increases mortality rate for AMI patients by 0.134, CHF patients by 0.077, Stroke patients by 0.115, and Pneumonia by 0.061 in system hospitals (Table 12).

Only one market characteristics had a statistically significant and strong effect in IQI mortality models. A greater percent of older people (>65 years old) in a market significantly reduces mortality rates for AMI, CHF, Stroke, and Pneumonia (Table 12). This finding is somewhat unexpected and counterintuitive. One possibility is that hospitals in markets with greater elderly population may have improved their clinical expertise on how to provide better inpatient services to elderly patients. Alternatively, other providers of services for elderly (i.e., skilled nursing facilities) may be located in these markets, and there are, thus, more opportunities to transfer sick, older patients to these settings where they ultimately may die.

Random Effects Models with Patient Safety Indicators

Tables 16 and 17 present random effects models with Patient Safety Indicators (PSIs) – Decubitus ulcer, Infection due to medical care, Post-operative PE and DVT, Post-operative sepsis, and Accidental puncture and laceration – as dependent variables.

Health system effects on adverse event rates were not observed in the PSI models. Test of linear restrictions showed significance in only one PSI for Accidental puncture and laceration, which may occur due to random variation (Tables 18 and 19). Thus, on one hand, structural characteristics of hospital-led health systems may be less important in improving patient safety in comparison with the effects of health systems on mortality outcomes (Tables 12 and 13). On the other hand, patient safety efforts may be newer programs so hospitals have yet to systematically work and improve in these areas.

In terms of the measures of internal clinical process and integration, hospital compliance with the JCAHO requirements for availability of patient specific information was marginally significant and associated with reduction of rates of Infection due to medical care (Table 16). This finding may be plausible because it is consistent with the direction (i.e., negative signs) in the rest of PSI models, even though not significant. However, there are other significant, but inconsistent findings that seem less plausible. For example, hospital JCAHO compliance with operative procedures performance area was significant and negative in one PSI model; however, significant and positive in another PSI model (Table 16). Hospital compliance with initial assessment procedures and anesthesia care may have also followed this inconsistent trend. Significant, but inconsistent results in JCAHO measures may appear due to random variation. The hospital characteristics that had statistically significant effects in PSI models are described below. As in the IQI models, investor owned hospitals were better quality performers than publicly owned hospitals in two PSIs models. The coefficients were negative and significant. The risk adjusted adverse event rates for Post-operative PE and

Table 16: Random Effects Models of Different Health System Types and Internal Clinical Process Effects on PSI Adverse Event Rates

Variable	Decubitus Ulcer		Infection Due to Medical Care		Post-operative PE or DVT		Post-operative Sepsis		Accidental Puncture or Laceration	
	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.
CHS	-0.272	0.306	-0.006	0.030	0.054	0.134	-0.059	0.245	0.010	0.053
CPIHS	-0.185	0.298	0.007	0.030	0.102	0.129	0.122	0.238	0.025	0.051
MCHS	-0.332	0.277	-0.022	0.028	0.143	0.121	0.037	0.221	0.078	0.048
DHS	-0.371	0.285	-0.011	0.028	0.060	0.123	0.067	0.226	0.068	0.049
Patient Specific Information	-0.038	0.076	-0.015*	0.008	-0.015	0.035	-0.002	0.068	-0.010	0.014
Medication Use	0.086	0.085	0.003	0.009	-0.062	0.039	0.060	0.076	-0.010	0.015
Initial Assessment Procedures	-0.053	0.085	-0.009	0.009	0.015	0.039	-0.061	0.076	0.037**	0.015
Operative Procedures	0.165	0.170	-0.033**	0.017	0.163**	0.075	-0.038	0.146	-0.045	0.029
Anesthesia Care	0.208	0.157	0.034**	0.016	-0.002	0.072	0.019	0.140	-0.036	0.028
Total Beds	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	-0.0002**	0.000
For-profit	0.129	0.215	-0.015	0.020	-0.190**	0.091	-0.162	0.182	-0.102***	0.036
Nonprofit	-0.107	0.180	-0.013	0.017	-0.290***	0.076	-0.165	0.154	-0.012	0.030
Service Scope and Mix (20 - 30)	-0.121	0.208	0.008	0.021	0.020	0.094	-0.174	0.193	0.046	0.037
Service Scope and Mix (10 - 20)	-0.171	0.168	-0.005	0.017	-0.011	0.076	-0.140	0.168	-0.012	0.029
Major Teaching	0.202	0.268	0.048*	0.025	0.126	0.112	-0.138	0.204	-0.016	0.044
Minor Teaching	-0.006	0.134	-0.006	0.013	-0.013	0.057	-0.124	0.107	-0.040*	0.023
Urban	-0.123	0.193	0.029	0.018	-0.131*	0.079	0.358**	0.165	0.011	0.032
Total Nursing Staff Per Staffed Bed	0.041	0.110	0.041***	0.011	0.014	0.048	-0.102	0.093	-0.019	0.019
RNs to LPNs Ratio	0.004	0.007	-0.001	0.001	0.002	0.003	-0.007	0.006	0.001	0.001

Continued

Table 16: Random Effects Models of Different Health System Types and Internal Clinical Process Effects on PSI Adverse Event Rates (Continued)

Variable	Decubitus Ulcer		Infection Due to Medical Care		Post-operative PE or DVT		Post-operative Sepsis		Accidental Puncture or Laceration	
Cash Flow to Total Revenue	-0.007	0.005	-0.001	0.001	-0.003	0.002	-0.001	0.004	0.002**	0.001
Age 19 - 64 (%)	0.013	0.013	-0.004***	0.001	-0.005	0.005	0.004	0.011	0.001	0.002
Age > 64 (%)	-0.003	0.009	-0.003***	0.001	-0.001	0.004	-0.010	0.008	-0.003*	0.002
Female (%)	0.028*	0.016	-0.002	0.002	0.004	0.007	0.020	0.014	-0.001	0.003
Black (%)	0.018***	0.004	0.000	0.000	0.002	0.002	0.007**	0.003	-0.001	0.001
Severity Score 3 & 4 (%)	0.088***	0.012	0.004***	0.001	0.020***	0.005	0.014	0.011	0.012***	0.002
Case Mix Index	-1.418***	0.459	0.005	0.043	-0.447**	0.215	0.710	0.436	-0.088	0.079
Log of Volume (Total Patients at Risk)	0.114	0.095	0.012	0.010	0.098**	0.040	-0.086	0.071	0.014	0.019
Hirschman HerfindahI Index	-0.396*	0.230	-0.045**	0.022	0.108	0.095	-0.166	0.186	0.031	0.039
HMO Penetration	0.338	0.315	-0.031	0.032	0.038	0.138	-0.422	0.265	-0.050	0.056
Log of Per Capita Income (1000s)	-0.020	0.284	-0.033	0.026	0.073	0.115	0.166	0.223	-0.065	0.047
Population Over 65 (%)	-2.504*	1.350	-0.107	0.125	-0.866	0.549	1.060	1.083	-0.156	0.224
MDs 45 - 54 Years Old Per Population	-0.220	0.174	0.039**	0.017	0.071	0.074	0.006	0.141	0.051*	0.030
Tight Physician-Hospital Arrangements	0.016	0.108	-0.006	0.011	-0.085*	0.049	-0.005	0.092	0.008	0.019
Hybrid Physician-Hospital Arrangements	0.110	0.109	-0.009	0.011	-0.038	0.049	-0.112	0.091	0.019	0.019
Second Time Period (1998 - 2000)	0.303***	0.079	0.041***	0.008	0.247***	0.037	0.440***	0.069	0.068***	0.015
Constant	-1.054	1.891	0.505	0.186	-0.264	0.788	-0.834	1.665	0.360	0.338
Sample Size	474		474		468		421		468	
Number of Groups	318		319		316		286		319	

Note: * means significance at .10 level, ** at .05 level, *** at .01 level

Table 17: Random Effects Models of Aggregated Health System Types on PSI Adverse Event Rates

Variable	Dicubitus Ulcer		Infection Due to Med Care		Post-op PE and DVT		Post-op Sepsis		Accident Puncture	
	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.
More Centralized	-0.222	0.285	0.001	0.029	0.087	0.124	0.038	0.227	0.020	0.049
More Decentralized	-0.341	0.275	0.018	0.027	0.114	0.120	0.049	0.218	0.075	0.048

Note: * means significance at .10 level, ** at .05 level, *** at .01 level

Table 18: p-values of Tests of Linear Restriction Comparing Centralized Health Systems to the Other System Types in PSI Random Effects Models

Health System Type	Decubitus Ulcer	Infection due to Medical Care	Post-operative PE or DVT	Post-operative Sepsis	Accidental Puncture or Laceration
Centralized Physician Insurance	0.659	0.531	0.584	0.275	0.68
Moderately Centralized	0.699	0.33	0.222	0.468	0.012**
Decentralized	0.559	0.774	0.941	0.37	0.057*

Note: * means significance at .10 level, ** at .05 level, *** at .01 level

Table 19: p-values of Tests of Linear Restriction Comparing More Centralized to More Centralized Health Systems in PSI Random Effects Models

Health System Type	Decubitus Ulcer	Infection Due to Medical Care	Post-operative PE or DVT	Post-operative Sepsis	Accidental Puncture or Laceration
More Decentralized	0.29	0.102	0.59	0.91	0.005***

Note: * means significance at .10 level, ** at .05 level, *** at .01 level

DVT and Accidental puncture and laceration were 0.190 and 0.102 lower for investor owned hospitals. Nonprofit hospitals also had lower adverse event rate for Post-operative PE and DVT in comparison with public hospitals (Table 16).

Other hospital-level findings are mainly scattered and do not form into any discernable trends in the PSI models. As the number of bed increases, the rate of adverse events for Accidental puncture and laceration declines. Hospitals in the major teaching category may have more patients that develop Infection due to medical care than hospitals with no teaching affiliation, i.e. reference group. Being in a minor teaching category may be associated with lower rates of Accidental puncture and laceration. Hospital location in urban areas was associated with a marginally significant decrease in the rate of Post-operative PE and DVT, but an increase in Post-operative sepsis (Table 16).

A greater number of nursing staff per patient bed has a significant and positive effect on patent safety outcomes in terms of Infection due to medical care rate. This rate increases by 0.041. Infection due to medical care is nursing sensitive, thus, having more nurses may increase a possibility of them making a mistake. Alternatively, having more nurses on staff may signal a sicker and more susceptible patient population that may not be captured by other variables. Also, hospitals that have a tightly managed physician-organization arrangements (POA) may have 0.085 lower rates of Post-operative PE and DVT in comparison with loosely integrated POAs (Table 16).

In terms of patient characteristics, however, several trends are worth noting. Hospitals with a greater percentage of highly severe patients in 3 and 4 risk groups have greater risk-adjusted adverse event rates detected in 4 out of 5 PSI models. This finding is strongly significant and positive (Table 16). A volume measure (number of patients at risk for an adverse event) is significant and positive for Post-operative PE and DVT adverse event rate, i.e. increasing the rates for these events. The directions for patients' acuity and volume reversed in the PSI models in comparison with the IQI models where patients' acuity and volume decreased risk-adjusted mortality rates. These findings may suggest that system hospitals choose to put more efforts and inputs into reducing well-monitored and evaluated inpatient mortality, rather than into less discernable and studied patient safety problems.

A significant and negative effect of hospitals treating more complex patient mix (CMI) was similar in both PSI and IQI models. As complexity of cases grows, the rates of Decubitus ulcer and Post-operative PE and DVT decrease by 1.418 and 0.447, respectively, which is similar with the IQI finding (Tables 16 and 12).
Another interesting finding that having a greater percent of black patients was associated with higher rates of Decubitus ulcer and Post-operative sepsis. Also, rates of risk-adjusted Infection due to medical care and Accidental puncture and laceration events were lower in hospitals with a greater percentage of elderly patients (over 64 years old) rather than in hospitals with a greater percent of younger patients (less than 19, i.e. reference category).

This finding is counterintuitive; however, younger surgical patients, such as trauma, ICU patients, may require quick clinical response/reaction, and thus, a greater possibility of making a mistake. These types of case complexity may not be captured in the empirical models. Also, having more patients in the middle age group (19-64) was also associated with a decrease in the rate of Infection due to medical care (Table 16).

Several market characteristics demonstrated statistically significant effects on patient safety outcomes. Hospitals located in markets with lower levels of competition are more likely to be better quality providers in terms of Decubitus ulcer and Infection due to medical care adverse events. These risk-adjusted rates decrease by 0.396 and 0.045, respectively, as HHI increases (i.e., competition decreases).

Decubitus ulcer rates may be 2.504 lower in markets with a greater percentage of elderly residents (over 65). Markets with greater proportion of physicians in the 45–54 age category per population are characterized by having statistically significant and positive (i.e., increasing) rates of Infection due to medical care and Accidental puncture and laceration. This may occur because more procedures provided in markets with the greater number of physicians.

A strong and positive trend was also observed in the second time period. The rates of Decubitus ulcer, Infection due to medical care, Post-operative PE and DVT, Post-operative sepsis, and Accidental puncture or laceration increased by 0.303, 0.041, 0.247, 0.440, and 0.068, respectively. This trend may be suggestive of a possible Balanced Budget Act's effect or other unobservable market or policy effects on patient safety outcomes. One of the explanations is that hospitals' proficiency and rigor in reporting of the adverse events may have been increasing, especially after the Institute of Medicine (IOM) reports in 1999 and 2000. The cross-sectional analyses are described in the following section.

Cross–Sectional Analyses

Since the panel data was limited to only two time periods (due to a JCAHO data limitation), it was impossible to use lagged quality outcomes and hospital financial performance to address a possible feedback issue in the panel model. The cross-sectional design, using three stage estimation models, which is evaluated separately for two years of 1997 (this year is chosen, because the 1997 JCAHO's data set has substantially more hospitals than the 1995 data set) and 2000, was proposed to reassure validity of empirical findings with panel data and to address a possible feedback issue.

Lagged quality outcomes and hospital financial performance and other variables reflective of preferable market conditions were proposed at this stage to account for a possible feedback or the effect of a system type choice. Three stage estimation models have been undertaken; however, due to serious limitations, cross – sectional analyses were viewed as problematic and unreliable. Multinomial logit models for estimating predicted probabilities for different types of health systems were conducted at first with the 1997 data.

The sample size for the year 1997 was 246 hospitals with complete data, i.e. system hospitals with HCUP and JCAHO data. The cross-sectional models with a full set of variables (Chapter 4) were run with types of systems as dependent (categorical) variables and IHS as a reference group. The number of observations has drop even more to about 146 observations for the multinomial models due to missing data in lagged quality outcomes (e.g., 45 missing for AMI) and lagged cash flow to total revenue (63 missing).

The models were also not sustainable – they did not provide an overall Chi-squared p-values, LR Chi-squared, and log likelihood, and a number of variables (e.g., major and minor teaching, for-profit ownership status) dropped out from the models. Sensitivity analyses demonstrated that the only one JCAHO variable – availability of patient specific information – had a significant and negative effect on mortality indicators. The rest of variables were not sufficient predictors of quality.

Since measures of internal clinical process and integration were weak and merging in JCAHO data lead to significant reduction of the sample size, a simplified model was undertaken. The simplified model differs from the three stage estimation model by excluding predicted scores of clinical integration (JCAHO) step from the analyses. All other components and descriptions of elements were similar with the three stage estimation model, and predicted probabilities for health systems were directly put into the final OLS model for estimating quality outcomes, and the clinical integration stage was not analyzed. Exclusion of JCAHO data increased the 1997 sample size to 738 observations. However, when the multinomial models were run, the number of observations still went down to about 330. This drop in observations happens due to a cumulative effect of missing values in key measures, lagged values of quality indicators (221 missing observation) and cash flow to total revenue (244 missing observations). The multinomial models remained unstable. Therefore, two factors – the weak clinical process measure and the significant decline in the sample size with and without JCAHO data – could sufficiently and unpredictably affect the cross-sectional findings. Therefore, the decision was made not continue further with the proposed cross-sectional analyses.

Summary

It was found that the IQI and PSI models have different patterns. In the IQI models, hospitals in CHS tend to perform better than hospitals in MCHS, DHS, and IHS in all four models. There is no difference in mortality indicators between hospitals in CHS and CPIHS in two models, but hospitals in CHS have better performance in the other two models than hospitals in CPIHS. System hospitals that are in compliance with the JCAHO performance area for availability of patient specific information may improve clinical process and integration of care delivery for patients at risk for CHF, Stroke, Pneumonia, and Infection due to medical care. The PSI models did not indicate any hospital-led health systems' effects on the rates of adverse events. There were some pattern effects as well as single effects of other hospital, patient, and market characteristic on mortality and patient safety rates. Tables providing schematic depictions of hypotheses that were supported, partially supported, and unsupported as well as implications of these and other main findings are discussed in greater detail in Chapter 6.

CHAPTER 6: DISCUSSION

Introduction

The purpose of this study was to assess structural and process elements associated with the delivery of high quality care. It is proposed that structural differences among health systems may yield differences in care provision, resulting in differences in quality outcomes. It is conceptualized that centralization of authority in centralized health systems and differentiation/specialization of services in decentralized health systems would result in different approaches to care delivery processes in various types of health systems and lead to different quality outcomes in these system types. Three research questions were posed:

1. What types of health systems and their member hospitals are associated with the best quality outcomes, produced by hospitals in those systems?
2. What types of health systems and their member hospitals are associated with the worst quality outcomes, produced by hospitals in those systems?
3. Are there differences in care delivery processes associated with positive or negative quality outcomes in hospitals in various types of health systems?

The conceptual model, based on Contingency Theory, suggested contrasting scenarios and hypotheses. According to Scenario 1, greater centralization of hospital-led health systems may allow systems' leadership to manage effectively increasing interconnectedness of providers, improve coordination, internal clinical processes, and integration of organizations, and consolidate certain administrative and possibly clinical services in centralized health systems, which would increase volume of services provided at a certain facility within the system. As a result, it was hypothesized that better quality outcomes would be observed in more centralized health systems in comparison with more decentralized health systems. It was also hypothesized that centralized physician-insurance systems would have better quality outcomes than just centralized health systems due to their tighter physician-hospital integration, which could improve internal process and integration of care delivery, and due to possible financial incentives that physicians may receive from their affiliated systems to improve quality.

According to Scenario 2, decentralization of large health systems may improve adjustments of hospitals with internal contingency of size and increase service availability and accessibility through differentiation of services. Specialization of tasks is also necessitated by and occurs as a result of structural complexity of large organizations. Specialization, formalization, and worker autonomy are positively correlated with decentralization of structures (Child, 1972; Scott, 2003). Decentralized organization may use specialization, formalization, and autonomy to improve effectiveness of organizational processes and, as a result, organizational performance. Different hospitals within Decentralized Health Systems (DHS) may get engaged into "internal competition" with their fellow members to improve quality. Thus, it was hypothesized that better quality outcomes could be observed in more decentralized health systems in comparison with more centralized.

The interplay of both scenarios provides that, on one hand, moderately centralized health systems can potentially become quality champions in comparison with other system types, because they may have found the "right" organizational structure and strategic balance between centralization and differentiation of their structures and services given the environment in which they operate. On the other hand, independent health systems were hypothesized to have the worst quality outcomes in comparison with other system types, because their structures may be characterized as neither centralized nor differentiated.

The data from seven well-established data bases were assembled for short-term, general, nonfederal hospitals from 11 states for 6 years from 1995 to 2000. Two research designs – panel and cross-sectional – were proposed. However, due to missing observations on key variables, the cross-sectional study was not viable. Random effects models, though, provided consistent and efficient results. In the following sections, the findings and conclusions are summarized, the implications and significance for the theory, policy and future research are provided, as well as, the limitations of this study are described.

Summary and Interpretation of the Descriptive Analysis

Descriptive analyses demonstrated that hospitals in the empirical, 11 state sample were different from the hospitals in the national sample. There were more hospitals in Centralized Physician/Insurance Health Systems (CPIHS) and Independent Hospital Systems (IHS); however, lesser hospitals in Moderately Centralized Health Systems (MCHS) and Decentralized Health Systems (DHS) in the empirical sample rather than in the national sample. There was no difference in the percentages of hospitals in Centralized Health Systems (CHS) in two samples. System hospitals in the empirical sample (in comparison with system hospitals in the national sample) were more likely:

a) to be larger by 30 beds on average;

b) to have nonpublic and voluntary ownership;

c) to be in major and minor teaching categories;

d) to provide a greater mix and number of services;

e) to be located in urban areas and less likely in rural areas;

f) to have a greater percentage of total nursing staff that were RNs.

Therefore, based on the t and Chi-squared tests, it was concluded that system hospitals in the empirical (11 state) sample were different than system hospitals in the national sample. The findings of this study cannot be generalized to hospitals in the USA.

In the descriptive study, it was also found that organizational characteristics of system hospitals varied by system type. More sample hospitals belonged to Moderately Centralized Health System (MCHS) and Decentralized Health System (DHS) types and lesser hospitals belonged to Centralized Health Systems (CHS), Centralized Physician/Insurance Health Systems (CPIHS), and Independent Hospital Systems (IHS). Most of system hospitals in the empirical sample had a voluntary, nonprofit ownership status. However, a greater percentage of DHS and IHS hospitals had for-profit status. CHS and CPIHS in comparison with other system types stand out by having:

a) a greater number of beds; more hospitals in major teaching category;

b) a greater number and scope of services provided;

c) a greater percentage of RNs of licensed nursing staff when compared with other system types.

In conclusion, there were clear organizational differences among hospitals in different types of health systems which were necessary to control statistically in the multivariate regressions.

The Adjusted Least Squared Means (ALSM) methodology was used to identify trends in quality and patient safety outcomes by system types during the study period. It was also examined whether there was a hospital system relationship with quality outcomes, controlling for residual differences in hospital level patient characteristics (age, gender, and race), acuity (3 and 4 levels of mortality and severity) and complication (case-mix index) that had measurable and significant effects on IQI mortality and PSI adverse event rates. The ALSM found a relationship between system types and inpatient quality indicators (IQIs), i.e., hospitals in DHS, CHS, and CPIHS in comparison with IHS hospitals had lower mortality rates during the 1995–2000 period.

However, in terms of PSI adverse event rates, the findings were less clear and significant. Mortality rates and patient safety adverse events increased or leveled off after 1998, which may be suggestive of the BBA effect, changes in the hospital reporting practice of patient adverse events post the Institute of Medicine (IOM) report on medical errors in 1999, and/or other market/policy effects on system hospitals' quality performance. Summarizing the ALSM findings and descriptive analysis of system differences, it may be concluded that:

a) both decentralization and centralization of hospital structures may be associated with decreased mortality rates;

b) hospital system effect was less clear when patient safety indicators were used as dependent variables;

c) even though the ALSM controlled for hospital specific patient characteristics, statistical controls for hospital and market characteristics were essential.

Multivariate analyses were conducted with statistical controls and helped to clarify hospital system effects on quality and patient safety outcomes in the ALSM models.

Summary and Interpretation of the Hypotheses Testing

Even though the conceptual model suggested that Inpatient Quality Indicators (IQI) mortally rates and Patient Safety Indicators (PSI) adverse events would flag potential quality problems in the same way, the empirical results show otherwise. Models with IQI mortality rates and PSI adverse events convey quite different stories of hospital system effects on quality performance. Thus, the findings from IQI (Table 20) and PSI models are summarized and discussed separately.

Inpatient Quality Indicator Models

In the conceptual model, the aggregation of centralized and centralized physician-insurance health systems into one category was proposed (i.e., systems with more centralized structures). The aggregation of decentralized and moderately decentralized health systems into another category was also proposed (i.e., systems with more decentralized structures). These made sense conceptually; however, empirically, these

Table 20: Summary of Hypotheses Tested in the IQI models

Hypotheses	Expected Direction	Supported
Centralization of structures → quality performance H 1: Hospitals in more centralized health systems would have better quality performance than hospitals in DHS	Decrease Mortality	Yes
Tighter physician-hospital integration → quality performance H 2: Hospitals in CPIHS would have better quality performance than hospitals in CHS	Decrease Mortality	No
Decentralization to outcomes → quality performance H 3: Hospitals in DHS would have better quality performance than hospitals in more centralized structures	Decrease Mortality	No
Combination of centralization and differentiation → quality performance H 4: Hospital in MCHS would have better quality than hospitals in other system types	Decrease Mortality	No
Low centralization and differentiation → quality performance H 5: Hospital in IHS would have worse quality than hospitals in other system types performance	Increase Mortality	Partially supported; hospitals in IHS were worse than in CHS

aggregations were not satisfactory in singling out hospital system effects on quality performance. Also, the cross-sectional study was not viable due to missing and incomplete data. Thus, empirical evaluation of which system type may have a better internal process and integration of care delivery in place that could lead to lower mortality rates was not possible.

Therefore, the findings for five essential system types (instead of aggregated system categories) are discussed. The effects of systems' internal clinical processes and integration on quality are discussed for hospitals in general, rather than specifically by each single system type.

Hypothesis 1, centralization of hospital-led health systems would result in better quality performance was supported. Hospitals in Centralized Health Systems (CHS) had lower mortality rates for Acute Myocardial Infarction (AMI), Congestive Heart Failure (CHF), Stroke, and Pneumonia patients compared with almost all other types of health systems at varying significance levels (Tables 11 and 12). Only quality performance of hospitals in Centralized Physician/Insurance Health Systems in terms of Stroke and Pneumonia mortality rates were similar to those in CHS hospitals.

Centralization of hospital-led health systems may result in more effective internal clinical processes, and thus, better quality performance. Centralization of structures may possibly improve internal process of care delivery and integration of services by:

a) enhanced coordination of activities, communication between providers, timely adjustments of process of care delivery and structures to external pressures (Shortell et al., 1996 and 2000);
b) development and diffusion of management and clinical information systems, quality management, and care management practices (Alexander et al., 2003, Savage et al., 1997);
c) possible clinical integration of providers into an Integrated Delivery System (Shortell et al., 1996).

Thus, it is possible to conclude that hospitals in CHS may have introduced more effective structures that improve process of care delivery and integration of services. Superior structure and process of care delivery may decrease mortality rates in CHS hospitals.

Hypothesis 2 was not supported. Hospitals in CPIHS were not better quality performers in comparison with hospitals in CHS, which had lower mortality AMI and CHF mortality rates than CPIHS hospitals. There were no statistically significant differences between these two types of systems in terms of Stroke and Pneumonia mortality (Table 12). It was hypothesized that CPIHS hospitals may have a higher level of physician-hospital integration than hospitals in CHS, resulting in more effective clinical process and integration of services. The CPIHS may also introduce financial and other incentive systems for their affiliated physicians, stimulating them to improve quality. Therefore, the CPIHS hospitals may have lower mortality rates in comparison with hospitals in other system types. However, having higher levels of centralization of physician arrangements and insurance products as in CPIHS hospitals did not lower inpatient mortality. In conclusion, the findings suggest that that centralization of hospital services at the system level as in CHS may contribute to reduction of inpatient mortality.

Hypothesis 3, which proposed that hospitals in decentralized health systems (DHS) would be better quality performers (i.e., having lower mortality rates) than more centralized health systems under certain conditions, was not supported. DHS hospitals had higher mortality rates than CHS hospitals in all four IQI models. These findings suggest that decentralization of leadership, differentiation and divisionalization of services may add administrative layers and increase bureaucratization of structures. Bureaucratization may create barriers in information exchanges, disable leadership to make and communicate decisions quickly. Bureaucratization may also remove accountability of clinical personnel. It is also possible that the volume of service offerings is low in any given hospital in DHS, due to a lack of consolidation of clinical departments. Thus, it is more difficult to achieve a certain level of clinical excellence in DHS hospitals. These may explain why hospitals in DHS had higher mortality rates than hospitals in CHS.

Hypothesis 4 was that hospitals in moderately centralized health systems (MCHS) would be better quality providers due to their ability to take advantage of both centralization and differentiation strategies. It was suggested that if appropriate balance is achieved, the MCHS hospitals' quality performance would improve. However, hypothesis 4 was not supported. Quality performance of hospitals in MCHS was worse than in CHS hospitals and no different from other system types. Therefore, this balancing of two somewhat opposing strategies – centralization of leadership and differentiation of services – may not be effective in achieving superior quality performance. Porter (1980) characterized organizations that pursue multiple and somewhat conflicting strategies which result in inconsistent performance as "stuck in the middle," which may result in inconsistent performance. In conclusion, it is possible to suggest that hospitals in MCHS may experience a possible misfit of conflicting structures and processes with their environment, which resulted in unsatisfactory quality performance.

In answering the first research question on which type of hospital-led health system is associated with better quality outcomes, the findings suggest that hospitals in Centralized Health Systems are associated with lower mortality rates as measured as Inpatient Quality Indicators (IQIs) for AMI, CHF, Stroke, and Pneumonia.

Hypothesis 5 suggested that hospitals in independent hospital system (IHS) would produce worse quality outcomes than hospitals in all other types of health systems was partially supported. Hospitals in IHS were worse quality providers in comparison with hospitals in centralized health system (CHS). It was found that hospitals in CHS have lower mortality rates for AMI, CHF, Stroke and Pneumonia patients (Table 11). Although quality performance of hospitals in IHS was not statistically different from quality performance of hospitals in CPIHS, MCHS, and DHS, the direction (i.e., negative signs) of coefficient estimates for these system types were suggestive of their lower mortality rates in comparison with IHS hospitals (Table 11). Therefore, it is possible to conclude that the lack of centralization and differentiation may have contributed to the poor IHS hospitals' quality performance, i.e. higher mortality rates. Having low levels of centralization may preclude hospitals in IHS from effective decision making, communication of policies to their clinical and managerial staff, and coordination of clinical services and activities with their other system members. Having low levels of differentiation may preclude these hospitals from maintaining substantial infrastructure, physician arrangements, and resource base in their submarkets.

In answering the second research question on which type of hospital-led health system is associated with worse quality outcomes (i.e., higher mortality rates), the findings are partially suggestive that hospitals in Independent Hospitals Systems were associated with lower mortality rates as measured as Inpatient Quality Indicators (IQIs) for AMI, CHF, and Pneumonia.

Patient Safety Indicator Models

The support for Hypotheses 1–5 was not found in the PSI models (Table 21). It is possible to conclude that hospital-led health systems' structural characteristics did not affect patient safety adverse events. On one hand, patient safety improvements may require clinicians to pay more attention to and to be involved at a greater level in adverse events' prevention and management. Education and awareness of both clinicians and patients may reduce the rates of adverse events in system hospitals. Several interventions may be proposed:

a) training of clinicians on patient safety guidelines;
b) increasing clinicians accountability for making mistakes;
c) introduction of the routine system checks (e.g., set reminders for clinicians to remove catheters, periodically turn patients with long length of stay over to prevent pressure ulcers, etc.)

On the other hand, it is possible that the state of the art guidelines and protocols on the improvement of patient safety and reduction of adverse events are still underdeveloped. Patient safety is a relatively new issue for hospitals to focus on and there may be big differences due to reporting patterns among these hospitals. Therefore, hospital-led systems may not be able to promote improvements in patient safety at this stage and require more time for the system effect to show up.

Table 21: Summary of Hypotheses Tested in the PSI models

Hypotheses	Expected Direction	Supported
Centralization of structures → quality performance H 1: Hospitals in more centralized health systems would have better quality performance than hospitals in DHS	Decrease Mortality	No
Tighter physician-hospital integration → quality performance H 2: Hospitals in CPIHS would have better quality performance than hospitals in CHS	Decrease Mortality	No
Decentralization to outcomes → quality performance H 3: Hospitals in DHS would have better quality performance than hospitals in more centralized structures	Decrease Mortality	No
Combination of centralization and differentiation → quality performance H 4: Hospital in MCHS would have better quality than hospitals in other system types	Decrease Mortality	No
Low centralization and differentiation → quality performance H 5: Hospital in IHS would have worse quality than hospitals in other system types performance	Increase Mortality	No

Implications of the Findings

This study builds upon the previous empirical work on hospital systems and quality of care. The study contributes to the general body of knowledge in several ways described as follows:

- Rather than examining the impact of hospital systems generally on quality and patient safety, the impact of different types of health systems on quality outcomes was studied. Hospital-led systems vary considerably in their structures and they have very different effects on these key outcomes. Whether different system types have different effect on quality is important for policymakers and hospital managers to know and consider;

- The conceptual model provides opposing scenarios and empirical tests reveal that centralization of health system's structure may decrease mortality rates in system hospitals;
- Healthcare Cost and Utilization Project State Inpatient Database (HCUP SID) quality and patient safety indicators were used as multiple quality signals, conveying different stories at present (i.e. there were no system effect in PSI models), which may be useful for future research by suggesting that conceptual and analytical models should be separately developed and specified when quality signals are measured by mortality rates and patient adverse events;
- JCAHO variables were proposed as measures of internal clinical process and integration and it was found that hospital compliance with JCAHO performance area for availability of patient specific information may be an important measure of clinical process and integration, which should be used in future studies along with other possible measures of clinical processes.

Implications to Theory

Contingency theory was used to develop the conceptual model. Contingency theory provided two opposing scenarios on how different types of hospital-led health systems have evolved through either centralization or differentiation of their structures and services. Contingency theory was useful and versatile in developing of empirically testable hypotheses. This research has confirmed that system hospitals' structural characteristic – centralization – may improve hospital quality performance measured by Inpatient Quality Indicators. Thus, providing support for Scenario 1, which stated that the leadership of Centralized Health Systems may pursue centralization of structure in order to effectively integrate their task, services, production lines at the system level and result in improved quality performance.

This study has also found no system effects on hospital quality performance measured by Patient Safety Indicators. This finding may suggest that the centralization of authority may have a lesser effect on conditions (i.e., patient adverse events) that are yet less developed, unlike the mortality rates, in terms of correct detecting, reporting, monitoring, treatment, and preventing. In-hospital mortality has been studied for a long time; however, patient safety issues are relatively new problems, taking a "center stage" only after the IOM report in 1999.

Thus, the effectiveness of centralization may be conditioned upon how well clinical and organizational approaches of quality improvement are defined and the end results (i.e. quality outcomes) are monitored. However, if there are no such conditions in place (as yet for patient safety issues), centralization may lack its advantages over other structural characteristics.

The findings have also partially supported the proposition that health systems with low centralization and differentiation (i.e., Independent Hospital Systems) may be less effective in managing of both internal contingencies of task interdependence and organizational size. Hospitals in this system type may be disadvantaged in dealing with their internal pressures to restructure.

In the study, it was not possible to evaluate directly the external environment's and environmental shifts' effects on system structures and outcomes, because the proposed cross-sectional study that meant to test these effects was not viable due to data limitations. In the longitudinal study, the association between the systems' structures and quality outcomes was evaluated, holding the external environment's characteristics (e.g., hospital competition, managed care, and other market conditions) constant. It is possible to suggest that future studies should test a relationship or the fit between the external environment, organizational structure, and organizational performance, given data availability.

Implications to Policy and Management

Public (e.g., federal and state governments), private (e.g., employers, health plans) organizations, and, in some instances, consumers would probably like to know that centralized health systems may produce better quality performance in terms of mortality outcomes, so they can potentially:

a) get better hospital value when making purchasing decisions, weighing quality differences against costs, or seeking care in these system hospitals;
c) give hospital systems direct or indirect incentives to adopt such a structure;
d) give hospital leaders information about how to structure their system to improve quality.

Similarly, health policymakers and hospital managers may draw useful conclusions from knowing that hospital compliance with JCAHO performance area score for availability of patient specific information may improve system hospitals' quality performance. This finding may be suggestive of the importance of continuous hospital investment in information systems and improvements of their clinical records.

The study also found that system and hospital organizational characteristics were less dominant in the PSI models in comparison with the IQI models. On one hand, it may be related to the reporting issues. On the other hand, it may be related to individual characteristics of clinicians, such as their knowledge of and compliance with patient safety protocols and guidelines. Both of these issues may be addressed by improving the hospital information and reporting system, installing routine system checks for adverse events, and providing additional training and education on patient safety issues to both clinical personnel and consumers. Future research needs to evaluate a potential Balanced Budget Act (BBA) effect, changes in the hospital reporting practice, and other market/policy effects on patient safety adverse events and medical errors.

Implications to Methodology

One possible implication to methodology is as follows. It is proposed that system hospitals' compliance with JCAHO performance standards may be used in measuring internal clinical process and integration, such as a use of clinical information systems and clinical evidence-based practices, guidelines, protocols, and medical registries (Burns, 1999). It is found that one proposed measure of internal clinical process and integration, i.e. hospitals' compliance with JCAHO performance standards for availability of patient specific information, had a statistically significant and negative (i.e., decreasing) effect on mortality rates. This finding may be useful for measuring structure–process–outcome relationships and contribute to conceptual and empirical modeling in future studies.

The results demonstrate that as hospital compliance with JCAHO requirement for availability of patient specific information increases, mortality rates decrease for CHF, Stroke, and Pneumonia patients. Adverse events for Infection due to medical care may also be reduced in system hospitals that were in compliance with this JCAHO performance area.

Availability of Patient Specific Information may ensure that the necessary information about the patients care is obtained and maintained in the medical record in a timely manner and readily available for clinicians' use. Therefore, hospitals with greater compliance with JCAHO performance area for availability of patient specific information may have a superior system of clinical information sharing and coordinating care delivery that can be effectively utilized in comparison with hospitals with lesser compliance with this JCAHO requirement.

However, all other JCAHO variables were not significant predictors of hospital quality performance in this study. On one hand, the JCAHO accreditation has been trying to focus their standards on the best practices and evidence-based medicine (Sprague, 2005). On the other hand, the JCAHO-led accreditation process has been criticized, because: accreditation is voluntary, it is scheduled in advance (i.e., giving hospitals time "to put on their best face"), JCAHO is founded by health care industry, JCAHO does not enforce change, and accreditors rarely deny or terminate accreditation

(Sprague, 2005). Therefore, some of the JCAHO measures may be more useful for research purposes than the other measures. At least one significant and possibly useful measure was found that may be associated with internal clinical process and integration in hospital-led systems and is helpful for focusing internal quality improvement efforts. This measure should be used with a set of other possible measures of clinical integration in future research, linking structure–process–outcomes.

As a result, this study contributed to the general knowledge on how hospital system integration affects quality of care, which may be useful for the further development of theoretical and conceptual models, policy and managerial interventions to decrease in-hospital mortality and patient adverse events, and for improving methodology by better linking structure–process–outcomes. However, there is also need to identify possible limitations of this study and provide directions for future studies in the following sections.

Limitations of the Study

Taxonomy of health system is largely focused on structural rather than managerial/operational characteristics. Even though Alexander et al. (2003) discovered that there was an association between centralization of service, physician arrangements, and insurance products and centralized decision making in CHS, there were no data available in this study to directly quantify a leadership style in one or another system type. Thus, it was assumed that centralization of structures is also reflective of centralization of leadership and decision making. Also, Luke and Wholey (1999) in their commentary suggested that taxonomy was not taking into consideration that multihospital systems range from local to regional to national in their scope. However, the taxonomy describes different system types in terms of their geographic location/dispersion. For example, hospitals in Centralized Health Systems and Centralized Physician/Insurance Health Systems tend to be located in close geographic proximity, and hospitals in Decentralized Health Systems are spread over a broad geographic area (Bazzoli, et al. 1999). The taxonomy is work in progress, and thus, future studies may need to research whether regionalization and systems' geographic dispersion affect organizational dimensions of hospital systems.

Another potential criticism is that the taxonomy has not been reflective of changes in the hospital industry. Dubbs, Bazzoli, and colleagues (2004) reexamined organizational configuration of health systems in the classification, using the 1998 data. They concluded that "the 1998 cluster categories are similar to the original taxonomy, however, they reveal some new organizational configurations" (p. 207). They found that the centralized categories combined into the Centralized Health System and the decentralized categories split into the Decentralized and Decentralized Physician/Insurance Health Systems. Their findings may not have an effect on the current study, since the key structural dimensions remained unchanged for all system types and the Centralized Health Systems' structure was not affected by re-classification.

Since the panel data were limited to only two time periods (due to a JCAHO data limitation), it was impossible to use lagged quality outcomes and hospital financial performance to address a possible feedback issue in the panel model. It was proposed to use the cross-sectional design using three stage estimation models with lagged quality and financial performance measures. Also, it was also planned to evaluate which system type had developed "better" internal clinical process and integration in this cross-sectional study. We hoped to analyze how the external environments and the shifts in external environments may affect quality outcomes as well.

However, the cross-sectional models were not stable and this design was not viable due to a large number of missing observations. It was impossible to compare and validate the results using both longitudinal and cross-sectional designs and control for a possible feedback problem, evaluate clinical processes by system type, and the external environment's effects on the hospital system quality performance. Future research needs to address these issues by collecting more data, ideally for another 3 years from 2000–2003.

The IQIs and PSIs were used to flag possible quality problems; these indicators were also generated from the secondary data bases and may have errors inherent in administrative data bases (Scott, Youlden, & Coory, 2004). The ongoing debate on reliability and validity of claims data has not been resolved. However, the panel data were used; and the system hospitals' quality performance was examined using multiple risk-adjusted indictors, large, well-established data sets, and advanced econometric models that may improve reliability and validity of findings and help distinguish trends in hospital quality outcomes by different types of health systems. Therefore, this study has both strengths and weaknesses as any other empirical study. However, it is believed that the strengths balance out the weaknesses in this case. The future research possibilities and conclusion are discussed in the following section.

Suggestion for Future Research

In conducting the current study, several research possibilities are discovered and discussed below. Several suggestions are also made that may be of value for other researchers. In the descriptive study, the increase in the percentage of CHS hospitals after 1998 was discovered. Reasons for this increase are not yet known and this trend has not been studied. Future research need to look at further advancement and development of different types of hospital-led health systems in recent years.

It may be useful to use different conceptual and empirical approaches in studying hospital quality performance as measured as IQI and PSI. This study found that system and hospital organizational characteristics were less dominant in the PSI models in comparison with the IQI models. Thus, future research should evaluate individual patient and clinician characteristics in their association with patient safety, as well as, possible effects of and trends in patient safety outcomes in association with the hospital reporting patterns, the Balanced Budget Act (BBA), or other unobservable market or policy interventions. Data on leadership styles and direct measures of process of care delivery in different system types and their effects on quality performance were not available. A future study may try to collect quantitative and/or qualitative data on leadership/management styles and processes of care delivery by different types of hospital-led systems. Combining quantitative and qualitative data on leadership style and process of care delivery could provide more insight on how health systems' structure, process, and outcomes are linked together. JCAHO performance scores in particular areas should be evaluated further and potentially used as measures of clinical process in future research. One of these measures (i.e., hospital compliance with JCAHO performance area for availability of patient specific information) should be used in studying structure–process–outcomes relationships in hospitals, as the findings suggested, it has significant influence on hospital mortality outcomes.

In this study, it was impossible to directly control for system hospital referral practices to long-term care facilities. It is likely that hospitals in CHS have developed more efficient referral strategies, and thus, reduced their inpatient mortality. A future study could use a 30– or 90– day mortality rates or re-admission to hospitals in addition to in-hospital mortality outcomes.

Another research possibility is to look at a primary care–inpatient care link in association with hospital quality performance. It is plausible that large centralized health systems may be more likely to have advanced primary care capacity and/or be capitated and hence have more capability/incentives to provide superior preventive and primary care services, develop ambulatory surgical and emergency centers to their population in comparison with other system types. Therefore, CHS may be triaging patients before their admission to a hospital.

This triaging may allow hospitals concentrate their efforts, time, and resources on patients with the actual needs for intensive care and/or to get those in need of them the services required in a timely manner. Less severe patients' care may be effectively managed on the pre-hospital stage. Therefore, this study provides some ideas on how to advance future research on system hospitals, their leadership and process of care delivery, and integration with other health care providers in association with quality of care.

Conclusion

Using Contingency theory as the conceptual framework, this study provides evidence for a hospital-led health system effect on quality of care. The findings suggest that hospitals in Centralized Health Systems were quality "champions", being able to decrease AMI, CHF, Stroke, and Pneumonia mortality rates in comparison with other hospital system types. Centralization of hospital structures may improve internal clinical processes by enhanced coordination of activities, communication between providers, timely adjustments of process of care delivery and structures to external pressures, and other mechanisms.

System hospital compliance with the JCAHO performance area for availability of patient specific information system may have improved the process of care delivery for CHF, Stroke, and Pneumonia patients in system hospitals. System hospitals may have been continuously investing in their information and clinical record systems that resulted in improvements in quality of care.

It is also concluded that hospital-led health systems' structural characteristics may not affect patient safety adverse events. However, a lack of hospital systems' effect on PSIs may be explained by a newness of the patient safety issues, specific changes in the hospital reporting patterns of adverse events and medical errors after the IOM report of 1999, and possible characteristics of clinical personnel (e.g., varying levels of knowledge about and awareness of in-hospital adverse events and medical errors). Thus, patient safety issues should be further researched in order to identify the directions for quality improvements and adverse event prevention.

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APPENDIX 1: Correlation Matrix

	iqi 15	iqi 16	iqi 17	iqi 20	psi 03	psi 07	psi 12	rpps13	psi 15	CHS
iqi 15:AMI	1.000									
iqi 16: CHF	0.618	1.000								
iqi 17: Stroke	0.646	0.671	1.000							
iqi 20: Pneumonia	0.607	0.705	0.696	1.000						
psi 03: Decubitus ulcer	0.034	-0.045	-0.073	0.021	1.000					
psi 07: Infection due to med care	-0.038	-0.047	-0.079	-0.062	0.282	1.000				
psi 12: Post-op PE and DVT	-0.051	-0.055	-0.063	-0.027	0.198	0.262	1.000			
psi 13: Post-op sepsis	-0.092	-0.136	-0.128	-0.125	0.237	0.201	0.318	1.000		
psi 15: Accident Puncture	-0.001	-0.004	0.053	0.041	0.101	0.183	0.053	0.016	1.000	
CHS	-0.095	-0.148	-0.117	-0.124	0.068	0.065	0.014	0.024	-0.018	1.000
CPIHS	0.053	0.069	0.062	0.094	0.055	0.074	0.068	0.024	-0.042	-0.105
MCHS	0.116	0.135	0.125	0.157	-0.049	-0.022	-0.007	-0.046	0.156	-0.209
DHS	-0.133	-0.093	-0.113	-0.160	-0.062	-0.074	-0.029	0.014	-0.094	-0.276
IHS	0.125	0.016	0.063	0.065	0.103	0.036	-0.042	0.001	-0.046	-0.054
total number of beds	-0.005	0.011	0.050	0.135	0.213	0.200	0.201	0.046	-0.056	0.001
public ownership	-0.125	-0.099	-0.125	-0.093	0.110	-0.003	0.125	0.067	0.024	0.299
nonprofit ownership	0.276	0.295	0.312	0.345	-0.057	0.078	-0.028	-0.093	0.140	-0.042
investor ownership	-0.228	-0.266	-0.268	-0.326	-0.007	-0.085	-0.049	0.061	-0.171	-0.145
service scope and mix (0-10)	-0.058	-0.055	-0.093	-0.128	0.083	0.064	-0.004	0.029	-0.014	0.006

APPENDIX 1: Correlation Matrix (Continued)

	iqi 15	iqi 16	iqi 17	iqi 20	psi 03	psi 07	psi 12	rpps13	psi 15	CHS
service scope and mix (10 - 20)	-0.009	-0.012	-0.061	-0.043	-0.147	-0.188	-0.147	-0.012	-0.107	0.056
service scope and mix (30+)	0.036	0.038	0.106	0.104	0.112	0.163	0.153	-0.001	0.116	-0.060
major teaching status	-0.009	0.007	0.092	0.114	0.129	0.173	0.165	0.015	-0.005	0.022
minor teaching status	0.086	0.057	0.100	0.074	0.090	0.045	-0.028	-0.027	-0.003	0.013
nonteach status	-0.072	-0.056	-0.148	-0.137	-0.161	-0.148	-0.077	0.015	0.006	-0.025
total nursing staff per staffed bed	-0.031	0.003	0.111	0.039	0.034	0.272	0.058	0.039	0.126	0.003
RNs to LPNs ratio	-0.004	0.001	0.041	0.080	0.069	0.104	0.189	-0.006	0.034	0.069
urban location	0.004	-0.056	-0.079	0.005	0.136	0.112	0.023	0.143	-0.053	0.027
rural location	-0.004	0.056	0.079	-0.005	-0.136	-0.112	-0.023	-0.143	0.053	-0.027
operating margin	-0.057	-0.066	-0.100	-0.143	-0.121	-0.148	-0.119	-0.009	-0.044	-0.078
cash flow to total revenue	-0.048	-0.067	-0.113	-0.122	-0.104	-0.065	-0.098	-0.016	0.004	0.015
HHI	0.061	0.112	0.119	0.045	-0.272	-0.206	-0.026	-0.072	0.099	-0.108
HMO penetration	-0.015	-0.017	-0.032	0.042	0.168	0.155	0.082	0.084	-0.064	0.059
% of hospital's patient age < 19	0.120	0.075	0.139	0.191	0.064	0.007	-0.002	0.013	0.032	-0.130
% of hospital's patient age 19 - 64	0.057	0.059	0.118	0.178	0.196	0.122	0.134	0.092	0.091	0.001
% of hospital's patient age 64 +	-0.107	-0.080	-0.154	-0.220	-0.150	-0.072	-0.073	-0.059	-0.071	0.082
per capita	0.034	0.005	0.040	0.080	0.106	0.131	0.171	0.130	-0.017	0.021

APPENDIX 1: Correlation Matrix (Continued)

	iqi 15	iqi 16	iqi 17	iqi 20	psi 03	psi 07	psi 12	rpps13	psi 15	CHS
population over 65 in the market	-0.263	-0.266	-0.294	-0.325	-0.085	-0.102	-0.083	0.006	-0.098	0.046
total population in the market	-0.030	-0.126	-0.117	-0.071	0.230	0.092	-0.010	0.085	-0.109	0.033
MDs per 1000 population	0.045	0.028	0.075	0.100	0.112	0.219	0.168	0.051	0.025	0.084
MDs in 45-54 age group per pop	0.032	0.026	0.060	0.078	0.107	0.201	0.167	0.071	0.053	0.087
% of female patients in a hospital	0.157	0.119	0.085	0.133	0.127	-0.015	-0.014	0.065	0.047	-0.056
% of black patients in a hospital	-0.039	-0.135	-0.063	-0.033	0.367	0.162	0.197	0.210	-0.050	0.128
% patients with mortality risk 3 and 4	-0.213	-0.230	-0.270	-0.303	0.142	0.126	0.091	0.116	0.085	0.102
% patients with severity risk 3 and 5	-0.202	-0.258	-0.284	-0.311	0.204	0.192	0.111	0.113	0.110	0.085
CMI	-0.173	-0.198	-0.166	-0.200	-0.003	0.139	0.021	0.006	-0.016	0.018
Volume (num. of iqi 15 patients)	-0.192	-0.123	-0.108	-0.053	0.111	0.197	0.101	0.082	-0.018	0.032
Volume (num. of iqi 16 patients)	-0.114	-0.083	-0.098	-0.004	0.322	0.218	0.182	0.185	-0.082	0.079
Volume (num. of iqi 17 patients)	-0.097	-0.059	-0.097	0.020	0.202	0.196	0.140	0.089	-0.035	0.020

APPENDIX 1: Correlation Matrix (Continued)

	iqi 15	iqi 16	iqi 17	iqi 20	psi 03	psi 07	psi 12	rpps13	psi 15	CHS
Volume (num. of iqi 20 patients)	-0.035	-0.036	-0.039	0.065	0.251	0.258	0.216	0.136	0.021	0.019
Volume (num. of psi 03 patients)	-0.025	0.020	0.041	0.132	0.230	0.252	0.236	0.071	-0.065	0.043
Volume (num. of psi 07 patients)	-0.035	-0.016	0.022	0.118	0.255	0.265	0.234	0.104	-0.013	0.013
Volume (num. of psi 12 patients)	-0.041	-0.015	0.014	0.092	0.104	0.241	0.164	0.017	0.028	-0.004
Volume (num. of psi 13 patients)	-0.029	0.003	0.021	0.082	0.030	0.210	0.098	-0.044	0.001	-0.009
Volume (num. of psi 15 patients)	-0.057	-0.032	0.002	0.088	0.216	0.274	0.240	0.101	-0.006	0.035
1st time period (1995 - 1997)	0.029	0.050	-0.016	-0.011	-0.165	-0.266	-0.402	-0.389	-0.182	0.052
2nd time period (1998 - 2000)	-0.029	-0.050	0.016	0.011	0.165	0.266	0.402	0.389	0.182	-0.052
	CPIHS	MCHS	DHS	IHS	beds	public	nonpro~t	investor	serv 0-10	serv 20-30
CPIHS	1.000									
MCHS	-0.240	1.000								
DHS	-0.317	-0.631	1.000							
IHS	-0.062	-0.124	-0.164	1.000						
total number of beds	0.083	0.003	-0.047	-0.022	1.000					
public	0.061	-0.103	-0.110	0.007	0.030	1.000				

APPENDIX 1: Correlation Matrix (Continued)

	CPIHS	MCHS	DHS	IHS	beds	public	nonpro~t	investor	serv 0-10	serv 20-30
nonprofit ownership	0.114	0.297	-0.351	0.073	0.047	-0.460	1.000			
investor ownership	-0.166	-0.265	0.463	-0.086	-0.071	-0.128	**-0.822**	1.000		
service scope and mix (0 - 10)	-0.047	-0.002	0.000	0.081	-0.123	0.065	-0.109	0.080	1.000	
service scope and mix (10 - 20)	-0.028	-0.077	0.037	0.063	-0.454	-0.072	-0.099	0.157	-0.286	1.000
service scope and mix (30+)	0.051	0.081	-0.038	-0.103	0.524	0.043	0.153	-0.198	-0.174	**-0.894**
major teaching status	0.127	0.095	-0.177	-0.010	0.500	0.013	0.130	-0.154	-0.002	-0.289
minor teaching status	-0.014	-0.040	0.017	0.061	0.186	0.007	0.134	-0.153	-0.107	-0.212
nonteach status	-0.066	-0.023	0.094	-0.049	-0.477	-0.014	-0.201	0.234	0.098	0.370
total nursing staff per staffed bed	0.063	0.092	-0.126	-0.002	0.050	0.022	0.106	-0.133	-0.068	-0.204
RNs to LPNs ratio	0.043	-0.012	-0.074	0.058	0.256	-0.041	0.184	-0.179	-0.172	-0.158
urban location	0.019	0.018	-0.062	0.053	0.251	0.010	-0.093	0.098	-0.087	-0.085
rural location	-0.019	-0.018	0.062	-0.053	-0.251	-0.010	0.093	-0.098	0.087	0.085
operating margin	-0.083	-0.103	0.184	0.020	-0.105	-0.098	-0.349	0.452	0.002	0.073
cash flow to total revenue	-0.172	0.004	0.089	0.018	0.057	-0.020	-0.269	0.313	-0.044	-0.028
HHI	-0.068	0.048	0.057	-0.001	-0.282	-0.124	0.117	-0.051	-0.011	0.127
HMO penetration	0.054	-0.053	-0.053	0.104	0.145	0.048	0.031	-0.065	-0.004	-0.056
% of hospital's patient age < 19	0.192	0.073	-0.123	0.020	0.177	0.097	0.091	-0.164	-0.132	-0.203

APPENDIX 1: Correlation Matrix (Continued)

	CPIHS	MCHS	DHS	IHS	beds	public	nonpro~t	investor	serv 0-10	serv 20-30
% of hospital's patient age 19 - 64	0.102	0.088	-0.164	0.050	0.332	0.217	0.055	-0.201	-0.080	-0.302
% of hospital's patient age 64 +	-0.178	-0.095	0.169	-0.040	-0.296	-0.181	-0.089	0.215	0.128	0.297
per capita income in the market	-0.079	0.051	-0.013	0.006	0.293	0.067	0.042	-0.090	-0.035	-0.152
population over 65 in the market	-0.123	-0.099	0.171	-0.077	-0.070	0.068	-0.253	0.240	0.012	0.191
total population in the market	0.143	-0.013	-0.103	0.024	0.110	0.066	-0.048	0.011	0.106	-0.086
MDs per 1000 population	-0.043	0.031	-0.067	0.054	0.379	-0.014	0.122	-0.127	-0.059	-0.180
MDs in 45-54 age group per pop	-0.055	0.013	-0.047	0.059	0.346	-0.032	0.125	-0.119	-0.074	-0.175
% of female patients in a hospital	0.107	0.058	-0.112	0.064	-0.192	-0.081	0.125	-0.087	-0.035	0.054
% of black patients in a hospital	0.050	-0.043	-0.118	0.160	0.253	0.206	-0.095	-0.026	-0.034	-0.106
% patients with mortality risk 3 and 4	-0.139	-0.132	0.164	-0.030	-0.154	-0.107	-0.131	0.215	0.147	0.192
% patients with severity risk 3 and 5	-0.103	-0.159	0.174	-0.023	-0.033	-0.088	-0.167	0.243	0.118	0.115
CMI	-0.088	-0.099	0.161	-0.065	0.309	-0.141	-0.076	0.175	-0.042	-0.179

APPENDIX 1: Correlation Matrix (Continued)

	CPIHS	MCHS	DHS	IHS	beds	public	nonpro~t	investor	serv 0-10	serv 20-30
Volume (num. of iqi 15 patients)	0.052	-0.046	0.020	-0.075	0.613	-0.029	0.000	0.018	-0.092	-0.332
Volume (num. of iqi 16 patients)	0.022	-0.061	-0.003	0.006	0.642	-0.026	-0.022	0.041	-0.122	-0.173
Volume (num. of iqi 17 patients)	0.094	-0.099	0.035	-0.033	0.694	-0.080	0.008	0.043	-0.123	-0.255
Volume (num. of iqi 20 patients)	0.059	-0.026	-0.030	0.020	0.659	-0.086	0.119	-0.078	-0.104	-0.249
Volume (num. of psi 03 patients)	0.089	-0.005	-0.062	-0.036	**0.888**	0.010	0.065	-0.079	-0.107	-0.382
Volume (num. of psi 07 patients)	0.141	0.007	-0.103	0.006	**0.891**	0.030	0.082	-0.111	-0.131	-0.469
Volume (num. of psi 12 patients)	0.090	0.005	-0.053	-0.017	**0.821**	-0.094	0.123	-0.077	-0.130	-0.470
Volume (num. of psi 13 patients)	0.054	-0.002	-0.013	-0.042	**0.729**	-0.142	0.140	-0.065	-0.135	-0.415
Volume (num. of psi 15 patients)	0.100	-0.007	-0.076	0.005	**0.896**	0.001	0.081	-0.091	-0.126	-0.431
1st time period (1995 - 1997)	0.100	-0.100	0.011	-0.026	-0.016	-0.015	-0.061	0.078	-0.066	0.100
2nd time period (1998 - 2000)	-0.100	0.100	-0.011	0.026	0.016	0.015	0.061	-0.078	0.066	-0.100

	serv 30+	majteach	minteach	nonteach	total nurse	RNs/ LPNs	urban	rural	margin	cashflow
service scope and mix (30+)	1.000									
major teaching status	0.298	1.000								
minor teaching status	0.268	-0.180	1.000							
nonteach status	-0.427	-0.455	**-0.795**	1.000						
total nursing staff per staffed bed	0.242	0.242	0.074	-0.217	1.000					
RNs to LPNs ratio	0.243	0.204	0.089	-0.207	0.135	1.000				
urban location	0.128	0.096	0.105	-0.154	-0.124	0.090	1.000			
rural location	-0.128	-0.096	-0.105	0.154	0.124	-0.090	**-1.000**	1.000		
operating margin	-0.076	-0.260	-0.026	0.184	-0.014	-0.094	0.032	-0.032	1.000	
cash flow to total revenue	0.049	-0.084	0.030	0.025	0.115	-0.008	0.047	-0.047	**0.778**	1.000
HHI	-0.126	-0.176	-0.110	0.208	0.061	-0.059	-0.468	0.468	0.136	0.079
HMO penetration	0.059	0.134	0.036	-0.115	-0.070	0.043	0.507	-0.507	-0.146	-0.081
% of hospital's patient age < 19	0.271	0.153	0.123	-0.206	0.199	0.094	-0.074	0.074	-0.051	-0.036
% of hospital's patient age 19 - 64	0.348	0.273	0.224	-0.372	0.214	0.157	0.068	-0.068	-0.181	-0.057
% of hospital's patient age 64 +	-0.365	-0.248	-0.202	0.337	-0.245	-0.147	0.009	-0.009	0.133	0.054
per capita income in the market	0.173	0.338	0.028	-0.234	0.020	0.174	0.231	-0.231	-0.201	-0.044

APPENDIX 1: Correlation Matrix (Continued)

APPENDIX 1: Correlation Matrix (Continued)

	serv 30+	majteach	minteach	nonteach	total nurse	RNs/ LPNs	urban	rural	margin	cashflow
population over 65 in the market	-0.202	-0.076	-0.155	0.187	-0.133	-0.145	-0.067	0.067	0.087	0.105
total population in the market	0.039	0.071	0.033	-0.074	-0.028	-0.069	0.176	-0.176	-0.106	-0.058
MDs per 1000 population	0.213	0.453	0.133	-0.401	0.103	0.215	0.160	-0.160	-0.222	-0.002
MDs in 45-54 age group per pop	0.215	0.390	0.144	-0.371	0.078	0.221	0.119	-0.119	-0.213	-0.006
% of female patients in a hospital	-0.039	-0.096	-0.057	0.111	0.022	-0.001	-0.040	0.040	-0.037	-0.143
% of black patients in a hospital	0.125	0.284	0.164	-0.324	0.053	0.112	0.164	-0.164	-0.109	-0.043
% patients with mortality risk 3 and 4	-0.265	-0.160	-0.141	0.226	-0.174	-0.075	0.071	-0.071	0.113	0.068
% patients with severity risk 3 and 5	-0.174	-0.068	-0.083	0.117	-0.113	-0.026	0.118	-0.118	0.131	0.105
CMI	0.204	0.092	0.110	-0.156	0.053	0.116	0.213	-0.213	0.150	0.190
Volume (num. of iqi 15 patients)	0.384	0.211	0.149	-0.265	0.179	0.238	0.198	-0.198	0.099	0.143
Volume (num. of iqi 16 patients)	0.235	0.288	0.072	-0.243	0.075	0.199	0.254	-0.254	-0.001	0.094
Volume (num. of iqi 17 patients)	0.320	0.305	0.085	-0.265	0.104	0.223	0.257	-0.257	0.017	0.140

APPENDIX 1: Correlation Matrix (Continued)

	serv 30+	majteach	minteach	nonteach	total nurse	RNs/ LPNs	urban	rural	margin	cashflow
Volume (num. of iqi 20 patients)	0.305	0.396	0.097	-0.332	0.165	0.248	0.196	-0.196	-0.042	0.062
Volume (num. of psi 03 patients)	0.443	0.508	0.130	-0.432	0.166	0.252	0.225	-0.225	-0.107	0.078
Volume (num. of psi 07 patients)	0.544	0.514	0.185	-0.485	0.238	0.313	0.248	-0.248	-0.100	0.071
Volume (num. of psi 12 patients)	0.543	0.467	0.174	-0.446	0.270	0.304	0.218	-0.218	-0.037	0.140
Volume (num. of psi 13 patients)	0.490	0.430	0.158	-0.408	0.255	0.268	0.185	-0.185	0.005	0.172
Volume (num. of psi 15 patients)	0.502	0.512	0.162	-0.463	0.227	0.303	0.238	-0.238	-0.091	0.099
1st time period (1995 - 1997)	-0.072	-0.047	-0.008	0.036	-0.093	-0.089	0.045	-0.045	0.180	0.143
2nd time period (1998 - 2000)	0.072	0.047	0.008	-0.036	0.093	0.089	-0.045	0.045	-0.180	-0.143
	hhi	HMO penet	age <19	age 19-64	age 64+	pop incm	pop old 65+	tot pop	tot mds	md(45-54)/pop
HHI	1.000									
HMO penetration	-0.502	1.000								
% of hospital's patient age < 19	0.010	-0.111	1.000							

APPENDIX 1: Correlation Matrix (Continued)

	hhi	HMO penet	age <19	age 19-64	age 64+	pop incm	pop old 65+	tot pop	tot mds	md(45-54)/pop
% of hospital's patient age 19 - 64	-0.126	0.043	0.416	1.000						
% of hospital's patient age 64 +	0.064	0.047	**-0.863**	**-0.818**	1.000					
per capita income in the market	-0.299	0.294	-0.117	0.234	-0.056	1.000				
population over 65 in the market	0.148	-0.180	-0.315	-0.423	0.434	-0.025	1.000			
total population in the market	-0.518	0.255	0.150	0.062	-0.129	0.045	-0.248	1.000		
MDs per 1000 population	-0.306	0.268	-0.120	0.310	-0.097	0.647	-0.122	0.023	1.000	
MDs in 45-54 age group per pop	-0.276	0.236	-0.114	0.300	-0.095	0.635	-0.118	0.023	**0.962**	1.000
% of female patients in a hospital	-0.011	0.039	0.609	0.146	-0.466	-0.217	-0.305	0.142	-0.178	-0.162
% of black patients in a hospital	-0.221	0.097	0.062	0.426	-0.276	0.201	-0.059	0.063	0.321	0.276
% patients with mortality risk 3 and 4	-0.049	0.088	**-0.730**	-0.560	**0.773**	-0.011	0.356	-0.066	-0.003	0.011
% patients with severity risk 3 and 5	-0.090	0.065	-0.620	-0.456	0.645	-0.025	0.353	-0.039	0.051	0.058
CMI	-0.166	0.137	-0.564	-0.278	0.511	0.059	0.238	-0.050	0.169	0.172

APPENDIX 1: Correlation Matrix (Continued)

	hhi	HMO penet	age <19	age 19-64	age 64+	pop incm	pop old 65+	tot pop	tot mds	md(45-54)/pop
Volume (num. of iqi 15 patients)	-0.162	0.125	-0.033	-0.021	0.032	0.068	0.046	0.006	0.066	0.061
Volume (num. of iqi 16 patients)	-0.260	0.213	-0.140	-0.022	0.101	0.205	0.111	0.106	0.222	0.195
Volume (num. of iqi 17 patients)	-0.255	0.207	-0.060	-0.037	0.059	0.178	0.063	0.111	0.211	0.199
Volume (num. of iqi 20 patients)	-0.250	0.210	-0.013	0.044	-0.016	0.239	-0.023	0.132	0.291	0.271
Volume (num. of psi 03 patients)	-0.257	0.157	0.031	0.241	-0.154	0.342	-0.019	0.060	0.402	0.356
Volume (num. of psi 07 patients)	-0.293	0.172	0.268	0.363	-0.371	0.288	-0.130	0.142	0.345	0.320
Volume (num. of psi 12 patients)	-0.231	0.155	0.110	0.230	-0.197	0.186	-0.102	0.056	0.352	0.336
Volume (num. of psi 13 patients)	-0.181	0.114	0.048	0.157	-0.118	0.117	-0.074	0.014	0.345	0.319
Volume (num. of psi 15 patients)	-0.266	0.167	0.101	0.276	-0.217	0.306	-0.062	0.089	0.389	0.364
1st time period (1995 - 1997)	-0.087	-0.062	0.061	-0.084	0.008	-0.246	0.013	0.097	-0.069	-0.092
2nd time period (1998 - 2000)	0.087	0.062	-0.061	0.084	-0.008	0.246	-0.013	-0.097	0.069	0.092

APPENDIX 1: Correlation Matrix (Continued)

	% female	% black	% mort 34	% sever 34	CMI	Vol iqi 15	Vol iqi 16	Vol iqi 17	Vol iqi 20	Vol psi 03
% of female patients in a hospital	1.000									
% of black patients in a hospital	-0.021	1.000								
% patients with mortality risk 3 and 4	-0.381	-0.074	1.000							
% patients with severity risk 3 and 5	-0.374	0.024	**0.940**	1.000						
CMI	-0.634	-0.003	0.553	0.604	1.000					
Volume (num. of iqi 15 patients)	-0.229	-0.033	0.093	0.127	0.509	1.000				
Volume (num. of iqi 16 patients)	-0.163	0.295	0.216	0.245	0.352	0.674	1.000			
Volume (num. of iqi 17 patients)	-0.155	0.113	0.141	0.194	0.417	0.763	0.844	1.000		
Volume (num. of iqi 20 patients)	-0.078	0.132	0.138	0.187	0.302	0.660	0.787	0.825	1.000	
Volume (num. of psi 03 patients)	-0.245	0.252	-0.046	0.044	0.345	0.697	0.774	0.790	0.753	1.000
Volume (num. of psi 07 patients)	-0.043	0.252	-0.217	-0.102	0.225	0.719	0.736	0.792	0.784	0.910

APPENDIX 1: Correlation Matrix (Continued)

	% female	% black	% mort 34	% sever 34	CMI	Vol iqi 15	Vol iqi 16	Vol iqi 17	Vol iqi 20	Vol psi 03
Volume (num. of psi 12 patients)	-0.165	0.074	-0.102	0.008	0.480	0.753	0.616	0.760	0.698	0.837
Volume (num. of psi 13 patients)	-0.182	0.028	-0.067	0.037	0.516	0.671	0.507	0.642	0.566	0.748
Volume (num. of psi 15 patients)	-0.205	0.230	-0.087	0.016	0.363	0.742	0.775	0.827	0.806	0.950
1st time period (1995 - 1997)	0.037	-0.069	-0.063	-0.028	-0.015	-0.025	-0.098	-0.005	-0.137	-0.038
2nd time period (1998 - 2000)	-0.037	0.069	0.063	0.028	0.015	0.025	0.098	0.005	0.137	0.038
	Vol psi 07	**Vol psi 12**	**Vol psi 13**	**Vol psi 15**	**1st time**	**2nd time**				
Volume (num. of psi 07 patients)										
Volume (num. of psi 12 patients)	1.000									
Volume (num. of psi 13 patients)	0.886	1.000								
Volume (num. of psi 15 patients)	0.746	0.929	1.000							
1st time period (1995 - 1997)	0.969	0.921	0.798	1.000						
2nd time period (1998 - 2000)	-0.078	-0.029	0.041	-0.098	1.000					

Vita

Askar S. Chukmaitov was born on June 18, 1973, in Almaty City, Kazakhstan. In 1996, he received his Medical Doctor degree from the Kazakh State Medical University (formerly Almaty State Medical Institute), Almaty City, Kazakhstan. After receiving his medical degree, he worked as a health reform demonstration site manager on the USAID-founded ZrdavReform project, Abt Associates, Inc. In 1999, he received his Master of Public Administration with a concentration in Health Administration from the University of Nebraska at Omaha, the USA. He returned to Kazakhstan and worked as a national component coordinator for the World Bank Health Reform Project and the Ministry of Health of Kazakhstan. In August 2001, he enrolled in the Department of Health Administration's doctoral program at Virginia Commonwealth University, and completed the requirements for the Ph.D. degree in September, 2005. After defending his dissertation, he assumed a full-time position as an Assistant Professor at Florida State University College of Medicine, Division of Health Affairs, Department of Family Medicine and Rural Health. His areas of interest include various aspects of quality of care/outcomes, hospital systems, long-term care, integration/disintegration of health care providers (i.e., primary care, hospital, and long-term care).