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The Structural Response and Performance of General Hospitals in a Managed Care Environment

Denise M. McCollum

SCHOOL OF ALLIED HEALTH PROFESSIONS
DEPARTMENT OF HEALTH ADMINISTRATION
VIRGINIA COMMONWEALTH UNIVERSITY

This is to certify that the dissertation prepared by Denise M. McCollum, *The Structural Response and Performance of General Hospitals in a Managed Care Environment,* has been approved by her committee as satisfactory completion of the dissertation requirement for the degree of Doctor of Philosophy.

Committee:

[redacted]
Director of Dissertation
School of Allied Health Professions

[redacted]
Committee Member
School of Allied Health Professions

[redacted]
Committee Member
School of Allied Health Professions

[redacted]
Committee Member
School of Allied Health Professions

[redacted]
Committee Member
School of Medicine

[redacted]
Dean, School of Allied Health Professions
(or Dean's Representative)

[redacted]
Dean, School of Graduate Studies

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(Date)

The Structural Response and Performance of General Hospitals in a Managed Care Environment

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

By

Denise M. McCollum

M.H.A.. Baylor University, 1988
B.S. University of San Francisco, 1979

Director: James W. Begun, Ph.D.
Professor
Department of Health Administration

Virginia Commonwealth University
Richmond, Virginia
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Abstract

THE STRUCTURAL RESPONSE AND PERFORMANCE OF GENERAL HOSPITALS IN A MANAGED CARE ENVIRONMENT

By Denise M. McCollum, Ph.D.

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Major Director: James W. Begun, Ph.D., Professor

The study purpose is to link hospital structure, represented by each hospital's professional contingent, service mix, and inpatient capacity; and its environment, characterized by the penetration of managed care enrollees. The secondary purpose is to test the relationship between hospital structural change and subsequent hospital performance.

The study employs a non-experimental panel design, with a sample of 1882 community hospitals (service type: general medical and surgical). Environmental variables are measured for the base year 1989. Hospital structural variables are measured for 1989 and 1994, with change variables computed. Performance variables are

measured for 1989 and 1995, with change computed for cost measures. Hospital structural change is viewed as a dependent variable related to the environment, as well as an independent variable related to performance.

Descriptive data are extracted from the American Hospital Association Annual Survey of Hospitals. Hospital cost performance data are from the Health Care Financing Administration Prospective Payment System Minimum Data Sets. Hospital mortality data for 1989 are from Medicare Hospital Mortality Information.

HMO enrollment data are extracted from the Interstudy Edge and aggregated to metropolitan statistical area (MSA) level. Market competition data are from the 1989 Area Resource File. A Herfindahl-Hirschman index (HHI) is calculated for each hospital's MSA.

Analytical hypotheses are tested using ordinary least squares (OLS) technique. Results from Part 1 suggest that where HMO penetration was relatively high, sample hospitals tended to contain growth in their registered nurse (RN) staff between 1989 and 1994. Higher HMO penetration is also associated with more stabilization in occupancy rates, preventive services, and ambulatory workload. In contrast, market competition is associated with changes to a higher Medicare case-mix index (CMI), and increase in ambulatory visits.

Results from Part 2 indicate positive associations between increased RN staff and hospital cost growth between 1989 and 1995. Hospitals which did not experience an increased CMI are similarly linked with cost growth. Alternatively, reduction in hospital bedsize is associated with more controlled growth in hospital cost per patient day.

Several control variables display noteworthy associations with the variables of interest. Theoretical and management implications for community hospitals are discussed.

CHAPTER I. INTRODUCTION

A recurring objective in American health care policy is adequate health services for all citizens. This goal includes appropriate levels of access, cost, and quality care within the medical system. Our society, rich in organizations (Scott, 1992), has witnessed the emergence of the general hospital as a social and economic institution, a storehouse for sophisticated medical technology and scientific expertise. Rosemary Stevens (1989) describes American voluntary hospitals as businesses which simultaneously carry American hopes of altruism, solidarity, and community spirit. Additionally, the corporatization of hospitals through the emergence of profit-making chains introduced capitalism into American medicine on a large scale (Starr, 1982).

Recently, however, the tide of American opinion has not favored the continued expansion of hospital facilities. Robinson (1994) characterizes the hospital as challenged by important developments in epidemiology, technology, and economics. Furthermore, concern for the tremendous rise in medical spending has propelled public and private purchasers to increasingly negotiate payments for hospital services for prospectively determined amounts.

The focus of this study is the community hospital organization and its response to a changing economic and market environment. One pivotal change came in the 1980s with the Medicare Prospective Payment System (PPS). According to Eli Ginzberg

(1995), hospitals adjusted to PPS, not by reducing their expenditures, but rather by finding new sources of revenues. In the face of declines in hospital occupancy rates from the mid-70% level in 1985 to about 60% in 1995, relatively few hospitals were forced to merge, convert, or close. In 1988, for example, a peak year for hospital failures, only 70 closures were identified out of a sample of 1535 nongovernment, short-term, acute care hospitals (Ozcan and Lynch, 1992). Hospital survival mechanisms included the formation of alliances to benefit from economies of scale and increased access to capital.

Cost-shifting, or transferring the cost of care to another's pocketbook (Eastaugh, 1992) was also a tactical response from hospitals seeking to maintain customary revenues without fundamentally changing their methods of internal operation.

A second pivotal factor challenging the hospital organization is the emergence of managed care companies, which have rapidly grown to dominate specific sectors of the inpatient market. In 1995, 73% of U.S. workers with health insurance received their coverage through managed care in the form of a health maintenance organization (HMO), a preferred provider organization (PPO), or a point-of-service plan (Jensen et al., 1997). Fifty million people in the U.S., or 20 percent of the population, were insured through HMOs in 1996 (Dunn, 1996). Furthermore, both the Medicare and Medicaid programs are developing managed care systems for their covered populations. In 1995, approximately 3 million Medicare beneficiaries were enrolled in HMOs, representing about 8 percent of the Medicare population (Virginia Association of HMOs, 1997).

Clearly, the managed care philosophy, with emphasis on primary care services, disease prevention, and cost reduction, introduces several new challenges from the

hospital's external environment. From the hospital perspective, many questions arise regarding new economic and social incentives. Will hospital structures support outpatient services and expanded preventive medicine missions? In the labor arena, have hospitals retained elaborate numbers of staff, or have they "reengineered" in efforts to focus on core competencies and lucrative product lines? Duke (1996) observes that hospitals are struggling to rethink and reorganize what they do, who does it, and how everything is financed. The question remains whether thought has been translated to action

Apart from these structural issues, do hospitals operate more efficiently as a result of their participation in managed care contracting? To what degree have cost savings been achieved? In this new environment of market competition and managed care, have hospitals succeeded in maintaining, or improving the quality of care rendered?

The issues of cost containment and quality in health care are particularly important with the projected growth and needs of the Medicare population. As the American "Baby Boomers" age, they will lay claim to a national health insurance program already considered overburdened in 1996. People over the age of 64 will total 17.5 percent of the population by 2020, up from 12.5 percent in 1990 (U.S. Census Bureau, 1990). Clearly, considerable demand for medical care will exist for this senior population, which currently utilizes inpatient services at five times the rate of those under the age of 65. The challenge for hospitals will be to deliver patient services and to remain viable under new risk-bearing reimbursement methods (Murray and Anderson, 1996).

The managed care contracting model, involving capitated reimbursements and assumption of financial risk, could eventually become the dominant payment method for general hospital services. By examining those hospitals already immersed in managed care delivery systems, this study examines the direction of future structural development for the typical community hospital.

According to Robinson and Casalino (1996), managed care began as a reform in health care financing, but will culminate as a revolution in health care organization. This study will assist in determining whether this second revolution has begun.

Historical Background

"From cash cow to cost center." This phrase typifies the feeling that the hospital sector is due for monumental change, where the acute care hospital could move from the center of the health care delivery system to the periphery (Brennan, 1996; Ginzberg, 1995; Goldsmith, 1989; Robinson, 1994).

Foster (1989) claims that American hospitals, known in the 19th century as a place to die, have gone from rags to riches to rags once again. Indeed, during a twentieth century buildup, the community hospital evolved from a locally supported charity to a complex institution, dependent on sophisticated equipment and highly differentiated personnel (Lawrence and Dyer, 1983). A downward swing toward hospital destitution has not been easy to detect, however. For example, the Prospective Payment Assessment Commission (PROPAC) (1996) noted record profit margins for American hospitals in 1996.

When the American economy took a downturn in the 1970s, the cost of health care did not. Federal regulation targeting cost containment was enacted in the 1980s, establishing Medicare's Prospective Payment System and introducing Diagnosis Related Groups (DRGs). Typical hospital response to economic pressures in the 1980s consisted of horizontal and/or vertical integration, diversification, and aggressive marketing (Duke, 1996; Ginzberg, 1995). According to Foster (1989), the hospital response to DRGs was called "restructuring," where hospitals were subsumed into systems or possibly affiliated into confederations.

The Prospective Payment Assessment Commission (1996), observing that the hospital industry is operating in an increasingly price-competitive environment, characterizes three hospital financial strategies: controlling costs, seeking alternative revenue streams, and expanding market share. Alternative revenue streams are sought through broadening the scope of services, such as offering more outpatient surgeries or skilled nursing facilities. Strengthening market share, or securing a patient base, often occurs through contractual arrangements with provider groups or managed care companies.

Robinson (1996b) summarizes five forms of growth and integration in health care organizations: increased share of a particular market for a particular product (within-market horizontal integration); expansion into a new geographic region (across-market horizontal integration); development of new services (product diversification); entry into new marketing and distribution niches (channel diversification); and linkages into suppliers (vertical integration). Foster (1989) interpreted the movement to systems as the

disappearance of autonomous hospitals. External changes do not necessarily change hospital operations, however, specifically in terms of quality and community service (Shortell, 1988).

Grumbach (1995, p.167) describes an American model of health care which fostered the growth and financing of the modern hospital: "focused on specialization, technology, and curative medicine, with relative inattention to basic primary care services, including such needs as disease prevention and supportive care for patients with chronic and incurable ailments. A pluralistic delivery system, which is often fragmented and lacking coordination..." From this acute care perspective, hospitals were not designed to meet the full spectrum of health care needs for their patient populations. Yet the 1990s appear to be the period when hospital services are redefined for the managed care environment.

Purpose of the Study

The primary purpose of this study is to explore the relationship between hospital structure, represented by each hospital's professional contingent, service mix, and inpatient capacity; and the hospital environment, characterized by the penetration of managed care health plans. On a secondary level, the study searches for a link between change in hospital structure and associated organizational performance.

The American hospital is a fascinating subject for organizational research due to its blend of tradition, professionalism, regulation, medical technology, human service, politics, and economic influence, to name a few distinguishing features. According to John Griffith (1989), hospitals are the creations of the society around them. This study

combines a familiar problem - the most desirable ways to organize - with a prominent community element - the community hospital - in order to characterize the current challenge of delivering acceptable inpatient care at a reasonable cost.

Although the observation and analysis of hospital trends are useful to healthcare managers, this study primarily seeks to test organizational theory. Collection and evaluation of available hospital data allow for empirical application of structural contingency theory (SCT) and existing literature in organizational adaptation.

Statement of the Problem

Primarily, this study determines whether a selected group of American hospitals made significant structural changes during a particularly turbulent period in their recent history, from 1989 to 1994. Further, the study searches for the strongest environmental influences on structural changes. Influence is measured in the following dimensions: the degree of managed care entrenchment into the hospital's market, the hospital's performance record as impetus for change, and individual hospital characteristics considered inherent to management structure.

Wherever general hospitals show significant structural changes, the secondary study problem is to identify their performance differences after the transition; as well as to compare performance between "adaptive" hospitals, and those hospitals which have essentially retained their prototypical structures in spite of environmental change.

Three major assumptions are made in approaching this study. First, community hospitals in 1987, fresh from weathering prospective payment reform, are generally assumed to be a poor "fit" with the values, objectives, and financial incentives of the

managed care revolution. Second, community hospitals are observed in their reactive capacity only: hospital response to the managed care movement is being studied rather than hospital influence over the environment. Third, from a theoretical perspective, it is assumed that the study hospitals will always seek a better fit with their environment and that better performance will result from better fit. These assumptions will be further developed in the review of the literature as well as the theoretical framework for the study.

Goals and Objectives

This study is undertaken as a systematic assessment of organizational realignment in the midst of tremendous industrial turbulence. The study is designed to:

1. Detect prominent structural changes in hospitals participating in managed care markets, as well as those hospitals comparatively unaffected by managed care.
2. Quantify specific structural changes in community hospitals observed over the study period; and determine whether there is an association between hospital structure, environment, and performance outcomes.
3. Identify trends in the availability of hospital services, as well as the utilization of medical professionals, in defining the community hospital of the 21st century.

The practical steps needed to progressively accomplish this project are:

1. Formulation of a conceptual study model, where hypotheses may be explicitly and vigorously tested.

2. Operationalization of study variables, based on the selected theoretical framework of structural contingency theory.
3. Selection of reliable sources for data.
4. Appropriate exploratory and confirmatory analysis of hospital and managed care data.
5. Definitive interpretation of analytic results, in reference to the hypotheses, as well as the study's contribution to the literature and introduction of additional research questions.

Scope of the Study

This research effort is directed toward nonfederal general medical and surgical hospitals, where organizational survival is closely related to operating patient revenues. Although the main study focus is upon community hospitals, a broad sample within this base will provide comparative data for various geographic regions and hospital bedsize. With the use of selected control variables, hospital environment and structure will be representative of the community hospital population within the United States.

This study includes hospitals in metropolitan statistical areas (MSAs) only. MSAs are defined as having a city with a population of at least 50,000 or an urbanized area with a population of at least 100,000 (Area Resources File, 1996). The geographic dispersion of rural hospitals and their long-distance trauma and emergency patient transport systems make sparsely populated regions inappropriate for a study including measures of hospital competition and local medical services. Furthermore, the continued survival of a rural hospital might be determined by policy considerations rather than that

hospital's economic viability. For example, in 1991 the Health Care Financing Administration funded demonstration projects to stimulate rural hospital care delivery and grow healthcare networks in remote areas (Burke, 1991).

A data base directed toward metropolitan statistical areas is advantageous for analyzing hospitals in large urban areas, where market competition is potentially powerful in shaping management strategies (Cleverly and Harvey, 1992b).

Conceptual Framework: Contingency Theory

Perhaps Williamson stated it most succinctly when he observed that "organization form matters" (1985, p. 274). According to Pfeffer (1982), the dominant approach to explaining organizational structures in the sociological and business school literature has been structural contingency theory (SCT), with its emphasis on efficiency. SCT argues that the design of the organization depends on various contextual factors. Prominent study factors include task uncertainty, size, strategy, and environment (Donaldson, 1995).

Galbraith (1973, p. 2) summarizes structural contingency in the following way:

1. *There is no best way to organize.*
2. *Any way of organizing is not equally effective.*

The first statement challenges theorists who have attempted to develop general principles applicable to organizations in all times and places. The second statement challenges the economic view that organizational structure is irrelevant to organizational performance (Scott, 1992). Scott adds a third maxim to this contingency theory:

3. *The best way to organize depends on the nature of the environment to which the organization relates.*

This study follows the consonance theory of SCT, with the premise that there is an effectiveness or efficiency-seeking orientation on the part of organizational managers that attempts to produce congruence between organizational designs and the contextual factors that affect the appropriateness of those designs (Pfeffer, 1982). As an example, Perrow (1970) states:

> *We must assume here that, in the interest of efficiency, organizations wittingly or unwittingly attempt to maximize the congruence between their technology and their structure.*

Drazin and Van de Ven (1985) summarize the premise that context and structure must somehow fit together if the organization is to perform well. This research combines two specific forms of contingency theory in the following propositions. Primarily, in the congruency proposition, a simple unconditional association is hypothesized to exist among variables in the model. For example, the greater the task uncertainty, the more complex the structure. Secondly, in the contingency proposition, a conditional association of two or more independent variables with a dependent outcome is hypothesized and can be directly subjected to an empirical test (Fry and Schellenberg, 1984). In an example of this proposition, the "fit" between task uncertainty and organizational structure could be hypothesized to determine the organization's efficiency.

Organizational Context and Structure

Organizational characteristics may be viewed as structural and contextual. Structural dimensions describe the internal traits of the organization, while contextual

dimensions describe the organizational setting that influences those structural dimensions (Daft, 1992).

In the research literature, three elements of context have been frequently investigated: organizational size, technology, and environment (Pfeffer, 1982). The environment, a subset of context, includes all elements outside the boundary of the organization, such as the industry, government, customers, and suppliers (Daft, 1992).

Contingency research often considers the environmental dimension of uncertainty, sometimes measured as change, and sometimes including a component of complexity (Pfeffer, 1982). Lawrence and Dyer (1983) offer two broad categories of environmental factors: information complexity and resource scarcity. In health care, the information domain might consist of explosions in medical knowledge, regulation, drugs and treatments, new technologies, and competition. The domain of resource scarcity, on the other hand, may be represented by the availability of capital and the rise of third-party payments. Customers, competitors, government, and labor forces are all recognized as impacting on resource availability.

As an illustration of balance between two domains, post-World War II hospitals experienced extravagant growth in technology and services, predominantly financed by government programs and private insurers (Lawrence and Dyer, 1983). One might see that information complexity rose in the form of expensive technologies and product variation, while resource scarcity was low. However, since 1969 when President Nixon declared a "national crisis" in health care costs, resource constraints have increased in the form of regulated health planning and utilization review (Lawrence and Dyer, 1983).

Since 1983, the preliminary implementation date for DRG regulation, hospitals have been curtailing their inpatient services by shortening their average length of stay and eliminating elaborate diagnostic procedures. Lawrence and Dyer (1983) mention other indicators of increasing resource constraint: renewed interests in hospital management, collaborative efforts between hospitals, and medical services delivered outside of hospital walls.

Pfeffer and Salancik (1978) use a similar set of factors to characterize the environment: degree of concentration of resources, scarcity or munificence of resources, and degree of interconnectedness among organizations.

Once the environmental context has been adequately described, researchers attempt to relate an organization's structure to its context. Lawrence and Lorsch (1967) developed the hypothesis that there is a positive correlation between the degree of environmental uncertainty and the degree of flexibility in a unit's organizational form. They described the two fundamental ingredients to organizational flexibility as differentiation and integration (or coordination). Lawrence and Lorsch (1967), working at the sub-system level and the organizational level, found that differentiation and integration are antagonistic states, resolved by more effective organizations. They argued that each organizational subunit would develop a structure matching its own subenvironment, thereby posing more problems for integrating and coordinating the entire system.

Pugh et al. (1969) found clear relationships between organizational structure and the contextual elements of size, technology, and location. The contingency of size refers

to the scale of the organization, especially the number of its members (Donaldson, 1995). The expanding size of organizations gives rise to increasing complexities in subdivision of responsibilities, structural differentiation, and coordination (Blau, 1970).

Technology has been defined as the tools, techniques, and actions used to transform organizational inputs into outputs. Technology is the organization's production process, and it includes machinery and work procedures (Daft, 1992). In her studies of manufacturing technology, Woodward (1965) observed that different technologies impose different demands on organizations, demands which must be met through an appropriate structure.

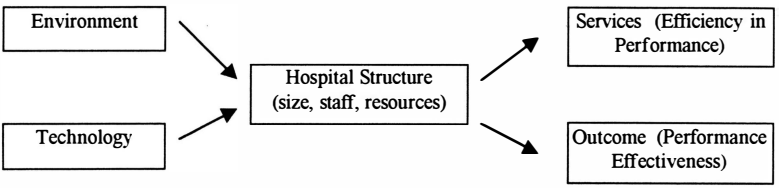
In studying location, Blau and Scott (1962) found that geographical, cultural, and community setting can influence an organization, thereby suggesting a requirement for study controls in these areas. These elements are developed in Scott's (1992) ecological level of analysis, where the organization is a collective factor functioning in a larger system of relations. Scott expands this concept by identifying four sublevels within the ecological level: 1) the organizational set, or group of roles undertaken by one organizational unit, 2) the population of organizations, or aggregate of organizations which are alike in some respect, 3) the areal organizational field, or collection of organizations within a specific geographic area, and 4) the functional organizational field.

Basic Models of Organizational Structure and Performance

While determinants of structural features are interesting to students of organizational theory and administration, a concern for the consequences of hospital structure will be shared among providers, patients and policymakers (Flood and Scott,

1987). Flood and Scott (1987) arrive at a synthetic model to summarize their investigation of technology, structure, and performance in hospitals (Figure 1). At the center of their model is hospital structure, including the dimensions of size, staff qualifications, and resources. Hospital performance is measured by service efficiency, morbidity, and mortality rates.

Figure 1. Synthetic Model of Hospital Structure and Performance (Source: Flood and Scott, 1987, p. 26).

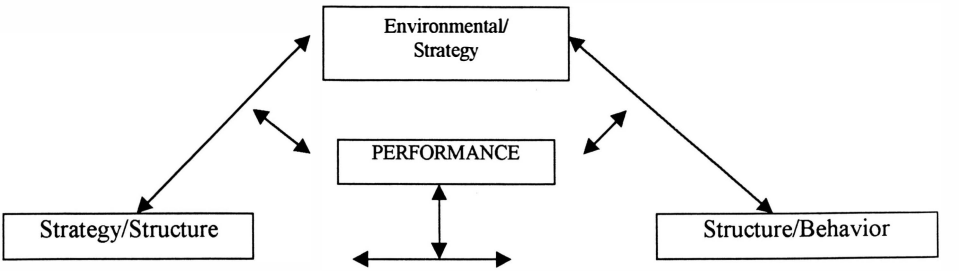


Kimberly and Zajac (1985) proposed a more complex model, linking organizational environment, strategy, structure, and behavior, with all interrelationships influencing organizational performance (Figure 2). This model, consistent with strategic adaptation literature, focuses on the interrelationships that directly affect performance. Going one step further, however, performance becomes a central variable; with feedback from prior performance stimulating strategic adaptation (Kimberly and Zajac, 1985).

Kimberly and Zajac (1985) also emphasized that both macro environmental changes and micro behavioral changes must be considered in their impact on managerial

decisions within the health care firm. The determinist and volunteeristic perspectives come together here to comprise the organization's context.

Figure 2. Model of Strategic Adaptation
(Source: Kimberly and Zajac, 1985, p. 281).



The study at hand incorporates elements from the models depicted in Figures 1 and 2. Both models are specifically oriented to the health care industry. Furthermore, the authors have considered the accumulated knowledge and contributions of prior studies. The consummate goal is to pattern institutional response to significant environmental shifts, allowing for a variety of conditions and contingencies.

The American hospital may be likened to an organization at the epicenter of an unpredictable earthquake (Shortell et al., 1995). Rapid and fundamental changes threaten to push the hospital to the margins of the health care system (Robinson, 1994). This inquiry seeks to describe these disruptive forces, and to discover whether American hospitals have indeed undertaken significant changes to reinvent themselves.

Outline of the Remaining Chapters

In Chapter 2, the Literature Review, studies concerning the effects of managed care and market competition upon the hospital industry are reviewed, along with economic evaluations of hospital behavior under various reimbursement policies. Methods for measuring market competition are presented and discussed. Hospital performance in terms of efficiency and quality, the subject of a multitude of studies, is also reviewed. All references to the literature are discussed in relation to the variables and measures selected for this study.

Chapter 3, the Theoretical Model, presents a more detailed framework for this study, including Donaldson's (1987) Structural Adjustment to Regain Fit (SARFIT) and Child's (1972) assessment of the environment's impact on organizational decisionmakers. The concepts of "fit" and "structure" are discussed as preludes to model formulation. The study hypotheses are stated.

Chapter 4, Methodology, describes the research design. Methods of data collection, variable measurement and analysis are presented and regression models are specified according to the study hypotheses presented earlier.

Chapter 5, Results, summarizes descriptive statistics and comparisons, bivariate analysis, and regression model estimations for the hospital sample. Part 1 evaluates hospital change variables as dependent variables, while Part 2 considers the same change variables as independently affecting hospital performance at a later point in time.

Chapter 6, Discussion, evaluates the results in relation to the original hypotheses and considers whether results may be generalized to a broader population. Implications

of the study are enumerated, and design limitations are listed and discussed. Topics and methods for future research are identified, and overall conclusions are made.

CHAPTER II. LITERATURE REVIEW

The purpose of this review is to summarize existing commentary and research on the managed care environment surrounding the study hospitals. Specifically, the post-PPS managed care movement is described in some detail, with emphasis on the growth of HMOs, or health maintenance organizations, and their impact on the acute care hospital of the mid-1980s. The rise of market competition among hospitals is reviewed as an integral subset of the managed care environment confronting hospitals. Additionally, studies are presented which investigate hospital performance issues throughout the 1980s and 1990s. Literature pertinent to defining and measuring hospital contextual factors is useful in determining an appropriate analytic model of hospital response.

Hospitals in a Managed Care Environment

In 1994, the United States spent close to 14 percent of its gross domestic product on health care (Reinhardt, 1996) while all other industrialized nations had maintained a ratio below 10 percent (Schieber et al., 1994). The largest single element of national health expenditures (NHE) in 1994 was hospital care at $338.5 billion, or 35.7 percent. Eighty-eight percent of all hospital care in 1994 was delivered in short-term, acute care community hospitals, and 63 percent was for inpatient services alone (Levit et al., 1996).

Various efforts in controlling costs generated by hospital providers have been attempted, including the shift of economic risk from payors to physicians and hospitals

(Horowitz and Kleiman, 1994) and the momentous reduction of inpatient bed-days fueled by this country's insurance industry (Reinhardt, 1996). Efforts in cost control do not necessarily address issues such as access, quality, or efficiency, however. While cost containment is the central issue for health care policy in the 90's, the concept of efficiency must include quality as well (Rice, 1992).

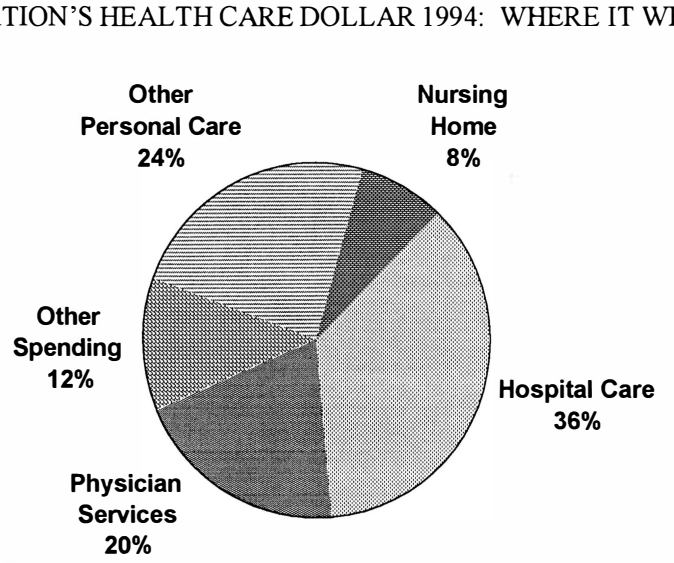
Table 1 summarizes information on national health care spending between 1980 and 1994, depicting an overall decline in growth. Costs for hospital care were particularly constrained in 1993 and 1994. Figure 3 represents the hospital's portion of national health care expenditures in 1994. The acute care hospital remains a relevant object of health care study, due to its prominent position in the health service industry.

Table 1. National Health Expenditures Aggregate Amounts (in Billions of Dollars) and Average Annual Percent Change by Type of Expenditure* Selected Years 1980-1994.
(Source: HCFA, Office of the Actuary (1997).

Type of Expenditure	1980	1985	1990	1991	1992	1993	1994
National Health Expenditures	247.2	428.2 (11.6)	697.50 (10.2)	761.30 (9.1)	833.60 (9.5)	892.30 (7)	949.40 (6.4)
Health Services and Supplies	235.6	411.8 (11.8)	672.9 (10.3)	736.3 (9.4)	806 (9.5)	863.1 (7.1)	919.2 (6.5)
Personal Health Care	217.0	376.4 (11.6)	614.7 (10.3)	676.2 (10)	739.8 (9.4)	786.5 (6.3)	831.7 (5.7)
Hospital Care	**102.7**	**168.3 (10.4)**	**256.4 (8.8)**	**282.3 (10.1)**	**305.3 (8.1)**	**324.2 (6.2)**	**338.5 (4.4)**
Physician Services	45.2	83.6 (13.1)	146.3 (11.8)	158.6 (8.4)	174.7 (10.1)	181.1 (3.7)	189.4 (4.6)
Dental Services	13.3	21.7 (10.2)	31.6 (7.8)	33.3 (5.6)	37 (11)	39.2 (6)	42.2 (7.6)
Other Professional Services	6.4	16.6 (21.2)	34.7 (15.8)	38.3 (10.4)	42.1 (10)	46.3 (10)	49.6 (7.1)
Home Health Care	2.4	5.6 (18.9)	13.1 (18.4)	16.1 (22.4)	19.6 (22.3)	23 (17.1)	26.2 (13.8)

*Percent increase is average annual percent change from previous year shown

Figure 3. The Nation's Health Dollar: 1994.
(Source: HCFA, Office of the Actuary, 1997).



Managed care may be defined as the control by organizations and institutional arrangements of choices traditionally made within the patient-physician relationship (Rodwin, 1995). In other words, managed care organizations use various methods to change the decisions of doctors and providers (Hurley and Freund, 1993). Essentially, managed care combines the delivery and financial dimensions of medical care in a number of ways, such as utilization review, preadmission certification, case management and capitation agreements (Anderson and Fox, 1987).

A prominent form of managed care came into existence when the Medicare prospective payment system (PPS) placed hospitals under financial risk for services

provided to their Medicare patients. PPS basically changed the financial incentives facing hospitals but left physicians and patients unaffected, initiating conflicts in cost containment efforts (Glandon and Morrisey, 1986).

As Medicare cost-plus reimbursement shifted in the mid-1980s to the prospective payment system (Ginzberg, 1995), other managed care initiatives proceeded to pressure hospitals. First generation managed care practices relied on price discounts, while second generation managed care incorporated stricter forms of utilization management. Third generation managed care models utilize capitated payment that place providers at overall financial risk for the care of enrolled populations (Shortell, et al., 1995). Capitation has been called the most rapidly growing form of managed care (Tabbush and Swanson, 1996). With only 7 percent of the revenue of hospitals and medical groups capitated in 1995, Bader and Matheny (1994) projected growth to reach 17 percent by 1996.

Zwanziger et al. (1996) studied the effects of reimbursement shifts upon California hospitals between 1983 and 1988. Two measures of hospital service mix were used: specialization and differentiation. The new reimbursement mechanisms studied were the Medicare PPS and the growth of selective contracting plans. Other hospital data, such as its level in the market, ownership, and bedsize were also collected. Their results indicated that the competition among hospitals tended to increase differentiation, while higher financial PPS pressure was associated with increased specialization. Additionally, they concluded that hospitals tended to adopt some high visibility services offered by their competitors.

The forementioned study incorporates several elements of the intended research, including the evaluation of hospital characteristics, in the form of service mix, amid a drastic change in reimbursement systems. In their California study, however, hospital response is examined throughout two concurrent financial contingencies, whose effects may have interacted with one another.

The proposed study period takes place after hospital implementation of PPS in order to more fully isolate and characterize other managed care influences. Furthermore, the intended study is on a national rather than state level; involving a broader sample, but sacrificing the specific measurement advantage obtained in the California research.

HMO Growth

In an effort to quantify the managed care environment surrounding American hospitals, the proposed study focuses on the growth of health maintenance organization (HMO) enrollment within the insured patient population. Health maintenance organizations have changed the health care market by integrating the functions of insurance and health care provision (Christianson et al., 1991). HMOs may be defined as groups of physicians and other health care professionals who provide a wide range of services to subscribers and their dependents on a prepaid basis (McDonnell et al., 1986).

Individuals who enroll in an HMO contract for health service delivery from a limited panel of providers for a fixed period and fee (Luft, 1981). Because of the risk involved in capitated premium payments, HMOs have an economic incentive to monitor service utilization and costs. HMOs are organized in various models according to

physician affiliation, including staff, group, network, and independent physician association arrangements (McDonnell et al., 1986).

A major competitor to the HMO has been the preferred provider organization, or PPO, where a limited panel of physicians and hospitals also delivers health care services to a defined group of patients. Compared to HMOs, PPOs are distinguishable by their use of negotiated fee schedules and greater consumer choice of providers (Lissovoy et al., 1986).

According to Shelton (1989), the more HMO and PPO plans dominate the insurance-health plan market, the more hospitals are likely to compete on the basis of price, assuming that HMOs and PPOs are more price-sensitive in contracting than prior fee-for-service insurance payors. Furthermore, growth in the market share of HMOs and PPOs limits the degree to which hospitals can cost-shift their contracted and government business to charge-paying customers. It is highly likely that PPS implementation did not initially bring about structural change in hospitals, specifically due to hospitals' freedom in shifting charges to non-Medicare payors.

Shelton (1989) observes that HMO market penetration, in relation to all health insurance products and in relation to PPO market penetration, may be the most important determinant of price competitiveness deriving from selective contracting.

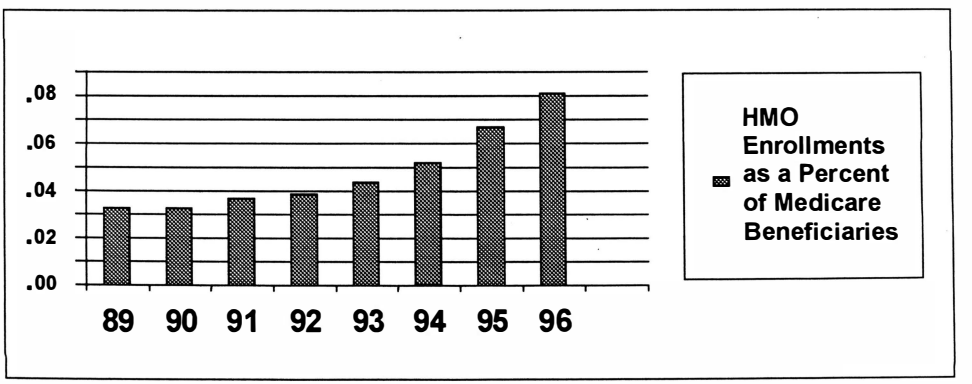
Although HMOs are not a recent phenomenon, they became an important part of federal policy with the passage of the Health Maintenance Organization Act (Dorsey, 1975). After assisting HMO development between 1973 and 1983 with loans and grants, the federal government promoted further HMO growth by supporting their enrollment of

Medicaid and Medicare beneficiaries. The Omnibus Budget Reconciliation Act (OBRA) of 1981 gave states substantial flexibility to contract with HMOs for their Medicaid programs. The Tax Equity and Fiscal Responsibility Act (TEFRA) of 1982 redefined HMO participation with Medicare, as well as establishing attractive new payment rates for HMOs enrolling Medicare beneficiaries (Christianson et al., 1991).

Amid these environmental changes, the number of HMOs grew rapidly, from 234 plans in December 1981 to 626 plans in December 1986; followed by a leveling off from 1986 to 1988 and a slight decline from 1988 to 1989. Total HMO enrollment climbed steadily for the entire period between 1978 and 1989, however (Christianson et al., 1991). Annual rate of growth in HMO enrollment averaged 16.2 percent between 1990 and 1995 (VAHMO, 1997). By 1994, HMO enrollment reached 50 million (GHAA, 1995); and according to 1995 surveys more than one in five Americans (58.2 million) were enrolled in HMOs (VAHMO, 1997).

Hospital involvement in HMO contracting will expand as HMOs enroll more

Figure 4. National Medicare HMO Growth.
(Source: VAHMO, 1997).



seniors. In 1995, approximately 3 million Medicare beneficiaries (8 percent of the Medicare population) were enrolled in HMOs (See Figure 4).

Studies of Hospital Response to HMO Growth

Previous research has examined the relationship between hospitals and health maintenance organizations. Feldman et al. (1990) analyzed four communities and 102 contract forms to determine HMO strategies in hospital selection. As prepaid plans competed for market share in the 1980's, it was assumed that they would increasingly attempt to reduce the cost of hospital services. Study results indicated that in HMO contracting, hospitals were selected because of their affiliation with HMO physicians, convenience to plan employees, and hospital reputation over service cost.

Once the HMO-hospital contract has been established, an important research question is whether HMO affiliation will induce hospitals into price competition, or greater efficiency. Feldman et al. (1986) assessed the impact of HMOs on revenue, cost, and net income per admission in Twin Cities hospitals from 1979 to 1981. Some HMOs had obtained negotiated discounts from hospitals. The researchers found that hospitals which gave larger discounts did not have lower costs per admission. Similarly, hospitals with a large share of patients from HMOs or government Medicare and Medicaid programs did not have lower costs per admission than other hospitals. Another important observation was that neither HMO market share nor discounts had an adverse effect on hospital profits. This study concluded that HMOs are only one agent in the market, and that HMO-induced competition did not contain expenditures in the subject hospitals.

Various research efforts have explored the relationship between HMO market share and associated hospital utilization. Chernow (1995) studied the impact of non-IPA HMOs on the number of short-term general hospitals in the American Hospital Association data base from 1982 to 1987. His results indicate that a 10-percentage point increase in the non-IPA HMO market share will reduce the number of hospitals by 4%, causing an approximate 5% reduction in the number of hospital beds. No statistically significant relationship was found between non-IPA HMO penetration rates and hospital occupancy rates.

Robinson (1996a) studied HMO market penetration and hospital utilization in private nonprofit and for-profit hospitals in California between 1983 and 1993. The growth of HMO penetration in local hospital markets was measured from patient discharge abstract data. Outcome measures included hospital closures, changes in bed capacity, changes in acute care admissions, length of stay, inpatient days and ambulatory visits.

Robinson's (1996a) results indicated that during the study period, hospital expenditures grew 44% less rapidly in markets with high HMO penetration than in markets with low HMO penetration. Reductions in volume and service mix accounted for 28% of reduced growth in hospital expenditures, decreased bed capacity accounted for 6%, and changes in intensity (services per patient day) accounted for 10%. Robinson's conclusion was that managed care is shifting the acute care hospital from the center to the periphery of the health care system.

The intended study measures HMO penetration and resulting hospital utilization, and some outcome measures are similar to those in Robinson's (1996a) research. The intended work has a national scope, while Robinson's sample was limited to California hospitals. The intended study spans the years 1989 to 1995, where Robinson gathered a decade of data through the year 1993. Managed care penetration, in the form of HMO enrollment, is common to both studies, but subject to different methods of measurement. Finally, the intended study analyzes hospital outcomes in staff ratios as well as Robinson's variables of hospital costs and service utilization.

In a more specific analysis of hospital critical care, Angus et al. (1996) studied the effect of managed care insurance on ICU resource use in Massachusetts state hospitals in 1992. A Massachusetts cohort was selected because Massachusetts is one of the most highly penetrated managed care markets in the country (Zinner, 1995). In 1992, 19 managed care companies provided care for 35% of the population and 19% of the adult, non-childbirth-related hospitalizations (Massachusetts Assoc. of HMOs, 1996). It should be noted, however, that enrollment figures, rather than managed care intensity, constitute this definition of market penetration.

Angus et al. (1996) compared ICU hospitalizations covered by four payer groups: commercial fee-for-service, commercial managed care, traditional Medicare patients, and Medicare-sponsored managed care. ICU length of stay (LOS) was the main outcome measure selected for ICU resource utilization. It was acknowledged that this measure is somewhat crude, and that managed care organizations may have reduced ICU expenditures through decreased daily resource use (Angus et al., 1996).

Findings from this study indicated that patients covered under managed care consume fewer ICU resources, primarily due to a difference in the patient-related factors such as age, severity of principal illness, comorbidity and reason for admission. Payor status had no independent effect on ICU LOS. The conclusion was that as managed care case mix changes in the future to include sicker and older patients, the initial advantages of reduced resource consumption may diminish (Angus et al., 1996).

Since ICU services are estimated to comprise 30% of hospital costs in the United States (Halpern et al., 1994) this study and another ICU research effort by Rapoport et al. (1992) are relevant to the issue of managed care contracting and hospital utilization. Both studies employ a broader definition of managed care penetration than the intended study, however.

The accelerated growth of managed care organizations and arrangements has added new dimensions to environmental turbulence surrounding hospitals, and generated a structural revolution in the financing and delivery of health care (Brooke, 1992). In one example, hospitals may structurally integrate physicians into administrative activities in an attempt to improve organizational efficiency and lower costs.

Alexander and Morrisey (1988) evaluated five integrative strategies for physicians and resultant hospital costs. The five dimensions of hospital-physician integration included measurements in general administrative participation, participation in hospital governance, salaried hospital-based physicians, employment of admitting physicians, and management-oriented medical staff committees. The dependent variable of hospital cost was measured as the total 1982 expenditures for the hospital per adjusted

discharge. Their findings suggested that physician involvement in the administrative structure of the hospital, at least through administrative positions and clinical employment, is associated with increased, rather than decreased hospital costs.

In addition to variables for hospital-physician integration, Alexander and Morrisey (1988) incorporated hospital control variables for case mix, production output volume (in dollars), wage rate, hospital size, medical staff size, teaching/nonteaching, hospital control, and regional location. Development of a full model including these hospital control variables led to the conclusion that physician participation in hospital governance did not affect hospital costs when other cost function variables were held constant.

The intended study has several features similar to Alexander and Morrisey (1988), namely sampling from an AHA survey of hospitals, measurement of the dependent variable of hospital cost, and inclusion of hospital control variables for case mix, size, teaching status, hospital control, and regional location. Additionally, the intended study includes a measure for the number of physicians employed by the hospital as a percentage of the entire hospital staff. This investigation, a form of update to the physician integration issue, attempts to determine whether hospitals have indeed sought to employ more physicians and thereby exert greater organizational cost control. Past data have suggested that more than 70% of all expenditures on health care are directly influenced, if not controlled, by the medical profession (Relman, 1980).

In summary, the managed care environment surrounding American hospitals is comprised of multiple delivery systems, with primary focus on utilization and financial

controls to affect cost (Boland, 1993). With managed care establishing itself as a "moving target" (Boland, 1993), the intended study has selected an HMO-based measurement of managed care penetration to indicate the environmental contingency faced by the subject hospital organizations.

While hospital studies have demonstrated a change in capacity and utilization in response to HMO presence (Robinson, 1996a), changes in hospital staff mix and service scope have not been thoroughly examined. Addition of these elements in the intended study could possibly develop further insight into the nature of the managed care contingency.

Market Competition and Hospital Efficiency Studies

Hospital behavior amid competition has been studied and measured from many perspectives since the 1980s. One major research question was whether procompetitive policies promoted efficiency in individual hospital operations (McLaughlin, 1988). A second series of studies examined external hospital strategies, such as formation of alliances, mergers, and even closure, in dealing with competitive change (Williams et al., 1992). Established measures of market competition and previous studies of hospital response are important in formulating a foundation for the current proposal.

Competition may be defined in business as rivalry for customers or markets, with competitors being more or less evenly matched (Webster's Dictionary, 1966). "Perfect competition," a term used in economics, is a market structure in which there are (1) numerous buyers and sellers, (2) perfect information, (3) free entry and exit, and (4) a homogeneous product (Folland et al., 1993). When these basic assumptions are violated,

economists generally acknowledge that the market fails to achieve an efficient outcome. Market failure provides an opening for public interventions in the market (Johannesson, 1996).

Many have criticized the applicability of ideal market conditions in the health care sector (Folland et al., 1993). Although procompetitive policies in health care markets were being promoted as cost containment strategies during the 1980s, McLaughlin (1988) observed that few of these markets were competitive or moving toward maximum efficiency.

The concept of efficiency may be related to competitive markets through the First Fundamental Theorem of Welfare Economics, stating that competitive markets under certain conditions are economically efficient (Folland et al., 1993). Vilfredo Pareto defined efficiency as an economically optimal outcome in society, where it is impossible to improve the lot of any person without hurting someone else (Folland et al., 1993).

McLaughlin (1988) interpreted production efficiency as choosing the optimal combination of inputs to produce a given output in the least costly way. An expected outcome of increased price competition in health care was production efficiency; yet McLaughlin suggested that the response to HMOs and other changes in the financing and delivery of health services was increased nonprice competition, or rivalry. McLaughlin (1988) made the concession that in 1988, it was possibly too early to see the cost containment effects of increased efficiency caused by competitive pressures.

In a related study, Robinson et al. (1988) hypothesized that hospitals competed with other nearby hospitals, but on a nonprice rather than price basis. This idea was

translated into the working hypothesis that competitive pressures encourage hospitals to accommodate patient and physician preferences for longer lengths of stay.

In a study of 747 nonfederal short-term hospitals, Robinson et al. (1988) compared measures of hospital concentration and competition with length of stay for ten surgical procedures. Competition-related percentage increases in length of stay (7% to 23%) were identified for all procedures. It was concluded that there was a strong positive association between the number of hospital competitors in the local market and the average length of stay in U.S. hospitals.

The notable distinction in this study is the timing of its data sources: 1982. Prior to the implementation of PPS, this well-controlled study suggested that hospitals under competitive pressure were destined to have a difficult time in adjusting to prospective reimbursement. Physicians would have to be convinced to alter their practice styles, and patients would have to live with shorter acute care postoperative recovery time in order to shorten the average length of stay (Robinson et al., 1988).

More recently, Jones (1990) argued that 10 years of competition in the employer-based private health insurance system did not achieve appreciable containment of costs. Specifically, policy toward competition consisted of multiple choice of health insurance plans for employees and HMO development through the 1980s. Jones (1990) suggested that the multiple choice in health plans must be curtailed or heavily managed for risk selection in order to lower health care costs.

Chilingerian (1992) focused these issues in health service efficiency upon the individual hospital, and further upon the physician staff. With a prediction that in the

1990s, 60% of all employees and their dependents would be enrolled in some kind of managed care indemnity plan like an HMO or PPO, Chilingerian (1992) urged hospitals to retain physicians whose experience and judgement reduce the amount of unnecessary tests, drugs, and patient days in the hospital. Where in the past, physician judgement was not questioned, hospital price variation was beginning to be attributed to physician practice patterns.

Changes in reimbursement policy and resultant hospital utilization rates were evaluated under the Medicare Competition Demonstration from 1984 (Rossiter et al., 1988). Analysis was conducted which compared service use and cost experience of participating HMOs and competitive medical plans (CMPs). The measure for efficiency in this study was hospital days per 1000 person years. Medicare enrollees in the demonstration experienced a median of 1951 hospital days per 1000 person years, 57 percent of the median of 3432 days per 1000 in the local market from which the plans drew enrollment. Independent practice associations (IPAs) experienced higher hospital use rates than staff and group model HMOs. These comparisons were not adjusted for various risk factors, but it was predicted that further adjustment would favor the demonstration plans.

The National Medicare Competition Evaluation (Rossiter et al., 1988) analyzed the economic aspects of patient care in terms of cost and utilization, with results indicating that competitive health plans in the Medicare sector could reduce health care costs through production efficiency. One important comparison to be made, however,

was quality of care between demonstrations and fee-for-service providers. The intended study includes a quality measure as an integral element of hospital performance.

Hospital cost inflation between 1982 and 1986 was a subject of study by Robinson and Luft (1988), where data on 5490 nonfederal, short-term general hospitals were used to evaluate the relative effectiveness of regulatory and market-oriented cost-control policies on hospitals. AHA data was the primary source of cost, utilization, and other individual hospital measures. The effects of various cost-control strategies among several state programs were evaluated using a multivariate statistical approach that controlled for hospital-specific changes in patient mix, wage rates, volume of services provided, and other relevant factors. Additionally, the researchers examined how the effects of various strategies differed for private nonprofit, public, or investor-owned hospitals.

Robinson and Luft (1988) found that California's market-oriented cost-control policy reduced inflation rates by 10.1% compared to a control group of 43 states. Hospitals with large percentages of patients insured by Medicare's prospective payment system experienced cost inflation rates 16.1% lower than hospitals with small percentages of Medicare patients. Investor-owned hospitals experienced rates of cost increase 11.6% higher that private nonprofit hospitals and 15% higher that public hospitals. These results support the hypothesis that rate regulation in the form of competition can yield desirable effects in controlling hospital costs.

The intended study does not review state regulatory policies; however its emphasis on competitive mechanisms and resulting hospital expenses is similar to

Robinson and Luft (1988). It is interesting to note the following study observation, describing the local nature of hospital services:

> Hospital markets are inherently local rather than national in character, given the unwillingness of physicians and patients to travel large geographic distances except for the most complicated of hospital services. Buyers can thus only exploit cost and price differences within local markets, not among different local markets.(Robinson and Luft, 1988, p. 2681)

In their study of pro-competition policies, Melnick and Zwanziger (1988) also concluded that such policies could indeed increase hospital cost containment and move hospital competition to the price-based arena. Melnick and Zwanziger (1988) grouped California's short-term hospitals according to the level of competition within their markets. After controlling for the effects of the Medicare prospective payment system program, the rate of increase in cost per discharge for hospitals in highly competitive markets was 3.53% lower than the rate of increase for hospitals in low competition markets during the period from 1983 through 1985.

The study design presented by Melnick and Zwanziger (1988) was in three analytical steps, with the first step using analysis of variance (ANOVA) to compare hospital behavior before and after the introduction of selective contracting and Medicare PPS. Selective contracting refers to the procedure whereby a third-party payer can legally exclude providers from their list of participating providers without significant threat of antitrust prosecution. Under the selective contracting law, both public and private payers can negotiate terms and conditions with each specific provider whom they will reimburse for services to their subscribers (Melnick and Zwanziger, 1988).

The second step used multivariate regression analysis to test whether there were significant differences in the behavior of hospitals, depending on the competitiveness of the market in which they were located. Measures of hospital cost, revenue, and use were analyzed for hospitals in high-competition and low-competition markets.

In the third step of their study, Melnick and Zwanziger (1988) estimated the separate effects of the Medicare PPS program, selective contracting, and increased competition upon hospitals. The results from previous multiple regression analyses were used to quantify the effects of the PPS program on urban hospitals for three measures of performance: cost per discharge, total inpatient costs, and number of inpatient discharges. The estimated regression coefficients were multiplied by the corresponding values of the independent variables to calculate the rates of change for hospitals under different market conditions.

This study is important because it supports conclusions that after PPS and selective contracting implementation, greater competition among hospitals led to reduced hospital costs. Similarities with the intended research include a characterization and measurement of market competition, as well as measures of hospital cost and volume, representing hospital behavior. While the Melnick and Zwanziger (1988) study was concerned with PPS and selective contracting as policy issues, the intended study intends to follow up on a time period following PPS implementation. The Melnick and Zwanziger (1988) research study collected financial data from the state of California only; with the idea that California foreshadowed a trend due in other states. In the intended study, data are collected on a national level.

In the forward march of managed care, the closure of hospital beds was a central consideration in cutting the excess hospital capacity (Cerne and Montague, 1994). Another hospital resource that could be reduced, discussed by Hadley et al. (1996), was hospital staff. Using data from the American Hospital Association and the Medicare Program, researchers analyzed the effects of financial pressure and market competition on changes in several measures of performance of 1435 acute care hospitals between 1987 and 1989.

It was observed that the least profitable hospitals constrained their growth in total expenses to half that for the most profitable hospitals (13.3% versus 27.6%) by limiting the growth of their staffs and their total assets. These changes were associated with a reduction in inefficiency of 1.8% compared with a very slight increase in inefficiency for the highest profit group. Additionally, hospitals in highly competitive markets appeared to control expenses relative to those in the least competitive areas. No evidence was found to suggest that financial pressures created by either low profits or market competition resulted in hospitals engaging in cost-shifting.

The study by Hadley et al. (1996) is similar to the intended study in its use of AHA and Medicare data, its measurement of hospital staff size as an indicator of hospital response, and its focus on competitive pressures and resulting efficiency between hospitals. There are some differences, however: Hadley's indicators of hospital revenue growth and profit are not included as performance variables in the intended study.

Wickizer et al. (1996) estimated the impact of hospitals' various managed care strategies on the cost per hospital discharge. Thirty-seven member hospitals of seven

health systems were surveyed, with separate cross-sectional regression analyses performed on inpatient data from 1991 and 1992. The multivariate model was estimated with hospital cost per discharge as the dependent variable. Pooled discharge data indicated three dimensions of hospital managed care strategy that consistently related to lower costs per hospital discharge: the proportion of hospital revenues derived from per case or capitation payment, the hospital's mechanisms for sharing information on resource consumption with clinicians, and the use of formalized, systematic care coordination mechanisms.

This study by Wickizer et al. (1996) is similar to the intended study, due to its emphasis on managed care strategies, specifically the "fixed price" hospital incentives, and also in measuring the efficiency variable as hospital cost per discharge. With only 37 hospitals surveyed, the authors limited the generalizability of their sample; however, with over 40,000 discharges analyzed for the research period and individual hospital surveys completed on managed care strategies, a smaller number of hospitals allowed for detailed evaluation.

Market Competition and Hospital Quality Studies

Melnick and Zwanziger (1988) suggested that further studies look at the effect of competition on quality in hospitals. This area was pursued by Shortell and Hughes (1988) who examined the influence of regulation of hospital rates, state certificate-of-need programs, competition, and hospital ownership on mortality rates among Medicare inpatients in 1983 and 1984. Their results indicated no statistically significant

association between mortality rates among inpatients and the degree of competition, represented by the number of hospitals located in the market area.

Shortell and Hughes (1988) sought to test the hypothesis that hospitals facing severe regulatory constraints and payment controls, operating in highly competitive markets, would be particularly prone to lower their technical performance, resulting in adverse patient outcomes. Their study also held an underlying assumption that hospitals located in states where HMOs have enrolled a higher proportion of the population face more pressure to compete with each other for patients on the basis of price. The intended study carries a similar hypothesis: that HMO dominance will stimulate hospital competition based on price, and that hospital quality should be examined as a result.

Methods for Measuring Market Competition

The method of measurement of market competition is crucial in evaluating the behavior of competing hospitals. A common measure in econometric models of hospital performance is the Herfindahl-Hirschman Index (HHI), defined as the sum of squares of market shares, expressed as a percent, held by each firm in an industry. The maximum value is 10,000 and the minimum approaches zero. The HHI has been considered a good measure because it captures the size distribution of firms: larger firms get more weight (Folland et al., 1993).

Some criticism has also been presented regarding the HHI. White and Chirikos (1988) reported statistical bias in using the HHI as an exogenous variable in hospital regressions, with other demographic and economic hospital characteristics as possible confounders.

Robinson et al. (1988) measured the number of competing hospitals in each local market according to the latitude and longitude coordinated for each of the country's nonfederal, short-term general hospitals. Next, a computer algorithm searched for all the neighboring institutions within a 24-kilometer (km) radius of the subject hospitals. Straight-line distances between hospitals were calculated from latitude and longitude coordinates. Markets were defined according to whether they included 0, 1 through 4, 5 through 10, or more than 10 neighboring hospitals within a 24-km radius.

Phibbs and Robinson (1993) further refined the measurement of hospital competition in their variable-radius measure of local hospital market structure in California. Hospital discharge abstracts from 1983 were used to measure the radii necessary to capture 75 percent and 90 percent of each hospital's admissions. With radii used to define each hospital's service area, two measures of local market structure were calculated: the number of other hospitals within the radius and a HHI based on the distribution of hospital bed shares in the market.

The calculated radii were used as the dependent variables in regression models, with corresponding hospital characteristics as the independent variables. Estimated parameters of market radii were then used to predict local market structure for all federal, short-term, general hospitals in the continental United States.

Although the Phibbs-Robinson variable-radius method appears most desirable in an extensive hospital market analysis, its 1983 calculations of hospital competition levels were not collected within the time period necessary for the intended research project. The intended study utilizes the HHI approach to measuring competition within a

hospital's market. The HHI is well known and generally accepted in the health care industry, it is a relatively straightforward measure, and its data sources are available for analysis. Furthermore, the limitations of the HHI will be acknowledged and examined within the context of this research design.

Control Variables: Measuring Hospital Strategic Behaviors

In addition to measuring market competition among hospitals, the intended research intends to measure hospital behaviors in response to a more demanding economic environment. From the organizational standpoint, hospitals have been studied in several external transitions: forming alliances, merging into existing systems, or even closing.

Alliance networks were originally formed to offer hospital members the same buying clout available to national health care systems, as well as the opportunity to contract on a national level (Larkin, 1989). These objectives could be considered reactive behaviors amidst increased market competition, offering hospitals more cost efficiency and contracting control. Alliances studied in the 1990s, on the other hand, have considered changing their method of health care delivery and developing community-based, integrated networks (Smith and Trout, 1992). Some administrators have been successful in voluntary collaboration: eliminating duplicative services and technologies (Johnsson, 1991).

One variable in the intended study will identify whether the subject hospitals are alliance members, since alliance membership could be considered a control element in the structural indicators measured.

System membership is also an organizational feature which should be recognized in a study of hospital behavior. In a study of multihospital systems (MHS), Alexander and Morrisey (1988) developed a model to explain the affiliation patterns of hospitals. They assessed the role of a hospital's market, management activity, and mission compatibility with the system as predisposing conditions of MHS affiliation. The model was tested on a sample of 306 affiliated and 918 nonaffiliated hospitals under conditions of market equilibrium and disequilibrium, and for hospital entry into both non-profit and investor-owned multihospital systems. Results on the study factors suggested variable impact on MHS entry, according to the hospital's market and the type of system with which the hospital affiliated.

The intended study contains research elements similar to the model from Alexander and Morrisey (1988), including variables classifying the subject hospitals as a system member, non-profit, or investor-owned. Although market measurements are not the same between studies, both analyses seek to characterize the market surrounding the hospitals. The main topic under consideration for Alexander and Morrisey, however, is what kind of market conditions cause hospitals to affiliate, while the intended study compares the structural behavior of system versus non-system hospitals in varying competitive markets.

A survey by Bogue et al. (1995) evaluated the postmerger uses of 60 AHA hospitals between 1983 and 1988. Survey topics included the premerger competition between hospitals, competition in their environment, and what happened to the hospitals after their merger. Mergers often served to convert acute, inpatient capacity to other

functions, with less than half of the acquired hospitals continuing acute services after merger. Bogue et al. (1995) concluded that mergers may reflect two general strategies: elimination of direct acute competitors or expansion of acute care networks.

The intended study is primarily directed toward the acute, inpatient capacity and staffing of the study hospitals in response to a competitive environment. Hospital mergers represent an organizational response not specifically being studied, yet they are a common form of hospital reorganization which must be considered in researching structural change.

A well documented hospital response to the managed care payment environment is closure. Williams et al. (1992) investigated hospital closures occurring in 1985 through 1988, after the implementation of Medicare's PPS. They found that a hospital's financial status and mission or community standing were determinants of hospital closure. Closed hospitals were much less likely to be publicly owned, but more likely to offer fewer facilities and services, and have fewer cases. Competition appeared to affect the odds of closure through its effects on the number of cases. Additionally, hospitals in areas with small or declining population were more at risk than other hospitals in both urban and rural areas.

The intended research will track the hospitals closed in the study period, in order determine whether their loss could introduce bias into the study sample.

In summary, procompetitive policies from government and other third party payors have caused various strategic hospital responses, both internal and external to each organization, and stimulated studies in hospital efficiency and quality. Among the

analytic challenges are the measures which characterize the hospital's market, as well as hospital behavior.

Hospital Performance Studies in Efficiency

According to this study's model of organizational structure, poor economic performance places pressure on the organization's rulers, the dominant coalition, to reorganize (Donaldson, 1987). Therefore, in addition to environmental factors impacting on hospital structure, individual organizational performance should be considered as an exogenous factor in a hospital's structural changes. The intended study considers two dimensions of performance as instrumental in promoting hospital change strategies: financial success and quality care.

In the evaluation of hospital financial success, the literature provides various research concepts and study methods which aid in the development of the current proposal. Scott and Shortell (1988), for example, defined efficiency as the ratio of outputs to inputs: the number of products and/or services provided by a given supply of resources. Capital, labor, and equipment are three categories of inputs, and they are generally measured in dollar value. "Productivity" refers to a special subclass of efficiency measures that emphasize outputs as related to labor inputs (Scott and Shortell, 1988).

The intended study measures productivity with hospital labor inputs as indicators of structural change. Additionally, the measurement of cost per patient day serves to represent hospital efficiency in a more comprehensive manner.

Gooding and Wagner (1985) defined organizational performance in input-output terms in their meta-analysis of 31 published field studies. Their purpose was to review the relationship between organizational size and performance, with productivity and efficiency representing the performance dimension. Productivity measures were defined as those measuring absolute output, while efficiency measures involved the calculation of a ratio of outputs to inputs.

Although initial meta-analysis failed to substantiate an overall size-performance relationship in the 31 studies, Gooding and Wagner (1985) identified three moderating variables in subgroup meta-analyses. First, level of analysis differences (organizational versus subunit analysis), second, differences in operationalizing the "size" variable (employees, log of employees assets, transactions, etc.), and third, differences in operationalizing the "performance" variable (productivity versus efficiency).

These measurement moderators served to clarify relationships between organizational size and performance. For example, a positive relationship was found between organizational size and productivity, but no positive relationship was found between organizational size and efficiency, suggesting the absence of net economy of scale effects (Gooding and Wagner, 1985).

These findings are significant to the current proposal because they emphasize the critical operationalization of organizational structure and performance. Even the straightforward construct of organizational size may be considered as multidimensional (Kimberly, 1976). Additionally, organizational and subunit studies have yielded different

results, according to the level of analysis employed. The intended study utilizes variables for size and performance exclusively at the organizational level.

In their study of 160 hospitals in eight states, Watt et al. (1986) sought to compare how hospital operating strategies might affect their relative success in a price-conscious market. Their research question was whether significant differences existed between the economic performance of investor-owned chain and not-for-profit hospitals. Data were obtained from the AHA survey, Medicare cost reports, and Medicare case-mix indexes for 1980.

This study employed an interesting sampling method by matching 80 investor-owned chain general hospitals with similar not-for-profit general hospitals. Matches were made on the basis of location, scale of operation, services offered, and average length of stay.

Indicators of economic performance in this study included gross inpatient charges, total costs for inpatient services, hospital revenues (costs to patients and third-party payers), productivity in use of personnel and physical assets, charge-to-cost markups, and capital-structure financial ratios, such as net fixed assets per adjusted bed.

Of particular interest to the intended study, Watt et al. (1986) recorded hospital efficiency under the category "Use of Personnel and Physical Assets." Measures included FTE per adjusted average daily census, salary and benefits per adjusted day, and patient care square feet per adjusted bed.

The intended research similarly utilizes AHA and Medicare data sources, as well as measures in FTE utilization and facility cost per adjusted patient day. Watt et al.

(1986) sampled hospitals from only eight states; however their sample was carefully selected to represent 70% of the nation's for-profit hospitals. The intended study is more limited in its definition of successful hospital performance, yet broader in its sampling method.

The measurement of hospital cost per adjusted patient day does not capture some important aspects of hospital cost structure, according to Grannemann and Brown (1986). In their nationwide study of 867 non-federal, short-term U. S. hospitals, they specified a multiple-output cost function, with separate measures of inpatient days and discharges, emergency department visits, and outpatient visits. Case-mix measures for both inpatient and outpatient care were also deemed important.

With data from the AHA's 1982 Ambulatory Care Survey, supplemented by AHA's Annual Survey and the Area Resources File, Granneman and Brown (1986) performed basic regression with ordinary least squares analysis for the cost function. They recommended separating the cost of a discharge from the cost of a patient day, primarily in order to avoid distortions that could arise across hospitals in average length of stay. A hospital stay was viewed as (1) a quantity of medical services associated with the admission or discharge (such as lab tests and other ancillary support), plus (2) daily services (including routine nursing and hotel services) associated with the time spent in the hospital (Grannemann and Brown, 1986).

Because of this important distinction, the intended study will include variables for cost per adjusted patient day and also average cost per discharge as indicators of hospital performance.

In studying the financial performance of hospitals, Friedman and Shortell (1988) built their cost equation on one dependent variable: patient care expense per adjusted admission, divided by the area wage index. Financial performance was measured in two ways: net operating margin before taxes as a portion of patient care revenue, and net income margin after estimated federal income taxes as a proportion of total income.

Beyond the measurement of hospital costs, the hospital industry does not carry a standard definition of financial success. Up until 1987, the literature that covers financial performance measures as independent variables generally focuses on hospital failure as a relevant outcome (Glandon et al., 1987). Unlike firms in other industries, hospital performance is not easily compared through financial ratios. Hospitals experience multiple, competing objectives, they often lack the profit goal, they have a clear separation of ownership and management of assets, and they have no organized market for the equity of the firm (Glandon et al., 1987).

Valdmanis (1990) acknowledged difficulty in comparing public and nonprofit hospitals from lack of an accurate performance gauge. She applied nonparametric analysis to hospital production data, using Farrell's (1957) measure of technical efficiency. In Farrell's framework, a firm is considered technically efficient if it is operating on the best practice production frontier. The efficiency measure of each hospital is assessed as to what is the minimal input necessary to still produce the given output level (Valdmanis, 1990).

Data were obtained from the 1982 AHA Survey of Hospitals, with the sample limited to acute-care general hospitals (of 200 or more beds) located in Michigan

(metropolitan areas of 500,000 or more). Outputs were defined as the number of acute inpatient days and intensive care unit days, number of surgeries, and number of ambulatory plus emergency room visits. Inputs consisted of the number of active and associate physicians, number of medical residents, number of FTE nonphysician labor and nurses, and capital defined as net plant assets (i.e., capital value after asset depreciation).

Findings from Valdmanis' nonparametric analysis (1990) indicated that sample public hospitals were more efficient relative to the sample not-for-profit (NFP) hospitals. Upon further investigation, the NFP hospitals appeared to offer more specialized surgical services, such as open-heart surgery, requiring more sophisticated labor and capital than public hospitals.

Although the intended study does not use a nonparametric methodology, its design is influenced by the inputs and outputs selected in Valmanis' (1990) measures of technical efficiency. Specifically, variables representing the professional contingent in a hospital are similar to labor inputs, while the number of adjusted patient days and discharges could be interpreted as outputs. The intended study includes a measure for hospital bedsize; however the bedsize variable is used to indicate change in hospital capacity rather than formulate a capital input in an efficiency model.

Vita (1990) evaluated the behavior of hospital costs, using a translog function and data from a sample of 296 short-term, general care hospitals in California. The dependent variable was a cost variable, defined as the total operating expenses of the hospital. Outputs consisted of medical/surgical discharges, obstetric discharges, pediatric

discharges, outpatient and emergency room discharges, all other discharges, and corresponding length-of-stay variables. Payroll data were used to compute five input prices: management and supervisory wage rates, nursing wage rates, non-physician medical practitioners and technicians wage rates, auxiliary personnel wage rates, wage rates for all other personnel, and the number of beds (a fixed input). Control variables included an index of casemix complexity, as well as indicators for system membership and for-profit/not for profit organization.

Vita (1990) found that the translog function was useful for assessing the degree of overall scale economies at the sample mean. The "overall scale economies" refer to the proportional increase in all outputs that would result from a proportional increase in all inputs. Vita (1990) was testing a cost function for determining optimal size in hospitals. The intended research utilizes similar concepts in cost and outputs, however there is no emphasis on detailed price inputs or scale economies.

The intended study will consider hospital financial performance, in the form of cost, as both an exogenous variable and an endogenous variable, for the purpose of tracing the relationship between hospital performance and structural change.

Cleverley and Harvey (1992b) sought to examine the linkage between executive strategies and hospital performance amid 1025 U.S. hospitals in large urban areas in 1988. With the idea that competitive forces are shaping the management strategies in the health care industry, they compared and contrasted performance indicators of a large group of successful versus unsuccessful hospitals. Cleverley and Harvey (1992b) found

that cost control was the most important factor influencing financial performance. Other factors of importance included market share, diversification, and financing policy.

The data were obtained from the Healthcare Financial Management Association's (HFMA) Medicare Cost Report, which provided information on virtually every U.S. hospital operating in a large urban area during 1988. To summarize the analysis, a high-performance group and a low-performance group of hospitals were identified, and their composite financial average financial ratios were compared. Next, a multiple regression equation was fitted to the entire data set of 1025 hospitals, using Return On Asset Investment (ROI) as the dependent variable, and other strategy variables as the independent variables.

Cleverley and Harvey's (1992b) definitions of market share and successful performance hold particular significance in formulating the intended hospital study. Primarily, market share was defined as the percentage of total net patient revenue, both inpatient and outpatient, to total net patient revenue in the county in which the hospital was located. This method of measuring market share appears to be a step toward calculating the Herfindahl-Hirschman Index, an indicator of market competition, assuming that one could substitute hospital beds for net patient revenue in determining percentages. Secondly, Cleverley and Harvey (1992b) used a financial criterion for defining a successful hospital. Return on Asset Investment (ROI), the hospital performance measure, was defined as follows:

$$\frac{\text{Net Income + Interest}}{\text{Total Assets}}$$

Cleverley and Harvey (1992b) found cost control to be highly influential in hospital financial performance, and they named four strategies that seemed particularly effective in improving hospital ROI: relatively low length of patient stay, often achieved through physician profiling, high labor productivity, represented by FTEs per adjusted patient day, overhead cost control, and high capital expense ratios, possibly due to labor-saving equipment.

The intended study, influenced in many respects by Cleverley and Harvey (1992b), defines successful hospital performance as cost control and examines the strategies of length of stay and labor productivity. The intended research in hospital competition, structural change, and hospital performance shares other issues with Cleverley and Harvey (1992b), such as hospital diversification, or service scope, and patient selection, or case-mix.

Molinari et al. (1993) studied the relationships between "insider" board participation and hospital viability. In their research, financial ratio analysis was chosen for measuring hospital financial performance. Major dimensions of performance included hospital operating margin, net income to patient revenues, return on total assets, hospital occupancy rate, and net plant, property, and equipment per bed. "Insiders" were defined as medical staff members or the CEO of each hospital. Relationships were studied cross-sectionally. Measures included the presence or absence of insiders on the board, and financial viability (with controls for the organizational factors of system affiliation, ownership, size, region, and corporate restructuring). Through multiple regression

analysis, the authors found significant relationships between insider participation and all outcomes, with the exception of occupancy rate.

Molinari et al. (1993) set out to compare the theories of agency and managerialism in hospital governance, which is clearly distinguished from the intended research; however, their use of financial performance measures and their study design provide a standard for further empirical evaluation of organizational structure in hospitals.

The major data sources for Molinari et al. (1993) consisted of the California Health Facilities Commission Financial Disclosure data set and the AHA governance survey, a total of 190 respondents out of 426 short-term general non-Kaiser hospitals. Results were limited in generalizability to the state of California. The intended research samples a much broader national spectrum of hospitals, lending strength to the generalizability of its results.

Wan (1995) utilized linear structural relations (LISREL) to analyze the relationships between hospital efficiency, hospital financial viability, and hospital characteristics, such as bedsize, staff mix, HCFA case-mix index, and number of hospital competitors. The sample consisted of 85 short-term acute care hospitals in Virginia. In this study, data were drawn from the AHA's 1986 and 1987 files, the Federal Register, and the 1987 Health Services Cost Review Council.

Wan (1995) defined hospital efficiency as the cost of inputs used in production of outputs, a concept closely related to productivity. "When a procedure minimizes the cost for producing a specific output, efficiency is achieved (Wan, 1995)." In his study, Wan

further delineated three efficiency variables: cost efficiency, represented by average cost per patient discharge, process efficiency, measured by average length of stay (ALOS), and technical efficiency, calculated through data envelopment analysis (DEA). The DEA calculation was made using a relative ratio of patient care outputs to labor inputs.

Wan (1995) found that hospital efficiency was linked to hospital size, severity of patient treated, and metropolitan size. Hospitals with a large bed size, with more severe patients in special units, located in large metropolitan areas, tended to be less efficient. Although the sample size was limited, the study emphasized the importance in contextual factors, such as market forces and population size, as organizational factors affecting variation in hospital performance. The intended study has adopted a similar focus on the determinants of hospital structure, with resultant hospital efficiency.

To summarize this collection of hospital performance studies, financial success may be considered a result of strategic behaviors exhibited by individual hospitals in response to their environment, market conditions, and control features. The intended study seeks to evaluate hospital financial performance at two different times, in order to test the influence which past financial performance has upon hospital structural strategies. Variables including operating costs, labor inputs, and bedsize indicate the resources dedicated to patient stays, presenting a cost view of efficiency in the measurement of successful hospital performance.

Hospital Performance in Quality

In addition to cost containment, data on patient outcomes have increasingly been considered in judging hospital performance. This trend, coupled with the move toward

more capitated arrangements, places greater emphasis on providers' efficiency and outcomes (Baskin and Shortell, 1995). The literature provides many insights into defining and measuring hospital quality; however the analysis of quality in health care continues to present substantial methodological challenges.

Scott and Shortell (1988) viewed hospital quality as individual institutional effectiveness in the provision of health services in the short run. Although the type and amount of health services provided to the patient were also seen as important for long-term health, the manager and the institution were judged to have little control over these factors. After reviewing several studies on tradeoffs between efficiency and effectiveness, Scott and Shortell (1988) concluded that a higher quality of care, on the average, is not associated with higher costs, although the cost/quality relationship may differ for specific situations.

Donabedian (1966) categorized indicators of quality care into three groups: structure, process, and outcome. Structural indicators refer to the characteristics of providers, their tools and resources, and the physical and organizational setting in which they work. Process indicators refer to the set of activities that go on between the providers and the patient, such as patient histories or physical exams. Outcomes indicate the changes in a patient's health status that can be attributed to receiving health care, such as postsurgical infections, death, and satisfaction with the care process itself.

Various studies have associated hospital characteristics with quality outcomes. In relating hospital quality to teaching status, Flood and Scott (1978) reported no or mixed evidence that teaching status was associated with lower mortality. Flood et al. (1984b)

also found strong and consistent support between volume of cases treated and lower mortality for a variety of surgical and medical patient types.

Further developing the question of volume and quality, Kelly and Hellinger (1985) studied four surgical procedures in 373 nonfederal hospitals in 1977. They tested whether individual surgeon volume or hospital volume was more closely associated with better outcomes. They concluded that the relationship between volume and mortality is held at the institutional level, supporting the argument that organizational factors, not physician factors, are involved.

In their study of a single special procedure, Freeland et al. (1987) observed that selective contracting in local areas can potentially decrease duplication of services, reduce cost to purchasers, and lower expected mortality and morbidity for some patient groups. However, the argument can be made that these gains must be evaluated against reductions in continuity of care and access to care. They collected data from 37 California hospitals that performed coronary artery by-pass graft surgery (CABG). They found that in the study region, 19/37, or half, of the hospitals had an annual volume of less than 150 CABG operations per year.

In relating the qualifications of physicians and quality of hospital care, Rhee (1977) analyzed data from 454 physicians and their 2500 patients in 22 short-term general hospitals, utilizing the Physician Performance Index to measure quality in the physician process. He found that hospitals, variable in their degree of structured control over practice, were more predictive of quality than were the physicians' qualifications. In support of these results, Flood et al. (1982) analyzed data on 500 surgeons treating

8000 patients in 15 hospitals and utilized adjusted measures of morbidity at seven days following surgery and mortality at forty days following surgery for quality care indicators. They found no relation between physicians' qualifications and quality outcomes.

Quality in nursing care was investigated by Wan and Shukla (1987), who studied 60 community hospitals in 1981. They utilized hospital incident rates (reports concerning errors in medication, intravenous line administration, patient falls and injuries, inappropriate diagnostic and therapeutic interventions, etc.) as indicators for hospital quality. Independent variables were contextual factors, such as poverty level, education level, and age of the patients; and organizational characteristics, such as size, efficiency of support systems, nursing staff skill mix, staffing levels, case-mix index, and patient acuity index. Multiple regression analysis was performed for each type of incident rate, using the contextual and organizational variables as explanatory factors. Data was collected from the Health Area Resources File, hospital surveys, and the Federal Register.

Wan and Shukla (1987) observed that contextual variables are attributes of the hospital's region and community, which vary by location, and are largely beyond the hospital's control. Organizational variables were further classified into structural and design variables. Structural variables, such as type of hospital, number of beds, and case mix, were viewed as relatively outside the control of operational managers. Design variables, such as nursing structure, staffing patterns, and management systems, were seen as individual hospital developments and well within operational control.

The most notable findings from Wan and Shukla (1987) were threefold. First, hospitals located in areas with high bed/population ratios had significantly lower rates of medication errors, suggesting that competitive forces have a positive effect on quality of care. Second, hospitals located in areas where a higher percentage of the population was over 65 years old had significantly higher rates of patient falls and patient injuries. Third, and perhaps most striking, is that nursing skill mix (registered nurse hours and licensed practical nurse hours per patient day), nursing model, and nursing resource consumption were not significantly related to any of the incident rates. The conclusion was that nursing competence is more important than nursing staff skill mix in affecting the quality of nursing care.

The intended study incorporates several predictor variables from Wan and Shukla (1987), including the factors of hospital competition, hospital size, case-mix index, and nursing staff ratios. The intended study gathers data from a broad institutional base, but does not offer measures calculated from separate survey, such as patient acuity level, nursing hours per patient day, or support system efficiency. The most prominent difference between Wan and Shukla's study (1987) and the intended research is their choice of hospital incidence rates versus the mortality measures to indicate hospital quality. Both measures have inherent weaknesses for the purpose of gauging institutional performance, yet neither should be rejected without acceptable substitutes.

Keeler et al. (1992) employed three sets of criteria for comparing quality in hospitals: explicit criteria, implicit review, and sickness-adjusted outcomes (mortality within 30 days of admission). A total of 14,008 elderly patients with one of five diseases

(congestive heart failure, acute myocardial infarction, pneumonia, stroke, or hip fracture) were randomly sampled from 297 hospitals in five states. Two time periods were used for sampling: 1981 to 1982 and 1985 to 1986. Hospital types were defined according to the structural characteristics of size, ownership, urban or rural setting, state, size of training programs, city-county hospitals, and proportion of Medicaid and Medicare patients seen.

Explicit criteria for measuring hospital quality were developed from process measures, reviewed by experts and developed into five process scales: physician cognitive diagnostic, nurse cognitive diagnostic, technical diagnostic, technical therapeutic, and monitoring with the intensive care unit or telemetry. The five scales were then combined into one explicit process scale. A stratified random sample of 10% of the included medical records were selected to undergo implicit review, which was reweighted to match the explicit review sample in demographic and hospital characteristics. Five physician reviewers were trained in review and they used a structured form to rate medical records.

With the aid of a computerized recursive partitioning algorithm, hospital quality regression trees were constructed to analyze the data. Results consisted of comparisons across measures of quality care, as well as measures across types of hospitals. For virtually all 19 listed hospital characteristics, there was agreement among the three measures of quality. Poor explicit and implicit process was consistently associated with excess mortality. In terms of hospital type, hospitals in bigger cities and certain states showed better average quality. Better quality was also associated with more teaching,

private ownership, and bigger hospitals. Nonprofit and for-profit hospitals were reported to provide similar quality.

The importance of this study is its ability to link clinically detailed data on process and outcomes, with remarkable consistency across hospital categories (Keeler et al., 1992). The results clearly lend validity to the researchers' formulation of hospital "excess mortality," that is, the difference between their predicted mortality rate and the observed mortality at each hospital. The intended study utilizes HCFA data of predicted and observed hospital mortality in order to establish its performance measure of quality.

The relationship between hospital cost and quality has been explored, with inconsistent results (Fleming, 1990). Burstin et al. (1993) studied the link between hospital financial characteristics, patient payer mix, and the incidence of negligent medical injuries. They performed a retrospective medical record review of 30,195 records in 51 acute care hospitals in New York in 1984. Negligence was reported as the percentage of adverse events due to negligence, thereby using adverse events as a control for the intensity of patient care. Adverse events were interpreted as injuries caused by medical management, as opposed to the underlying disease process.

Hospital financial information was obtained from 1984 cost reports, and hospital operating information was collected from the 1985 AHA Guide to the Health Care Field. Financial data were presented per discharge. Hospitals were grouped into quartiles according to inpatient operating costs per hospital discharge. Through regression analysis, it was found that the likelihood of negligent medical injury was highest in those hospitals with the lowest inpatient operating costs per hospital discharge. Further

analysis indicated that financially distressed hospitals (those with fund balances or assets in the lowest quartile) had a higher mean negligence rate than the other hospitals.

In measuring hospital negligent medical injuries, the study by Burstin et al. (1993) incorporated an interesting measure for hospital quality, avoiding bias from patient risk factors. Record review for over 30,000 patients was thorough, yet sampling from acute care hospitals in New York State in 1984 places definite limitations on the generalizability of results. The variable for hospital financial performance, inpatient operating costs per discharge, is utilized in the intended study, as well as several multivariate methods selected to analyze hospital data.

Harkey and Vraciu (1992) investigated the link between hospital profitability (defined as net operating income divided by net operating revenues) and quality (perceptions of quality by patients, physicians, community residents, and employees). They analyzed the financial data for 82 small and medium-sized hospitals in 21 states. Factor analysis was used to identify a broad quality factor as an independent variable, which was then related to hospital operating margin in regression equations.

In the quality factor analysis, variables that loaded on the quality factor included items from the patient, employee, and physician surveys, suggesting that all three perspectives shared similar definitions of quality. In the regression analysis, significant predictors were the quality factor, percent Medicare and percent managed care, together accounting for 29 percent of variance in operating margin. Other environmental and reimbursement-linked variables were tested but did not prove significant: population size, hospital bed size, population income, and competitive environment.

Although Harkey and Vraciu (1992) focused on hospital profitability and the intended study measures hospital cost versus quality, the inclusion of an independent reimbursement variable appears to be appropriate for both models. The literature clearly suggests that percent Medicare volume is as important as HMO penetration data in the influence of hospital structure and performance.

Cleverley and Harvey (1992a) studied a small sample of eight HCFA high-mortality hospitals and found that these "poor quality" hospitals were also less profitable. In testing the association between quality and profitability, two measures of profitability were used: operating margin and return on total assets. All eight hospitals had operating margins that were lower than the median value for their region/bedsize peergroup.

Carrying their analysis one step further in economic investigation, the authors found that poor quality hospitals had prices and costs-per-discharge which were lower than the norm. On the other hand, their occupancy rates were comparatively high, defying the hypothesis that only high-perceived quality will generate greater patient demand and subsequent increased volume.

The study reported by Cleverley and Harvey (1992a) spurred Levitt (1994) to explore the relationship between hospital investment in property, plant, and equipment (PPE) and quality of patient care. In Levitt's research, quality was measured by hospital-specific confirmed failure rates from Peer Review Organization (PRO) Generic Quality Screens (GQS), including 26 screens of medical care.

The advantage to measuring cash investment in PPE is that hospital cash flows are evaluated over multiple years, providing a robust measure of financial activity (Kane,

1991). Financial variables were taken from the Massachusetts hospitals audited financial statements spanning fiscal years 1984 through 1989. Hospital-specific GQS confirmed failure rates were calculated from the Massachusetts PRO "review abstracts" of patients discharged between 1 April 1989 and 30 September 1990, including 65,523 reviews at 87 hospitals.

Multivariate models were used to test for possible confounders, such as Herfindahl index, Medicare and Medicaid payer mix, case-mix severity, bed size, occupancy, and teaching hospital status. For comparison, hospitals were divided into two groups: those with higher versus those with lower median confirmed failure rates. Next, multivariate analyses were performed, using weighted least squares regression models. Results indicated that those hospitals that invested more money per bed over the six-year period had lower confirmed failure rates.

The intended study is similarly concerned with cost and quality, although different measures are used. The intended study also attempts to capture hospital performance over a period longer than one year, although a six-year financial measure is not available, and emphasis is generally on hospital labor costs rather than capital investment.

In conclusion, ample literature is available in the topics of managed care penetration, health care market competition and hospital performance. Past research has linked these concepts with some success, generally limited to specific timeframes (immediately post-PPS, for example) and regions (California, Massachusetts). The intended study is designed to build on prior techniques and discoveries and investigate

the association between economic context, structural change and performance in American hospitals.

CHAPTER III. THEORETICAL MODEL

Introduction

This chapter provides more detail to the theoretical framework of the study, beginning with contingency theory in general and describing Donaldson's SARFIT (Strategic Adjustment to Regain Fit) model. The theoretical dimensions of environment, fit, and structure are discussed in relation to the study model; and hypotheses relating these constructs are introduced. In further hypotheses, hospital performance is related to the organization's environment as well as its ability to change.

This research effort is based on previous works in contingency theory, directed toward the relationships between environment, organizational structure, and organizational performance. Thompson (1967) proposed that the organization is shaped by the environment. This foundational concept has been further developed into the following observation: the environment of each organization poses a particular challenge to that organization, which in turn must determine a response. The organization can be seen as dependent upon the environment to survive or grow (Donaldson, 1995).

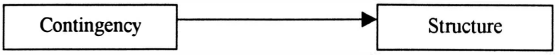
This expanded concept of dependency is consistent with Scott's open systems perspective. Scott (1992) stresses that "reciprocal ties ... bind and relate the organization with those elements that surround and penetrate it (1992, p.93)." Buckley (1967) further defines an open system as one where environmental interchange is an essential and underlying factor to system viability.

Donaldson (1995) considers three mechanisms by which the organization deals with its environment. The first method is for the organization to be an effective competitor through superior organizational performance. The second method is to influence the environment through co-opting powerful environmental organizations. The third method is to alter the environment through merger between organizations. This research project focuses on the first mechanism, taking into account the internal structure of the subject organization and its success in framing superior performance.

Organizational research in environmental selection does not typically study the failure of an entire organization. Rather, organizations often adapt to their environments by means of structural or behavioral modifications. Organizational change must therefore be examined for selection at the population level (between competing firms), and also at the organizational level (Aldrich and Pfeffer, 1976).

The main prevailing theories of structural change are contingency determinism and strategic choice (Donaldson, 1987). In contingency determinism (Figure 5), a specific change in contingency promptly leads to structural change in the organization. As an example, Blau (1970) generalized that increased organizational size generates structural differentiation, resulting in greater sized administrative components for coordination. Burns and Stalker (1961), Chandler (1962), Woodward (1965), and Lawrence and Lorsch (1967) are other prominent contingency theorists in organization structure.

Figure 5. Contingency Determinism
(source: Donaldson, 1967, p.274).



The strategic choice model, associated with Child (1972), also portrays the organization in its attempt to match structure with contingency; except with added complexity. Child introduces the concept of political process within the organization, whereby the "dominant coalition" re-establishes structural forms, but also manipulates environmental features in order to achieve fit.

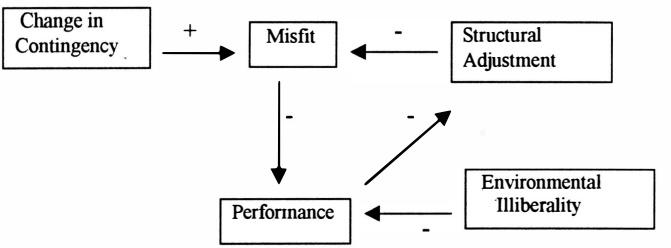
To improve upon these contingency approaches to organization structure, Donaldson (1987) presents a model based on structural-functional theory. This type of theory assumes that a state of equilibrium is disturbed by an exogenous force, leading to disequilibria, ineffectiveness, and eventual restitution through the adoption of a different structure. Donaldson's SARFIT model, or structural adjustment to regain fit (1987), properly validated, is offered as a refinement of the contingency idea and a more accurate model of structural functional logic. In contrast to contingency determinism, the SARFIT model is a more elongated set of processes which occur over time.

The conceptualization of variables in contingency theory has been criticized. For example, analysts say that the theoretical concepts are not clear (Tosi and Slocum, 1984). Furthermore, the relationships between concepts are not seen as adequately specified (Schoonhoven, 1981). Tosi and Slocum (1984) name three key dimensions that must be sharpened in order to discover empirical relationships in contingency: effectiveness, environment, and congruency. The intended research seeks to clarify these

dimensions through the use of the SARFIT model. SARFIT has addressed contingency theory weaknesses in conceptual clarification and specification.

Under SARFIT (Figure 6), the need for structural change in the organization arises from the substandard performance, coming from a mismatch between structure and contingency. "Mismatch" is further defined as the misfit between the new value of the contingency variable and the old structure (Donaldson, 1987). Mismatch produces a range of dysfunctional behaviors in the organization, leading to low economic performance. Poor performance places pressure on organizational leaders (the dominant coalition) to reorganize. However, low performance only leads to structural change if the environment is adverse, or "illiberal" (Child, 1972).

Figure 6. Structural Adjustment to Regain Fit (SARFIT) General Model. (Source: Donaldson, 1987, p.4).



In comparison to the SARFIT model, the intended study model incorporates the concepts of contingency and organizational performance as precursors to organizational change. According to the intended study, the arrival of the managed care era was a tremendous change in contingency to community hospitals. Unlike Donaldson's SARFIT example, however, structural misfits are not directly identified among the

subject units. In the intended study, substandard hospital performance is presumed to be a consequence of poor fit with the managed care contingency. Performance is measured and related to structural adjustments made by each hospital at a later point in time.

Measures for managed care infiltration and past hospital performance therefore assume the role of major independent variables; and changes in hospital structure are dependent variables. To account for SARFIT's condition of environmental illiberality, a variable for market competition is included as a possible moderator to one or both of the independent variables.

Theoretical Dimensions

Environment

The studies of Burns and Stalker (1961) and Lawrence and Lorsch (1967) analyzed how the characteristics of market and technological environments affected the internal structure of an organization. Later research described environmental factors in more general terms, such as certainty or complexity; without reference to specific sector source, such as the market or the government (Tosi and Slocum, 1984).

Tosi and Slocum (1984), seeking to frame the environment in a more precise way, specify environmental sectors as (a) users of output, (b) input sources, and (c) external regulators. Examples are customers, capital sources, raw product supplies, and technology and science.

In health care organizational research, the focus has often been on how organizations react to a complex and uncertain regulatory environment, or to a new

competitive environment. The environment is perceived as a force which restricts the range of organizational action (Kimberly and Zajac, 1985).

More recently, researchers have suggested perspectives which reach beyond traditional structural contingency theory. For example, the firm has been interpreted to adapt its environment to the organization, rather than make internal structural changes (Child, 1972). Or an adaptive firm has been interpreted as reactive to its individual model of the environment, a perceptual bias which is not necessarily appropriate for successful adaptation. Other relatively new theoretical approaches in structural contingency include the change in organizational boundaries to gain environmental control, and the interactive environmental dimensions of uncertainty and resource dependence (Grandori, 1987).

This study is based on Child's (1972) argument for the environment, which states that the maintenance of organizations depends upon some degree of exchange with outside parties. Three environmental conditions are highlighted as important: (1) environmental variability, or the degree of change which characterizes environmental activities relative to an organization's operations, (2) environmental complexity, referring to the range of environmental activities relevant to an organization's operations, and, (3) environmental illiberality, or the degree of threat that is imposed by external competition, hostility, or even indifference.

Although Child (1972) recognizes that environmental conditions can be regarded as a source of variation in organizational structure, he also considers strategic and political factors, whereby organizational decision-makers may define the product,

geographic location, organizational boundaries, customers, and other environmental limits to organizational operations. There is a proposed link between the decision-makers' evaluation of the organization's position in the environment and the action they take regarding internal structure.

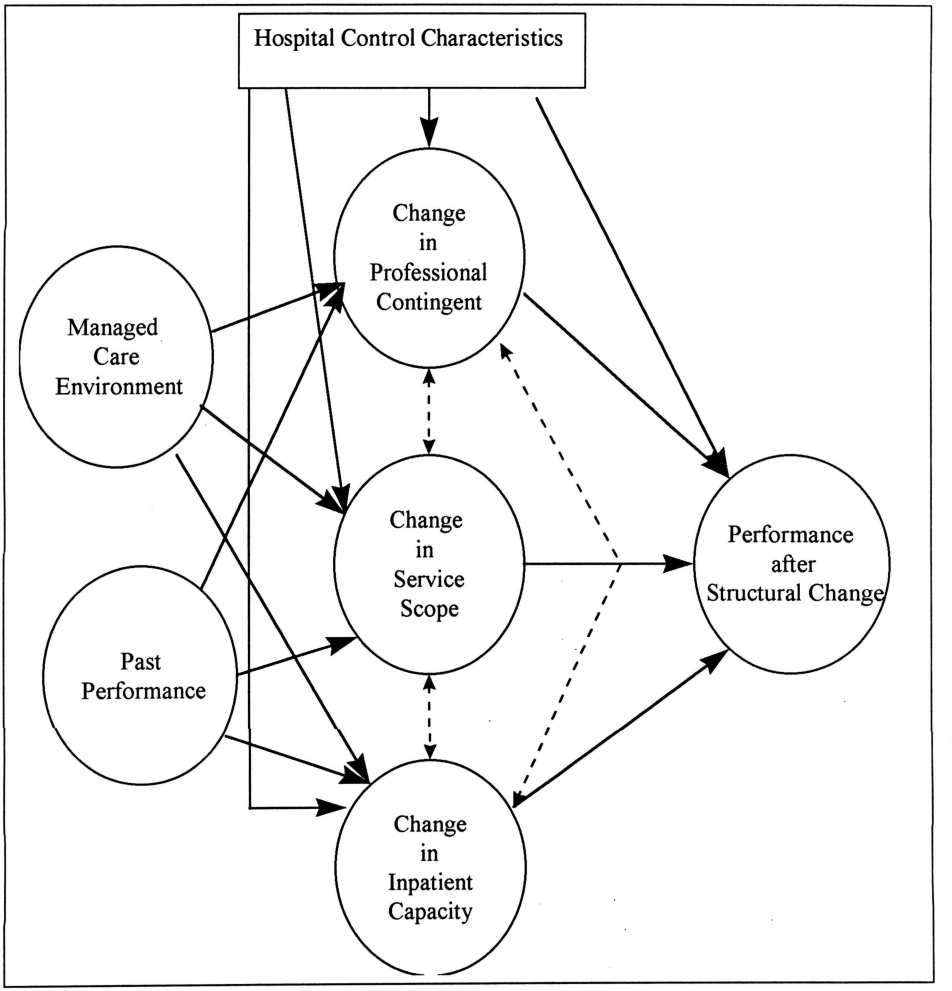
In the intended research model (Figure 7), the environmental contingency is represented by the infiltration of HMO insurance plans into the revenue streams of the community hospitals under study. A growth in managed care plans indicates an increase in environmental uncertainty for individual hospitals. Community hospitals in 1986 were facing a new paradigm in managing care, including capitated reimbursement methods, preventive medicine, patient education, and other efforts to reduce hospitalization for enrolled populations.

The intended study model includes a variable for market competition as an element of the hospital's managed care environment. With reference to environmental illiberality in the SARFIT model, hospitals also encountered some degree of stringent business conditions in maintaining their occupancy rates. This situation is indicative of competitiveness (Williamson, 1970). Thus, market competition plays a role in moderating the effect of each hospital's performance variable. Low performance is predicted to lead to structural change, only if the environment is competitive.

One may note that the SARFIT model is a loop of events: once a misfit has been detected and resources found to be scarce, correction in organizational structure is predicted, with additional changes made until performance improves. The design for the intended study demonstrates the cyclical nature of the original model, and further

analysis could measure structural and performance variables over numerous time periods for the subject organizations.

Figure 7. Study Model Describing Hospital Structural Responses to Managed Care Penetration and Their Effects on Hospital Performance.



Fit

Fit, or congruency, between the environment and the organization, is a basic theme in most contingency studies. Improving congruency between the environment and the organization is proposed to improve effectiveness (Tosi and Slocum, 1984; Yasai-Ardekani and Nystrom, 1996). Sophisticated theories of natural selection predict that when firms operate in highly competitive markets in which large numbers of firms are dependent on the same scarce resources, organizational structures that fit the environment will outperform less fit forms (Grandori, 1987).

Donaldson's application of the SARFIT model (1987) defines organizational strategy as the theoretical contingency which acts upon organizational structure. Product diversification is the strategy selected for measurement and analysis of fit with four levels of structural decentralization: functional, functional with subsidiaries, product divisional, and holding company. A simple matrix arrangement of various categories allows a clearcut decision of "match" or "mismatch" based on literature from Chandler (1962), Mintzberg (1979), and others.

The intended study will adopt its analysis of fit from Drazin and Van de Ven (1985), who associate good organizational performance with good structural fit. They present three different conceptual approaches to fit: the selection, interaction, and systems approaches. Depending on the approach, each concept refines the meaning of contingency theory and the expected empirical results (Drazin and Van de Ven, 1985).

In the first approach, the selection approach, basic fit is presumed to be a congruence between context and structure, and is represented by correlation or regression between singular variables.

The second approach to fit, the interaction method, considers interactions between pairs of context-structure factors, and predicts that such interactions will affect organizational performance. Residual analysis of context-structure relationships indicates organizational fit, and deviations from this fit indicate low performance.

The third approach to fit is the systems approach, which seeks to avoid the other methods' reductionism of organizational factors. Advocates argue that only by simultaneously addressing many contingencies, structural alternatives, and performance criteria can researchers holistically understand organizational design (Drazin and Van de Ven, 1985). Systems analysis focuses on differences in pattern profiles, which account for several variables at one time. Analysis of variance, multiple analysis of variance, formulation of ideal unit values, and correlation of unit distance scores with associated unit performance values constitute a few methods for testing fit in the systems approach.

The intended study will utilize the selection approach for determining fit between the managed care environment and existing hospital structures.

Structure

Three integral elements of hospital structure were selected for the study: professionalism, service scope, and inpatient capacity. All three dimensions are important to the hospital's core competencies, and they are fundamentally connected with

resource utilization in the hospital's production function. These dimensions act as benchmarks in tracking hospital change and adaptation to a managed care environment.

Galbraith (1973) incorporated several dimensions of structure in his contingency theory on organizing for effectiveness: (1) rules and programs, or standardization, (2) hierarchical referral, or centralization of decision making, (3) professionalization, (4) creation of slack resources, (5) creation of self-contained tasks, (6) creation of vertical information systems, and (7) creation of lateral relations.

In regard to professionalization, Galbraith suggested that organizations, in an effort to control behavior in job-related situations, select responsible workers who have the appropriate education, skills and attitudes. As a consequence, the work force will make task-relevant decisions without sacrificing control over outcome quality.

In a study of acute care hospital operating room suites, Schoonhoven (1981) found that greater specificity in Galbraith's contingency arguments allowed for stronger empirical support in relating uncertainty to professionalization. In Schoonhoven's study, uncertainty was measured by variation in operating room schedules. Professionalization was measured by the initial level of training (B.S. degree and R.N. ratio), and current professional activities, such as membership in professional organizations and journals read.

One major structural dimension of the intended study is professionalization within the subject hospitals. Under economic pressure from a managed care environment and directed toward greater efficiency, poor performing hospitals are predicted to change their professional mix to suit the new conditions.

In the intended study, the dimension of professionalism summarizes the number of salaried physicians, dentists and nurses comprising the hospital personnel base. The purpose of evaluating the constituency of the core hospital staff is to detect any shifts in the professional framework over the study period. A measure for total FTEs indicates whether hospitals are indeed "downsizing" their staff elements. It is imperative to determine if hospitals are changing their human resource base, a major organizational input, in response to the demands of the managed care environment.

Signifying structural change, hospitals could possibly have employed more physicians to help control independent practitioners' utilization of hospital services. Physicians have been estimated to control up to eighty cents of the national health care dollar by specifying hospital services, diagnostic procedures, drugs, and therapies.

The study's professional dimension also includes measures for RNs, LPNs, and RN/(RN+LPN) ratios, as indicators for any professional downsizing or substitutions that take place in bedside patient care. In response to managed care incentives, RN's, or registered nurses could have been cut from hospital staffs or replaced by nursing assistants (Lumsdon, 1995).

H1: Poorly performing community hospitals, experiencing competition or operating in a more pervasive managed care environment, will increase their number of salaried physicians and decrease their number of registered nurses.

The second structural dimension in the study, change in services, relates to the ability of organizations to change their boundaries. In the case of hospitals, the transition is predicted to move from the acute-care, inpatient settings to outpatient visits and ambulatory services associated with preventive care.

The dimension of service change reflects specific programs in health promotion which may have been undertaken by hospitals in order to attract managed care business. Promotion of outpatient services signifies the hospitals' ability to change its structure, specifically in providing outpatient visits, outpatient surgeries, patient education, fitness promotion, women's health programs, occupational health, and geriatric screening programs. This change in service scope indicates yet another aspect of the hospital's adaptation toward organizational survival.

H2: Poorly performing community hospitals, experiencing competition or operating in a more pervasive managed care environment, will increase their ambulatory, preventive, and screening services.

The third structural dimension in this study, hospital inpatient capacity, is related to the concepts of organizational size and the management of slack resources. Hospital inpatient capacity was widely publicized in the 1980s as the number of inpatient days steadily decreased in the United States. In terms of plant size, the average community hospital simply maintains fewer beds than it did prior to the implementation of the Medicare Prospective Payment system and other reimbursement changes. Hospital

bedsize, occupancy rate, and case-mix have been reliable indicators of hospital workload and throughput. These study measures can quantify the downsizing, or reduction in acute care capacity, undertaken by the subject hospitals.

H3: Poorly performing community hospitals, experiencing competition or operating in a more pervasive managed care environment, will reduce their inpatient capacity.

Hospital Performance Measures

The intended study model (Figure 7) includes two performance dimensions: one as a stimulus to structural variation, and another as a result of structure. According to Child (1972), a theory of organizational structure has to take account of performance, with performance treated as an input as well as an outcome. In other words, structural variables would depend upon decisions made with reference to some standard of required performance, as well as some prediction of how structural change will affect performance levels.

To measure organizational performance in contingency theory, researchers often use the concepts of effectiveness and efficiency. Pfeffer and Salancik (1978) define effectiveness as an organization's ability to create acceptable outcomes and actions. Tosi and Slocum (1984) offer three dimensions, or outcomes, that have been used to measure effectiveness: efficiency, referring to the way in which resources are arranged to produce a unit of output, some outcome preference of organizational membership such as job

satisfaction or pay, and some general, socially responsible outcome. Tosi and Slocum suggest that managers and researchers exercise their values in selecting desirable outcomes, and that effectiveness in one area may involve a tradeoff somewhere else.

In this study, the theoretical construct of hospital performance is initially represented by dual dimensions of facility efficiency and quality. The efficiency dimension stems from various studies in financial performance of health care institutions (Cohen and Dubay, 1990; Friedman and Shortell, 1988; Manheim et al., 1989). Efficiency is defined here as a productivity ratio, with facility expenses divided by patient output. Two ratio measures are taken: the facility-wide expenses divided by adjusted patient days, and the facility expenses divided by the number of adjusted inpatient discharges.

Measures of quality are seen as helpful in formulating a balanced profile of hospital performance. With managed care becoming a prominent influence on hospital systems, evaluation of outcomes encourages external review, accountability and continuous improvement in hospitals (Shortell et al., 1995). In the interest of analyzing available, hospital-level quality data, each unit's adjusted mortality rate is collected for performance evaluation.

Hospital Performance as a Result of Structural Change

Miller and Friesen (1984) suggest that organizations are complex entities, where elements of structure, strategy and environment have a natural tendency to coalesce. The connection between structural change and performance in hospitals is therefore an appropriate and necessary focus of study. When sales growth and profitability (return on

equity) were used as performance measures for a sample of 89 Canadian and Australian firms, more successful firms changed structural variables in a dramatic, rather than incremental, way (Miller and Friesen, 1984).

The study approach by Miller and Friesen is particularly successful in focusing on relationship clusters, because organizational change is evaluated over time (Kimberly and Zajac, 1985). The intended study intends to create a similar effect by incorporating variables of change over a period of five years.

Child (1972) raises two questions for a theory in organizational structure. Primarily, he asks how performance standards and their achievement may act as a stimulus to structural variation. Secondly, he considers how that structural variation will affect later performance levels. In the second case, Child suggests that organizational decision-makers do believe that structural design has some consequences for performance. Child also names other strategic possibilities, such as choice of environment, choice of market strategies, or selection of operating scale and technology, as significant influences apart from structural design.

The intended study investigates the causal link between hospital structural change and performance, with variable measurements identified earlier in this chapter. Application of the SARFIT theory calls for collection of performance measures at a later point in time, following hospital structural changes.

H4: In a more competitive or pervasive managed care environment, community hospitals which increase their number of physician staff and decrease their

proportion of registered nurses will demonstrate better performance than those hospitals which do not make such changes.

H5: In a more competitive or pervasive managed care environment, community hospitals which increase their ambulatory, preventive, and screening services will demonstrate better performance than those hospitals which do not make such changes.

H6: In a more competitive or pervasive managed care environment, community hospitals which reduce their inpatient capacity will demonstrate better performance than those hospitals which do not make such changes.

Hospital Characteristics as Controls

An underlying dimension in determining the organization's structure is added to the SARFIT model: basic characteristics of hospital size, location, Medicare reimbursement, Medicaid reimbursement, and administrative control. These conditions are often included in studies of hospital environmental response. Selected hospital characteristics, depending on their strength and magnitude, could possibly be viable forces in promoting or impeding any structural innovations.

Hospital administrative control characteristics include strategic decisions which hospitals had made prior to 1989 or 1995, such as system membership, alliance participation, physician liaison contracting and management contracting. The influence of contextual elements over corresponding organizational structure and performance have been estimated elsewhere (Astley, 1985; Flood and Scott, 1987; Pugh et al., 1969).

For the purpose of this study, the individual hospital unit is seen as appropriate for analysis. Despite the recent prominence of hospital mergers and alliances, individual hospital units, unlike those in other industries, must accommodate the unique needs of the surrounding community. Hospitals are relatively site-bound, and they must answer to local conditions (Lawrence and Dyer, 1983). Even though organizational design may be evaluated as a means of satisfying those who in charge, the reconciliation of economic and social criteria is foremost (Child, 1972).

Together, the dimensions of managed care environment, hospital structure, and hospital performance constitute this inquiry into strategic contingency and the response pattern of successful hospitals. A summary of the study hypotheses is given in Table 2.

Table 2. Summary of Study Hypotheses.

H1	Poorly performing community hospitals, experiencing competition or operating in a more pervasive managed care environment, will increase their number of salaried physicians and decrease their number of registered nurses.
H2	Poorly performing community hospitals, experiencing competition or operating in a more pervasive managed care environment, will increase their ambulatory, preventive, and screening services.
H3	Poorly performing community hospitals, experiencing competition or operating in a more pervasive managed care environment, will reduce their capacity.
H4	In a more competitive or pervasive managed care environment, community hospitals which increase their physician staff and decrease their registered nurses will demonstrate better performance than those hospitals which do not make such changes.
H5	In a more competitive or pervasive managed care environment, community hospitals which increase their ambulatory, preventive, and screening services will demonstrate better performance than those hospitals which do not make such changes.
H6	In a more competitive or pervasive managed care environment, community hospitals which reduce their inpatient capacity will demonstrate better performance than those hospitals which do not make such changes.

CHAPTER IV. METHODOLOGY

This chapter introduces the study's research design, data sources, sampling approach, variable measurements and methods of analysis. Variable definitions provide a detailed description of the model components to be tested.

Research Design

The study employs a non-experimental panel design in determining whether a managed care environment could significantly influence change in hospital structure. The study design could be described as correlational, involving data collection on multiple variables and exploring the relationships between them. An advantage of the correlational design is the ability to investigate complex relationships between several variables in a single study (Grady and Wallston, 1988). Competing hypotheses about variable relationships may be tested at once, allowing for future studies in causality.

A major disadvantage to correlational designs is that causality may not be assumed from demonstrated relationships. However, if findings from correlational studies can be replicated and supplemented with other data, a convincing argument for causality can be made. Such an argument would include covariance between key variables, predictor variables preceding the criterion, or dependent variable, in time, and the absence of alternative explanations of the relationship (Grady and Wallston, 1988).

The study incorporates a longitudinal approach. Longitudinal surveys collect data on more than one occasion from sample members of the population of interest. The purpose of this collection method is to measure change, and to insure data accuracy. Longitudinal data, also known as panel designs, often describe variations in population characteristics that are sensitive to changes in time (Cox and Cohen, 1985). Longitudinal designs can establish a temporal relationship between variables, in which one variable precedes and predicts some other variable (Grady and Wallston, 1988). The design provides potential for causal conclusions, because predictor variables are measured in a time period prior to the criterion, or dependent variable.

Specifically, variables constituting the hospital's environment are measured in the base year 1989. Variables for hospital response indicate the degree of structural change demonstrated over a five-year period, from 1989 to 1994. Hospital performance following structural change is measured in 1995. This design places structural change as a central focus, both dependent and independent in its relationship with other hospital factors and other places in time.

The base year of 1989 assumes that the study hospitals had fully implemented PPS rules, and their PPS transition period was ended. 1989 was a peak year for hospital spending, as well as continued growth in HMO memberships. Both factors are important in determining the sensitivity of hospital response behaviors. From that base year of 1989, the following five years register structural transition and associated significant change. A five-year period is also limited so as to avoid the widespread mortality of community hospital organizations from the original study sample.

According to contingency theory, some lag time between observations in structural change and organizational performance is desirable. To establish this effect in study design, hospital performance is measured in the survey year 1995 and related to structural changes from 1989 to 1994.

Data Sources

Data are collected from three sources: the American Hospital Association Annual Survey of Hospitals Data Base, Health Care Financing Administration Datasets (Minimum Cost Data), and the Area Resources File (ARF).

The American Hospital Association (AHA) Annual Survey of Hospitals Data Base is a derivative of the AHA Annual Survey of Hospitals. This survey has been conducted annually since 1946, and it is widely utilized by researchers as a comprehensive source of individual hospital data. AHA surveys from 1989, 1994, and 1995 are utilized in this study.

The Health Care Financing Administration (HCFA) constructed its Prospective Payment System (PPS) VI Minimum Data Set from HCFA Form 2552-85, utilized for hospital cost reporting and utilization data from 1 October, 1988 through 1 October, 1989. Similarly, PPS XII Minimum Data Set is available for the reporting period 1 October 1994 through 1 October 1995. Both data sets are offered for public use.

HCFA's mortality files are compiled from Medicare Hospital Mortality Information and from the Medicare/Medicaid Accreditation System (MMACS). This administrative data is available for public use. HCFA's 1989 mortality files are used in the study.

The Area Resources File (ARF) maintains regional census data and health resource information from 1976 to the present. This study utilizes the ARF for HMO membership statistics, population data and market data on a countywide basis for the year 1989.

Data on HMO membership were reported in the ARF and collected by the Interstudy Edge census for 1989, with data as of 1 July 1989. HMO membership is calculated to include Pure Members (renamed in 1992 as Traditional HMO Enrollment) and Open-ended Enrollment. Supplemental Medicare and Other HMO Enrollment figures are not included.

In this study, market data collected from the ARF are aggregated to the Metropolitan Statistical Area (MSA) level established by the Office of Management and Budget in 1994. These metropolitan areas are a revision of previous standards, and they use demographic data drawn from the 1990 Decennial Census. An area is defined as an MSA if there is a city with a population of at least 50,000, or if there is an urbanized area of at least 50,000 population with a total metropolitan population of at least 100,000. In addition to a central city, an MSA may include other counties having close economic or social ties to the central county (ARF, 1996).

Study Sample

The selection of a study sample defines the relevant product and geographical markets for the hospitals of interest. Although some hospitals produce specialized services such as psychiatric or orthopedic programs, most hospitals may be viewed as

multi-product firms offering a multitude of diagnostic and therapeutic services (Santerre and Neun, 1996).

With the American Hospital Association providing the study frame from its 1989 Annual Survey of Hospitals, this study's unit of analysis is the community hospital with service type described as general medical and surgical. The community hospitals under study include local government, not-for-profit, and for-profit institutions. By definition, community hospitals are not units within other institutions (American Hospital Association, 1990). Moreover, the sample hospitals did not provide nursing home services in the base year 1989. Such restrictions allow for homogeneity in the type of hospital services provided, although a few hospitals added nursing home units over the 6-year study period. This development is utilized as a control in 1995 financial performance measures.

The study's exclusion of federal hospitals is a method of selecting those units with revenues closely linked to the volume of patients served; however teaching hospitals are included in the sample if they meet other sample criteria. Patient stays within the study hospitals are defined as short-term, but hospital bedsize is not restricted. Only those hospitals reported as operational for the entire 12-month survey period are included in the original 1989 sample.

Once the relevant product market, or cluster of inpatient services, has been defined, a logical step is to determine the relevant geographical market (RGM). An appropriate geographical area reflects both the travel costs involved and the ability of patients to switch to alternative suppliers when price or quality is variable. Many

researchers have based the RGM on boundaries such as counties, metropolitan areas, or cities, due to data availability and practical concerns (Santerre and Neun, 1996). In this study, major emphasis is upon market competition between hospitals; therefore only those units in areas classified as MSAs (metropolitan statistical areas) are sampled.

The timeframe for hospital structural change is taken from AHA survey years 1989 and 1994. Hospitals which are deleted from the AHA Summary of Hospitals for the years between1989 and 1994 are also deleted from the study sample. Reasons for AHA deletion include hospital closure, change to an outpatient facility, or merger into another hospital (American Hospital Association, 1990). Similarly, those hospitals added to the AHA Summary after 1989 are not included in the study sample. Additions are usually due to demergers, mergers, and new survey participants. The study sample retains additions to the AHA's registered and unregistered files when subject hospitals were merely moved between those two categories and were present in the 1989 group.

Other deletions to the study sample are due to two or more hospitals sharing one Medicare Provider Number, as some systems will report; and specific hospitals which changed their service type during the study period.

By selecting a group of integral hospital units and following their internal changes over a period of five years, the study provides some control in maintaining consistent organizational identities. Despite the exclusion of federal and rural hospitals, the national study sample is extensive, varied, and largely representative of the target population: acute-care, general-purpose community hospitals. Operational definitions and sources of variable measurements are listed in Table 3.

Table 3. Operational Definitions of Indicator Variables.

Variable	Definition	Treatment in Analysis	Sources of Data
Environment			
Managed Care Environment			
HMOPEN89	Percent HMO enrollees (traditional and open-ended) in the MSA population	Continuous variable	ARF 1988, 1990 (for population); ARF/Interstudy Edge 1989 (for HMO enrollment)
HHIDC89 HHIPD89	Market competition: Herfindahl Index measures, calculated from the number of admissions and IP days for nonfederal medical/surgical hospitals in MSA	Continuous variable	AHA 1989
MSASTGH9	Market competition: Sum of short-term general hospitals in MSA	Continuous variable	ARF 1989
Past Performance			
CSTDAY9	Expenses per adjusted patient day, corrected for wage index and case-mix	Continuous variable	HCFA 1989 PPS VI, 10/1/88-10/1/89 (for expenses); HCFA Wage Index Survey 88; HCFA Case-mix Index 89
CSTDISC9	Expenses per adjusted patient admission, corrected for wage index and case-mix	Continuous variable	HCFA 1989 PPS VI, 10/1/88-10/1/89 (for expenses); HCFA Wage Index Survey 88; HCFA Case-mix Index 89
MORT30	Observed mortality rate divided by expected mortality rate, within 30 days of admission, for all HCFA diagnostic and procedure codes	Continuous variable	HCFA Mortality files, 1989 (Also see Appendix A, "HCFA Diagnostic and Procedure Codes")
CUMDIFF	Hospital specific excess in mean survival over 180 days	Continuous variable	HCFA Mortality files, 1989

Table 3. Operational Definitions of Indicator Variables (cont.)

Variable	Definition	Treatment in Analysis	Sources of Data
Hospital Response			
Professionalism			
DIFFTE	Difference in the total FTEs between 1989 and 1994	Continuous variable	AHA 1989, 1994
DIFMD	Difference in physician and dentist FTE totals between 1989 and 1994	Continuous variable	AHA 1989, 1994
DIFRN	Difference in RN FTE's between 1989 and 1994	Continuous variable	AHA 1989, 1994
DIFLPN	Difference in LPN FTE's between 1989 and 1994	Continuous variable	AHA 1989, 1994
DIFNURS	Difference in RN/(RN+LPN) ratios between 1989 and 1994	Continuous variable	AHA 1989, 1994
Services			
DIFAMB	Difference in OP visits between 1989 and 1994	Continuous variable	AHA 1989, 1994
DIFSURG	Difference in OP surgeries between 1989 and 1994	Continuous variable	AHA 1989, 1994
DIFPREV	Difference in scores reflecting hospital services in patient education, fitness centers, women's health programs, occupational health programs and geriatric assessment programs, 1989-1994	Continuous variable	AHA 1989, 1994 (Also see Appendix B, "Scoring for Preventive Services")
Inpatient Capacity			
DIFBED	Difference in number of staffed beds between 1989 and 1994	Continuous variable	AHA 1989, 1994
DIFOCCRT	Difference in the ratio of average daily census to staffed beds between 1989 and 1994	Continuous variable	AHA 1989, 1994
DIFCMI	Difference in Medicare case-mix between 1989 and 1994	Continuous variable	HCFA Case-mix index files, 1989, 1994

Table 3. Operational Definitions of Indicator Variables (cont.)

Variable	Definition	Treatment in Analysis	Sources of Data
Later Performance			
CSTDAY5	Expenses per adjusted patient day, corrected for wage index and case-mix	Continuous variable	HCFA PPS XII, 10/1/94-10/1/95 (for expenses); HCFA Wage Index SurveyAug.95; HCFA Case-mix Index 94
CSTDISC5	Expenses per adjusted patient admission, corrected for wage index and case-mix	Continuous variable	HCFA PPS XII, 10/1/94-10/1/95 (for expenses); HCFA Wage Index Survey Aug.95; HCFA Case-mix Index 94
DIFCSTDY	Difference in cost per patient day, 1989-1995	Continuous variable	HCFA PPS XII, 10/1/94-10/1/95 (for expenses); HCFA Wage Index Survey Aug.95; HCFA Case-mix Index 94
DIFCSTDS	Difference in cost per admission, 1989-1995	Continuous variable	HCFA PPS XII, 10/1/94-10/1/95 (for expenses); HCFA Wage Index Survey Aug.95; HCFA Case-mix Index 94
Control Variables			
ADC	Average daily census	Continuous variable	AHA 1989, 1995
MHSMEM	System member	Dichotomous, 1=yes 0=no	AHA 1989, 1995
ALL	Alliance member	Dichotomous, 1=yes 0=no	AHA 1989, 1995
CONPHY	Contract with physician to liaison with staff	Dichotomous, 1=yes 0=no	AHA 1989 only
MNGT	Contract managed	Dichotomous, 1=yes 0=no	AHA 1989, 1995
LOCSYS	Belongs to system shared by at least one other hospital in MSA	Dichotomous, 1=yes 0=no	AHA 1989, 1994
MAPP8	Member of Council of Teaching Hospitals	Dichotomous, 1=yes 0=no	AHA 1989,1995
HMCR	Medicare discharges/Hospital total discharges.	Continuous	HCFA PPSVI 1989, HCFA PPXII 1995
HMCD	Medicaid discharges/ Hospital total discharges	Continuous	HCFA PPSVI 1989, HCFA PPXII 1995

Table 3. Operational Definitions of Indicator Variables (cont.)

Variable	Definition	Treatment in Analysis	Sources of Data
SUNITS	Maintains a separate nursing-home unit	Dichotomous, 1=yes 0=no	AHA 1989, 1995
PUB	Public hospitals (HCFA Control codes 8-13)	Dichotomous, 1=yes,0=no	HCFA PPS VI 1989 HCFA PPSXII 1995
FP	For-profit hospitals (HCFA Control codes 3-6)	Dichotomous, 1=yes,0=no	HCFA PPS VI 1989 HCFA PPSXII 1995
ANOVA Variables			
REGION	Region/state code	1-New England 2-Mid Atlantic 3-South Atlantic 4-East North Central 5-East South Central 6-West North Central 7-West South Central 8-Mountain 9-Pacific	AHA 1989 (See Appendix C, "AHA Region Codes, 1989")
CNTRL	HCFA code for ownership/control	1-Voluntary, NP, Church 2-Voluntary, NP, Other 3-Proprietary, Individual 4-Proprietary, Corporate 5-Proprietary, Partnership 6-Proprietary, Other 8-Government, City-County 9-Government, County 10-Government, State 11-Government, Hospital District 12-Government, City 13-Government, Other	HCFA PPS VI 1989 HCFA PPSXII 1995

With the stated restrictions in mind, the original 1989 sample consists of 2188 observations. Hospital changes due to closure or merger are responsible for 255

observations lost between 1989 and 1995. Other sample adjustments as mentioned earlier (-51) bring the final population size to 1882 community hospitals.

Variable Measurements

Independent Variables

In the study model, the hospital environment is represented by variables for managed care penetration and past performance, both moderated by market competition. Managed care penetration is measured by percentage of HMO enrollees in the hospital's MSA population during 1989. The variable for past performance is represented by three measures: cost per patient day (1989), average cost per discharge (1989), and HCFA mortality ratio (1989).

The standardized mortality ratio is frequently used to measure hospital performance (Knaus et al., 1986). Information for the HCFA mortality rate was collected from Medicare beneficiaries discharged from over 5000 acute care hospitals in the United States (HCFA, 1993). Seventeen diagnoses were included in mortality statistics (see Appendix A). For these diagnoses, each hospital's standardized mortality ratio was calculated by dividing the observed mortality rate by its predicted rate. Predicted mortality rates were determined from multivariate HCFA models based on age, gender, prior hospitalizations, reason for admission, and the presence of specific comorbid illnesses identified by ICD-9-CM (International Classification of Diseases Clinical Modification) codes (HCFA, 1993). Mortality ratios less than 1.0 indicate better than expected performance, while ratios higher than 1 indicate performance below the expected level.

In accordance with the SARFIT model, the effects of past performance upon hospital structural response is modified by environmental illiberality, which is represented by a variable for market competition or concentration within a market area. The Herfindahl-Hirschman index (HHI) is the most commonly used method of measuring the degree of concentration in the market. The HHI is derived by summing the squared market shares, expressed as percentages, of all hospitals in the defined market, or

$$\text{HHI} = \sum_{i=1}^{N} Si^{2}$$

where $0<\text{HHI} \leq 10{,}000$ and S_i stands for the percentage market share produced by the *i*th hospital. When a market area is dominated by one hospital, the HHI value is 10,000. As the value of HHI approaches zero, the industry is considered to be less structurally concentrated, or more competitive (Santerre and Neun, 1996).

In this study, two hospital output indicators are used in calculating the market share and establishing HHI values: number of admissions and number of inpatient days. For scaling purposes, HHI variables are divided by a factor of 10,000 so $0<X<1$. For this study, hospital admissions and inpatient days, indicators of utilization, are considered more appropriate measures of market share than hospital bed-size, also commonly used in the Herfindahl formula. A third measure for market competition is the sum of all short-term general hospitals in each hospital's MSA.

Dependent Variables

Hospital response, or the structural changes made by each hospital in response to the managed care environment, is represented by three dimensions and a number of

variables. Change in professional contingent is measured by the difference in total FTEs (full-time equivalents) employed between 1989 and 1994. Hospital physician and dentist FTEs from the 1989 AHA survey are compared with 1994 figures. Similar data are collected and change is computed for RN FTEs (registered nurses), LPN FTEs (licensed practical nurses) and nurse ratio RN/(RN+LPN) measures from 1989 and 1994.

In capturing hospital changes in services, hospital workload volume is collected for outpatient visits and outpatient surgeries between 1989 and 1994. The differences in these two measures over the study period indicate hospital shift from inpatient to ambulatory care. Other preventive services in patient education, fitness, women's health, occupational health, and geriatric assessment are combined into an overall preventive score, indicating the change in hospital provision of those services between 1989 and 1994. Preventive service scoring is described in Appendix B.

While expanding ambulatory services, hospitals are viewed as reducing their inpatient capacity in response to their managed care environment. Measures in bedsize and occupancy rate indicate the changes made in downsizing the inpatient capability between 1989 and 1994. The HCFA case-mix index is also measured over the structural change period, for determining any shift in case intensity.

Since structural change in hospitals is predicted to affect performance, the later performance measures are patterned after initial measures of hospital efficiency. Unfortunately, HCFA mortality measures for hospitals were no longer reported by 1995. Hospital performance in 1995 is therefore defined as the cost per patient day and cost per

patient discharge between 1989 and 1995, as well as the difference between the 1989 and 1995 costs, adjusting for case-mix and wage index differences between hospitals.

Data Analysis

Preliminary analysis includes a descriptive statistical summary of all indicators and a check for their normality in distribution, using the SAS Univariate Procedure. Observations with very extreme values are deleted. For those continuous variables which are not normal and are retained in the research model, appropriate transformation is considered to correct for skewness and kurtosis in distributions. A chi-square analysis is used to compare the original 1933 study hospitals (those which retained their identity over the entire study period) with the 255 hospitals which were attritions in the form of mergers, demergers, or closures. The z-test for proportions (Wassertheil-Smoller, 1990) is performed to determine whether ownership/control is similar between the sample group and the attrition group.

The dependent variables from Part 1 are tested to see if there is a significant change in these measures between 1989 and 1994. Once this inquiry has been answered, the effects of hospital region and ownership are separately evaluated with all dependent variables, through analysis of variance (ANOVA). The purpose is to determine whether the categorical variables of hospital location and ownership/control are significant in the study models for hospital change and subsequent hospital performance.

Correlation analysis is employed to indicate univariate relationships between independent and dependent variables. Specifically, significant correlations between independent and dependent variables are desirable. In contrast, independent variables are

evaluated for collinearity with one another, which will only provide duplicate information and interfere with accurate regression estimates. Decisions are made to eliminate those independent variables which demonstrate collinearity. Such variables threaten to hinder the interpretation of regression model coefficients (Canavos and Miller, 1995).

The analytical hypotheses are tested using ordinary least squares (OLS) technique. After controlling for several organizational characteristics, this multivariate technique measures the impact of the managed care environment on hospital structure. Analysis is performed twice for each dependent structural variable. First, the independent effects of market competition are measured along with all other independent variables. Second, the theoretical interactions between hospital performance variables and market competition are tested as independent variables. The general linear regression model (Neter & Wasserman, 1974) for these relationships follows:

$$Y_i = \beta_0 + \beta_1 X_{i1} + \beta_2 X_{i2} + \beta_3 X_{i3} + \ldots + \beta_{p-1} X_{i,\,p-1} + \varepsilon_i$$

where:

$\beta_0, \beta_1, \ldots \beta_{p-1}$ are parameters

$X_{i1,\ldots,} X_{i,\,p-1}$ are known constants

ε_i are independent $N(0, \sigma^2)$

$i = 1, \ldots n$

The OLS model is applied to study hypotheses as follows:

H1: Poorly performing community hospitals, experiencing competition or operating in a more pervasive managed care environment, will increase their number of salaried physicians and decrease their number of registered nurses.

Where:

Y1 = change in salaried physicians
Y2 = change in RNs

X1 = HMO penetration
X2 = past performance
X3 = market competition

H2: Poorly performing community hospitals, experiencing competition or operating in a more pervasive managed care environment, will increase their ambulatory, preventive, and screening services.

Where

Y1 = change in outpatient visits
Y2 = change in ambulatory surgeries
Y3 = service scale, 0-6, 0= no new services
6= all new services

X1 = HMO penetration
X2 = past performance
X3 = market competition

H3: Poorly performing community hospitals, experiencing competition or operating in a more pervasive managed care environment, will reduce their capacity.

Where

Y1 = change in bedsize
Y2 = change in occupancy rate
Y3 = change in case-mix index

X1 = HMO penetration
X2 = past performance
X3 = Market competition

Analysis follows Drazin and Van de Ven's selection approach to fit (1985), where regression is used to test the congruence relationship between specific variables.

Additional estimation equations for interaction in hypotheses H1 through H3 introduce the variable of market competition as a moderator to the effects of HMO penetration and past performance, so that X1 = (HMO penetration * market competition), and X2 = (past performance * market competition).

For hypotheses H4 through H6, the ordinary least squares (OLS) method is used to test hospital change measures and their independent effects upon hospital performance.

H4: In a more competitive or pervasive managed care environment, community hospitals which increase their physician staff and decrease their registered nurses will demonstrate better performance than those hospitals which do not make such changes.

H5: In a more competitive or pervasive managed care environment, community hospitals which increase their ambulatory, preventive and screening services will demonstrate better performance than those hospitals which do not make such changes.

H6: In a more competitive or pervasive managed care environment, community hospitals which reduce their inpatient capacity will demonstrate better performance than those hospitals which do not make such changes.

Where:

Y1 = change in performance, 1989-1995
X1 = HMO penetration
X2 = past performance
X3 = market competition
X4 = change in salaried physicians
X5 = change in registered nurses
X6 = change in outpatient visits
X7 = change in ambulatory surgeries
X8 = change in service scale
X9 = change in bedsize
X10 = change in occupancy rate
X11 = change in case-mix

In addition to the variables of interest, control variables representing hospital characteristics are included in regression equations. These controls include measures in hospital size, local system membership, alliance membership, physician liaison contracting, management contracting, percent Medicare discharges and percent Medicaid discharges.

Limitations in Study Design

The study is necessarily limited by the reliability of its data, most notably in measuring managed care penetration and hospital market competition. In general, all measures appear to be available and reasonably reliable for the target population. HCFA's 1989 mortality indicator for hospital performance appears to provide sufficient variability in support of analysis within the target sample. Hospital mortality data are not

available from 1995, however, and a satisfactory substitute measure in hospital quality was not found.

Analytic results may be somewhat limited by the heterogeneity of the sample hospitals in regard to size. Generally, larger hospitals tend to treat more complex cases and provide a much broader spectrum of care, while a patient day in a small hospital is very different (Eastaugh, 1992). In order to partially compensate for this condition, hospital performance measures are adjusted according to their associated HCFA case-mix index. Nonetheless, the overall diversity of the sample contributes to extensive ranges displayed within the dependent variables of change.

CHAPTER V. RESULTS

This chapter summarizes analytic results of the study, including various assessments of the hospital sample, descriptive statistics of the study variables, bivariate correlations of all variables, and OLS model-building estimates. An analytic test for fit between context and structure is also constructed, using measures from 1989. The regression models in Part 1 evaluate hospital change variables as dependent variables; while regression models in Part 2 consider the independent effects of structural change upon hospital performance.

Comparison of Final Sample Observations with Attritions

The original study population of nonfederal, community hospitals was comprised of 2188 observations in AHA survey year 1989. From this group, 255 hospitals did not maintain their 1989 AHA identification throughout the survey year 1995. In Table 4, a chi-square analysis compares the retained sample and the attrition sample in terms of region, AHA ownership/control, and bedsize.

Prominent regional differences are shown in New England, where 28 hospitals dropped out of the sample instead of an expected 16. State hospitals (1 loss observed, 5 expected) and county hospitals (5 losses observed, 10 expected) did not experience proportionate attrition. For-profit corporate hospitals experienced an excessive attrition during the study period (64 lost, 43 expected). In reference to bedsize, where the chi-

square value was highest, those hospitals with less than 200 beds were overrepresented in the attrition group, while larger hospitals of 300 or more beds were underrepresented.

Table 4. Comparison of Sample Hospitals (N=1933) With Attritions (N=255) Occurring between 1989 and 1995.

Region (AHA Categories)	Sample Frequency Observed/ Expected	Sample Cell Chi-Square	Attritions Frequency Observed/ Expected	Attritions Cell Chi-Square	Chi-Square Value (p-value)
1. New England	108 / 120	1.23	28 / 15.8	9.31	
2. Mid- Atlantic	320 / 312	.212	33 / 41.1	1.61	
3. South Atlantic	327 / 332	.081	49 / 43.8	.612	
4. East N. Central	346 / 339	.134	38 / 44.8	1.02	
5. East S. Central	126 / 122	.137	12 / 16.1	1.04	
6. West N. Central	95 / 94.5	.002	12 / 12.5	.018	
7. West S. Central	252 / 254	.023	36 / 33.6	.177	
8. Mountain	78 / 75.1	.112	7 / 9.91	.853	
9. Pacific	281 / 284	.024	40 / 37.4	.179	
					16.77 (.033)
Ownership/Control (AHA Categories)					
12. state	45 /40.6	.468	1 /5.36	3.54	
13. county	77 /72.4	.287	5 /9.56	2.17	
14. city	46 /44.2	.076	4 /5.83	.573	
15. city/county	10 /10.6	.034	2 /1.40	.259	
16. hospital district	112 /109	.102	11 /14.3	.776	
21. church	301 /296	.086	34 /39.0	.651	
23. other NFP	1016 /1014	.003	132 /134	.024	
31. FP individual	2 /2.6	.160	1.0 /.349	1.21	
32. FP partnership	18 /16.8	.088	1.0 /2.21	.666	
33. FP Corporation	306 /327	1.33	64 /43.1	2.93	
					22.62 (.007)
Bedsize (AHA Categories)					
6-24	10 /15	1.67	7 /2.0	12.7	
25-49	99 /104	.264	19 /13.7	2.00	
50-99	257 /263	.149	41 /34.7	1.13	

Table 4. Comparison of Sample Hospitals (N=1933) With Attritions (N=255) Occurring between 1989 and 1995.(cont.)

Region (AHA Categories)	Sample Frequency Observed/ Expected	Sample Cell Chi-Square	Attritions Frequency Observed/ Expected	Attritions Cell Chi-Square	Chi-Square Value (p-value)
Bedsize (AHA Categories)					
100-199	502 /518	.531	85 /68.4	4.02	
200-299	430 /430	.000	57 /56.7	.001	
300-399	283 /266	1.10	18 /35.1	8.32	
400-499	155 /147	.378	12 /19.5	2.86	
500+	197 /188	.414	16 /24.8	3.13	
					38.69 (.001)

General Description of Sample Hospitals

The final study sample consisted of 1882 observations, with the greatest frequency (339) in the East North Central Region, the second highest frequency (322) in the South Atlantic Region, and the third highest frequency (311) in the Mid-Atlantic Region. The remaining observations (48% of the total) were dominated by the Pacific and West South Central Regions. Table 5 presents the frequency and percentage breakdown for each of the regions. The states included in these AHA regions are listed in Appendix C.

Table 5. Distribution of Final Sample Hospitals (N=1882) According to AHA Region

Region	Frequency	Percentage
1. New England	106	5.6
2. Mid-Atlantic	311	16.5
3. South Atlantic	322	17.1
4. East N. Central	339	18.0
5. East S. Central	120	6.4
6. West N. Central	94	5.0
7. West S. Central	241	12.8
8. Mountain	74	3.9
9. Pacific	275	14.6

The final sample of hospital observations varies in ownership/control between the years 1989 and 1995. Table 6 details the HCFA categories and percentages for hospital ownership/control at the beginning and ending of the study period. The frequency of various hospital types show some difference between hospital samples from 1989 and 1995; however the percentage of each hospital type remains fairly constant between the survey years. The Z test for comparing two proportions (Wassertheil-Smoller, 1990) indicates that group sizes from 1989 may be considered statistically the same as group sizes from 1995, with the exception of Group 6 (Proprietary, Other, where Z=-2.66).

Voluntary, nonprofit hospitals dominate the sample with 69% of the total '95 observations. Proprietary hospitals comprise 17%, and local government hospitals comprise 14% of the total observations.

Table 6. Distribution of Final Sample Hospitals According to HCFA Ownership/Control.

Control Code	1989 Frequency (N=1843)	1989 Percentage	1995 Frequency (N=1819)	1995 Percentage
1. Vol. NP, Church	340	18.4	308	16.9
2. Vol. NP, Other	911	49.4	941	51.7
3. Proprietary, Individual	5	.3	1	.1
4. Proprietary, Corporate	296	16.1	288	15.8
5. Proprietary, Partnership	11	.6	21	1.2
6. Proprietary, Other**	16	.9	4	.2
8. Government, City-County	34	1.8	26	1.4
9. Government, County	78	4.2	79	4.3
10. Government, State	41	2.2	45	2.5
11. Government, Hospital District	68	3.7	72	4.0
12. Government, City	25	1.4	21	1.2
13. Government, other	18	1.0	13	.7

** Z value is significant at the .05 level for rejecting the hypothesis that the '89 Group= '95 Group

Measurement of Hospital Structural Changes

A preliminary concern in the research study is whether the sample hospitals displayed definitive change in the selected structural measures during the time period 1989 to 1994. Change variables were calculated by subtracting the variable's 1989 value from its 1994 value. This difference was subjected to the Student's *t* value for testing that the population mean is 0 (SAS Institute, 1990). All variables indicating change in structure were found to be statistically significant, as shown in Table 7.

Table 7. Descriptive Statistics and T-Test Results for Variables of Change (Dependent Variables, Part 1).

Variable	1989 Mean (SD) N	1994 Mean (SD) N	Change '89-'94 Mean (SD) N
FTE (Full-time equivalents)	1026 (975) 1880	1143 (1079) 1880	117 *** (308) 1880
FTEMD (Full-time equivalents, Doctors and dentists)	12.8 (53.9) 1882	18.1 (57.1) 1882	5.25 *** (51.5) 1882
FTERN (Full-time equivalents, registered nurses)	255 (245) 1882	284 (273) 1882	29.3 *** (103.4) 1882
FTELPN (Full-time equivalents, licensed practical nurses)	47.2 (48.1) 1882	38.5 (40.0) 1882	-8.6 *** (26.8) 1882
NURS Ratio of FTERN/ (FTERN+FTELPN)	.811 (0.121) 1882	.853 (.100) 1882	.0417*** (.0830) 1882
AMB (Ambulatory visits)	85,757 (95,554) 1880	115,743 (124,184) 1880	29,986*** (73,857) 1880
SURG (Outpatient surgical procedures)	3190 (2793) 1881	4053 (3527) 1881	863 *** (2063) 1881
PREV (Preventive service score)	2.19 (1.17) 1882	1.74 (1.26) 1882	-.442*** (1.26) 1882
BED (Staffed beds)	261 (191) 1882	253 (192) 1882	-7.59 *** (63.6) 1882
OCCRT (Occupancy rate)	.632 (.167) 1882	.588 (.166) 1882	-.0437 *** (.123) 1882
CMI (Medicare Case-mix index)	1.30 (.172) 1875	1.38 (.219) 1875	.0832 *** (.115) 1875

***Student's t-test shows a p-value < .001 for difference variable of change .

Structural change statistics indicate that the mean number of hospital FTEs increased by 117 during the five-year study period. Within the measures of professionalism, the mean number of physician and dentist FTEs increased by 5.25, the mean number of RN FTEs increased by 29.3, and the mean number of LPN FTEs decreased by 8.6. The ratio for nursing staff, RN FTEs/(RN+LPN FTEs), reflected these changes with a mean increase of .0417.

Outpatient services were greatly increased, with the mean of ambulatory visits raised by almost 30,000 per year, and the mean of outpatient surgical services expanded by 863 procedures per year. Contrary to expected growth trends, however, the mean of the overall preventive service score decreased by .44 for the study hospitals.

Inpatient capacity measures changed in their expected directions over the study period, with the mean number of staffed beds decreasing by 7.59, the mean of hospital occupancy rates decreasing by .0437, and the mean of hospital case-mix index values increasing by .0832.

Descriptive Statistics for Dependent Variables in Part 2

Dependent variables in Part 2 were measured as regular hospital expense ratios for 1995. Additionally, the changes between expense ratios from 1989 to 1995 were computed. Descriptive statistics for these variables are displayed in Table 8. Most notable is the limited growth in hospital expenses over six years, averaging 4.4% per year in cost per day and 1.6% per year in cost per discharge. Differences in cost per day and

cost per discharge exhibit a large standard deviation, indicating broad variability in the sample data (Zolman, 1993).

Table 8. Descriptive Statistics for Dependent Variables, Part 2.

Variable Name	N	Mean	Standard Deviation
CSTDAY5 (Cost per patient day, 1995)	1793	710	247
CSTDISC5 (Cost per discharge, 1995)	1793	3871	1288
DIFCSTDY (Difference in cost per day between 1989 and 1995)	1771	148	250
DIFCSTDS (Difference in cost per discharge between 1989 and 1995)	1771	332	1311

Descriptive Statistics for Independent Variables

Table 9 summarizes descriptive statistics for independent continuous variables in the study, including variables of interest and control variables. In the environmental category, HMO penetration has a mean of 14.75, which appears appropriate, considering the exclusive use of metropolitan statistical areas in collecting the hospital sample. The means for both types of Herfindahl index are almost identical. With a value of .17, the average Herfindahl index is associated with market conditions of oligopoly (McCue and Ozcan, 1992). The oligopolistic market is characterized by a few dominant firms, presenting barriers to entry for potential competitors (Santerre and Neun, 1996). The third measure of market competition, the number of short-term general hospitals in each hospital's MSA, has a mean value of 29.5.

Table 9. Descriptive Statistics for Independent Continuous Variables, Parts 1 and 2.

Variable Name	N	Mean	Standard Deviation
Variables of Interest Included in Parts 1 and 2			
HMOPEN89 (HMO penetration, 1989)	1882	14.75	15.65
HHIDC89 Herfindahl index for hospital discharges, 1989)	1882	.1736	.1705
HHIPD89 (Herfindahl index for hospital patient days, 1989)	1882	.1730	.1702
MSASTGH9 (Short-term general hospitals in MSA, 1989)	1882	29.5	30.3
CSTDAY9 (Cost per patient day, 1989)	1819	563.	150.
CSTDISC9 (Cost per patient discharge, 1989)	1819	3548.	953.
MORT30 (Mortality index at 30 days after discharge)	1876	1.005	.1826
CUMDIFF (Hospital specific excess in mean survival over 180 days)	1874	-.2496	2.86
Control Variables, Part 1			
BDTOT89 (Total staffed beds, 1989)	1882	261	191
ADC89 (Average daily census, 1989)	1882	181	158
HMCR_89 (%of discharges sponsored by Medicare, 1989)	1843	.341	.130
HMCD_89 (% of discharges sponsored by Medicaid, 1989)	1843	.117	.115
Control Variables, Part 2			
BDTOT95 (Total staffed beds, 1995)	1882	247	187
ADC95 (Average daily census, 1995)	1882	158	144
HMCR_95 (% discharges sponsored by Medicare, 1995)	1819	.382	.145
HMCD_95 (% discharges sponsored by Medicaid, 1995)	1819	.154	.130

Financial variables for past performance reveal an average cost per day of $563 and average cost per discharge of $3548 for the hospital sample in 1989. Performance quality is represented by the mean mortality ratio at 30 days (1.005), indicating that observed performance was slightly better than expected. The average for hospital-specific excess in mean survival over 180 days is calculated at -.2496, showing slightly negative hospital performance.

In this sample, Medicare's portion of hospital discharges has a mean of 34% for 1989 and 38% for 1995. Medicaid's portion of discharges has a mean of 12% in 1989 and 15% in 1995. On the average, these payors insure approximately 50% of the patient volume in the sample hospitals.

Table 10 summarizes descriptive statistics for categorical control variables in the study. Hospital alliance membership was reported among 32% of the sample in 1989 as well as 1995. In 1989, 35% of the sample hospitals contracted for a physician liaison to interface with the medical staff. Figures for 1995 were not available. Membership in hospital systems with other local hospitals was reported by 27% of the sample in 1989 and 34% in 1994. System membership in general was more common, with 44% of the sample reported as system members in 1989 and 50% reported as system members in 1995. Membership in the Council of Teaching Hospitals was reported by 12% of the sample in 1989 and 11% of the sample in 1995. Contract management was reported by 8% of the sample hospitals in 1989 and 5.6% of the sample in 1995.

Table 10. Descriptive Statistics for Categorical Control Variables, Parts 1 and 2 (N=1882, unless otherwise stated).

Variable Name	Description	Frequency	Percent
ALL89	Alliance member (89)	597	31.7
ALL95	Alliance member (95)	603	32.0
CONPHY89	Physician liaison for medical staff (89)	660	35.1
LOCSYS89	Local system member (89)	512	27.2
LOCSYS94	Local system member (94)	634	33.7
MAPP889	Member of Council of Teaching Hospitals 89	231	12.3
MAPP895	Member of Council of Teaching Hospitals 95	212	11.3
MHSMEM89	System member (89)	831	44.2
MHSMEM95	System member (95)	941	50.0
MNGT89	Contract managed (89)	153	8.1
MNGT95	Contract managed (95)	106	5.6
SUNITS95	Maintains a separate nursing home or long-term care unit (95)	340	18.1
PUB89	Public hospital (89) N=1843	264	14.3
PUB95	Public hospital (95) N=1819	256	14.1
FP89	For-profit hospital (89) N=1843	328	17.8
FP95	For-profit hospital (95) N=1819	314	17.3

In accordance with the study frame, the original community hospitals did not contain a nursing home or long-term care unit. However, if this type of unit were added, the host hospital was retained in the analysis. A total of 340 hospitals, or 18% of the final sample, reported a separate nursing home or long-term care unit in 1995.

Bivariate Analysis

Bivariate correlations between the dependent and independent variables from Part 1 are shown in Appendix D. The original study model contains 11 dependent variables in Part 1. Correlation values reported at a 0.05 level of significance were used as criteria to screen potentially significant relationships among variable pairs.

Among the variables of interest, the most prominent correlations are shown between HMOPEN89 (HMO penetration 89) and DIFNURS (difference in nursing ratio) (r=-0.092 and p=.0001), HHI89 (Herfindahl index 89) and DIFOCCRT (difference in occupancy rate) (r=0.096 and p=.0001), CSTDISC89 (cost per discharge 89) and DIFCMI (difference in case-mix) (r=0.208 and p=.0001), CSTDAY9 (cost per patient day 89) and DIFOCCRT (difference in occupancy rate) (r=0.106 and p=.0001), CSTDISC9 (cost per discharge 89) and DIFFTE (difference in FTEs) (r=0.096 and p=.0001), and MORT30 (mortality rate) and DIFNURS (difference in nursing ratio) (r=0.123 and p=.0001). Other statistically significant Pearson correlations occur for difference in RNs, difference in ambulatory visits, and difference in beds.

All of the dependent variables in Appendix D show some significant correlation with continuous and dichotomous control variables, with one exception. The variable for difference in preventive services score shows no significant relationship the other study variables.

Appendix E summarizes correlation statistics for dependent and independent variables in Part 2. There are four dependent variables, all of which are based on hospital costs. The 11 dependent variables from Part 1 now assume the role of independent

variables of interest. HMO data, market variables and performance variables from 1989 are retained in the model as well as standard control variables of hospital size, affiliation, and strategy.

The most prominent correlations among variables of interest in Part 2 occur between the following variable pairs: DIFBED (difference in beds) and CSTDAY5 (cost per patient day 95) (r=-0.105 an p=.0001), DIFBED (difference in beds) and DIFCSTDY (difference in cost per patient day) (r=-0.147 and p=.0001), and (DIFOCCRT) (difference in occupancy rate) and DIFCSTDY (difference in cost per day) (r=-0.146 and p=.0001). The variable DIFCMI (difference in case-mix index) shows significant correlations with all dependent variables with the exception of CSTDISC5 (cost per discharge 95).

Correlation statistics also show strong associations between both Herfindahl values and CSTDAY5 (cost per day 95) (r=0.096 and p=.0001), as well as the number of general hospitals in the MSA and DIFCSTDS (difference in cost per discharge) (r=-0.112 and p=.0001). The variables CSTDAY9 (cost per patient day 89) and CSTDISC9 (cost per discharge 89) are significantly correlated with all dependent variables in Part 2, with the exception of one pair: CSTDISC9 (cost per discharge 89) and CSTDAY5 (cost per day 95) (r=0.029 and p=.220).

The most prominent correlations between control variables and the dependent variables occur among size characteristics, system variables and nursing home indicators. Dichotomous control variables showing significant association with dependent variables are particularly noteworthy, since their presence is probably underreported in data surveys.

ANOVA Analysis for Region and Ownership/Control

Table 11 portrays the effects of two categorical variables upon all dependent study variables. The variable REGION (Region 89) is an AHA category applied to the hospital sample, both in 1989 (Part 1) as well as 1995 (Part 2). Variables for ownership/control, CNTRL89 and CNTRL95, were collected from HCFA for 1989 and 1995. These variables were applied to the hospital sample in Parts 1 and 2.

Although many significant associations are found between the dependent variables and hospital region, the most prominent involves the variable CSTDAY5 (cost per day 95), with an R-square of 0.084 (p=.001). In contrast, the variable CSTDISC5 (cost per discharge 95) carries a lower R-square of 0.025 (p=.001). The variables DIFRN (difference in RN FTEs) and DIFBED (difference in beds) also show formidable association with hospital region, with R-square values of 0.034 (p=.001) and 0.031 (p=.01), respectively. In addition to confirming that hospital cost per day is affected by region, these results specifically link propensity for change in RN staff and bedsize to geographic location.

In tandem with these results, the effects of hospital ownership/control are found to be strongest on the variables DIFCSTDY (difference in cost per day) (r-square=0.041, p=.001), CSTDISC5 (cost per discharge 95) (r-square=0.064, p=.001), and DIFCSTDS (difference in cost per discharge) (r-square=0.077, p=.001).

In response to these results, dichotomous variables for public/private ownership and profit/not-for-profit control were developed and tested in separate regression models.

Table 11. ANOVA Results for Regional and Ownership/Control.

Variable	REG89		Ownership/ Control	
	R-square	F-value	R-square	F-value
Part 1				
DIFFTE (Difference in full-time equivalents, 89-95)	0.020	4.75****	0.026	4.49****
DIFMD (Difference in full-time equivalents, doctors and dentists, 89-95)	0.003	0.68	0.016	2.67***
DIFRN (Difference in full-time equivalents, registered nurses, 89-95)	0.034	8.24****	0.024	4.11****
DIFLPN (Difference in full-time equivalents, licensed practical nurses, 89-95)	0.013	3.07***	0.015	2.62***
DIFNURS Difference in ratio of FTERN/(FTERN+FTELPN), 89-95	0.030	7.19****	0.022	3.69****
DIFAMB (Difference in ambulatory visits, 89-95)	0.010	2.31**	0.020	3.39****
DIFSURG (Difference in outpatient surgical procedures, 89-95)	0.005	1.21	0.017	2.90****
DIFPREV (Difference in preventive service score, 89-95)	0.014	3.22***	0.005	0.80
DIFBED (Difference in staffed beds, 89-95)	0.031	7.55***	0.010	1.71*
DIFOCCRT (Difference in occupancy rate, 89-95)	0.007	1.65	0.010	1.71*
DIFCMI (Difference in Medicare case-mix index, 89-95)	0.026	6.26***	0.028	4.88****
Part 2				
CSTDAY5 (Cost per patient day, 95)	0.084	20.33****	0.028	4.71****
DIFCSTDY (Difference in cost per day, 89-95)	0.021	4.65****	0.041	6.83****
CSTDISC5 (Cost per discharge, 95)	0.025	5.81****	0.064	11.16****
DIFCSTDS (Difference in cost per discharge, 89-95)	0.021	4.68****	0.077	13.29****

*Significant $p < .10$ level
**Significant $p < .05$ level
***Significant $p < .01$ level
****Significant $p < .001$ level

Collinearity Diagnostics

In the multiple linear regression model, collinearity can occur when two or more predictor variables display a very high correlation. Problems arise when collinear variables offer redundant information and cause ambiguous regression results (Canavos and Miller, 1995). Appendices F and G display correlation statistics for the study's original set of independent variables. For study purposes, a correlation value of .45 was used to screen for potential collinearity among independent variables. A second method used to confirm suspected collinearity was applied from the SAS regression procedure. When two variables were found to be collinear, they were individually evaluated for their statistical significance in the model as well as their theoretical and conceptual importance to the study. In more complex cases, regression analysis was performed and results reviewed to determine whether collinearity was distorting regression coefficients. Because of the large number of variables already included in regression models and the potential for collinearity, variables offering redundant information were not retained.

In Part 1, the following variables were immediately eliminated due to potential problems in collinearity: MSASTGH9 (the number of short-term general hospitals in a hospital's MSA), HHIPD89 (the Herfindahl index calculated with patient days as market share), CUMDIFF (the hospital-specific excess in mean survival over 180 days), and BDTOT89 (the hospital's number of staffed beds reported for 1989). These eliminations were fairly straightforward because their correlations were relatively high, and because other measures in the study could provide similar, if not identical, information.

Two sets of correlations in Part 1 posed more of a challenge. MAPP889, indicating whether a hospital was a member of the Council of Teaching Hospitals, correlated with ADC89 (average daily census '89), with an "r" value of 0.495 and p-value of .0001. Collinearity was verified in the SAS regression procedure. A reasonable discovery is that among the sample community hospitals, larger hospitals had a tendency to include a teaching mission in their departmental activities. Since hospital size has proven to be critical as a control variable, both in the literature and in the preliminary analyses of this study, ADC89 was retained as an independent variable in the regression model and MAPP889 was eliminated.

The second problem correlation occurred between MHSMEM89 (member of a hospital system in '89) and LOCSYS89 (member of a hospital system shared by at least one other hospital in the MSA in '89). Logic dictates that some redundancy exists in the variability provided by these measures. The "r" value for their correlation was 0.498 with a p-value of .0001. Again, the SAS regression procedure verified collinearity in this relationship. Since the data collected for local system membership was more specific and considered more relevant to hospital management decisions, the LOCSYS89 variable was retained for regression analysis instead of the MHSMEM89 variable.

In Part 2, potential collinearity arose in correlations detected between the following variables: DIFFTE (difference in FTEs) and DIFRN (difference in RN FTEs), DIFNURS (difference in nursing ratio) and DIFLPN (difference in LPN FTEs), BDTOT95 (total staffed beds reported in '95) and ADC95 (average daily census in'95), MAPP895 (membership in the Council of Teaching Hospitals, '95)and ADC95 (average

daily census in '95), and HMCR_95 (Medicare portion of hospital discharges) and HMCD_95 (Medicaid portion of hospital discharges).

The SAS procedure for detecting collinearity did not confirm loading problems with all these variable pairs, however. In response to this information, the regression model for Part 2 was run several times to test specific variable effects on parameter estimates. A revised regression model for Part 2 was developed without the variables DIFFTE (difference in total FTEs), DIFNURS (difference in nursing ratio), BDTOT95 (total staffed beds reported in 1995), and MAPP895 (membership in the Council of Teaching Hospitals, '95). Variables for DIFRN (difference in RN FTEs), DIFLPN (difference in LPN FTEs), HMCR_95 (Medicare portion of hospital discharges) and HMCD_95 (Medicaid portion of hospital discharges) were retained for analysis.

In findings similar to Part 1, the variables MHSMEM95 (member of a hospital system, '95) and LOCSYS94 (member of a hospital system shared by at least one other hospital in the MSA in '95) showed some degree of correlation ($r=.382$, $r=.0001$). In order to maintain consistency and avoid collinearity, MHSMEM95 was deleted as a predictor variable and LOCSYS94 was retained in the regression model for Part 2.

Transformation of Variables

All study variables were analyzed using the SAS univariate procedure. Tests for normality appeared acceptable for all variables, with the exception of DIFMD (difference in physician and dentist FTEs). This variable was found to be deficient. Subsequent transformation of the DIFMD variable did not improve its normality nor its regression

results. Since it was deemed unsuitable for the regression model, the variable DIFMD was retained for ANOVA analysis only.

Preliminary regression analyses were performed, using revised models for Part 1 and Part 2 as discussed. Residuals were plotted against the corresponding X-values to test the first assumption of the regression model: that a linear association exists between response and predictor variables. With the regression model appropriately applied, residuals should exhibit no pattern when graphed against any variable. Secondly, residuals were plotted against the predicted Y-values to test the second regression assumption: that the error variance is constant (Canavos and Miller, 1995).

Residual plots were acceptable for the most part; however all regressions did not generate residuals with completely random errors. Further investigation identified individual variables exhibiting regression model deficiencies.

After several trials, it was found that transformation of selected dependent and independent variables would remedy these apparent violations of model assumptions. The following dependent variables from Part 1 were transformed: DIFFTE (difference in FTEs), DIFLPN (difference in LPN FTEs), DIFBED (difference in staffed beds), DIFAMB (difference in ambulatory visits), and DIFSURG (difference in outpatient surgical procedures). Regression models were also improved with the transformation of the following independent variables: HMOPEN89 (HMO penetration, '89) and HHIDC89 (Herfindahl index for hospital discharges, '89). The transformation method consisted of taking the square root of each variable's absolute value, and then putting back in its sign.

With transformation of selected variables, desirable residual plots (with no discernable pattern) were obtained for all regression models in Part 1 and Part 2. At this point, the third and fourth regression assumptions were tested for each analysis performed. These assumptions state that random errors are independent and normally distributed (Canavos and Miller, 1995). Residuals were analyzed with the SAS univariate procedure, and their normality was found to be acceptable.

Model Estimations, Part 1

Tables 12 through 14 summarize model estimates and their significance for the study's ten dependent variables of change in Part 1. All models have statistically significant F-values.

Table 12 describes staffing statistics. The average change in hospital FTEs was a positive one. Among the variables of interest, the HMO penetration rate carried a negative association with DIFFTE. In a similar observation of change, the average difference in RN FTEs was accomplished through adding personnel. HMO penetration rate was also negatively associated with DIFRN. Hospital mortality ratio for 1989 was significant in the DIFRN regression as well, showing a positive association with increased RN staff.

Table 12. Standardized Estimates for Change in Hospital Staff.

Variable	Standardized Estimate for DIFFTE† N=1816	Standardized Estimate for DIFRN N=1818	Standardized Estimate for DIFLPN† N=1818	Standardized Estimate for DIFNURS N=1818
HMOPEN89†	-0.076***	-0.077***	0.008	-0.052*
HHIDC89†	0.036	0.004	-0.049*	0.017
CSTDISC9	0.013	0.001	0.036	-0.014
MORT30	0.033	0.085****	-0.032	0.122****
ADC89	0.119****	0.206****	-0.227****	0.001
HMCR_89	-0.089****	-0.059**	-0.011	0.060**
HMCD_89	-0.002	0.030	-0.023	0.074***
ALL89	0.036	-0.015	-0.054**	0.020
CONPHY89	0.014	-0.017	-0.024	0.007
MNGT89	0.005	-7.593×10^{-5}	-0.008	0.051**
LOCSYS89	-0.067***	-5.158×10^{-4}	0.002	-0.035
PUB	0.066***	0.082****	0.062**	-0.010
Intercept	0.000*	0.000	0.000	0.000
R-square	0.056	0.073	0.064	0.034
Adj. R-square	0.050	0.067	0.058	0.027
F-ratio	8.996****	11.865****	10.265****	5.232***

Notes: † Variable is transformed through square root.
*Significant $p < .10$ level.
**Significant $p < .05$ level.
***Significant $p < .01$ level.
****Significant $p < .001$ level.

The difference in LPN FTEs, which was significant as a staff reduction, was negatively associated with HHI, indicating that increased competition promoted change in this area. The difference in hospital nursing ratios, significantly positive in the sample, was negatively associated with HMO penetration rates and positively associated with mortality rates.

Therefore, these analyses show that when HMO penetration was relatively low and poor performance was demonstrated through slightly higher mortality rates, sample hospitals tended to change overall staff, and specifically add RN staff, between 1989 and 1994. The direction of change was to increase staff members, on the average. On the other hand, conditions of a competitive market were associated with a movement toward change (reduction) in the number of LPNs working in the sample hospitals during the study period.

Among the control variables, ADC89 (average daily census) and PUB (public ownership/control) displayed significant positive association with staff changes in FTEs, RNs and LPNs; while HMCR_89 (Medicare portion of discharges) was negatively associated with FTE and RN staff increases. The variable for hospital membership in a local system was also negatively associated with overall change in hospital FTEs.

In regard to hospital capacity in Table 13, the difference in hospital beds reflects a significant reduction in staffed beds over the study period. The difference in beds between 1989 and 1994 is positively associated with cost per discharge in 1989. Difference in occupancy rate, also a negative change on the average, is not significantly associated with the variables of interest. Case-mix index in 1994, which shows a significant increase over the study period, is positively associated with hospital cost per discharge, HHI, and mortality rates in 1989.

To interpret these results, poor performance factors in the form of relatively high '89 costs and high mortality rates were associated with a hospital's propensity to change its bedsize and its case-mix index. Additionally, it appears that hospitals in a less

competitive MSA, with fewer HMO enrollees, were more prone experience change in their occupancy rates over the study period. One may observe that reduction of beds and reduction of occupancy rate constituted the general direction of change. Finally, low competition (in the form of a higher HHI) was associated with a higher change in CMI, consisting of an overall movement toward more complex cases.

Among the control variables, average daily census showed strong negative association with hospital cuts in beds and occupancy rate, suggesting that hospitals with smaller patient volumes were more prone to make these changes in capacity. The proportion of Medicare and Medicaid patients carried a significant negative association with the upward shift in hospital case-mix index, indicating that cases from other insurance sources were becoming more complex over the study period.

Table 13. Standardized Estimates for Change in Hospital Capacity.

Variable	Standardized Estimate for		
	DIFBED† N=1818	DIFOCCRT N=1818	DIFCMIN=1817
HMOPEN89†	-0.043	-0.044**	0.002
HHIDC89†	-0.035	0.046	0.082***
CSTDISC9	0.066***	0.018	0.140****
MORT30	0.029	0.011	0.045**
ADC89	-0.096****	-0.061**	0.314****
HMCR_89	-0.006	0.038	-0.049**
HMCD_89	0.044*	0.020	-0.047**
ALL89	-0.033	0.002	0.004
CONPHY89	0.032	-0.040	-0.013
MNGT89	0.024	-0.018	-0.018
LOCSYS89	-0.036	-0.035	0.005
PUB	0.046*	-0.002	-0.036
Intercept	0.000	0.000**	0.000*
R-square	0.023	0.020	0.143
Adj. R-square	0.017	0.013	0.138
F-ratio	3.586****	2.990****	25.139****

Notes: † Variable is transformed through square root.
*Significant $p < .10$ level.
**Significant $p < .05$ level.
***Significant $p < .01$ level.
****Significant $p < .001$ level.

Table 14 displays the results of regression analysis between ambulatory workload and independent study variables. Changes in hospital preventive service scores, which had significantly decreased between 1989 and 1994, are negatively associated with HMO penetration rates. The variable measuring difference in ambulatory visits, which generally increased over the study period, displays a positive association with HHI and a negative association with HMO penetration. The difference in surgical procedures, DIFSURG, increased among the sample hospitals, shows a negative association with HMO penetration rate.

Table 14. Standardized Estimates for Change in Hospital Ambulatory Workload.

Variable	Standardized Estimate for		
	DIFPREV N=1818	DIFAMB† N=1816	DIFSURG† N=1817
HMOPEN89†	-0.094***	-0.056**	-0.060**
HHIDC89†	-0.039	0.060**	0.013
CSTDISC9	0.012	0.011	-0.010
MORT30	0.002	-0.002	-0.011
ADC89	0.046	0.236****	0.174****
HMCR_89	0.020	-0.062**	-0.123****
HMCD_89	-0.046*	-0.042*	-0.095****
ALL89	-0.013	-0.035	0.057**
CONPHY89	-0.044*	0.019	-0.007
MNGT89	-0.038	0.005	-0.007
LOCSYS89	-0.032	-0.072***	-0.017
FP89	-0.046*	-0.069***	-0.488*
Intercept	0.000	0.000***	0.000****
R-square	0.017	0.090	0.071
Adj. R-square	0.010	0.084	0.065
F-ratio	2.554**	14.896****	11.511****

Notes: † Variable is transformed through square root.
*Significant $p < .10$ level.
**Significant $p < .05$ level.
***Significant $p < .01$ level.
****Significant $p < .001$ level.

These results indicate that hospitals in areas with less HMO penetration were more prone to change their preventive services, often by removing some of the measured

services. Additionally, these hospitals showed more change in their ambulatory visits and surgical procedures during the 1989-1994 interval. Furthermore, less competition in the MSA was associated with greater increase in ambulatory visits during the study period.

Control variables display several notable associations. Average daily census, the variable indicator for hospital size, is positively associated with changes in ambulatory and outpatient surgical workload. Medicare and Medicaid patient volumes are negatively associated with expansion in ambulatory services. Results also indicate a negative relationship between hospitals' local system membership status and their associated increase in ambulatory workload. Additionally, for-profit ownership is negatively associated with hospital change in ambulatory services during the study period.

Results of Interaction Models, Part 1

Regression analysis was performed for the interaction models proposed in Part 1. Results from this series of analyses are listed in Appendix H. Generally, results from regressions using interaction terms were similar to their independent variable counterparts. One important exception was found: the interaction between cost per discharge in 1989 and competition (CSTDISC9*HHIDC) displays a significant positive relationship with the dependent variable for difference in ambulatory visits (DIFAMB(T)).

Model Estimations, Part 2

Table 15 summarizes regression results for Part 2, where dependent variables for hospital financial performance are analyzed against independent variables of environment

and change from Part 1. The dependent variables are DIFCSTDY (difference in cost per patient day) and DIFCSTDS (difference in cost per discharge). Each model is run twice in order to include dichotomous variables for ownership/control, PUB5 (public hospital) and FP95 (for-profit ownership). All four regression models display significant results.

For interpretation purposes, low values for DIFCSTDY and DIFCSTDS are considered good performance. The variable DIFCSTDY is significantly associated with several independent variables. Positive associations occur with DIFRN and DIFLPN(T). Negative associations occur between DIFCSTDY and the variables DIFBED(T), DIFOCCRT, and DIFCMI. These relationships carry a p-value of 0.05 or lower.

These results indicate that hospitals which did not change their RN or LPN FTEs between 1989 and 1994 were associated with good performance in 1995. Additionally, those hospitals which experienced change in bedsize, occupancy rate and case-mix index were associated with good performance.

The independent variable for cost per discharge in 1989 is negatively associated with all four of the dependent financial variables, suggesting that hospitals with a history of high costs were more likely to control their growth in spending from 1989 to 1995.

Table 15. Estimates of Hospital Performance.

Variable	Standardized Estimate, Difference in Cost Per Day N=1767	Standardized Estimate, Difference in Cost Per Day N=1767	Standardized Estimate, Difference in Cost Per Discharge N=1767	Standardized Estimate, Difference in Cost Per Discharge N=1767
DIFRN	0.074***	0.069***	0.050**	0.039*
DIFLPN†	0.055**	0.051**	0.012	0.002
DIFAMB†	0.014	0.019	-0.034	-0.026
DIFSURG†	-0.013	-0.010	-0.055**	-0.050**
DIFPREV	0.020	0.025	0.013	0.021
DIFBED†	-0.267****	-0.275****	-0.006	-0.019
DIFOCCRT	-0.258****	-0.260****	0.048**	0.043*
DIFCMI	-0.127****	-0.127****	-0.053**	-0.052**
HMOPEN89†	0.010	0.016	-0.022	-0.010
HHIDC89†	0.040	0.033	0.040	0.023
CSTDISC9	-0.236****	-0.260****	-0.353****	-0.395****
MORT30	0.024	0.021	0.004	-0.005
ADC95	-0.009	0.015	0.050*	0.091****
HMCR_95	0.016	0.026	0.078***	0.099****
HMCD_95	0.099****	0.089****	0.071***	0.047*
SUNITS95	-0.074****	-0.080****	0.007	-0.002
ALL95	0.053**	0.068***	0.004	0.026
MNGT95	0.046**	0.049**	0.059***	0.061***
LOCSYS94	-0.042*	-0.054**	-0.065***	-0.078****
PUB95		0.060***		0.156****
FP95	-0.095****		-0.155****	
Intercept	0.000****	0.000****	0.000****	0.000****
R-square	0.221	0.218	0.220	0.219
Adjusted R-square	0.212	0.208	0.207	0.210
F value	24.826****	24.280****	24.007****	24.462****

Notes: † Variable is transformed through square root.
*Significant $p < .10$ level.
**Significant $p < .05$ level.
***Significant $p < .01$ level.
****Significant $p < .001$ level.

In Table 15, the variable DIFCSTDS is positively associated with the variables DIFRN and DIFOCCRT; and negatively associated with the variables DIFSURG(T),

DIFCMI, and CSTDISC9. All of these variable relationships are significant to at least a 0.05 level.

To interpret these statistics, hospitals which did not change their staff RN FTEs or occupancy patterns are associated with good performance in controlling cost per discharge. Also, hospitals which did change their workload in the form of outpatient surgical procedures are associated with good performance. Hospitals with smaller change to occupancy rates over the study period are associated with lower difference in cost per discharge in 1995. Finally, hospitals experiencing a relatively large change in CMI are associated with good financial performance over the study period.

When the dependent variable is difference in cost per discharge (generally reflecting an increase between 1989 and 1995), hospitals showing high costs in '89 appear to have contained their cost growth during the study period.. In the area of poor performance, changes to increase staff, and specifically RNs, are associated with higher hospital cost differences over time. Decreasing occupancy rate is associated with bad performance, a result which differs from analysis measuring cost per patient day. Alternatively, increasing outpatient surgical procedures and increasing case complexity are associated with reducing operational costs.

Control variables in these regressions are particularly noteworthy. The proportion of Medicare patients is significantly associated with growth in cost per discharge. The proportion of Medicaid patients is positively associated with both dependent variables, indicating poor performance outcomes in hospitals with more Medicaid patients. The SUNITS95 variable for nursing home capability is negatively associated with

DIFCSTDY, suggesting that those hospitals which adopted a nursing home service controlled their costs better than those which did not.

Under the category of external affiliations, the variable ALL95 is positively associated with DIFCSTDY, an indicator for poor financial performance. Those hospitals which were contract managed are also positively associated with the DIFCSTDY and DIFCSTDS variables, suggesting poor performance. In contrast, hospitals in local systems are significantly associated with good performance through their negative regression estimates with both financial variables.

Of particular interest among the control variables, public hospitals are significantly associated with the dependent cost variables in a positive direction, indicating poor cost performance. For-profit hospitals have a significant association in a negative direction, indicating hospitals with good cost performance.

Summary of Findings in Comparison to Study Hypotheses

Tables 16 and 17 review general aspects of the hypothesized and observed relationships between variables of interest in the study. Only associations with statistical significance (p-value of 0.10 or less) are listed. The change variables in Part 1 and Part 2 are interpreted in reference to the magnitude of their change (small to large) as well as the direction. The variables DIFBED and DIFOCCRT were hypothesized and observed as reductions, while DIFRN was originally hypothesized as a reduction and observed as an increase. Other change variables were observed as increases, with the exception of DIFPREV. This variable was expected to increase, but it was observed to decrease over the period of study.

Table 16. Comparison of Hypothesized and Observed Variable Relationships, Part 1.

Dependent Variables of Change	HMOPEN89	HHIDC89	CSTDISC9	MORT30
DIFMD				
DIFRN	- Supported in hypothesized direction			+ Supported, but opposite of the hypothesized direction
DIFAMB	- Supported, but opposite of the hypothesized direction	+ Supported, but opposite of the hypothesized direction		
DIFSURG	- Supported, but opposite of the hypothesized direction			
DIFPREV	- Supported in hypothesized direction			
DIFBED			+ Supported in hypothesized direction	
DIFOCCRT	- Supported, but opposite of the hypothesized direction			
DIFCMI		+ Supported, but opposite of the hypothesized direction	+ Supported in hypothesized direction	+ Supported in hypothesized direction

Table 17. Comparison of Hypothesized and Observed Variable Relationships, Part 2.

a.

Dependent Variables	DIFRN	DIFSURG	DIFBED
DIFCSTDY	+ Supported in hypothesized direction		- Supported in hypothesized direction
DIFCSTDS	+ Supported in hypothesized direction	- Supported in hypothesized direction	

b.

Dependent Variables	DIFOCCRT	DIFCMI	CSTDISC9
DIFCSTDY	- Supported in hypothesized direction	- Supported in hypothesized direction	- Supported in hypothesized direction
DIFCSTDS	+ Supported, but opposite of the hypothesized direction	- Supported in hypothesized direction	- Supported in hypothesized direction

CHAPTER VI. DISCUSSION

This chapter discusses the study's hypotheses and how they compare to significant relationships observed between selected variables. Research questions are revisited in reference to analysis and broader study implications for health services management. Limitations of the study are discussed. Future research projects are suggested, based upon findings from this study.

Hypothesis Testing and Interpretation

Regression models in Part 1 indicate that HMO penetration in 1989 was significantly associated with sample hospitals that did not make changes. Specifically, hospitals involved with managed care appear to have kept their RN FTEs relatively stable and did not add ambulatory visits, outpatient surgical procedures, or additional preventive services. This series of observations is in opposition to Hypotheses 1, 2, and 3. It was hypothesized that HMO penetration would stimulate reduction in RNs and growth in outpatient services.

In considering the RN staffing hypothesis, however, the observed results bear some relation to the original hypothesis in respect to curbing growth. In other words, hospitals located in areas of high HMO penetration did not expand their RN staff between 1989 and 1994, in contrast to the trend observed in other institutions. It is possible that surveys of staff reductions after 1990 would have supported Hypothesis 1 in terms of

actual reductions in nursing personnel, because additional RN staff in the year 1989 may have offset overall reductions taken later in the study period.

In the area of hospital performance, mortality ratios have a positive association with RN staffing changes, supporting Hypothesis 1, yet reversing the expected direction. Since mortality is a measure of quality and cost per discharge is a measure of financial success, it seems reasonable that these performance variables display opposite relationships with hospital change in RN staff. Unfortunately, the financial variable is not significant in regression testing for DIFRN.

A possible explanation for results in outpatient services is that hospitals greatly involved in HMO contracting were not focused on expanding their outpatient utilization. In fact, HMO contractors might seek inpatient services exclusively from hospitals, and obtain ambulatory services elsewhere. On the other end of the spectrum, those community hospitals which had not experienced an influx of HMO opportunities were free to develop product lines other than acute inpatient care.

It was hypothesized that hospitals in areas of high HMO penetration would experience a reduction in their patient occupancy rates, presumably due to more emphasis on outpatient procedures in the managed care environment. On the contrary, study results indicate that hospitals in areas of low HMO penetration were the most likely to see a reduction in occupancy rates. Once again, the arrival of HMO organizations appears to have stabilized hospital utilization rather than stimulated monumental change.

Hypotheses that market competition would promote hospital change were supported in association with variables for difference in ambulatory services and case-

mix index, but the directions of these relationships were not as expected. According to these results, conditions of greater competition were associated with hospitals which did not raise their ambulatory workload over the study period. Possibly, these hospitals responded to competition in other ways, such as emphasizing core inpatient services.

Maintaining a more sedentary case-mix index may have been another method for competitive hospitals to "stick to what they know," instead of venturing into more complex and extraordinary treatment regimens. With the onset of greater technological capabilities and DRG reimbursement practices, hospitals which were somewhat unchallenged in their MSA were more prone to produce a more complex patient episode.

The transition to a higher case-mix index was also displayed, as hypothesized, in hospitals experiencing poor performance in 1989. The variables for cost per discharge and mortality ratio exhibit significant associations with change in case-mix index in Part 1. These results are supportive of the theoretical framework linking poor performance with organizational predilection for change in structure.

Further empirical support for structural contingency theory is found in the positive significant relationship between hospital cost per discharge and subsequent change in bedsize. Higher costs in 1989 are associated with hospitals' reduction in bed capacity between 1989 and 1994.

In Part 2, several significant associations are found between dependent variables of cost and the independent variables of hospital change. Hospitals which changed their staffing by adding RN FTEs were associated with higher costs, including difference in cost per patient day and difference in cost per discharge. This finding is in support of

Hypothesis 4. Hypothesis 5 is supported with respect to outpatient surgeries only: hospitals which succeeded in expanding their outpatient surgeries were associated with lower costs. Changes in preventive services and ambulatory visits did not show significant relationships to the dependent cost variables.

Hypothesis 6, regarding the association between change in hospital capacity and good performance, is extensively supported. Significant relationships are found between bed reductions and desirable cost performance. Hospitals with greater increases in case-mix index were also associated with lower cost differences, both in cost per patient day and cost per discharge.

In reference to Hypothesis 6, hospitals which experienced greatly reduced occupancy rates exhibited mixed results with dependent financial variables. In these models, reduced occupancy was associated with good performance in cost per patient day and poor performance in cost per discharge. Although patient length of stay was not measured, descriptive statistics indicate that average occupancy rate decreased and average case-mix index increased over the study period. If occupancy rate was reduced by eliminating unnecessary hospitalizations and retaining inpatients in need of more complex services, then improved control over cost per patient day could possibly coexist with higher cost per patient discharge.

In Part 1, 11 statistically significant relationships are detected among a total of 32 hypothesized associations. Five of these associations are in the expected direction. Of the 14 variable relationships hypothesized in Part 2, 7 associations are confirmed in the expected direction, and one is supported in the opposite direction from expected.

It is also found that hospitals with higher cost per discharge figures in 1989 were significantly associated with better cost performance, or lower cost increases, over the study period. This result is in support of the SARFIT theory, where previous poor performance stimulates structural response and improved performance on the part of the organization.

Responses to Research Questions

This study presents three basic research questions. The first question is whether community hospitals exhibited significant structural change in the years following the implementation of Medicare prospective payment practices. Descriptive statistics for change variables indicate that change did indeed occur: in staff size, outpatient services and hospital capacity. The direction of change was not always as expected, however. Instead of reducing RN FTEs, the average trend was for hospitals to add RNs to the staff. Additionally, results indicate that community hospitals did not expand preventive services. For the services measured, the average change was to eliminate preventive health programs.

The second research question searches for the strongest environmental influences on structural changes within the community hospitals. In comparing HMO enrollment (as an indicator of managed care penetration) with the Herfindahl index of market competition, results suggest that managed care is a prominent force in keeping internal hospital structure stable. It seems evident that with the establishment of managed care insurance sources, community hospitals are being relegated to a specific acute-care

capacity, rather than the regional health center that was envisioned by a few industry analysts.

Consistent with the SARFIT contingency theory, variables for poor past performance show significant positive relationships with structural variables in the study. In other words, past performance may be considered a substantial influence in promoting structural change in hospitals.

The third research question seeks to link organizational change with subsequent performance. The study carries some empirical evidence that, at least from an economic standpoint, community hospitals which conducted specific changes in ambulatory services and inpatient capacity were found to be better performers over a defined period of time (1989-1995).

Theoretical Implications

The SARFIT (Structural Adjustment to Regain Fit) theory was solidly supported with regard to the inclusion of poor past performance as a substantial factor in promoting structural change among hospitals. However, the theoretical relationship between interaction effects and structural change was supported in just one application. In that test, a variable for hospital cost per discharge '89 interacted with the corresponding Herfindahl value for market competition. Their interaction held a stronger effect upon difference in ambulatory visits than the cost per discharge variable alone.

Of the three elements of hospital structure selected for the study, professionalism and inpatient capacity were more consistently related to the other theoretical constructs. Although hospital change in ambulatory and preventive services can be accurately

measured, in this study outpatient service scope was not successfully linked with the managed care environment.

Implications for Health Services Management

The results of this study indicate that hospitals have indeed begun to make internal changes in response to the managed care revolution. However, the direction of these changes was not always in accordance with study expectations.

In this sample of community hospitals, HMO penetration was significantly associated with more change variables than market competition. In the hospital environment, competition for acute care patients has been fairly stable. Recently, post-PPS challenges for various ambulatory services have appeared from other sources, such as clinics, doctors' offices, laboratories, and home health care agencies (HCIA, 1995). Managed care is a relatively new phenomenon as well. A longitudinal look at both market competition and managed care penetration could possibly reveal more about hospital response to contingencies.

In summary, the community hospital was expected to become more things to more people in order to survive. The reasoning was that the managed care system delivers health at all levels, not just the traditional acute care episode. In one scenario, hospitals could be expected to expand in ambulatory and preventive services in support of the HMO concept. In an alternative scenario, hospitals would be splintered off as smaller pieces of an integrated network of patient care.

This study found that higher HMO penetration brought some stability in hospital nursing staffs. Possibly, hospitals involved with managed care found that HMO contracts

brought more predictable workload requirements. Additionally, hospitals located in areas with high HMO penetration almost exclusively maintained their acute-care inpatient focus. Clearly, study results suggest that the future direction for community hospitals is to move from the center to the periphery of the health care spectrum.

In relation to hospital performance, reduction in utilization was beneficial to facility costs per patient day, but damaging to costs per patient discharge. Assuming that future reimbursements will be made according to the individual admission rather than by the patient's length of stay, full utilization of the facility will become desirable in the future.

Although study models in Part 1 showed limited support for the SARFIT suggestion of interaction in structural readjustment, independent variables representing the contingency (HMO penetration), environmental illiberality (HHI) and past performance (mortality at 30 days) demonstrated significant associations with the hospitals' propensity for change. Further application of the SARFIT theory and refinement of test models could possibly provide more insight into hospital change in staffing patterns and capacity.

The initial sample of community hospitals was selected based on specific stand-alone properties. These hospitals were not units of larger institutions, nor did they include nursing home services. With 5681 general medical and surgical hospitals in the AHA survey base for 1989, the study sample comprised approximately 31% of the total, with specific features as stated above.

Therefore, the generalization of study results to a larger population of American hospitals should only take place with these features in mind. Additionally, study results confirm the dynamic nature of acquisitions and mergers among hospitals (HCIA, 1995), indicating a trend toward "systemness." In the future, the loss of a unique identity will probably render the stand-alone local hospital extinct.

Study Limitations

The most prominent limitation to the study is loss of the initial 255 hospitals in the original population. These hospitals underwent the ultimate structural change by losing their identity between 1989 and 1995. This loss occurred through hospital closure, merging with other hospitals or occasionally by demerging into smaller organizational units. The remaining population held some bias with respect to representation in region, ownership/control, and bedsize.

In the New England region, for example, the expected number of attritions was 16 hospitals, but the actual number was 28 hospitals. While 15 state or county hospitals were expected to be lost to the population, only 6 actually disappeared. In the category of size, more of the smallest hospitals (6-24 beds) were lost while larger-sized hospitals (300-399 beds) were retained beyond their proportionate predictions.

Other limitations to the study are related to variable measurements and their imprecision as indicators in the models. A second source of error is the aggregation of county data into MSA market areas. Thirdly, missing data necessitated reduced sample sizes and occasional substitutions in measurement. The effects of these limitations are variable in themselves; and in some instances they are offset by the panel study design or

the large sample size. A fourth limiting element in the analysis is the absence of data regarding the relationship between medical staff and their hospitals.

The study measure for HMO penetration, which was the number of HMO enrollees per population (in 100s), is somewhat nonspecific to the dependent variable of hospital change. In other words, a more ideal measure would be more directly related to hospital issues. Examples of more accurate measures are the proportion of discharges who were enrolled in HMOs, or the number and size of HMO contracts held by sample hospitals.

The range of the study's variable for HMO penetration was 0% to 127.8%, rather than 0% to 100.0%. This statistical artifact is due to Interstudy reporting methods. According to Interstudy, all membership for a particular HMO is included in the county where the HMO address is located. HMO enrollees could actually be located in surrounding counties (Area Resources File, 1996). Furthermore, Interstudy data did not report HMO addresses prior to 1991, thereby allowing for possible inaccuracy in HMO enrollment figures.

The study's aggregation of county HMO enrollment data to the MSA level served to alleviate, but not eliminate, these sources of bias. The single MSA where HMO penetration reached the maximum value (127.8%) was Los Angeles, where HMO concentration is historically dense. Other MSAs carried an HMO penetration rate of 100%. They were located in the San Francisco Bay Area, also highly infused with managed care plans.

The study variable for market competition, HHI, utilized hospital share of admissions for nonfederal medical-surgical hospitals in every MSA. Other competitors for ambulatory care, such as freestanding clinics, laboratories, doctors' offices, and home health services, were not accounted for. Greater detail in the assessment of the health services market might have allowed for more significant findings in the formulated models of change.

The aggregation of HMO penetration and market competition data to the MSA level had positive and negative effects upon the study's results. Primarily, the combination of geographic information from multiple counties eliminated the error associated with patients who cross county lines in order to obtain medical care. Secondly, the study was concerned with competition inside urban centers of health care delivery, and so MSA assignments were appropriate. Problems arise, however, when MSAs are too big to adequately represent the travel distance between potential patients and the sample hospitals. For example, the MSA for Washington D.C. includes Baltimore and all areas in between. Geographic measures for local hospital markets have been developed in more detail (Phibbs and Robinson, 1993), and would probably present a more specific picture of the sample hospitals.

When particular data were unavailable for a target year, the closest possible data set was substituted. Specifically, hospital cost figures from 1995 were adjusted with their 1994 case-mix index. The variable for each hospital's local system membership was collected from 1994 survey data in place of 1995 data. Data sources for mortality rates

had been discontinued since 1992, and no substitutes were found. Similarly, the control variable for hospital contracting of a physician liaison was discontinued since 1993.

Although other data sets were present and appropriate for the timeframe of the study, missing observations degraded the financial analysis to a minor extent. Out of 1882 hospitals retained in the sample, only 1767 were analyzed due to missing data elements. Many of the missing observations were in HCFA's cost data, however AHA had some observations missing in the categorical control variables. A relatively large sample size allows for study conclusions to be made despite these imperfections.

An interesting problem arose when the variable DIFMD was not found suitable for regression analysis. Lack of information regarding the hospital's medical staff remains an important limitation. Admittedly, the physicians and dentists who were hospital employees could not be considered as proxies for independent medical practitioners. However, the increase in medical FTEs was being investigated to determine whether hospital employment was a viable option for physician-managers. These individuals were professionals who could help manage decision-making among the medical staff. The variable indicating a contracted position for a physician liaison is the only measure for physician involvement in the regression models.

Study Population Compared to National Hospital Trends

Several important national trends faced hospitals just prior to 1994. Prominent issues included concern over health care expenditures, the steady rise of uninsured Americans, and projected expenses from Medicare and Medicaid, where beneficiary populations were growing as well. Concurrently, the health care industry was forming

integrated networks, ambulatory care centers, and home-based alternatives to hospital stays. At the local level, many hospitals went through activities with mergers, HMO alliances, and PHO (physician-hospital organization) formation (HCIA, 1995).

From a broad sample of more than 4000 hospitals, HCIA (1995) reported that by 1994 inpatient utilization continued to decline, with an average occupancy rate of 46%. Hospital profitability was rising, however, and hospital staffing levels were being curtailed. The combined portion of Medicare and Medicaid patients discharged from the typical U.S. hospital reached 55.7%, up 7.3% from 1990.

Some of these trends are reflected in the sample hospitals, where the occupancy rate fell from 63% in 1989 to 59% in 1994. A close resemblance occurs in the sample's combined Medicare and Medicaid statistic of 53.6% in 1995. Also a close match, the average cost per discharge in the HCIA survey for 1994 (wage and case-mix adjusted) was $3924. Hospitals in the study sample reported an average 1995 figure of $3871.

Unlike HCIA's summation of hospital trends, the study at hand finds limited evidence of reduced staffing. Across the nation and probably across the sample, the greatest reduction in hospital FTEs occurred after 1990, only partially offsetting increases in 1989 and 1990. Since the study period includes 1989 to 1994, some staffing changes apparently cancel each other out. This understanding makes the prominence of staff increases even more powerful in the study.

Future Research Projects

Since this study could best be described as an exploratory one, possibilities in further investigations are numerous. For example, a separate analysis could examine the

attrition set of hospitals, and determine what environmental factors caused closure or merging behaviors. With the current study as a base, a more extensive model for hospital fit could be developed and empirically tested. A shift in the period analyzed, to 1991-1996, could also provide more definitive results with regard to the hypothesized change in staffing patterns.

In another direction, the elements of the current study could be applied to a larger hospital sample, including hospital units acting as subsidiaries. Although previous research has compared hospital performance on the basis of control and ownership, this study's elements are clearly applicable to hospital performance evaluation under changing environmental pressures.

In an ideal study, the constant shifts and alliances in hospital organizations could be controlled in order to analyze their performance over time. This study and its references also illustrate the importance of medical insurance sources in the structural responses of health service managers.

The economic impact of an inpatient stay cannot be denied in terms of national health care expenditures. This study has provided interesting evidence that the presence of managed care insurance has actually frozen community hospitals into their acute-care role. Yes, hospitals are changing; and yet in this study period their approach toward internal organization has stayed curiously the same.

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Appendix A: HCFA Diagnostic and Procedure Codes (DAPCD)*

DAPCD	NAME
00	OVERALL
01	ACUTE MYOCARDIAL INFARCTION
02	CONGESTIVE HEART FAILURE
03	PNEUMONIA / INFLUENZA
04	CHRONIC OBSTRUCTIVE PULMONARY DISEASE
05	TRANSIENT CEREBRAL ISCHEMIA
06	STROKE
07	FRACTURE OF NECK OF FEMUR
08	SEPSIS
09	ANGIOPLASTY
10	CORONARY ARTERY BYPASS GRAFT
11	INITIAL PACEMAKER INSERTION
12	CAROTID ENDARTERECTOMY
13	HIP REPLACEMENT / REVISION
14	OPEN REDUCTION OF FRACTURED FEMUR
15	PROSTATECTOMY
16	CHOLECYSTECTOMY
17	HYSTERECTOMY

*Source: HCFA Public Use Files, MORTAL90.

Appendix B: Scoring Method for Hospital Preventive Services, Variable DIFPREV

Survey results for five hospital services were combined into a 1989 composite score. These services were patient education, fitness center, women's health center/services, occupational health services, and comprehensive geriatric assessment. If a service was reported as hospital-based in 1989, then the composite score was increased by a factor of 1. The maximum possible score was 5 and the minimum possible score was 0.

For the survey year 1994, similar information was collected for patient education center, fitness center, women's health center/services, occupational health services, and geriatric services. If the hospital or a subsidiary provided the service, then the composite score was again increased by 1. Once again, the maximum possible score was 5 and the minimum possible score was 0.

The variable DIFPREV was obtained by subtracting the 1989 composite score from the 1994 composite score. The maximum possible value for DIFPREV was 5 and the minimum possible value was –5.

Appendix C: AHA Region Codes, 1989

Region 1 (New England)	Maine New Hampshire Vermont Massachusetts	Rhode Island Connecticut
Region 2 (Mid-Atlantic)	New York New Jersey Pennsylvania	
Region 3 (South Atlantic)	Delaware Maryland District of Columbia Virginia West Virginia	North Carolina South Carolina Georgia Florida
Region 4 (East North Central)	Ohio Indiana Illinois	Michigan Wisconsin
Region 5 (East South Central)	Kentucky Tennessee	Alabama Mississippi
Region 6 (West North Central)	Minnesota Iowa Missouri North Dakota	South Dakota Nebraska Kansas
Region 7 (West South Central)	Arkansas Louisiana	Oklahoma Texas
Region 8 (Mountain)	Montana Idaho Wyoming Colorado	New Mexico Arizona Utah Nevada
Region 9 (Pacific)	Washington Oregon California	Alaska Hawaii

Appendix D: Correlation between Dependent and Independent Variables, Part 1

Independent Variable	DIFFTE	DIFMD	DIFRN	DIFLPN	DIFNURS	DIFAMB	DIFSURG	DIFPREV	DIFBED	DIFOCCRT	DIFCMI
HMOPEN89	-0.027	0.051	-0.067	0.058	-0.092	-0.004	-0.025	-0.070	-0.036	-0.073	-0.010
HHIDC89	0.021	-0.030	0.013	-0.038	0.058	0.024	-0.004	0.022	-0.006	0.096	0.011.
HHIPD89	0.021	-0.030	0.013	-0.038	0.058	0.024	-0.004	0.021	-0.007	0.096	0.011
MSASTGH9	-0.041	0.022	-0.043	0.054	-0.086	-0.039	-0.001	-0.009	-0.002	-0.050	-0.044
CSTDAY9	0.040	0.002	0.031	0.062	-0.013	-0.052	-0.001	-0.008	0.080	0.106	0.112
CSTDISC9	0.096	-0.001	0.056	-0.043	-0.036	0.055	0.038	0.014	0.034	-0.006	0.208
MORT30	0.036	-0.012	0.076	0.008	0.123	-0.040	-0.041	-0.006	0.036	0.034	-0.018
CUMDIFF	-0.032	0.013	-0.078	-0.005	-0.092	0.038	0.056	0.006	-0.042	-0.022	0.016
BDTOT89	0.248	0.028	0.217	-0.266	-0.026	0.244	0.275	0.024	-0.160	-0.004	0.350
ADC89	0.262	0.033	0.224	-0.258	-0.030	0.250	0.275	0.037	-0.092	-0.076	0.339
HMCR_89	-0.155	-0.045	-0.125	0.051	0.031	-0.084	-0.132	0.034	0.028	0.067	-0.102
HMCD_89	0.082	0.015	0.103	-0.034	0.066	0.036	-0.026	-0.040	0.054	0.007	-0.001
ALL89	0.095	0.102	0.036	-0.134	0.000	0.110	0.154	0.022	-0.065	-0.007	0.108
CONPHY	0.083	0.114	0.036	-0.118	-0.012	0.141	0.118	-0.027	-0.000	-0.038	0.095
LOCSYS89	-0.088	-0.027	-0.043	0.031	-0.030	-0.126	-0.058	-0.047	-0.027	-0.062	-0.004
MAPP889	0.167	0.084	0.104	-0.084	-0.082	0.206	0.153	0.021	-0.032	-0.003	0.209
MHSMEM89	-0.036	0.020	-0.005	0.000	-0.058	-0.064	0.033	-0.041	-0.032	-0.039	0.076
MNGT89	-0.039	-0.033	-0.015	0.050	0.061	-0.058	-0.092	-0.044	0.049	-0.006	-0.088

Appendix E: Correlation between Dependent and Independent Variables, Part 2

Independent Variable	CSTDAY5	CSTDISC5	DIFCSTDY	DIFCSTDS
DIFFTE	0.026	0.087	0.001	0.014
DIFMD	-0.012	-0.020	-0.011	-0.015
DIFRN	0.010	0.070	-0.007	0.028
DIFLPN	0.038	-0.023	-0.001	0.006
DIFNURS	0.006	0.023	0.012	0.046
DIFAMB	-0.013	0.049	0.017	0.011
DIFSURG	-0.040	-0.026	-0.043	-0.057
DIFPREV	-0.014	0.028	-0.010	0.015
DIFBED	-0.105	-0.004	-0.147	-0.028
DIFOCCRT	-0.082	0.072	-0.146	0.069
DIFCMI	-0.096	0.025	-0.162	-0.126
HMOPEN89	-0.017	-0.073	-0.004	-0.056
HHIDC89	0.096	0.026	0.041	0.091
HHIPD89	0.096	0.026	0.042	0.091
MSASTGH9	-0.084	-0.043	-0.053	-0.112
CSTDAY9	0.283	0.143	-0.316	-0.253
CSTDISC9	0.029	0.345	-0.295	-0.386
MORT30	0.085	-0.040	0.054	0.065
CUMDIFF	-0.064	0.033	-0.050	-0.050
BDTOT95	-0.156	0.124	-0.089	-0.088
ADC95	-0.175	0.144	-0.093	-0.067
HMCR_95	-0.119	0.055	-0.023	0.072
HMCD_95	0.084	0.058	0.064	0.024
ALL95	0.037	0.086	0.097	0.068
LOCSYS94	-0.012	-0.103	-0.125	-0.182
MAPP895	0.047	0.262	-0.023	-0.045
MHSMEM95	-0.013	-0.038	-0.058	-0.132
MNGT95	0.080	0.055	0.077	0.116
SUNITS95	-0.134	0.016	-0.163	-0.045

Appendix F: Correlation Matrix of Independent Variables, Part 1

	HMOPEN89	HHIDC89	HHIPD89	MSASTGH9	CSTDAY9	CSTDISC9	MORT30	CUMDIFF	BDTOT89
HMOPEN89	1.00	-0.356	-0.357	0.395	-0.016	-0.022	-0.058	0.039	0.020
HHIDC89	-0.356	1.00	0.999	-0.607	0.078	-0.093	0.116	-0.030	-0.093
HHIPD89	-0.357	0.999	1.00	-0.606	0.078	-0.093	0.116	-0.030	-0.092
MSASTGH9	0.395	-0.607	-0.606	1.00	-0.048	0.096	-0.133	0.025	0.109
CSTDAY9	-0.016	0.078	0.077	-0.048	1.00	0.538	0.061	-0.038	-0.148
CSTDISC9	-0.022	-0.093	-0.093	0.096	0.538	1.00	-0.145	0.111	0.275
MORT30	-0.058	0.116	0.116	-0.133	0.061	-0.145	1.00	-0.892	-0.143
CUMDIFF	0.039	-0.030	-0.030	0.025	-0.038	0.112	-0.892	1.00	0.103
BDTOT89	0.019	-0.093	-0.092	0.109	-0.148	0.275	-0.143	0.103	1.00
ADC89	0.028	-0.122	-0.122	0.131	-0.178	0.274	-0.160	0.110	0.974
HMCR_89	-0.140	0.077	0.078	0.126	-0.158	0.003	-0.089	0.149	-0.241
HMCD_89	-0.058	-0.005	-0.004	0.078	-0.008	0.022	0.078	-0.162	0.092
ALL89	-0.10	0.022	0.021	-0.038	-0.070	0.052	-0.064	0.076	0.305
CONPHY	0.072	-0.075	-0.0751	0.049	-0.128	0.109	-0.077	0.035	0.310
LOCSYS89	0.174	-0.200	-0.197	0.223	0.111	0.054	0.046	-0.041	-0.050
MAPP889	0.154	-0.160	-0.160	0.152	0.071	0.322	-0.151	0.110	0.473
MHSMEM89	0.047	-0.024	-0.023	0.047	0.118	0.127	0.053	-0.043	0.064
MNGT89	-0.029	0.050	0.051	-0.048	0.027	-0.058	0.024	-0.008	-0.211

Appendix F: Correlation Matrix of Independent Variables, Part 1 (cont.)

	ADC89	HMCR_89	HMCD_89	ALL89	CONPHY	LOCSYS89	MAPP889	MHSMEM89	MNGT89
HMOPEN89	0.028	-0.140	-0.058	-0.010	0.072	0.174	0.154	0.047	-0.029
HHIDC89	-0.122	0.077	-0.005	0.022	-0.075	-0.198	-0.160	-0.024	0.050
HHIPD89	-0.122	0.078	-0.004	0.021	-0.075	-0.197	-0.160	-0.023	0.051
MSASTGH9	0.131	-0.126	0.078	-0.038	0.049	0.223	0.152	0.047	-0.048
CSTDAY9	-0.179	-0.158	-0.008	-0.070	-0.128	0.111	0.071	0.118	0.027
CSTDISC9	0.274	0.003	0.022	0.052	0.109	0.054	0.322	0.127	-0.058
MORT30	-0.160	-0.089	0.078	-0.064	-0.077	0.046	-0.151	0.053	0.024
CUMDIFF	0.110	0.150	-0.162	0.076	0.035	-0.041	0.110	-0.043	-0.008
BDTOT89	0.974	-0.242	0.092	0.305	0.310	-0.050	0.473	0.064	-0.211
ADC89	1.00	-0.246	0.119	0.314	0.339	-0.067	0.495	0.030	-0.210
HMCR_89	-0.246	1.00	-0.332	-0.062	-0.087	-0.018	-0.254	0.018	0.047
HMCD_89	0.119	-0.332	1.00	0.028	0.089	-0.105	0.190	-0.163	0.070
ALL89	0.314	-0.062	0.028	1.00	0.124	-0.047	0.145	-0.056	-0.090
CONPHY	0.339	-0.087	0.089	0.124	1.00	-0.056	0.180	-0.003	-0.092
LOCSYS89	-0.067	-0.018	-0.105	-0.047	-0.056	1.00	-0.025	0.498	0.041
MAPP889	0.495	-0.254	0.190	0.145	0.180	-0.025	1.00	-0.075	-0.076
MHSMEM89	0.030	0.018	-0.163	-0.056	-0.003	0.498	-0.075	1.00	-0.088
MNGT89	-0.210	0.047	0.070	-0.090	-0.092	0.041	-0.076	-0.088	1.00

Appendix G: Correlation Matrix of Independent Variables, Part 2

Independent Variable	DIFFTE	DIFMD	DIFRN	DIFLPN	DIFNURS	DIFAMB	DIFSURG	DIFPREV	DIFBED	DIFOCCRT	DIFCMI
DIFFTE	1.00	0.344	0.617	0.146	0.005	0.244	0.192	0.054	0.322	0.047	0.145
DIFMD	0.344	1.00	-0.008	0.057	-0.034	0.105	0.022	0.036	0.027	-0.004	0.038
DIFRN	0.617	-0.008	1.00	0.041	0.234	0.138	0.174	0.060	0.252	0.056	0.117
DIFLPN	0.146	0.057	0.041	1.00	-0.506	-0.024	-0.037	-0.017	0.169	0.042	-0.081
DIFNURS	0.005	-0.034	0.234	-0.506	1.00	-0.023	-0.004	-0.004	0.004	-0.003	0.018
DIFAMB	0.244	0.105	0.139	-0.024	-0.023	1.00	0.134	0.046	0.009	0.040	0.082
DIFSURG	0.192	0.022	0.174	-0.037	-0.004	0.134	1.00	0.024	0.039	-0.008	0.094
DIFPREV	0.054	0.036	0.060	-0.167	-0.004	0.046	0.024	1.00	0.024	0.029	0.046
DIFBED	0.322	0.027	0.252	0.169	0.004	0.009	0.039	0.024	1.00	-0.293	-0.030
DIFOCCRT	0.047	-0.004	0.056	0.042	-0.00	0.040	-0.008	0.029	-0.293	1.00	-0.055
DIFCMI	0.145	0.038	0.117	-0.081	0.018	0.082	0.094	0.046	-0.030	-0.055	1.00
HMOPEN89	-0.027	0.051	-0.067	0.058	-0.092	-0.004	-0.025	-0.070	-0.036	-0.073	-0.010
HHIDC89	0.021	-0.030	0.013	-0.038	0.058	0.024	-0.004	0.022	-0.006	0.096	0.011
HHIPD89	0.021	-0.030	0.013	-0.038	0.058	0.024	-0.004	0.021	-0.007	0.096	0.011
MSASTGH9	-0.041	0.022	-0.043	0.054	-0.086	-0.039	-0.001	-0.009	-0.002	-0.050	-0.044
CSTDAY9	0.040	0.002	0.031	0.062	-0.013	-0.052	-0.001	-0.008	0.080	0.106	0.112
CSTDISC9	0.096	-0.001	0.056	-0.043	-0.036	0.055	0.038	0.014	0.034	-0.006	0.208
MORT30	0.036	-0.012	0.076	0.008	0.123	-0.040	-0.041	-0.006	0.036	0.034	-0.018
CUMDIFF	-0.032	0.013	-0.078	-0.005	-0.092	0.038	0.056	0.006	-0.042	-0.022	0.016
BDTOT95	0.340	0.030	0.279	-0.237	-0.019	0.253	0.285	0.034	0.072	-0.073	0.344
ADC95	0.365	0.039	0.304	-0.226	-0.022	0.265	0.282	0.042	0.065	-0.010	0.326
HMCR_95	-0.159	-0.049	-0.146	0.021	0.022	-0.072	-0.122	0.020	-0.014	0.082	-0.081
HMCD_95	0.088	0.000	0.124	0.009	0.054	0.027	-0.018	-0.031	0.060	0.044	-0.054
ALL95	0.110	0.068	0.059	-0.131	0.022	0.164	0.124	0.069	-0.066	0.011	0.011
LOCSYS94	-0.059	-0.036	-0.025	0.035	-0.048	-0.101	-0.050	-0.053	-0.021	-0.037	0.058
MAPP895	0.187	0.077	0.124	-0.093	-0.067	0.207	0.161	0.028	-0.013	0.016	0.220
MHSMEM95	0.002	0.039	0.058	-0.039	-0.024	0.007	0.056	0.042	-0.045	-0.041	0.128
MNGT95	-0.056	-0.073	-0.027	0.025	0.078	-0.054	-0.108	-0.019	0.007	0.017	-0.052
SUNITS95	-0.005	-0.041	-0.023	0.011	-0.027	0.030	-0.007	0.110	0.047	0.058	0.057

Appendix G: Correlation Matrix of Independent Variables, Part 2 (cont.)

Independent Variable	HMOPEN89	HHIDC89	HHIPD89	MSASTGH9	CSTDAY9	CSTDISC9	MORT30	CUMDIFF	BDTOT95
DIFFTE	-0.027	0.021	0.021	-0.041	0.040	0.096	0.036	-0.032	0.339
DIFMD	0.051	-0.030	-0.030	0.022	0.002	-0.001	-0.012	0.013	0.030
DIFRN	-0.067	0.013	0.013	-0.043	0.031	0.056	0.076	-0.078	0.279
DIFLPN	0.058	-0.038	-0.038	0.054	0.062	-0.043	0.008	-0.005	-0.237
DIFNURS	-0.092	0.058	0.058	-0.086	-0.013	-0.036	0.123	-0.092	-0.019
DIFAMB	-0.004	0.024	0.024	-0.039	-0.052	0.055	-0.040	0.038	0.253
DIFSURG	-0.025	-0.004	-0.004	-0.001	-0.001	0.038	-0.041	0.056	0.285
DIFPREV	-0.070	0.022	0.021	-0.009	-0.001	0.014	-0.006	0.006	0.034
DIFBED	-0.036	-0.006	-0.007	-0.001	0.080	0.035	0.036	-0.042	0.072
DIFOCCRT	-0.073	0.096	0.096	-0.050	0.106	-0.006	0.034	-0.022	-0.073
DIFCMI	-0.010	0.011	0.011	0.044	0.112	0.208	-0.018	0.016	0.344
HMOPEN89	1.00	-0.356	-0.357	0.395	-0.016	-0.022	-0.058	0.039	0.010
HHIDC89	-0.356	1.00	0.999	-0.607	0.078	-0.093	0.116	-0.030	-0.090
HHIPD89	-0.357	0.999	1.00	-0.606	0.078	-0.093	0.116	-0.030	-0.090
MSASTGH9	0.395	-0.607	-0.606	1.00	-0.048	0.096	-0.133	0.025	0.103
CSTDAY9	-0.016	0.078	0.078	-0.048	1.00	0.538	0.061	-0.038	-0.114
CSTDISC9	-0.022	-0.093	-0.093	0.096	0.538	1.00	-0.145	0.112	0.280
MORT30	-0.058	0.116	0.116	-0.133	0.061	-0.145	1.00	-0.892	-0.128
CUMDIFF	0.039	-0.030	-0.030	0.025	-0.038	0.112	-0.892	1.00	0.091
BDTOT95	0.010	-0.090	-0.090	0.103	-0.114	0.280	-0.128	0.091	1.00
ADC95	0.013	-0.106	-0.106	0.120	-0.138	0.280	-0.146	0.098	0.968
HMCR_95	-0.160	0.124	0.124	-0.168	-0.163	-0.163	-0.096	0.156	-0.249
HMCD_95	-0.052	-0.024	-0.024	0.141	0.039	0.039	0.073	-0.162	0.060
ALL95	-0.053	0.044	0.043	-0.068	-0.090	0.005	-0.071	0.076	0.246
LOCSYS94	0.139	-0.179	-0.177	0.202	0.162	0.105	-0.005	0.002	0.018
MAPP895	0.126	-0.132	-0.131	0.128	0.090	0.315	-0.138	0.100	0.452
MHSMEM95	0.050	-0.028	-0.028	0.024	0.055	0.113	0.001	0.002	0.138
MNGT95	-0.042	0.047	0.047	-0.043	-0.003	-0.076	0.025	-0.016	-0.175
SUNITS95	-0.007	-0.029	-0.027	0.041	0.048	0.080	0.046	-0.037	0.073

Appendix G: Correlation Matrix of Independent Variables, Part 2 (cont.)

Independent Variable	ADC95	HMCR_95	HMCD_95	ALL95	LOCSYS94	MAPP895	MHSMEM95	MNGT95	SUNITS95
DIFFTE	0.365	-0.159	0.088	0.110	-0.059	0.187	0.002	-0.056	-0.005
DIFMD	0.039	-0.049	0.000	0.068	-0.036	0.077	0.039	-0.073	-0.041
DIFRN	0.304	-0.146	0.124	0.059	-0.025	0.124	0.023	-0.027	-0.023
DIFLPN	-0.226	0.021	0.009	-0.131	0.035	-0.092	-0.039	0.026	0.011
DIFNURS	-0.022	0.022	0.054	0.022	-0.048	-0.068	-0.024	0.078	-0.027
DIFAMB	0.265	-0.072	0.027	0.164	-0.101	0.207	0.007	-0.054	0.030
DIFSURG	0.282	-0.122	-0.018	0.124	-0.050	0.161	0.056	-0.108	-0.007
DIFPREV	0.042	0.020	-0.031	0.069	-0.053	0.028	0.042	-0.019	0.110
DIFBED	0.065	-0.015	0.060	-0.066	-0.021	-0.013	-0.045	0.007	0.048
DIFOCCRT	-0.010	0.082	0.044	0.011	-0.037	0.016	-0.041	0.017	0.058
DIFCMI	0.326	-0.081	-0.054	0.115	0.058	0.220	0.128	-0.052	0.057
HMOPEN89	0.013	-0.160	-0.052	-0.053	0.139	0.126	0.050	-0.042	-0.008
HHIDC89	-0.106	0.124	-0.024	0.044	-0.179	-0.132	-0.028	0.047	-0.029
HHIPD89	-0.106	0.124	-0.024	0.043	-0.177	-0.132	-0.028	0.047	-0.027
MSASTGH9	0.120	-0.168	0.141	-0.068	0.202	0.128	0.024	-0.043	0.041
CSTDAY9	-0.138	-0.163	0.039	-0.090	0.162	0.090	0.055	-0.003	0.048
CSTDISC9	0.279	-0.025	0.047	0.005	0.105	0.315	0.113	-0.076	0.080
MORT30	-0.146	-0.096	0.073	-0.071	-0.005	-0.138	0.001	0.025	0.046
CUMDIFF	0.098	0.156	-0.162	0.076	0.002	0.100	0.002	-0.016	-0.037
BDTOT95	0.968	-0.249	0.060	0.246	0.018	0.452	0.138	-0.175	0.073
ADC95	1.00	-0.243	0.080	0.259	-0.013	0.473	0.116	-0.171	0.054
HMCR_95	-0.243	1.00	-0.446	0.018	-0.089	-0.222	-0.013	0.120	0.040
HMCD_95	0.080	-0.446	1.00	-0.020	-0.099	0.141	-0.102	0.016	-0.014
ALL95	0.259	0.018	-0.020	1.00	-0.092	0.184	0.063	-0.060	-0.003
LOCSYS94	-0.013	-0.089	-0.099	-0.092	1.00	-0.037	0.382	-0.042	0.036
MAPP895	0.473	-0.222	0.141	0.184	-0.037	1.00	0.010	-0.072	-0.062
MHSMEM95	0.116	-0.013	-0.102	0.063	0.382	0.010	1.00	-0.088	0.135
MNGT95	-0.171	0.120	0.016	-0.059	-0.042	-0.072	-0.088	1.00	-0.007
SUNITS95	0.054	0.040	-0.014	-0.003	0.036	-0.062	0.135	-0.007	1.00

Appendix H: Parameter Estimates for Interaction Terms in Study. Standardized Estimates of Change in Hospital Staff. Interaction model.

Variable	Estimate for DIFFTE† N=1816	Estimate for DIFRN N=1818	Estimate for DIFLPN† N=1818	Estimate for DIFNURS N=1818
HMOPEN89†*HHIDC89†	-0.040	-0.032	-0.014	-0.009
CSTDISC9*HHIDC89†	0.033	0.024	0.017	-0.053
MORT30*HIIDC89†	0.063	0.054	-0.077	0.135****
ADC89	0.118****	0.197****	-0.217****	-0.007
HMCR_89	-0.086****	-0.062**	-0.009	0.054**
HMCD_89	$4.23*10^{-4}$	0.036	-0.023	0.078***
ALL89	0.036	-0.017	-0.055**	0.018
CONPHY89	0.013	-0.020	-0.022	0.004
MNGT89	0.005	-0.002	-0.008	0.047
LOCSYS89	-0.067***	0.004	0.004	-0.029
PUB	0.068***	0.087****	0.061**	-0.002
Intercept	0.000****	0.000	0.000	0.000
R-square	0.054	0.065	0.062	0.022
Adj. R-square	0.049	0.060	0.056	0.016
F value	9.450****	11.449****	10.896****	3.779****

Notes: † Variable is transformed through square root.

** Significant $p < .05$ level.

*** Significant $p < .01$ level.

**** Significant $p < .001$ level.

Appendix I. Parameter Estimates for Interaction Terms in Study. Standardized Estimates of Change in Hospital Capacity. Interaction model.

Variable	Estimate for DIFBED† N=1818	Estimate for DIFOCCRT N=1818	Estimate for DIFCMI N=1817
HMOPEN89†*HHIDC89†	-0.026	-0.031	0.019
CSTDISC9*HHIDC89†	0.066	0.041	0.173****
MORT30*HIIDC89†	-0.056	0.036	-0.054
ADC89	-0.091****	-0.061**	0.323****
HMCR_89	-0.007	0.040	-0.050**
HMCD_89	0.050	0.020	-0.037
ALL89	-0.036	0.002	-0.001
CONPHY89	0.032	-0.041	-0.014
MNGT89	0.022	-0.018	-0.021
LOCSYS89	-0.029	-0.035	0.016
PUB	0.049**	-0.001	-0.030
Intercept	0.000	0.000****	0.000***
R-square	0.020	0.012	0.137
Adj. R-square	0.014	0.013	0.132
F-ratio (P-value)	3.278****	3.200****	26.003****

Notes: † Variable is transformed through square root.

** Significant $p < .05$ level.

*** Significant $p < .01$ level.

**** Significant $p < .001$ level.

Appendix J: Parameter Estimates For Interaction Terms In Study. Standardized Estimates Of Change In Hospital Ambulatory Workload. Interaction Model.

Variable	Estimate for DIFPREV N=1818	Estimate for DIFAMB† N=1816	Estimate for DIFSURG† N=1817
HMOPEN89†*HHIDC89†	-0.082****	-0.031	-0.040
CSTDISC9*HHIDC89†	0.043	0.078**	0.019
MORT30*HIIDC89†	0.015	0.023	0.030
ADC89	0.046	0.230****	0.172****
HMCR_89	0.023	-0.060**	-0.119****
HMCD_89	-0.046	-0.041	-0.097****
ALL89	-0.013	-0.035	0.058**
CONPHY89	-0.045	0.017	-0.007
MNGT89	-0.037	0.006	-0.006
LOCSYS89	-0.032	-0.072***	-0.019
FP89	-0.049	-0.076***	-0.052**
Intercept	0.000**	0.000****	0.000****
R-square	0.018	0.090	0.070
Adj. R-square	0.011	0.085	0.065
F-ratio (P-value)	2.735***	16.286****	12.423****

Notes: † Variable is transformed through square root.

** Significant $p < .05$ level.

*** Significant $p < .01$ level.

**** Significant $p < .001$ level.

Vita