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# DO GENERAL, COMMUNITY HOSPITALS COMPETE BY SPECIALIZING IN HIGH VOLUME, HIGH REVENUE-GENERATING SERVICE LINES?

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DO GENERAL, COMMUNITY HOSPITALS COMPETE BY SPECIALIZING
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A dissertation submitted in partial fulfillment of the requirements for the degree of
Doctor of Philosophy at Virginia Commonwealth University


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ABSTRACT


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Among the challenges confronting U.S. healthcare are improved quality and
safety, greater efficiencies, and increased rivalry among competitors. Against the
backdrop of technological advancements, shifts in market dynamics, and organizational
restructuring, hospitals are likely to adopt clinical service line specialization as a
competitive strategy.

The purpose of the research was to determine if general, community hospitals
show evidence of specializing within the nation's six highest volume, highest revenue-
generating service lines and to identify market and organizational factors correlating with
such a strategy.

The study used a retrospective, non-experimental, correlational design to analyze
secondary 2003-2007 data of hospitals throughout Florida, Virginia, and Nevada.

Simultaneous regression and subsequently backward deletion, stepwise regression modeling was applied to analyze cross-sectional relationships between descriptive variables of markets and hospital organizations, as well as state as a covariate, and five selected measures of specialization. Six leading service lines were selected for study: cardiac surgery, cardiology, invasive cardiology, orthopedics, labor and delivery, and pulmonary services.

Results indeed show evidence of specialization among the top six service lines. There are, however, different characteristics supporting such evidence in each service line and thus variation from one line to the next. While this research is considered exploratory in nature, findings suggest that the general, community hospital, traditionally a full-service provider of a wide range of costly and complex services, may be undergoing transformations including specialization.

This study demonstrates the usefulness of examining service lines separately when assessing specialization. Complex differences among states may exist. There was no evidence from the sub-analysis of hospitals of specialization due to cluster effect.

At least six policy issues surface to warrant the need for further investigation: (a) source of hospital admission and drivers of physician referral patterns; (b) potential usefulness of case studies in studying service line strategies; (c) localized analysis of variations by state; (d) usefulness of studying specialization at the service line level; (e) loss of choice in access for labor and delivery as a service line; and (f) further analysis of hospital size as an important variable in its influence on strategic choices by hospitals.

CHAPTER ONE: INTRODUCTION


Overview

Among the many challenges confronting the U.S. healthcare industry are three major trends impacting strategic choices of the general, community hospital: (a) demand for improved hospital quality and safety, (b) the need for greater efficiencies to curb spiraling costs, and (c) increased rivalry among locally competing hospitals. Hospitals face these challenges against the backdrop of recent technological advancements, shifts in market dynamics, and organizational restructuring including the formation of hospitals into clusters. The latter is especially important given that clusters provide the administrative structures within which local systems are able to respond to external pressures by negotiating and facilitating service restructuring among member hospitals. Collectively, these changes and challenges are likely to encourage general, community hospitals to adopt clinical service line specialization as a competitive strategy. Specialization is also of interest because of the longstanding influence specialty physicians have historically exerted on inpatient services, referrals to hospitals and consequently hospital investments.

The purpose of the research is to determine if general, community hospitals show evidence of specializing specifically within the nation's six highest volume, highest revenue-generating service lines and to identify factors that correlate with such a strategy.

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Specialization by general, community hospitals is important because of the vital role these hospitals have played in the delivery of healthcare across America. Although the general, community hospital is widely considered the cornerstone of acute care delivery in the United States, sweeping changes are pushing the sector to rethink the traditional concept that every general hospital must provide the full range of diagnostics, medical care, and surgical services to meet the broad needs of the community it serves (Shi & Singh, 2004). The research seeks to observe whether general, community hospitals modify their delivery models in order to compete more effectively in their markets. While several theoretical arguments can be offered to explain why they might do this, little research has applied these perspectives to the study of specialization by general, community hospitals as they operate within the current, often turbulent environment.

Although there is more than one way to define and measure hospital specialization, this study defines it as a hospital's disproportionate servicing of cases within selected service lines. The top six lines, as defined by volume of inpatient discharges and charges generated, are selected because they represent areas where general, community hospitals are likely to invest in service restructuring. These six also offer the opportunity to assess hospital strategy in delivering inpatient care for widely prevalent, chronic conditions, as well as high demand, acute care cases. Based on national statistics from aggregate hospital charges as a measure of revenue-generating potential and case volumes in 2007, the top six service lines selected for study are: (a) labor and delivery, (b) pulmonary services, (c) cardiology, (d) cardiac surgery, (e) orthopedics, and (f) invasive cardiology. The research will examine the relationship

between measures of hospital specialization in each of these selected service lines and various market and organizational characteristics.

Purpose and Goals of the Research

The purpose of the research is to determine if general, community hospitals show evidence of specializing in the nation's six highest volume, highest revenue-generating service lines and, if so, to examine which identifiable organizational and local market characteristics are associated with such specialization. The drivers discussed above and other factors provide the backdrop for this study. The first step is to measure hospital specialization. Alternative measurement strategies will be assessed for their usefulness in studying specialization within general, community hospitals. The second step is to identify possible correlates of specialization. It is expected that particular market factors and organizational characteristics will be associated with general, community hospital specialization in high volume, high revenue-generating service lines. A last step will be to assess specialization within hospital clusters (local hospitals under common ownership), under the assumption that gains in specialization by one cluster member could be offset by losses in others.

This introductory chapter is organized into the following eight sections: (a) examination of the historical context for the development and expansion of the general community hospital, followed by a discussion of how growth in the number of specialty physicians has shaped the development of the general, community hospital; (b) assessment of some of the most important influences in recent decades that have brought change to the hospital sector (e.g., growth in medical technology, shifts in market

dynamics, and organizational restructuring); (c) introduction of three additional important trends that may have been driving hospitals to pursue specialization in recent years; (d) rationalization for why general, community hospitals might focus internally on inpatient service lines in making strategic choices about specialization; (e) theoretical argumentation that supports hospital specialization as a competitive strategy; (f) introduction of the research issues this study will address in studying hospital specialization; (g) summation of the methodology to be used; and (h) discussion of the potential significance of the research.

This study offers a number of potentially important policy-related benefits: (a) applying alternative measures of service line specialization; (b) highlighting the roles of organizational and market factors in hospital specialization; (c) shedding light on whether general, community hospitals are, as a competitive response to rival threats, modifying their historical, general hospital model of delivering a broad, even duplicative, array of services to the community; and (d) examining the possible role cluster formation might play in rationalizing clinical capacities across clustered hospital members. Specialization, of course, leads to a loss of choice among hospitals for inpatient care and to the need for inter-organizational coordination to ensure that physically separated facilities collectively function as holistic systems of delivery. Loss of choice thus represents a dimension of the policy implications associated with specialization. Should the study produce limited findings, they may imply that specialization is restrained by inertia and resistance grounded in historic expectations for professional and institutional autonomy and long-held assumptions about the traditional functioning of general,

community hospitals. Nevertheless, the contributions of specialization toward improved efficiencies and quality could be significant, suggesting that continued research in this area is still very much needed in order to inform and complement policy making.

## Historical Background

*Development and Expansion of the General, Community Hospital in the United States*

The earliest general, community hospitals were voluntary, supported by local philanthropy, and often established by influential physicians. Between 1840 and 1900, hospitals in the United States underwent a dramatic transformation, mostly from supplying food, shelter and comfort to the sick and poor to broadly providing skilled medical and surgical attention and nursing to all people in a community (Raffel, 1980). Institutionalization of medical care advanced in conjunction with three forces: (a) technological discovery, such as anesthesia for performing surgery, (b) the emergence of physician power and prestige, and (c) the advancement of urbanization (Haglund & Dowling, 1993; Martensen, 1996). Growth in surgical volume, largely accompanied by techniques in anesthesia, provided justification to expand the number of hospital beds, and hospitals grew in size and number well into the 20th century (Roemer, 1961). Once medical education became science-based, its laboratory and clinical instruction tied the teaching of physicians to hospitals as institutions for medical education (Anderson, 1990). As science progressed, advanced medical training became established, resulting in professional specialization that has remained a hallmark of American medicine. In turn, professional specialties influenced clinical service line investment and expansion by hospitals, especially in urban areas, where physicians trained and practiced.

In the first decade following World War II, the government assumed a central role in the country's healthcare through the funding of four major programs, which exerted lasting, transformational effects on the healthcare system's structure and support. The programs were: (a) funding for medical research through congressional appropriations to the newly created National Institutes of Health (NIH), (b) funding for hospital and medical care for war veterans through the Veteran's Administration, (c) funding for mental health, and (d) funding for community hospital constructions initiated with the 1946 Hill-Burton Act. Administration of all four programs demonstrates a common pattern of respecting the sovereignty of both medical professionals and local medical institutions (Starr, 1982). This single factor – the preservation of autonomy/ institutional sovereignty – allowed doctors and hospitals to share broadly in the postwar expansion of the healthcare system without regulatory interference and fueled the growing influence of specialty physicians on their local, community hospitals.

Three structural elements in the early second half of the 20th century contributed to the rise in specialization in medicine and growth in the breadth of services within general, community hospitals. These were: (a) an absence of regulation governing the number and geographical distribution of physicians entering a specialty, (b) the presence of financial incentives for individuals trained in medical and surgical specialties, and (c) the more rapid development of insurance covering hospital services as opposed to office services, thereby encouraging doctors to move into hospital-oriented specialties instead of office-based primary care (Starr, 1982).

The enactment of Medicare in 1965 provided a huge boost both for physician specialists and general, community hospitals. Medicare Part A covered the cost of hospitalization for the elderly and disabled, while Medicare Part B provided government subsidized, voluntary insurance to cover bills from physicians. Although community hospitals were largely constructed with the financing of local hospital bonds, federal monies for Medicare payments reimbursed hospital costs including depreciation. This revenue stream provided new capital for expansion. The hospitals with the largest, newest and most expensive facilities received the highest reimbursements because their non-cash, depreciation expense was higher than the depreciation expense of older, smaller hospitals (Starr, 1982). Meanwhile, physicians were paid by Medicare based on what were termed "prevailing" fees, and higher payments were made for identical services performed in a hospital versus an office (Blumberg, 1979).

Therefore, not only were physician incomes higher for those specialties that performed the most procedures in hospitals, this distorted pricing generally favored inpatient services. These biases produced overuse of hospital care and encouraged even more doctors to enter specialties, particularly in surgery, than the country needed. Wishing to serve the highest volume of patients, please physicians in exchange for their choice of hospital facility, and secure community support, hospitals offered the maximum range of services and the most modern technology, often regardless of whether they were duplicating services of other local institutions (Starr, 1982). This historical context produced the general, community hospital that has emerged as the dominant delivery model for hospitals nationally. It is the limitations of this model, however, that may now

be driving hospitals to consider service line specialization in today's rapidly changing environment.

<div align="center">*Influences Bringing Change to the Hospital Sector*</div>

Advancements in medical technology, shifts in market dynamics in the form of corporate hospital ownership and expansion of multi-hospital systems, and organizational restructuring through the formation of systems in clusters are all reshaping the hospital sector. In particular, these developments may be leading hospitals to engage in service specialization as a strategic choice. These changes began in the late 20th century and continue into the 21st. The environment in which the general, community hospital operates is thus dramatically different than it was in the pre-1990s era.

*The Influence of Medical Technology*

*The impact of Americans living with chronic illnesses*. Modern technology and advanced pharmaceuticals have rendered Americans less vulnerable to mortality from infectious and other forms of disease that in earlier decades led to imminent death. For example, current diagnostics can more quickly identify patients with risk factors for disease or with the early onset of a disease, thereby allowing intervention to preempt premature death. In addition, aggressive marketing on the part of industry including direct-to-consumer advertising has enabled consumers to identify symptoms of chronic conditions, contributing to diagnosis and prevalence statistics. As a consequence, half of all Americans are said to be living with one or more chronic conditions and illnesses such as heart disease, osteoarthritis, and chronic pulmonary conditions (Anderson & Horvath, 2004). Advances in pharmaceutical and medical device technology have allowed chronic

conditions and illnesses to displace infectious diseases and accidents as the primary causes of death. Health services in the United States are, therefore, increasingly caring for patients with chronic illnesses. More than 75% of healthcare spending is devoted to medical costs to treat chronic illness across multiple healthcare delivery settings (Anderson & Horvath, 2004), as people with multiple chronic conditions often see multidisciplinary providers for monitoring different illnesses and conditions (Berenson & Horvath, 2003).

Overnight hospitalization of the chronically ill now occurs only in the event of a need for surgical intervention or other disease-related episode requiring extensive invasive, diagnostic assessment or treatment. Some inpatient facilities, however, appear to be better prepared than others to serve the needs of chronically ill patients. For example, a wide disparity exists in charges billed for inpatient hospital care for patients with chronic conditions in their last 2 years of life, varying by nearly 100% between some of the best known institutions such as Mayo Clinic versus University of California at Los Angeles (Pear, 2008). The reasons some hospitals are better prepared than others to manage the chronically ill have not been fully studied, but the wide variances suggest that different strategies may be in place (Foundation for Accountability, 2001).

*The link between specialty physician referrals and hospital investment in technology*. Most general, community hospitals with more than 100 beds tried in the second half of the 20th century to become clinical centers offering medical services in all major specialty fields. To fill beds, these hospitals sought to associate with specialty physicians to gain referrals (Friedenberg, 1996). Although investment by a hospital in the

latest equipment played an important role in the 1970s and 1980s in influencing specialists to bring their patients to that facility (Robinson & Luft, 1985), hospital incentives for such investments diminished when Medicare reimbursement schemes shifted from cost-plus to diagnostic groups (Eastaugh, 1992). Nevertheless, the interest of specialty physicians in performing procedures in acute care facilities with the most up to date technology has remained intact.

In response to continuing advances in medical technology, general, community hospitals are viewed as trying to distinguish themselves from each other by opening centers for specialties such as cardiac services. The first decade of the 21st century is thus associated with spending and specialization, unlike the 1990s when managed care constraints forced cuts and consolidation. It is likely that the consolidations of the 1990s paved the way for the subsequent decade of specialization (Ain, 2002).

*Entrance of Corporate Hospital Ownership and Expansion of Multi-hospital Systems*

The earliest multi-hospital systems, defined by the American Hospital Association (AHA) as two or more hospitals that are owned, managed, or leased by a single organization (American Hospital Association, 2008), date back to early years of the 20th century, when denominational and other faith-based organizations sought to provide acute care (Starr, 1982). These not-for profit systems were mission-driven and demonstrated a commitment to serve the broader needs of the local community. Consequently, each hospital within these systems tended to function independently from other same-system members. Thus, while their hospitals shared scale advantages and mission, they effectively remained independent as providers of clinical services.

With entirely different objectives, for profit multi-hospital systems emerged in the late 1960s, in response to the continued growth in private insurance for hospital services and the emergence of Medicare and Medicaid payments. In the two decades to follow, a dramatic corporate-owned expansion of multi-hospital systems ensued. The traditional, highly autonomous, freestanding general hospital governed by its own board thus gave ground to rapidly growing systems run by corporate governance. The rise of the for profit chains introduced managerial capitalism to the American hospital sector, in contrast to independent or nonprofit hospitals over which community boards and medical staff exerted management and strategic direction (Starr, 1982). Up to the 1990s, however, most not-for profit, non-Catholic, hospitals remained independent, although a few not-for profit systems had emerged by that time.

In the 1990s, rising concerns over costs, uninsured Americans, and the threat of managed competition brought many more hospitals into multi-hospital systems. Moreover, these concerns changed the spatial configurations of systems and local patterns of competitive behavior in the period between 1989 and 2005 (Luke, 2010). As can be seen in Table 1, the numbers of for profit and Catholic systems actually declined in that period by an average annual rate of 0.7% and 2.4%, respectively, due to system mergers and acquisitions within their ownership categories. The number of hospitals per system grew slightly by 1.7%, especially within the Catholic system group. By contrast, the not-for profit systems grew at an average annual rate of 3.9%.

Table 1

Growth of U.S. Multi-hospital Systems by Ownership Type 1989-2005

| Ownership Type | 1989 No. of Multi-unit Systems | 1989 Average No. per System | 2005 No. of Multi-unit Systems | 2005 Average No. per System | Average Annual Growth in No. of Systems (%) |
|---|---|---|---|---|---|
| Catholic | 76 | 7.0 | 51 | 11.0 | (2.4) |
| For profit | 47 | 14.3 | 42 | 15.8 | (0.7) |
| Not-for profit | <u>173</u> | 4.6 | <u>319</u> | 4.4 | 3.9 |
| Total | 296 | 6.8 | 412 | 6.4 | 2.1 |
| No. of hospitals | 2,013 | | 2,637 | | 1.7 |
| Percentage of U.S. community hospitals (%) | 38 | | 55 | | |

Note: Sourced from "System Transformation: USA and International Strategies in Healthcare Organization and Policy," by R. D. Luke (2010), *International Journal of Public Policy.*

The advantages of multi-hospital system (MHS) affiliations are generally well known. They include: (a) economies of scale that spread administrative overhead, (b) the ability to provide a wide spectrum of services across multiple care settings, (c) purchasing leverage in negotiation with vendors, and (d) increased access to capital markets to fund growth (Snook, 1995). With increased emphasis on management and efficiencies, it is reasonable to expect growth in MHSs to increase the likelihood that hospitals will engage in cost containment and quality-enhancing measures, including possibly specialization. To date, however, little research has considered the effect of

system growth on hospital specialization, particularly with regards to competitive strategy.

*Organizational Restructuring: The Formation of Local and Regional Systems in Clusters*

The consequences of the 1990s restructuring reach well beyond system efficiencies and increases in market concentration (Cuellar & Gertler, 2003, 2005). As discussed earlier, the most significant changes in system formation occurred within the not-for profit, non-Catholic sector. Often, larger, urban hospitals led in the system formation as they sought market strength by merging with and acquiring other, typically smaller hospitals in and around their local markets (Luke, 2010).

The consequences of such organizational restructuring within the not-for profit sector, when combined with the overall system consolidation that occurred among Catholic and among for profit systems, are significant and could be relevant to this study. First, all of these changes produced a large number of local, urban-based hospital clusters that dominate most markets across the country. Second, the clusters provide important configurations within which system hospitals might engage in specialization – as same-system, same-market members seek to rationalize service capacities by sharing and trading service functions locally. The clusters, in other words, offer powerful mechanisms for minimizing duplications of services when service capacities are redistributed among local same-system hospitals. Thus, they have the potential of facilitating and hastening the pace of specialization in hospitals, at least within selected members of their hospital clusters. With few exceptions (Clement et al., 1997; Trinh, Begun, & Luke, 2008),

researchers have not assessed the impact of cluster formation on hospital efficiencies or specialization.

In his study of clusters and competitive advantage outside of the healthcare industry, Michael Porter defines a cluster generically as "a geographically proximate group of interconnected companies and associated institutions in a particular field," linked by what he termed "commonalities" and "complementarities" (Porter, 1998, p. 199). Whereas Porter's focus is mostly on collectives of otherwise independent companies within local areas, the clusters of interest in this study are those that systems form, through mergers and acquisitions in markets. From the perspective of this research, the important features Porter describes are geographic proximity and the interconnectedness, or configuration, of cluster members. The connectivity specifically allows smaller, outlying community hospitals to coordinate service capacity with larger, patient accessible, often tertiary care referral centers (Luke, Walston, & Plummer, 2004). The cluster organization thus offers the coordinative structure within which hospitals can engage in specialization by sharing and trading service capabilities among same-system members. Such configurations and possibilities are yet to be fully examined empirically.

*Potential Drivers of General, Community Hospitals Toward Specialization*

Against the foregoing backdrop of technological advancements, changes in market structure, and organizational restructuring, three overarching trends could potentially drive the general, community hospital to adopt clinical service line specialization as a competitive strategy. These are: (a) demand for improved hospital

quality and safety, (b) the need for greater efficiencies to curb ever-spiraling costs, and (c) increased rivalry among hospital competitors surviving consolidation of the 1990s.

*The Call for Improved Hospital Quality and Safety*

Demand for improvements in the U.S. healthcare delivery system has been on-going since the Committee on the Costs for Medical Care issued its final report (Committee on the Costs for Medical Care, 1932). This report revealed a growing body of evidence substantiating medical errors as a leading cause of death and injury in the United States and appealed to the nation for remedies to lower the error rate. Discussion reached new heights in 1999 when the Institute of Medicine (IOM) of the National Academy of Sciences issued "To Err is Human: Building a Safer Health System" and "Crossing the Quality Chasm: A New Health System for the 21st Century" (Institute of Medicine, 1999). In combination, these two contemporary studies recommended a sweeping redesign of the U. S. healthcare system in order to foster innovation and improve the delivery of quality care (Committee on Quality of Health Care in America, Institute of Medicine, 2001).

One recommendation stemming from the IOM report urged that patients be directed to hospitals and doctors performing the greatest volume of identical procedures, particularly costly, high risk, highly specialized surgeries with high mortality rates. This recommendation was based on surveys of hospital case volumes and the number of deaths occurring during, or shortly after, selected surgical procedures that provided evidence of an inverse relationship between case volume, as a measure of experience and expertise, and inpatient mortality, both for hospitals and operating surgeons (Begg,

Cramer, Hoskins, & Brennan, 1998; Luft, Bunker, & Einthoven, 1979). A growing body of research, most of which is supportive, has been published since 2000 documenting the relationship between lower patient mortality rates and surgeons and hospitals possessing greater procedure-specific experience and expertise (Birkmeyer et al., 2003; Hannan et al., 2005; Kahn, Ten Have, & Iwashyna, 2009; Moscucci et al., 2005). Such findings support strategic choices by hospitals to concentrate high demand for particular clinical resources through specialization.

The Leapfrog Group also has actively encouraged specialization by directing patient case volumes for purposes of improvements in healthcare quality and patient safety (The Leapfrog Group, 2000). With funding in 2000 by the Business Round Table and comprised of Fortune 500 chief executive officers, The Leapfrog Group began incorporating a volume/quality relationship into its evidence-based hospital referral (EBHR) criterion. The EBHR criterion encourages payers, hospitals, and physician groups to support hospital and physician providers demonstrating relatively larger volumes in particular procedures in the interest of improving patient safety (Birkmeyer & Dimick, 2004; Birkmeyer et al., 2002; Galvin & Milstein, 2000). Specialization across one or more entire service lines, as examined in the research, is consistent with the volume/quality relationship encouraged by The Leapfrog Group for particular, high risk surgical procedures.

Importantly, nowhere in the literature is there consideration of how hospitals might move to specialize or how their multi-hospital system clusters might facilitate specialization that would be consistent with the EBHR criterion for hospitals and the

IOM recommendations. Moreover, how general, community hospitals have responded to these opportunities is unclear. One possibility is that general, community hospitals are seeking a disproportionate share of cases in high volume, high revenue-generating service lines housing procedures targeted for analysis by The Leapfrog Group, such as cardiac surgery housing the coronary artery bypass graft (CABG) procedure. The goal of the research is to determine if hospitals are pursuing rational strategies of specialization by service line, especially among hospitals in same-system clusters, in part as a response to demands for improved quality and patient safety.

*The Need for Greater Efficiencies*

Despite the recent shift of service capacities to outpatient settings, approximately one-third of total national health expenditures in 2005 were for inpatient hospital services and supplies. Inpatient care costs increased from $417.0 billion to $611.6 billion in just five years between 2000 and 2005, for an average annual increase of 8.0% (Health, United States 2007, 2008). Reflective of the untenable escalation in healthcare costs, workers' health insurance premiums increased more than five times faster than their wages between 2000 and 2007 (Families USA, 2008).

With the ever-spiraling rise in healthcare costs, the pressure on hospitals to increase the efficiency with which they provide costly services remains intense. There are two basic forms by which a general, community hospital might engage in specialization in the pursuit of increased efficiency: (a) establish institutes or centers of excellence (Porter & Teisberg, 2006), or (b) prune services of low profitability lines (Eastaugh, 1992), each aimed to derive overall lower per unit costs per case. Regardless of the

approach, both involve strategies of specialization and need to be examined in future research as this study does not examine cost considerations in analyzing service line specialization strategies or choices. A third option, the shifting of service capacities within local or regional hospital clusters to "lead hospitals" within those clusters, is however considered in the research.

*Increased Rivalry Among Hospital Competitors*

In addition to the call for improved hospital quality and safety and the need for greater efficiencies to curb costs, the third trend potentially driving general, community hospital specialization is a heightened competitive environment following the merger and acquisition wave of the 1990s in the United States. While economic theory suggests that increased concentration, as occurred in healthcare in this period, should lead to lower price competition (Kovacic & Smallwood, 1994), consolidation can also increase non-price competition, of which specialization is a recognized form (Fennell, 1980, 1982; Luke et al., 2004; Succi, Lee, & Alexander, 1997). Little research has examined inpatient service line specialization as a strategic response to heightened market concentration.

Specialization in the Hospital Sector: Rationale for Focusing Internally

While the number of general, community hospitals has steadily declined in the wake of consolidation during the 1980s and 1990s, dramatic growth has subsequently occurred in the specialty surgery category. As shown in Table 2, the number of facilities in this category has doubled in just five years, between 2000 and 2005. This is consistent

Table 2

*Structure of the U.S. Community Hospital Sector: Number of Facilities*

| Type of Hospital | 2000 | 2005 | % Change |
|---|---|---|---|
| General, short-term | 4,915 | 4,936 | 4.3 |
| Long-term care | 1,856 | 2,108 | 13.6 |
| Specialty surgery | 46 | 91 | 97.8 |
| Total | 6,817 | 7,135 | 4.7 |

Note: Sourced from "The Economics of Specialty Hospitals," by J. E. Schneider, T. R. Miller, R. L. Ohsfeldt, M. A. Morrisey, B. A. Milner, & P. Li, 2008, *Medical Care Research and Review*.

with the overall expected shift toward specialization, whether such capacity is located within general or single-focused, specialty hospitals in the community.

Specialty hospitals – which historically have included long term psychiatric, rehabilitation, children's and other hospital types – fill particular service niches, serving targeted groups of patients with narrowly defined needs and condition. More recently, specialty hospitals have emerged that offer single-focused, specialist-provided procedures such as ophthalmic or orthopedic surgery. Many of these facilities are under physician-ownership or established through corporate financing (Shi & Singh, 2004).

One important counter response of general, community hospitals is to offer their own specialty centers or to focus on one or more lines of service. Service line competition is attractive as a hospital strategy for a number of reasons. It locks in

physician admissions to hospitals, taps into demand for consumer choice, creates profit centers, captures scale efficiencies, builds on the advantages of volume and quality, and enhances community image and reputation (Berenson, Bodenheimer, & Pham, 2006). There is growing evidence that the pre-1990s pattern of competing for physician loyalty by building the best facilities and obtaining the most up-to-date technologies is re-emerging (Berenson et al., 2006). The formation of hospital systems and clusters and the alliances with physicians in the early 21st century signal the likelihood that general, community hospitals are again giving greater attention to clinical service line strategies.

In the wake of technological advances described earlier, many general, community hospitals have opened free-standing, same-day surgery centers for the provision of lower risk, minimally invasive procedures such as cataract or laser vision surgeries. Pursuit of this defensive option by general, community hospitals is aimed at preventing physicians, for profit corporations, or local hospital rivals from opening their own ambulatory care centers. As a point of distinction for discussion purposes, this is termed "external specialization."

In contrast to "external specialization," the intentional shift by general, community hospitals in the mix of cases treated is a form of specialization that might be referred to as "internal specialization." Both strategic options are enhanced by the presence of local clusters because they provide a platform for hospital partners to collectively plan the community-wide delivery of care through shared resources and strategic commitment. All such forms of specialization are consistent with the recommendation that general, community hospitals reorganize around narrower ranges of

clinical activities, distinguish themselves on quality and service, and restructure their relationships with physicians (Grote, Levine, & Mango, 2006; Luke, Luke, & Muller, in press). Internal specialization, in particular, achieves the objective of insulating revenues of the institution's bedrock, inpatient services. If done within clusters of hospitals under a common ownership, internal specialization can preempt loss of shares to competitors, since such specialization is coordinated with same-system members. While considerable research is increasingly focusing on ambulatory, out-patient services, or external specialization, little attention is being paid to internal specialization, which is the focus of this study.

## Theoretical Perspectives on Specialization

Michael Porter's book on healthcare reform, in which he advocated the need for hospitals and other providers to specialize in defined clinical areas (Porter & Teisberg, 2006), highlights the role specialization might play in competitive strategy. Perhaps of greater importance is his emphasis on market structure and concentration (Porter, 1980) as determinants of market change. In other words, Porter emphasized the key role external forces in markets might play in driving strategic response. An alternative argument, known as the resource-based view (Penrose, 1959), is also consistent with specialization as a competitive strategy. By contrast, however, this perspective emphasizes internal resources and capabilities as the necessary foundations organizations need to be able to establish distinctive positions, such as through specialization, in markets. Penrose postulates that the existence of superior, internal resources and core

competences gives organizations long-term advantages by enabling them to establish
sustainable positions over time and, especially, in the face of on-going change.

Both the market structure and resource-based perspectives point to the need for
hospitals to engage in specialization strategies as a key means by which they might attain
competitive advantage in highly uncertain and rapidly changing healthcare environments.
While they emphasize different economic arguments, market structure and internal
resource and capability considerations are highly interdependent (Porter, 1985). Effective
positioning requires an understanding of market structures and competitor conduct, while
internal competencies shape the choices organizations make, including determining the
exigencies of positioning.

Work by Lawrence and Lorsch (1967) serves as a basis for viewing the role
clusters might play in facilitating specialization among member hospitals. The Lawrence
and Lorsch perspective would view inter-organizational structures such as same-system
hospital clusters as a contingent response to environmental turbulence and change. It also
explains the need for clusters, once formed, to balance two responses characteristic of
complex organizations – differentiation through specialization (as between the respective
hospital members) and integration (the unification of facilities that as a consequence of
differentiation need greater coordination). As noted in Chapter Two and borrowing from
Dayhoff and Cromwell (1993), differentiation, as applied to the study of hospitals,
contrasts the services offered by individual hospitals to those provided by same-system
members located in the same market. Integration refers to the processes and structures
needed to unify the differentiated entities. The work of Lawrence and Lorsch (1967)

provides a framework for explaining the conditions under which same-system hospitals might collectively engage in a coordinated scheme of service line specialization through both differentiation and integration. Their perspective is thus important to the research because it serves as the platform for explaining inter-organizational coordination of services in the local delivery of care.

Research Issues in Hospital Specialization: Options in Selecting Service Lines

It remains to be determined what areas of specialization general, community hospitals are most likely to pursue. Hospitals could emphasize service lines that reflect local community needs, are preferred by influential medical staff members, have a high financial impact on the hospital, enhance community image, or offer other benefits. Undoubtedly, any one hospital will have multiple reasons for seeking to develop selected service lines over time, should it choose to pursue such a strategy.

Given the substantial capital investments in high technology equipment discussed earlier, an increase in selective patient volumes is required to generate adequate returns to financially justify such outlays. Meanwhile, deep discounts on general, community hospital charges are demanded by private payers in exchange for the preferred provider, in-network status necessary to give community residents ease of access to a particular hospital. Uncompensated care (charity cases and bad debt) continually rises for U.S. community hospitals, having increased from $10.0 billion in 1988 to $36.4 billion in 2008 and reached 5.8% of total hospital expenses (American Hospital Association, 2009). Thus, only a fraction of the gross charges billed are actually collected. The pressure on hospitals therefore to fill beds with patients whose diagnoses will generate meaningful,

collectible revenue streams is both great and complex. Consequently, selecting top ranking service lines representing a combination of highest patient volume and highest revenue-generating potential based on charges captures two important dimensions that hospital administrators are likely to consider in judging what to emphasize in the pursuit of specialization strategies. Although it is acknowledged that actual costs and therefore profits by service line vary among hospitals, it is assumed that charges, in combination with patient volumes, can serve as a proxy for relative importance and thus a basis for the designation of service line priority.

Thus, a two-step process is used in identifying and selecting the nation's top service lines to study. Two separate steps are necessary because the top ranking hospital cases measured by patient volume are not necessarily the same as those ranked by total charges, and thus an effort is made to assess both lists in search of those major diagnostic classifications that appear among both top rankings. Both sets of rankings are drawn from the Clinical Classification System (CCS) of diagnostic categories from the Agency for Healthcare Research and Quality (AHRQ) national Healthcare Cost and Utilization Project (HCUP) data (Agency for Healthcare Research and Quality, 2007). The first step ranks categories by annual patient case volumes. As a second step, AHRQ's national statistics from HCUP are again utilized to identify leading diagnostic categories with one or more service lines providing hospital care ranked by aggregate dollar charges. Regardless of whether service lines are selected based on their ranking of aggregate charges by principal diagnosis or on the basis of total inpatient case volumes, the same six service lines emerge among the top 10 for selection over others and thus are chosen

for this study, namely: (a) labor and delivery, (b) pulmonary services, (c) cardiology, (d) invasive cardiology, (e) cardiac surgery, and (f) orthopedics. These same six service lines also emerge among the top ranking lines by patient volume and in terms of patient charges for the sample states in the research.

<div align="center">Overview of Research Methodology</div>

The study uses a retrospective, nonexperimental, correlational design to analyze secondary data relating to service line specialization by acute care general, community hospitals located in three states: Florida, Virginia, and Nevada. The study uses 2007 data, the most recent year for which hospital information is available from a combination of government and private sources. Hospital discharge data are obtained from Intellimed, a private company that provides to hospitals all-payer data made available to it by state hospital associations of individual states. Market and organizational measures used as independent variables are obtained from both the U.S. Census Bureau (U.S. Census Bureau, 2008) and AHA (American Hospital Association, 2008), as well as the Area Resources Files (ARF) collected by the Office of Data Management within the Health Resources and Services Administration (HRSA) of the U.S. Department of Health and Human Services (DHHS).

The study uses regression modeling to analyze cross-sectional relationships between market and organizational characteristics as independent variables and selected measures of specialization as the dependent variables. Five measures of specialization are examined as dependent variables: (a) **Internal Service Concentration**, measured by calculating an internal Herfindahl-Hirschman Index (HHI) that compares service line

shares within each hospital; (b) **Internal Share**, measured by the percentage of cases for each of the six service lines selected for study derived separately from among a single hospital's total cases across all service lines; (c) **Expected Market Share**, a hospital's variance from expected share, defined by the hospital's overall share in the market, in each of the six selected service lines; (d) **Market Change**, the change between 2003 and 2007 in a hospital's share of its local market in each of the selected service lines, and (e) **Cluster Change**, the change between 2003 and 2007 in a hospital's share of its cluster with sister hospitals in each of the selected service lines. The internal HHI, as a measure of concentration, represents the classic use of the index defined further in Appendix A. In the derivation of **Cluster Change**, a cluster is defined as a local market in which two or more hospitals in the same-system reside. Alternative methods for measuring specialization are discussed in Chapter Four on Methodology.

The study examines the influence of internal, organizational factors, including the tax status of a hospital system ownership (**Ownership**), whether a hospital in a same-system cluster enjoys leadership in share of service line case volume (**Cluster Lead Hospital**), and facility size based on inpatient bed count (**Hospital Size**). In addition, the study examines external, market factors, including population density (**Density**), population growth rate (**Growth)**, the population's proportion of persons 65 years and older (**Age**), those living in poverty (**Poverty**) as a percentage of the market population, the local presence of specialty physicians relative to the size of the residential population (Physicians) and degree of competitiveness (**Competitiveness**) as measured by the

inverse of each hospital's market HHI (Zwanziger & Melnick, 1988). State is treated as a covariate and entered into regression as a group.

<div align="center">Significance of the Research</div>

This study offers a number of potentially important benefits. First, it attempts to measure service line specialization, which is a likely response hospitals will make to increased financial and market pressures and significant organization and market structural change within the hospital sector. Second, it can contribute to understanding what might be some of the organizational and market correlates with hospital specialization. Third, findings may shed light on whether general, community hospitals are narrowing services as means by which competing local rivals modify their historical, general hospital model of delivering a broad, even duplicative, array of services to the community. Fourth, it examines the possible role cluster formation might play in the rationalization of clinical capacities across the clustered hospital members.

Service line specialization in hospitals is central to a number of management, research, and policy considerations. First, it highlights the interdependencies between the well-known economic and other performance advantages of specialization and the strategic advantages of increased market concentration. In order to assess this relationship, it is considered important to understand what factors might be associated with hospital specialization. Is it being done in a coordinated way within hospital system clusters or is it distributed across hospitals in ways that might have more to do strictly with local market forces? Second, does it reflect financial motivations, such as might be implied if hospitals were to emphasize the highest revenue-generating service lines that

are the focus of this study? As a corollary, to what extent are patterns of specialization reflective of increased preparedness by general, community hospitals to respond to an aging populace with multiple chronic diseases and conditions? Third, is this a growing trend in the hospital sector and, if it is, are the markets consolidating beyond that which occurred as a result of the recent wave in mergers and acquisitions? Fourth, what might be the implications for management and system design, if specialization is present across all top ranking service lines or not present at all? Additionally, what role might the clusters play in facilitating specialization, over what might be possible for free-standing hospitals? Fifth, how would information on patterns of hospital specialization help in confirming organizational responses to turbulent, environmental uncertainties? Sixth, how does the study of specialization within hospitals increase an understanding of non-price competitive responses typical of oligopolistic structure and behavior (Luke et al., 2004). Such comprehension can elevate the level of understanding of healthcare market strategy by hospital management and policymakers alike.

Findings and conclusions may ultimately point to ways by which hospitals might improve efficiencies, for example, by reducing redundancies within multi-hospital clusters. They could also highlight benefits of quality and safety improvement potentially available when patient volumes are increased in selected facilities where expertise, knowledge, and experience are concentrated. Depending on findings, new light could also be shed on how hospital systems navigate relationships among physicians, same-system hospitals in clusters, and even payers.

Addressing the identified gaps in research surrounding the presence of service line specialization by general, community hospitals will potentially guide future strategic thinking, decision-making, and resource allocation in the hospital sector (Birkmeyer, 2000). Commitment to a focused, clinical service lines orientation will allow traditional full-service, community hospitals to optimize their competitive positioning in local markets, capitalize on core competences, and leverage their value to sister companies or system affiliates, either locally or regionally. Attuned to such opportunities, they can avoid capitulating to niche, specialty hospitals (Devers, Brewster, & Casalino, 2003), possibly better integrate and even improve the quality of care they deliver to their patients. Such research benefits provide insights into potential strategies for the means by which higher quality, lower costing inpatient healthcare might be delivered in response to changing needs of our population.

# CHAPTER TWO: LITERATURE REVIEW

## Overview

The purpose of this chapter is to discuss what is known about whether general, community hospitals compete using specialization strategies and, more specifically, whether they specialize in high volume, high revenue-generating service lines. For simplicity of discussion, acute care hospitals providing both medical and surgical services to the public will be referred to as general hospitals throughout this and subsequent chapters. This chapter is divided into four sections. The opening section focuses on the historical context for the influence of specialty physicians on a general hospital case mix. The second section discusses three major trends potentially driving the general hospital to adopt clinical service line specialization as a competitive strategy: (a) demand for improved hospital quality and safety, (b) the need for greater efficiencies to curb spiraling costs of inpatient services, and (c) increased rivalry among hospital competitors following the rapid consolidation of the 1990s. This section integrates brief commentary on the growth in and countervailing pressure against specialization by acute care hospitals. The third section draws on the literature to offer a rationale for the service lines chosen as the focus of this study. It concludes with a fourth section and discussion of gaps in the literature and thus support for the research.

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Influence of Specialty Physicians on the General Hospital's Service Offerings

Specialization is a key area of research interest because of the longstanding influence specialty physicians exert on the mix of services hospitals offer. The steady growth in the science and complexity of medicine not only produced increased specialization in the medical profession, but a growing need for an institutional base within which physicians could be trained and practice (Anderson, 1990). Considered a hallmark of American medicine, professional specialization has directly influenced the breadth and depth of services general hospitals offer (Starr, 1982). It also has increased greatly the dependency of hospitals on physicians, as hospitals wishing to attract patients need to please specialty physicians who perform revenue-generating procedures and secure community support for them. The pursuit of physician patronage has thus contributed to high levels of service capacity duplication across local institutions (Starr, 1982).

The rise of private insurance, combined with passage of Medicare legislation in the mid-1960s, produced added financial incentives for hospitals to compete for physician loyalties by providing greater levels of service capacity. This incentive diminished somewhat when Medicare reimbursement shifted from cost-plus to a prospective payment system (PPS), with some arguing that the supply of specialized service capacity is actually determined solely by the extent to which substantial scale economies can be demonstrated with economic modeling (Dranove, Shanley, & Simon, 1992). Regardless, hospitals continued to grow in complexity, duplication increased, and the strong relationship between hospitals and specialty physicians remained intact. Given

the importance of this history, it is surprising that the relationships among specialty medicine, competition, and service line specialization by the general hospital have received relatively limited health services research attention.

Despite the tendency to increase complexity and duplicate services, market pressures on general hospitals have increased the need for them to reduce costs and increase revenues, especially after the introduction of coverage of the elderly and disabled by Medicare and the indigent by Medicaid. This has fueled service line competition, which has produced key secondary effects: (a) locking in physician commitment to specialized hospital services that are compatible with physicians' professional and financial interests, (b) tapping into heightened consumer expectations for quality, particularly influenced by the demands of the aging baby-boomer generation for evidence of technical expertise, (c) creating profit centers to focus on high margin services, and (d) enhancing community image and reputation (Berenson, Bodenheimer, et al., 2006).

Hospital specialization options that flow from the above pressures include: (a) internal specialization (formation of centers or institutes within a general hospital), (b) building free-standing, specialty hospitals, and (c) spinning off ambulatory-based specialty facilities, typically in collaboration with local physicians (Berenson, Bodenheimer, et al., 2006). All such options produce tensions between hospitals and specialty physicians, as shifts in capacity and location of services disrupt patterns of practice and realign established competitive and cooperative relationships between hospitals and members of their medical staffs (Berenson, Ginsburg, & May, 2006). One

option for reducing such tensions is for hospitals to employ their physicians, which has become an important and growing trend in the hospital sector (Casalino, November, Berenson, & Pham, 2008).

It is well documented that physicians can strongly influence the choice of hospitals by their patients (Sarel, Brendaly, Marmorstein, & Barach, 2005; Smithson, 2003), although there is mixed evidence that they generate demand to protect their incomes (Rice & Labelle, 1989). When choosing specialists and facilities for medical procedures, most patients rely on physician referrals, with relatively few making choices based on word of mouth or rankings provided by media, government, and private organizations (Tu & Lauer, 2008). Patient dependency on physicians thus increases the power that medical specialists are able to exert over hospitals, in managed care contract negotiations and in other valuable domains (Dranove & White, 1996). In fact, physicians are found to respond to economic incentives in making hospital referrals and admission decisions (Nakamura, Capps, & Dranove, 2007).

Still, the connection between specialty physicians and hospital choice is not seamless. Although hospitals have pursued acquisitions of physician practices as strategies to lock in referrals, analysis shows that just under one-third of such acquisitions actually led to increased referrals (Nakamura et al., 2007). Researchers have documented evidence of growing friction between hospitals and specialty physicians over competing services, in instances of newly established, physician-owned specialty hospitals and ambulatory surgery centers. Tension with community physicians over hospital emergency department (ED) call schedules has intensified the friction, as doctors especially in small,

single-specialty practices are reluctant to devote attention to high numbers of the uninsured, likely to seek medical treatment in the ED (Berenson, Ginsburg, et al., 2006). The evidence suggests that doctors are choosing either to be in competition with hospitals or employed by them (Casalino et al., 2008). In light of inconsistencies between intent and results, it is possible patient referrals may be more successfully restructured through local cluster arrangements than by reliance on hospital/physician relationships alone.

Trends Driving the General Hospital to Consider Service Line Specialization

Three major trends are driving the general hospital to adopt clinical service line specialization as a competitive strategy: (a) demand for improved hospital quality and safety, (b) need for greater efficiencies to curb costs of inpatient services, and (c) increasing non-price rivalry among local hospital competitors. These trends have surfaced against a backdrop of technological advancements that are extending the age of Americans with chronic conditions and facilitating growth in outpatient, same-day surgery services, rendering acute care inpatient services for the gravely ill and invasive procedures. In combination, all of these factors have spurred system restructuring, which includes an expansion of multi-hospital systems and, more recently, the formation of local and regional systems in clusters.

*The Call for Improved Hospital Quality and Safety*

Calls for improvements in the U.S. healthcare delivery system have continued since the Committee on the Costs for Medical Care issued its "Final Report: Medical Care for the American People" (Committee on the Costs of Medical Care, 1932). Two influential reports published in the 1990s by the Institute of Medicine (IOM) of the

National Academy of Sciences have increased concern about performance: "To Err is Human: Building a Safer Health System" and "Crossing the Quality Chasm: A New Health System for the 21st Century." The former revealed a growing body of evidence substantiating medical errors as a leading cause of death and injury in the United States and appealed to the nation for remedies to lower error rates (Institute of Medicine, 1999). The latter recommended a redesign of the American healthcare system to foster innovation and improve the delivery of quality care (Committee on Quality of Health Care in America, Institute of Medicine, 2001).

One key recommendation to come from these reports was that patients should be directed to hospitals and doctors who have performed the greatest volume of identical procedures, particularly costly, high risk, highly specialized surgeries with high mortality rates. This recommendation was based on the assumption that high volumes are correlated with high experience, high expertise, and thus high quality. The Leapfrog Group, which represents a coalition of Fortune 500 companies and group purchasing organizations (The Leapfrog Group, 2000), formalized a volume-driven recommendation for improving quality in the standards it circulated to participating hospitals. The standards established minimum, annual hospital volume levels for seven high-risk, costly procedures (Every et al., 1999; Harmon et al., 1999).

The Leapfrog Group based its recommendations on an extensive literature that provided albeit mixed support for the relationship between volume and quality (Begg et al., 1998; Eastaugh, 1992; Luft et al., 1979). A growing body of research has been published since 2000 that generally supports a positive relationship between patient

mortality rates and surgeons with greater procedure-specific experience (Birkmeyer et al., 2002; Birkmeyer et al., 2003; Brahmajee, 2006; Halm, Lee, & Chassin, 2002; Hannan et al., 2005; Milstein, Galvin, Delbanco, Salber, & Buck, 2000; Murin, 2005; Peterson, Coombs, DeLong, Haan, & Ferguson, 2004).

Based on mixed findings in these and other more recent studies, researchers have increasingly recommended that referrals to hospitals be based on demonstrated, superior, risk-adjusted outcomes and the adaptation of evidence-based therapies rather than on patient volume alone (Kumbhani et al., 2009). As an example, however, of the complexity in making choices, referrals to hospitals with the best outcomes for even high-risk obstetrics – where the choice may appear obvious – unfortunately remain the exception rather than the rule (Milstein, 2005). There is also evidence that mortality rate differences between high volume and low volume hospitals are mediated by unmeasured characteristics of patients and that surgeon volume alone may provide a more reliable indicator of quality, even if those physicians perform surgery in more than one hospital (Dimick, Birkmeyer, & Upchurch, 2005). There are some who argue that qualitative research methodologies should be used in assessing quality, rather than strictly traditional quantitative approaches (Christian, Gustafson, Betensky, Daley, & Zinner, 2005). This includes taking into consideration the impact on patient outcomes of multidisciplinary, inpatient care teams beyond the surgeon, and even across service lines in the case of patients with multiple co-morbidities.

Still, The Leapfrog Group's underlying message remains central to the call for increasing volumes to improve quality. By 2005, over half of all U.S. hospitals and two-

thirds of California's hospitals responded to its annual survey, even though reporting of adherence to The Leapfrog Group's standards for case volume and other quality measures remained voluntary (Murin, 2005). In October 2006, The Leapfrog Group announced its first-ever list of top hospitals based on its survey results from over 1,200 hospitals. The report revealed weak adherence to the volume requirements, as nine in ten responding hospitals failed to meet the standards for performing two high-risk procedures, coronary artery bypass graft (CABG) and abdominal aortic aneurysm (AAA) repair. Additional significant shortfalls were also noted (The Leapfrog Group News Archive, 2006), all of which raised questions about whether The Leapfrog Group should continue to promote volume-based specialization by general hospitals for the treatment of high-risk procedures. Consequently, The Leapfrog Group has more recently shifted its attention to "efficient" delivery of care in naming its 2009 top hospitals on the basis of adherence to standards in computer order entry systems, performance standards for high-risk procedures, ICU staffing, quality outcomes, length of stay, readmission rates, and incidence of hospital acquired infections (The Leapfrog Group, 2009).

Most hospitals in the U.S. are considered general, community hospitals (Shi & Singh, 2004), although a number of specialty hospitals fill particular service niches by serving targeted groups of patients with narrowly defined diagnostic needs or treatment requirements. Historically, specialty hospitals have tended to fall into such categories as psychiatric or rehabilitation hospitals. In recent decades, they have expanded into a number of procedural categories, such as cardiac and orthopedic surgery, many of which have been established under physician or corporate ownership (including many local

hospitals and clusters) arrangements. Table 3 documents a trend towards specialization

within the entire hospital sector.

Table 3

Trend in Specialization by All U.S. Hospitals

| Type of Hospital | 2000 | 2005 | % Change |
|---|---|---|---|
| General, short-term | 4,915 | 4,936 | 4.3 |
| Psychiatric | 491 | 481 | (2.0) |
| Rehabilitation | 1,102 | 1,235 | 12.1 |
| Long-term care | 263 | 392 | 49.0 |
| Subtotal non-surgical | 1,856 | 2,108 | 13.6 |
| Special surgery[a] | 46 | 91 | 97.8 |
| Subtotal specialty | 1,902 | 2,199 | 15.6 |
| Total community hospitals | 6,817 | 7,135 | 4.7 |
| Percentage of general, short-term community hospitals | 72.1 | 69.2 | |

[a]Special surgery includes orthopedic, cardiac, and general surgery centers.
Note: Sourced from Kaiser Family Foundation (2007) and the Medicare Payment Advisory
Commission (2005-2007).

Over the period 2000 to 2005, growth in the relatively small sub-sector of

hospitals, specialty surgical, far outpaced their general, short-term hospital counterparts,

showing an increase of 97.8% compared to 4.3%, respectively. Taken together, the

growth rate in all specialty hospitals of 15.6% is nearly four times that of the general, short-term community hospital category (Schneider et al., 2008). This could be explained by a new emphasis on hospital-specialist partnerships (Lake, Devers, Brewster, & Casalino, 2003). Initial reports from site visits indicate that physician-owners of specialty hospitals are more likely than others to refer to their own facilities, treat a healthier population than general, community hospitals, and deliver generally higher quality care to more satisfied patients (Greenwald et al., 2006). However, subsequent, larger scale studies have found that the quality of care received at cardiac hospitals is only equivalent to, but no better than, care provided at general, acute care hospitals. Moreover, patients with co-morbidities undergoing procedures at niche, special surgery hospitals experienced poorer 30-day mortality rates after discharge. Such findings suggest that single-focused, specialty hospitals may not be the best choice for patients requiring greater coordination and management of care (The Robert Woods Johnson Foundation, 2008). In fact, researchers undertaking a retrospective cohort study of over 700,000 Medicare patients at 1,130 hospitals who underwent coronary artery bypass graft (CABG) surgery during 2001 to 2005 concluded that greater cardiac specialization by the hospitals based on higher proportional discharges in cardiac surgery was not associated with clinically significant improvement in patient outcomes (Girotra et al., 2010). How the general hospital of the future staffs and organizes to accommodate patients having higher acuity and multiple co-morbidities remains a challenge (The Joint Commission, 2008). Inpatient service line specialization could be an alternative, by enabling

specialization, while retaining coordination internally as well as spatial and organizational integration with other established, general hospitals in the local market.

Despite the incentives to promote high patient volumes through targeted hospital specialization, general hospitals may still be reluctant to specialize. For example, it may be that hospitals in markets with excess hospital capacity are more inclined toward consolidation than those in markets in which capacities are constrained (Birkmeyer, 2000). Case mix also is likely to be a factor. Sowden, Deeks, and Sheldon (1995) have suggested the need to carefully assess case mix, which should reflect the need for multidisciplinary teams – resources typically available in general hospitals – to be available to treat patient populations that have greater severity and co-morbidities. In cancer treatment, for example, the benefit of access to team resources over a highly specialized treatment center has been demonstrated (McCarthy, Datta, Sherlaw-Johnson, Coleman, & Rachet, 2008). There is also the issue that distances and travel times limit patient access to specialty care provided in more distant facilities. This is especially important when planning rural access to specialized capabilities in urban centers (Onega, et al., 2008). It is also a concern in the transfer of patients from one urban area to another, especially for high risk patient populations and those requiring urgent, high level care such as burn victims.

Payers are increasingly recognizing that hospitals need to be compensated more fairly in treating more severe cases, based on the level of care required to treat them. In late 2007, Centers for Medicare and Medicaid Services (CMS) replaced its 538 Diagnostic Related Groups (DRGs) with 745 Medicare Severity Diagnosis Related

Groups (MS-DRGs), a move aimed at redistributing payments among different types of inpatient cases in order to account for complications and co-morbidities upon hospital admission (Centers for Medicare & Medicaid Services, 2008). A year later, CMS announced an end to payment for hospital acquired complications, making coding upon admission and case-mix management in general increasingly important to a hospital's financial health. Not only are these changes to the Medicare inpatient prospective payment system likely to result in payment increases to urban hospitals that treat more severely ill patients, but also the new payment policy could serve to promote specialization strategies by general hospitals.

These issues notwithstanding, specialization is already well advanced in most local markets. Academic medical centers generally have long functioned as centers receiving referrals for the provision of specialized services, especially for rare conditions and illnesses (Moses, Thier, & Matheson, 2005). Recognizing the unique qualities of hospital categories, a benchmark study designating the nation's top 100 hospitals in cardiovascular care for their superior clinical and financial value segregated general hospitals in tiers – major teaching hospitals, teaching hospitals, large community hospitals, medium community hospitals, and small community hospitals - to compare performance among peer hospitals in each group (Foster, 2009). Still, researchers have not confirmed that vertical integration, pursued by "hub" hospitals that acquire outlying "feeder" hospitals drives referrals to the hub or has improved efficiencies and/or outcomes (Nakamura et al., 2007).

Many issues remain to be addressed in the volume/quality arena, such as the role of intensivists and other hospital-based physicians, appropriate minimum volumes for particular procedures and diagnoses, risks associated with patient profiles including age, the indirect consequences of local redistributions of capacity, and differences in the validity of the volume/quality relationship across the medical specialties (Christian et al., 2005; Glance, Dick, Mukamel, & Osler, 2007; Goshima, Mills, Awari, Pike, & Hughes, 2008; Grilli, 2001; Konety, Allareddy, Modak, & Smith, 2006; Urbach & Baxter, 2004). Also, performance varies by a number of factors unrelated to volume, such as surgeon characteristics, how often a doctor performs a given procedure, subspecialty training and certification, and the hospital setting in which the surgeon operates (Birkmeyer, 2004; Dimick & Birkmeyer, 2008). These all show that hospital volume may be a weak proxy for quality of performance and thus outcomes for most surgical procedures. Individual quality measures have significant limitations for assessing surgeon performance, and a simple composite of mortality and volume may be a better predictor of performance than either measure alone.

Beyond the many confounding factors that could affect the volume/quality relationship, there is also the endogeneity problem – known as the "practice makes perfect" hypothesis – that volume could produce better performance, while at the same time, better performers could attract greater demand and thus higher volumes. Clearly, it is important that the direction of causality be established. And, finally, there are policy issues, including, in particular, the diminishing effect specialization could have on

competition and market-driven innovation (Epstein, 2002; Shortell, Morrison, & Hughes, 1989).

In sum, while the literature suggests that many factors affect performance and outcomes, in addition to volume and experience, it also provides general support for the relationship between volume and quality. Aside from the many conceptual, practical, and clinical arguments, general hospitals and their systems are motivated by competitive pressures and community expectations to provide the best care possible to their local populations (Dayhoff & Cromwell, 1993; Leander, 1993). On the other hand, it often appears that many hospitals today remain possibly suspended in the tension between two competing, strategic agendas: the need to compete for the same patients – leading to an emphasis on broadening the range of services offered – and the need to establish uniqueness and differentiation – leading to greater service line specialization. Research on organizational transformation reveals that organizations do not change their fundamental properties quickly, even when environmental opportunities and constraints change. Such structural inertia is even viewed as pathological (Carroll & Hannan, 2000).

*Approaches for Achieving Greater Efficiencies*

As recently as 2005, approximately one-third of total national health expenditures occurred in inpatient hospital facilities, despite the shift of services to outpatient settings to lower costs of patient care. Inpatient care costs thus remain a concern for policymakers and payers, having increased from $417.0 billion to $611.6 billion in just 5 years between 2000 and 2005, for an average annual increase of 8% (which was more than twice the rate of inflation over the same period) (Health, United States 2007, 2008). Partly as a

result of this, workers' health insurance premiums have increased more than five times faster than wages between 2000 and 2007 (Families USA, 2008). With the continuing spiral in healthcare costs, the pressure on hospitals to increase efficiencies remains intense.

One approach to improving efficiencies is to emphasize specialization, for example, by shifting capacity among hospitals in the same-system in a given market to eliminate redundancies and capture economies of scale (Dranove et al., 1992). While much research has examined economies of scale in hospitals, there is limited evidence of the role service line specialization might have played in generating efficiencies, either within individual hospitals or among same-system hospitals operating locally. Economies might apply to hospital specialization at three basic levels: (a) a pruning of service lines by individual hospitals to lower per unit costs per case (Eastaugh, 1992; Farley & Hogan, 1990), (b) the development of specialty institutes or centers within the walls of general hospitals, and (c) the shifting of service capacities within local or regional hospital clusters to "lead hospitals" within those clusters. The degree to which these are pursued and whether they are being pursued with success is not known, as there is little published research on patterns of specialization in hospitals. For example, despite the publicly announced designations of "centers of excellence" in bariatric surgery (to encourage payer coverage of procedures in quality institutions based on mortality statistics), there is limited evidence of the degree to which this has created greater efficiencies in the delivery of care for obesity (Surgical Review Corporation, 2007).

The rationale for specialization is rooted in the industrial revolution, with its concomitant focus on experience, economies of scale, the assembly line, and a division of labor. Henry Ford was one of the first to apply such concepts by introducing the assembly line to American automobile manufacturing in 1908 ("Henry Ford Changes the World, 1908," 2005). By applying the concept of "division of labor," the industrialist pursued the dual objectives of maximizing error-free quality while minimizing per unit costs of production. The learning strategies emphasized the benefits of repetition, retention and ultimately competence, as B. F. Skinner (1969) documented in his experiments about behavioral learning decades later.

In the hospital sector, specialty hospitals apply the concept that core competencies, cultivated by specialized routines and focused activities, can result in quality improvement, competitive advantage, and production economies (Shortell et al., 1989). While by comparison to the smaller, single focused hospital, the general hospital would be expected to experience efficiency losses attributable to their broader scope of services and accompanying internal politics and information impediments (Schneider et al., 2008), there is little evidence that specialty hospitals are more efficient than general hospitals (Carey, Burgess, & Young, 2008).

The alternative to single-facility specialization is internal specialization, which hospitals pursue by emphasizing selected, inpatient service lines. To the extent that this is tied to local hospital clusters, this configuration would build on an historic stream of arguments for specialization within complex multi-plant organizations. Skinner (1974), for example, argued that multi-plant firms engaged in producing multiple product lines

should restructure production such that individual plants specialize in narrower ranges of products and production activities. This would produce economies of scale in single-plant production, while maintaining the advantages attributable to economies of scope through multi-plant coordination. Skinner's "focused factory" approach is consistent with the concept of coordinated specialization within geographic clusters of hospitals. Skinner's concept relies on three premises that are relevant to hospitals and the hospital-based clusters, in particular: (a) there are multiple ways to achieve competitive advantage, (b) a general hospital, like a conventional factory, cannot easily achieve superior performance in every service line, and (c) simplicity, repetition, experience, and homogeneity of tasks contribute to improved performance.

In fact, one of the hallmarks of changes in U.S. industry during the second half of the 20th century was the adoption of lean production, flexible specialization, and focused factories, resulting in many business establishments becoming less diverse and more specialized (Schneider et al., 2008). Skinner's points suggest that specialization can be considered a strategy for collaborating hospitals within the same multi-hospital system, following the notion that hospitals, like manufacturing plants, may divide the functional service line tasks they share. The application of Skinner's focused factory principle for achieving efficiencies in sub-units is discussed further in Chapter Three, as the work of Lawrence and Lorsch (1967) is called upon to integrate same-system general hospitals with cluster analysis.

*Increased Rivalry Among Hospital Competitors*

In addition to the call for improved hospital quality and safety and the need for greater efficiencies to curb costs, the third trend potentially driving the general hospital to adopt clinical service line specialization is the increased rivalry generated by the merger and acquisition wave of the 1990s in the U. S. It produced two important effects related to specialization. First, it has greatly increased the levels of market concentration, as hospitals and other providers have formed system clusters at local and regional levels (Luke, 2010). Although economic theory postulates that increased concentration can lead to lower price competition (Kovacic & Smallwood, 1994), concentration can also increase non-price competition, of which specialization is an important form (Fennell, 1980, 1982; Luke et al., 2004; Succi et al., 1997).

Second, increased concentration in the acute care hospital sector has intensified the level of non-price rivalry among the much-reduced number of competitors in local markets (Alpha Center for Healthcare Planning, 1997; Douglas & Ryman, 2003). Some researchers find the growing importance of non-price competition among hospitals has revived tactics of the hospital's pursuit of individual physician referrals with renewed investments in high technology equipment and facilities, which Robinson and Luft (1985) described in the 1980s as a "medical arms race" (Devers et al., 2003). As evidence of the latter, hospitals invested nearly $20 billion in imaging equipment such as MRIs in 2000 (a year just following the most intense phase of the merger and acquisition wave), publicly affirming the expectation that the growth in spending on this technology would increase by 133% in the decade, 2000 – 2010. Based on a jointly published study by the

AHA and The Lewin Group, hospitals are expected to invest an estimated $200 billion on new hospital construction between 2004 and 2014 (American Hospital Association and The Lewin Group, 2005). Although retail clinics and ambulatory surgery centers captured much of the attention of healthcare professionals during the decade, the 29th Annual Construction & Design Survey published by Modern Healthcare shows that in 2007 most healthcare construction dollars were spent on inpatient hospital facilities, underscoring the continuing importance of non-price competitive strategies in an increasingly concentrated acute care sector (Robeznieks, 2008).

Others attribute the boom in hospital construction during the first decade of 2000 to more than the effects of market concentration, but also to changing demographics and psychographics, including, in particular, the prevalence and aging of baby boomers (Albert, Johnson, Gasperino, & Tokatli, 2003). With relatively greater wealth in approaching retirement, the graying consumer tends to demand not only more comfortable and convenient accommodations in healthcare (e.g., private rooms and valet parking) but access as well to the very latest developments in specialty equipment technology (e.g., robotics for surgery) than consumers in the past. Additionally, some acute care providers feel pressured to build or remodel facilities to be more environmentally friendly than structures of earlier eras, indicative of their hospital marketing efforts to cater to even the ideologies of targeted consumer audiences (Robeznieks, 2008). Such factors have led to substantial, increased capital spending in recent years by general hospitals. These investments, in one form or another, could well

signal targeted marketing strategies by general hospitals, consistent with a move toward specialization, especially in high volume, high revenue-generating service lines.

<center>Service Line as a Target of Specialization by Hospitals</center>

In the wake of technological advances, an increasing number of surgical and diagnostic procedures are being performed on an outpatient basis. Consequently, many general hospitals have opened free-standing, same-day surgery centers for lower risk, minimally invasive procedures such as cataract or laser vision surgeries. Considered a defensive strategy in communities where physicians or for profit corporations are opening ambulatory care centers and special surgery facilities without regulatory interference, this physical unbundling of services by a general hospital, historically offering only inpatient care, could be viewed as a means of "external specialization." While an option, such a segregation of services does not directly contribute volume to inpatient bed capacity utilization or provide service backup of the general hospital with acute care and emergency services. Consequently, outpatient services as a means of external specialization are not the focus of this research, even though they do constitute an important possible form of hospital specialization.

An alternative strategy for the general hospital is specializing along selected, inpatient service lines, or "internal specialization." It is consistent with the recommendation that general, community hospitals reorganize around a narrower range of clinical activity, distinguish themselves on quality and service, think more like the service retailers they are fast becoming, and overhaul their relationships with physicians (Grote et al., 2006). Choice of this strategic option is enhanced by the coordinated

involvement of geographical cluster members because cluster membership provides a pathway for hospital partners collectively to plan for a community-wide delivery of care through shared resources. It also achieves the objective of insulating patient volumes and thus revenues of a hospital's bedrock, namely inpatient services. This goal can be accomplished without losing shares of patients to competitors, since such specialization can be coordinated with same-system members. The concept is parallel to the creation of academic magnet schools within a citywide or countywide public school system (Brooks, Stern, Waldrip, & Hale, 1999). Specialization by internal, clinical service line thus emerges as a key strategy worthy of study and a concept proven to work outside of healthcare.

Prior to the early 1970s, the major variable employed for the analysis of community hospitals was hospital size, measured by number of inpatient beds. Among the early analyses of service scope was research conducted by Carr and Feldstein (1967) that grouped hospitals by the number of facilities and services. Research by Edwards, Miller, and Schumacher (1972) used four specific indices to classify community hospitals by scope of service. Another early study was conducted by the American College of Physician Executives in 1988. This study found that half of the hospital respondents to a survey indicated that they conducted service line management or operated "centers of excellence." The most prevalent service lines emphasized by hospitals at the time were categorized as cardiopulmonary, emergency care, intensive care, and oncology (Hammon & Davis, 1989). During this era, service line management grew in importance in the hospital sector.

While service line management has gained strength, the actual definition of a service line continues to vary from organization to organization (Tesch & Levy, 2008). Complicating comparative analysis is the fact that it is not strictly defined by the AHA. In fact, there are many ways to define service lines, including groupings along medical specialties, DRGs, specific patient conditions, surgical procedures, different patient services, or other clinical categories (Desai & Margenthaler, 1987). Whichever definition is chosen, a service line is traditionally considered a separate and distinct business unit within the hospital and often evaluated by management as a profit-and-loss center (Nackel & Kues, 1986).

Regardless of how services are segregated and defined, analyzing competitive position in the market based on specific hospital services rather than the volume of discharges in the aggregate is needed (Shi, 1997). For nearly two decades, hospitals have granted exclusive contracts with specialty physicians in hopes of securing a targeted stream of patients, offering evidence of service line specialization (Dranove & White, 1996). With the escalating battle between hospitals and physicians for control over specialty services in what may be a new medical arms race (Berenson, Bodenheimer et al., 2006), there is an even a stronger rationale for analyzing specialization in the general hospital sector, by assessing those inpatient service lines that can generate meaningful streams of revenue (and ultimately operating profit to cover administrative overhead) based on charges and patient volumes. In light of Americans living longer and with multiple co-morbidities, some researchers are placing more emphasis on coordination of care with a patient-centered service line model inclusive of primary care, disease

management, and prevention/education and wellness spanning multiple venues of service intervention (Porter & Teisberg, 2006; Tesch & Levy, 2008). This further complicates service line segregation for meaningful analysis.

*Selecting Service Lines to Study: A National Perspective*

There are various dimensions of inpatient specialization on which hospitals might focus. Three that might be considered are: (a) highest average patient charge per case, (b) highest demand as measured by patient volume, and (c) highest aggregate hospital revenue as measured by charges upon patient discharge. Focusing solely on patient volume without taking into consideration revenue-generating capability, by charge per case or in the aggregate, could highlight service lines that may not generate sufficient dollars to cover adequately the overhead of infrastructure needed to support high volumes of patients. A possible example is patients with mood disorders, classified among inpatient psychiatric services, ranked ninth in hospital patient volume by service line but 22nd in terms of aggregate charges, according to national HCUP statistics. Alternatively, selection of service lines based on the highest charge per case is likely to include highly specialized services for costly, rare conditions and thus lack relevancy to the broader needs of the local population. Instead, selecting top service lines representing a combination of high patient volume based on numbers of discharged cases and high revenue-generating ability based on charges captures two important dimensions that hospital administrators are likely to consider in judging what to emphasize in the pursuit of specialization strategies. This is especially true since profits after direct operating costs

and returns on specialized capital equipment by service line vary from hospital to hospital and are not publicly reported.

Thus, a two-step process is used in identifying and selecting the nation's top service lines to study in the sample of hospital data used for the research. The first step ranks the leading diagnostic categories by patient volume relying on AHRQ's national statistics derived from HCUP data (Agency for Healthcare Research and Quality, 2007), associating each leading CCS-classified category with one or more service lines providing hospital care for such patients, the top 10 of which are illustrated in Table 4.

Aside from general surgery and general medicine service lines that virtually all general hospitals offer, the top ranking service lines based on national statistics for inpatient volumes are likely to include: (a) labor and delivery, (b) pulmonary services, (c) cardiology, (d) cardiac surgery, (e) orthopedics, and (f) invasive cardiology. As a point of comparison, Thomson Healthcare, a private healthcare data services company, reports that its top five inpatient services lines, in descending order, based on number of patient visits for the most recent year (2007), and used in proprietary analyses for clients of Thomson Healthcare, are: cardiology, internal medicine, pulmonary, gastroenterology, and orthopedics (Strach & Young, 2007).

Still, hospital billing data for public or private payers are not organized by service lines but rather by diagnosis code upon discharge and are comprised of procedures that may cross multiple services lines. Indicative of support for aggregating charges by diagnosis for purposes of analysis in the research, HCUP staff published findings based

Table 4

Top Ten Inpatient Diagnostic Categories Based on 2007 Volume of Discharges

| Diagnosis Represented | Total Cases (000) | Rank by Diagnosis | Service Line(s) |
|---|---|---|---|
| Liveborn | 4,542.7 | 1 | Labor and Delivery |
| Pneumonia | 1,171.5 | 2 | Pulmonary Services, General Medicine |
| Congestive heart failure | 1,024.9 | 3 | Cardiology, General Medicine |
| Coronary atherosclerosis | 963.9 | 4 | Cardiology, Invasive Cardiology, Cardiac Surgery, Vascular Surgery, General Medicine |
| Trauma to perineum | 867.8 | 5 | Labor and Delivery |
| Osteoarthritis | 814.9 | 6 | Rheumatology, General Medicine, Orthopedics |
| Other maternal birth Complications | 810.4 | 7 | Labor and Delivery |
| Nonspecific chest pain | 788.4 | 8 | Not determinable |
| Mood disorders | 774.3 | 9 | Psychiatric Services, General Medicine |
| Cardiac dysrhythmias | 731.5 | 10 | Cardiology, Invasive Cardiology |

Note: Sourced from the Healthcare Cost and Utilization Project (HCUP) State Inpatient Databases (SID) of the Agency for Healthcare Research and Quality (AHRQ). Retrieved October 24, 2009, from http://hcupnet.ahrq.gov/HCUPnet.jsp. U.S. National Statistics are represented by $1,033.835.7 million in charges and 39.5 million cases.

on its HCUP data indicating that one-fifth of the national hospital bill was for treatment of five conditions: coronary artery disease, mother's pregnancy and delivery, newborn infants, acute myocardial infarction, and congestive heart failure, with circulatory diseases accounting for six of the 20 most expensive conditions billed to Medicare (Andrews, 2008). Similarly, the selection of service lines for purposes of this research is further examined using the CCS-classified diagnosis categories from AHRQ's national statistics based on national HCUP data. Ranked by aggregate dollar charges, the top ten are depicted in Table 5.

As illustrated by Table 5, regardless of whether service lines are selected based on their ranking of aggregate charges (revenues) by principal diagnosis or on the basis of total caseloads (volumes) of patients by principal diagnosis based on national statistics in 2007, the top six service lines selected for study readily emerge among the top ten rankings are represented by: (a) labor and delivery, (b) pulmonary services, (c) cardiology, (d) cardiac surgery, (e) orthopedics, and (f) invasive cardiology. (While septicemia, or blood infection, is ranked third in charges [and 11th in volume], and complication of device implant or graft, is ranked seventh in charges [and 14th in volume] according to the HCUP data, both defy categorization in a service line and thus are excluded from choice.) All six service lines, rather than only one or two, have been selected for study because they broadly represent inpatient treatment of both acute care needs and chronic diseases and conditions and span a high percentage of community dwellers of different ages potentially served by their local, general hospital. They are also

Table 5

Top Ten Inpatient Diagnostic Categories Nationwide Ranked by 2007

| Diagnosis | Hospital Charges ($ Millions) | Rank by $ Charges | Total Cases (000) | Service Lines(s) |
|---|---|---|---|---|
| Coronary atherosclerosis | 44,868.3 | 1 | 963.9 (4th) | Cardiology, Invasive Cardiology, Cardiac Surgery, Vascular Surgery, General Medicine, General Surgery |
| Liveborn infant | 9,624.5 | 2 | 4,542.7 (1st) | Labor and Delivery |
| Septicemia | 38,828.1 | 3 | 675.4 (11th) | Not determinable |
| Myocardial infarction | 33,826.7 | 4 | 624.9 (6th) | Cardiology, Invasive Cardiology, Cardiac Surgery |
| Osteoarthritis | 33,595.1 | 5 | 814.9 (5th) | Rheumatology, General Medicine, Orthopedics |
| Congestive heart failure | 32,312.1 | 6 | 1,024.9 | Cardiac, Invasive Cardiology, General Medicine |
| Implant complication | 30,580.3 | 7 | 623.9 (14th) | Not determinable |

Table 5-continued

| Diagnosis | Hospital Charges ($ Millions) | Rank by $ Charges | Total Cases (000) | Service Line(s) |
|---|---|---|---|---|
| Pneumonia | 29,864.3 | 8 | 1,171.5 | Pulmonary Services, General Medicine |
| Spondylosis | 25,813.3 | 9 | 633.7 (12th) | Orthopedics |
| Respiratory failure (adult) | 23,944.0 | 10 | 385.8 (28th) | Pulmonary Services |

Note: Sourced from the Healthcare Cost and Utilization Project (HCUP) State Inpatient Databases (SID) of the Agency for Healthcare Research and Quality (AHRQ). Retrieved October 24, 2009, from http://hcupnet.ahrq.gov/HCUPnet.jsp. U.S. National Statistics are represented by $1,033,835.7 million in charges and 39.5 million cases.

represented among the top ranking service lines, measured by charges and case volume, in the sample database for study.

*Alternatives to Selection of Service Lines Based on Volume and Revenue*

Alternative criteria for the selection of service lines exist. Previous research, for example, has focused on specialization as a means of reducing costs and thus improving economic efficiency. Such was the focus of much analysis in the 1980s by Eastaugh (1992), Farley and Hogan (1990), and others. More recently, Gu (2005) examined the effect of specialization on hospital financial performance using indicators of profitability from HCUP data for 11 states. However, these studies did not isolate the strategic choices by a hospital among service lines. Alternatively and from a competitive strategy perspective, this study seeks to identify patterns of relationships in response to opportunities or constraints externally in a hospital's marketplace, such as population

characteristics, or to strengths and resources internally, such as bed count or ownership

tax status, which could influence its choices in specialization. Therefore, the identity of

targeted service lines for study based on major national trends serves a useful purpose.

Since net profitability by service line is not reported publicly by hospitals and thus

unavailable in the databases used for analysis, the selection of service lines for study

based on rank by profitability is not considered an option. The benefits of utilizing

HCUP's clinical classification system as a means of consolidating scores of diagnoses

and associated procedures are described further in Chapter Four on Methodology.

<div align="center">Gaps in the Literature Bridged by the Study</div>

With this backdrop, the research aims to determine if evidence exists of

specialization in the form of high volume, high revenue-generating service lines among

general hospitals. Where evidence of such targeted specialization surfaces, descriptive

characteristics of hospitals will help fill the following gaps in the literature:

1. A focus on service lines which most, if not all, general hospitals could readily

offer, in assessing specialization as a local, competitive strategy, as opposed to highly

specialized, rarely performed procedures that do not necessarily relate to widespread

healthcare needs across a population;

2. Analysis of high demand, high revenue-generating service lines within a

hospital as a unit of study rather than the clinical outcomes of the patient, concentrating

on competitive strategies rather than clinical outcomes or cost efficiencies as is seen

throughout the literature in discussions about case volumes of hospitals or surgeons; and

3. Analysis of general, community hospital cluster relationships in a common multi-hospital system in the context of service line specialization.

This opens a vast opportunity for analysis of inpatient service line specialization as a competitive strategy by the general, community hospital. This endeavor could well be important in the study of specialization because of the new ground to be traversed for subsequent research. The potential value of undertaking this research is that:

1. Leaders in the hospital sector might gain insight into the factors associated with strategic choice, with an emphasis on specialization;

2. Healthcare outcomes might well be improved in those instances in which better outcomes follow higher volume, more narrowed focus. Understanding both the determinants of specialization and the relationships between specialization and outcomes could contribute to our improving quality;

3. Guidance for future research about specialization options by general community hospitals could be better framed; and

4. Hospitals may realize a strategically feasible pathway for avoiding duplication of services and for pruning marginal service lines without sacrificing responsiveness to the broad, acute and chronic care needs of their local community. Skinner's concept of focused manufacturing, and other arguments point to the need to include in the analysis an examination of the role cluster membership might play in shaping patterns of general hospital specialization.

Summary of the Chapter

This chapter reviewed the historical context for the influence of specialty physicians on a general, community hospital's case mix and thus its service lines. Three major trends driving the general, community hospital to adopt clinical service line specialization as a competitive strategy were discussed. The drivers are: (a) demand for improved hospital quality and safety, (b) the need for greater efficiencies to curb spiraling costs of inpatient services, and (c) increased rivalry among hospital competitors surviving consolidation of the 1990s. Briefly, the impact of surgical specialty hospitals, the influence of The Leapfrog Group on high-volume, specialty services, and countervailing pressure against volume-supported specialization were also discussed. The advantages and disadvantages of different measures of hospital specialization were compared, and the justification for selected measures was offered. Rationale for isolating the six highest revenue-generating, clinical service lines with highest patient case volume was presented. With the individual hospital as the unit of analysis, the last section isolated descriptive characteristics of hospital organizations and their market environments based on the literature, for correlation with each of the service lines targeted for study. The designation of lead hospitals in clusters is suggested as a possible facilitator of specialization and thus included among the descriptive variables chosen as predictors in the analysis. The gap in literature to be filled by the research concludes this chapter and lays additional justification for such a study as outlined.

CHAPTER THREE: THEORETICAL SETTING

Introduction

This chapter introduces the broad bodies of strategic management and organization theory as possible conceptual bases for explaining the pursuit of specialization by general hospitals. Following a summary of the origins and evolution of strategic management perspectives, the second section of the chapter briefly surveys 10 different views of strategic management classified as "schools of thought" by Mintzberg, Ahlstrand, and Lampel (1998). The objective is to identify those frameworks that might serve as a theoretical foundation for the formulation of constructs and hypotheses. Two perspectives emerge from this review, and both are subsequently discussed in greater depth: (a) the market structure perspective (called the "positioning" school by Mintzberg et al. and largely comprised of Porter's [1980] contributions drawn from industrial organization economics) that addresses organizational responses to external marketplace forces; and (b) the resource-based view that emphasizes core competences (resources and capabilities) and addresses the responses of organizations to external stimuli. The third section examines four prominent perspectives in organization theory. From this review, one theoretical perspective - based largely on the contributions of Lawrence and Lorsch (1967, 1969) – is identified as potentially helping to explain the role that complex organizations, specifically hospital clusters, might play in enabling hospitals to engage in

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specialization. As a response to turbulent conditions in the environment, their perspective recognizes the need for organizations, as uniquely differentiated units internally, to be concatenated and fused into an integrated whole. This is consistent with the necessity for general hospitals that are members of clusters to be differentiated (e.g., through service line specialization) as well as unified through inter-organizational coordination. The fourth section uses these three perspectives to identify the primary constructs of interest in this study. The market structure perspective draws attention to the key factors external to organizations, while resource-based view focuses on those elements considered internal to organizations. The perspective of Lawrence and Lorsch (1967, 1969) considers the role hospital clusters might play in facilitating service line specialization within selected cluster-member hospitals. The chapter concludes with a fifth section that formulates a series of hypotheses that guide the empirical analysis of general hospital specialization through highest patient demand (volume) and highest revenue-generating (based on charges) service lines.

<div align="center">Strategic Management Perspectives</div>

<div align="center">*The Origins and Evolution of Strategic Management*</div>

Strategic management, as a field of scholarly inquiry, comprises a number of perspectives that address how organizations formulate strategy – a process focus – and what factors are important in strategic choice – a content focus. The latter perspectives are of interest to this study, as they apply to the rationale for strategic choice. The former apply more to the mechanisms organizations use in decision making and thus do not apply to this study.

The origins of strategic management as a discipline in the 1950s and 1960s rest on the founding principles chiefly provided by Drucker, Selznick, Chandler, and Ansoff. Peter Drucker (1954), a prolific strategy theorist and organizational consultant, made many valuable contributions on the process side of strategic management, including the concept of management by objectives (MBO). Philip Selznick (1957) made many important contributions to organization theory that have application to the management of strategy, including his focus on mission and distinctive competencies in determining organizational responses to the environment. His work thus constitutes some of the early contributions to the assessment of internal organizational resources and capabilities as bases for gaining competitive advantage. He advocated for strengths and weaknesses to be assessed in light of opportunities and threats in the business environment, ultimately laying the foundation of thinking for the ubiquitous SWOT analysis performed by organizations the globe over. Alfred Chandler (1962) recognized the value of coordinating all aspects of management under a single, all-encompassing strategy for the organization. In his seminal work on strategy and structure, he advocated for a long-term, coordinated strategy to give a company structure, direction, and focus. Igor Ansoff (1965) built upon Chandler's early work by introducing a range of concepts for applying strategies aimed at directing market penetration, product development, market development, and diversification. He contributed as well by emphasizing the need for organizations to visualize and fill the distance between where a company is and where it wishes to be.

By the 1970s, much of the attention of theorists addressed issues of organizational size, growth, and portfolio (Buzzell & Gale, 1987). During the 1980s, strategic management concerned itself with corporate values, giving rise to a renewed interest in continuous process improvement to achieve both productivity gains and enhanced competitiveness (Deming, 1982) at a time when Japanese corporate culture supporting "kaizen" and total quality management were in vogue (Ohmae, 1982; Pascale & Athos, 1981). Hamel and Prahalad (1990) advanced the concept of core competency and the importance of identifying one or two key capabilities that distinguish an organization from its competitors. One of the most influential strategists of the 1980s was Porter, who introduced the concepts and tools of industrial organization economics for use in the analysis of strategy. Porter's work contributed importantly to the identification of market determinants and, therefore, will be used in identifying constructs of interest in this study.

Other perspectives were added in the 1990s and the subsequent decade, including the application of complexity theory and chaos theory to help explain the dynamic and adaptive nature of strategic decision making and the important role information plays in a knowledge-driven environment. During its evolution, the psychology (Barnard, 1938; Isenberg, 1984, 1986) and the limitations (Hamel, 2002) of strategic management were added as recognized dimensions. In summation, the body of strategic management represents a vast array of contributions by many individuals over recent decades, focusing either on the mechanisms of strategic decision making (processes) or the determinants of strategic choice (content). Because the research seeks to understand the drivers and thus the content of strategic choice (McClelland, 1953), perspectives on

content rather than process will be used in formulating research constructs. The next section attempts to sift through the different perspectives spanning much of the body of strategic management in search of concepts and frameworks that could be used in this research.

<center>*The Ten Mintzberg "Schools"*</center>

In an effort to synthesize the major conceptual perspectives in the field of strategic management, Mintzberg et al. (1998) suggested that the field could be summarized by grouping them into what they called "ten schools of thought." They assigned the following names to the schools: (a) design, (b) planning, (c) positioning, (d) entrepreneurial, (e) cognitive, (f) learning, (g) power, (h) culture, (i) environmental, and (j) configuration. Eight of the ten are readily discarded as they address process considerations: (a) design school (Selznick, 1957) for its emphasis on steps in decision making and the need to achieve a fit between strengths and weaknesses and external threats and opportunities; (b) planning school (Ansoff, 1965) for its emphasis on formal processes; (c) entrepreneurial school for its emphasis on intuitive thinking and visioning and the role of the chief executive in decision making (Schumpeter, 1942); (d) cognitive school for its focus on cognition as a means of information processing, knowledge mapping, and concept attainment (March & Simon, 1958); (e) learning school for its focus on the chaotic steps of strategy formulation (Bower, 1970; Burgelman, 1980; Lindblom, 1959); (f) power school for its focus on the process of negotiation and the use of power over others in alliances, joint ventures, and other network relationships, rendering a discontinuous process to the formulation of strategy (Alison, 1971; Astley &

Sachdeva, 1984; Hedberg & Jönsson, 1977); (g) culture school for its anthropologic focus on a social process of coalescence with perpetuation rather than introduction of change (Normann, 1977; Rhenman, 1973), and (h) configuration school for its historical emphasis on organizational transformation, combining the view of organizations as dynamic forms of characteristics and behaviors undergoing the process of start-up, turnaround, and integration (Chandler, 1962).

Mintzberg et al. (1998) maintain that only two schools focus directly on content. One is the positioning school, with its emphasis on market structure (concentration, barriers to entry, degree of differentiation) and rival conduct. The other is the environmental school, with its emphasis on external determinants (political, economic, social, and technological) of strategic change. Another perspective, the resource-based view, while not included among the 10 schools discussed by Mintzberg and colleagues, also focuses on content over process and thus will be examined for its relevancy to this study. The environmental school actually includes a fairly diverse collection of theoretical perspectives and analytical tools. For example, the authors include within this school such perspectives as contingency theory and population ecology. The environmental school will thus not be considered explicitly, but some perspectives will be discussed subsequently in this chapter.

*Market Structure Perspective*

Classifying Porter's contribution as the positioning school, as Mintzberg et al., (1998) and many others have done, actually misrepresents what Porter brought to field of strategy. Rather than positioning, Porter's most important contribution was to incorporate

the structural concepts and tools of industrial organization (IO) economics into the analysis of strategy (Hoskisson, Hitt, Wan, & Yiu, 1999). Grounded in decades of theoretical and empirical development, IO economics emphasizes the role market structure plays in driving competitive moves by rivals. Among the most important structural features are: market concentration, height of entry barriers, and degree of differentiation in the market (Bain & Qualls, 1987). Increased consolidation, higher entry barriers, and greater differentiation in the markets mean that fewer competitors exercise greater market power and, therefore, pose greater competitive threat than would be the case under other market conditions. In addition, Porter broadened the structural reach to include threats from buyers, sellers, new entrants, and substitutes.

Market concentration is an important factor in the analysis of the sector of healthcare services, given the significant consolidation that occurred in the 1990s, especially in the hospital sector. Following the wave of mergers and acquisitions in the 1990s, small numbers of often large and relatively powerful hospital rivals dominated competition in most urban markets across the country. Thus, it is important to include measures of market structure into an analysis of general hospital specialization, particularly market concentration.

Positioning, as a key dimension of strategy, helps to clarify the importance of specialization which can be viewed as a form of positioning. As Porter suggests, organizations in their competitive maneuvering generally decide among three generic competitive strategies or positions – cost leadership, differentiation, and focus (Porter,

1980). Each of these has direct application to service line specialization because each

calls for an element of distinction among competitors, if successful.

It is noteworthy that in their analysis of the healthcare industry itself, Porter and

Teisberg (2006) highlight the need for healthcare organizations, hospitals in particular, to

move away from the general hospital model in place for over a century toward

specialization strategies. Their specific criticisms of the industry include: (a) the range of

services is too broad for distinction to be found; (b) the focus on individual, discrete

services in the form of isolated procedures is too narrow, whereas a broader, more

integrative focus on care for diagnosed health problems (service line) would be better;

and (c) the geographic focus is too localized, whereas a broader geographic reach

inherent in specialization strategies is preferable. The general hospital model, they argue,

fails to capture the advantages of concentrating effort and identity on the treatment of

defined clinical problems. As a result, hospitals and other providers are too costly, not

sufficiently responsive to specific needs in the population, not sufficiently integrated, and

do not achieve the level of quality otherwise attainable with higher volumes in specific

areas.

What Porter and Teisberg (2006) miss in their analysis is how individual, free-

standing hospitals can specialize successfully in highly competitive environments. In

particular, they do not consider the role that hospital clusters, which now exist in nearly

all markets across the country, can play in facilitating the restructuring of service

capacities among local hospital same-system members. In other words, they did not

consider the impact of mergers, acquisitions, or other strategic maneuvers both on market

structure and on the ability of hospitals to restructure their clinical functions within local systems. Put another way, Porter and Teisberg argue for specialization but overlook the opportunities inherent in a focused factory strategy that same-system hospital clusters could offer. The discussion of clusters resumes later in this chapter in the context of work by Lawrence and Lorsch (1967, 1969).

Some have criticized the positioning school for its emphasis on consolidation, dominance, and mature markets (a criticism also leveled against the field of strategic management overall). An overemphasis on analytically derived strategies focused on market power could create blind spots to new information and emerging strategies. Bower and Christensen (1995) criticize the market structural approach for its lack of emphasis on new entrants and substitutes relative to threats within the vertical channel from buyers, sellers, and, of course, rivals. Given the increasingly important role technological change is playing in today's economy, they also point to the need for organizations to become more aware of the possibility that disruptive technologies in the form of innovations could change the bases on which markets are defined, the forms competition takes, and the players involved in that competition. Examples of disruptive technologically-based changes include the refrigerator replacing the icebox for chilling and the personal computer replacing mainframes for processing. Still another example is the retooling of the reservations process, boarding, and scheduling procedures by Southwest Airlines, which represented a major disruptive, technological change that structurally altered the forms of competition in the airlines industry.

The foregoing criticism is relevant because the healthcare industry is especially vulnerable to disruptive technological change, given the rate and degree of change in such areas as surgical devices, drug therapies, gene therapy, electronic medical records, and other innovations. It is therefore considered valuable to view specialization as not only a response to changes in market structure and relative market power but also as part of an evolving technological revolution in the healthcare field. It is important for providers to revisit traditional ways of organizing and delivering services in order to keep up with unexpected changes, in part, driven by changes in technology.

*The Resource-based View*

The resource-based view argues that competitive advantage is generated from distinctive resources and capabilities internal to an organization. It also suggests that if these resources and capabilities are protected against imitation, transfer, or substitution, they can help secure long-term advantages for an organization. Edith Penrose is credited with the founding idea of viewing a firm as a bundle of resources and linking a firm's performance to the interaction between material and human resources (Hoskisson et al., 1999). She argued that it is not the resources or capabilities themselves but the contributions they make to improving production processes that produce competitive advantage. Managerial capability, Penrose maintained, is a particularly important constraint that limits the growth of firms, a scenario generally known as the "Penrose Effect" (Penrose, 1959). More generally, this perspective suggests that an entity's growth is a function of firm-specific, distinctive resources and capabilities.

Decades later, Prahalad and Hamel (1990), Barney (1986; 1986; 1991; 1991), and others applied the resource-based view to strategy. Barney, for example, argued that superior performance relative to rivals results from acquiring and exploiting unique resources. Others maintained that well-chosen strategies allow firms to exploit their core competencies in the marketplace (Hoskisson et al., 1999). Figure 1 summarizes the application of the resource-based view to the achievement of sustainable competitive advantage in the marketplace.

Competitive Advantage Phase                                                  Sustainability Phase

| Productive use of the firm's resources which are valuable, rare, and appropriately offer….. | ⟹ | Short term competitive advantage | ⟹ | That needs to be sustained over time to defend against resource imitation, substitution, and mobility by rivals |
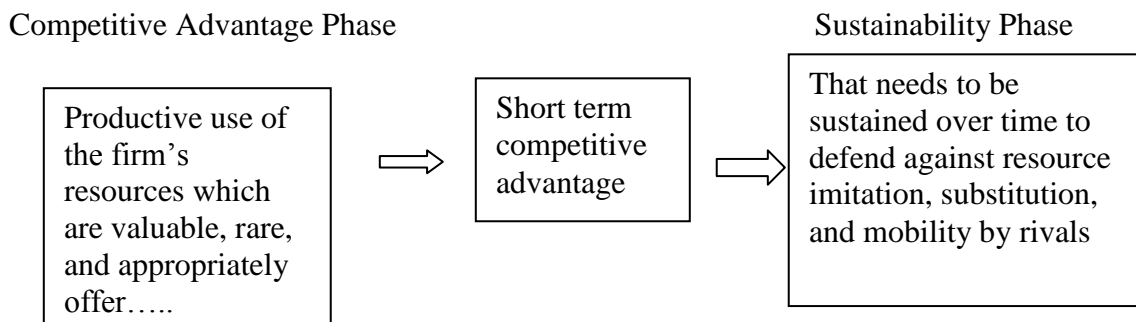
Figure 1. The resource-based view: sustaining competitive advantage over time.

Note: Sourced from Wade, M. & Hulland, J., (2004). The resource-based view and information systems research: review, extension, and suggestions for future research. *MIS Quarterly*, 28, 107 – 142.

The resource-based view can be seen as representing a hybrid of the learning and culture schools (Mintzberg & Lampel, 1999), as it highlights the assessment of core capabilities and competences as part of internal organizational design strategies and processes. The more descriptive learning school, reminiscent of the work of Itani and Roehl (1987), is compatible with the resource-based view to the extent that individual facilities, systems, and human resources are enhanced based on experience and learning.

The learning school sees strategies as emergent and derived from resources and capabilities that reflect an organization's core competencies.

As it is resistant to significant change, culture infuses an organization with the discipline to follow protocol and thus to insulate itself against errors that otherwise might be incurred were it to operate outside standard procedures. Such thinking reflects the influence of Japanese management practices especially prevalent in the 1980s (Hedberg & Jönsson, 1977). The culture school focuses on competencies rooted in an organization's culture rather than relying on leadership to direct its strategic focus. This, too, supports a focus on core competencies (distinctive resources and capabilities) that specialization presumably could refine and improve, building on evidence-based practices and experience. While not initially recognized by Mintzberg (1998) and colleagues among their 10 schools of thought, the resource-based view addresses the distinctive internal resources and capabilities needed for an organization to capture the advantages of specialization.

The resource-based view has been applied extensively to the information technology services sector, given the key role distinctive resources and capabilities play in that industrial arena. Some even consider it the dominant view of business strategy (Barney & Clark, 2007). With its focus on the internal sources of advantage and tie it to performance, it should instead be seen as providing an ideal complement to the market structure perspective with its emphasis on external factors and analysis.

In sum, the field of strategic management includes a collection of concepts, tools and analytical frameworks drawn from the study of organizations, business management,

and markets (Hoskisson et al., 1999). These have application not only to firms generally but also to healthcare organizations. The perspectives of strategy are especially applicable, given the rapidity and pervasiveness of change that have occurred in American healthcare in recent decades (Trinh & O'Connor, 2002). It is essential that one focus not only on an organization's external environment but likewise on the many internal resources and capabilities that enable organizations to produce distinctive responses to the many threats in their environments (Shortell & Zajac, 1990). By drawing specifically on Porter's concepts of market structure as an external determinant and Penrose's focus on distinctive resources and capabilities as internal determinants of service line specialization, the competitive response of general, community hospitals to their opportunities and threats can be examined in the context of theoretical constructs.

Organization Theory

Organization theory studies individual and group dynamics in an organizational setting as well as whole organizations, how they adapt, and the strategies and structures that guide them. The field has evolved to include a focus on power, culture, and the interaction among whole populations and among organizations. The relationship between environment and organizational structure is especially important in organizational theory and thus should provide additional conceptual support for the study of specialization by general hospitals.

*The Origins and Evolution of Organization Theory*

While the roots of organizational theory can be traced back to the ancient Greek philosophers Plato and Aristotle who recognized the influence of leadership,

organizational theory developed most meaningfully in the first half of the 20th century when Frederick Taylor (1917) established scientific management theory (Walonick, 2008). Taylor's principles, in addition to their focus on matching workers with tasks and closely supervising them, charged management with the task of planning and control. The Second World War shifted the emphasis externally to the field logistics and operations research. The early 1970s through the 1980s witnessed the introduction of four prominent perspectives amidst an explosion of theories developed in the body of organization theory: resource dependency theory, population ecology theory, exchange theory, and contingency theory.

*Assessing the Theoretical Perspectives*

Resource dependency theory (Pfeffer & Salancik, 1978) argues that organizations respond to demands made by external actors or organizations upon whose resources they are heavily dependent. Given such dependency, they will try to minimize those dependencies, especially should access to them be threatened (Pfeffer, 1982). They do this in part by entering into inter-organizational arrangements in order to minimize risk and augment organizational power. Unlike the resource-based view, resource dependency theory is developed from the perspective of relationships with other organizations as opposed to internal strengths, distinctiveness, and uniqueness. This perspective does not per se focus on internal restructuring strategies, such as those included in hospital specialization. As a result, resource dependency theory is not directly applicable to the study of general hospital service line specialization.

Population ecology theory (also called organizational ecology), developed by Hannan and Freeman (1989), suggests that social processes on a macro level play a greater role than managerial action in determining an organization's success or failure. This perspective analogizes to Darwinian evolution to explain founding and death rates of organizations as they respond to environmental stimuli. Population ecology theory asserts that: (a) organizations develop routines that ensure reliability and accountability, (b) reliability and accountability require organizational structures that are highly reproducible, (c) the reproduction of routines that are similar across organizations is the cause of organizational inertia, considered a consequence of selection, and (d) the environment will favor organizations with high inertia. This rather fatalistic perspective of organizational behavior, however, does not point to specific adaptive responses organizations might make to their environments. It therefore provides little help in formulating specific responses by hospitals to external stimuli, whose responses in this study include decisions to engage in service line specialization. Population ecology theory is therefore rejected for lack of applicability to the study.

Social exchange theory explains social change and stability as a process of negotiated exchanges between parties. The theory posits that all relationships are formed by the use of subjective cost-benefit analyses and comparisons of alternatives. While sociologist Homans (1958) is generally credited with consolidating the early foundations from which the theory took shape, Thibaut and Kelley (1959) are credited for having developed and promoted the theory of social exchange. They framed the theory on the premise that anticipated reciprocity, gain in reputation and influence over others, and the

perception of efficacy and thus even altruism constitute the reasons people engage in social exchange. During the 1970s and 1980s, Emerson and Cook (1978) expanded upon the theory in the study of power, equity, and the creation of commitment during bargaining processes between individuals, undertaken always with the goal of achieving balance. While widely applied in the study of organizational behavior, social exchange theory is principally relevant to vertical relationships and thus often paired with transaction cost analysis. Again, as with the former two perspectives, exchange theory does not address the kinds of strategic responses that would lead hospitals to engage in specialization for purposes of gaining competitive advantage for themselves in their markets and thus is not considered applicable to this study.

A fourth prominent framework, contingency theory, also addresses organizational adaptation to environmental change. However, it is set apart from the three previously discussed perspectives by its focus on horizontal strategies and coordination. This point of distinction renders it potentially applicable to the study of inter-organizational coordination among hospitals in their pursuit of service line specialization. In studying four large U.S. corporations, Chandler (1962) proposed a precursor to the theory's full development that the structure of an organization naturally evolves to accommodate strategy, in a rational, sequential manner in response to an organization's external environmental elements and forces. Specifically, this perspective has applications to the study of hospital clusters that could coordinate service line specialization by trading and shifting clinical capacities within systems in local markets. Proponents of the contingency theory (Burns & Stalker, 1961; Lawrence & Lorsch, 1967; Perrow, 1967; Rundall,

Starkweather, & Norrish, 1998; Thompson, 1967) suggest an organic form of organization is likely to be more effective than one less integrated when the environment is complex and dynamic, tasks and technologies are non-routine, and a relatively high percentage of professionals are involved.

From the foregoing, the work specifically by Lawrence and Lorsch (1967) is selected to serve as a theoretical bridge between externally driven, market-based challenges and internal capacity restructuring, as might be required by hospitals that are members of clusters in the pursuit of clinical specialization. The perspective provided by Lawrence and Lorsch thus justifies looking at the restructuring of clinical capacities within same-system hospital clusters as a contingent response to environmental turbulence. In more turbulent environments, complex, multi-organizational arrangements are expected to adopt two inter-related organizational strategies as they seek efficiencies and stability: (a) differentiation across facilities to achieve efficiencies as well as improved market positioning, (b) and integration to achieve unity among the differentiated, but otherwise interdependent entities. As noted in Chapter Two and borrowing from Dayhoff and Cromwell (1993), differentiation, as applied to the study of hospital specialization, contrasts the services offered by individual hospitals to those provided by competitors in the same market. This form of specialization focuses on "external" diversity. Integration is the process of fusing and unifying differentiated entities through inter-organizational coordination. The work by Lawrence and Lorsch therefore provides a framework for explaining the conditions under which same-system hospitals might collectively engage in a coordinated scheme of service line specialization.

Their perspective suggests that complex organizations must balance their pursuit of external, market opportunities for differentiation with increased efforts to integrate organizational activities. Organizations that do both and achieve a unity of effort, Lawrence and Lorsch suggest, should be better able to adapt to environmental turbulence. More diversification implies a greater need for coordination, given that specialized, but interdependent functions and processes need coordination across organizations. In this sense, the framework provided by Lawrence and Lorsch is well suited to the analysis of hospitals that are members of the same-system and located in the same market.

Many clusters are experimenting with mechanisms to integrate clinical functions across their local facilities. While the formation of hospitals into clusters is in itself a means of integration, this study does not examine integration as such. Instead, it examines the possibility that clustered hospital members might locally redistribute specialized capacities among their members in response to market threats.

It is unlikely, however, that all hospitals within a cluster will become more differentiated. While this study is not intended to offer empirical evidence of whether cluster hospitals differ hierarchically by the level and complexity of specialized services they offer, it is logical that where such differences exist among cluster hospitals at least one member will emerge as the site to which one or more targeted lines of services are shifted. Observation of such evidence is expected if clusters do indeed collaboratively engage in service redistribution. This suggests the need to identify the likely specialty service leaders within clusters, as their increase in specialization might be accomplished with a commensurate decrease in specialization by other hospital cluster members. It is

also possible, of course, that clusters will designate a single hospital as the cluster's designated "center of excellence" for a given specialty and another hospital for another specialty. Both possibilities – a single lead hospital within the cluster for all specialty areas or designated lead hospitals for individual specialties – are possible. This suggests the need for an independent variable that indicates whether or not a single hospital serves as lead hospital for each service line and cluster being examined.

Healthcare clusters facilitate the coordination of strategies across organizational boundaries. The work by Lawrence and Lorsch thus provides a useful framework within which to study the inter-organizational coordination of capacity and, more specifically, individual hospital specialization (Conrad & Shortell, 1993; Robinson, 1997; Shortell & Kaluzny, 2000). In this regard, it is particularly relevant that Lawrence and Lorsch (1969) also studied how organizations adjust to accommodate their environments, granting managers at all levels the authority to make decisions contingent on the current situation. Such a perspective gives the local hospital management the freedom to specialize in a service line based on its local environmental factors even if other clusters elsewhere in the system exercise the freedom not to specialize similarly because market circumstances differ. In fully applying this thinking, the study recognizes such freedoms for strategic choice at the local market level and therefore does not assess service line specialization across the same multi-hospital system or across market borders. Lastly, the risks of such choice are implicit, as a general hospital can only pursue specialization in certain services generating high patient volumes and revenues at the expense of forfeiting or lowering investment in lower volume, lower revenue-generating service lines.

The Conceptual Frame

As summarized in Figure 2, the review of the strategic management and organizational theory perspectives has identified three likely determinants of general hospital specialization, the first being external and the latter two being internal to the organization: market structure, resources and capabilities, and system configuration. While each is assumed to have an independent effect on the decision to specialize, some measures selected to represent each construct are likely to be correlated with measures for other constructs. This is because there is considerable endogeneity between external and internal factors. For example, highly concentrated markets are likely to produce greater numbers of clusters, larger clusters, and clusters that are more hierarchically configured (combinations of large, referral hospitals with smaller community hospitals). The latter is likely to be associated with greater specialization, given the greater possibilities for capacity restructuring that might exist within large, complex hospital clusters. It will be important, therefore, to minimize inter-correlations among the variables in selecting measures to represent the constructs.

Hypotheses for Empirical Analysis

Stemming from the simplistic graphic in Figure 2, three constructs are considered to be associated with patterns of service line specialization in general hospitals: market structure, distinctive resources and capabilities, and system configuration. This section discusses the indicators considered for inclusion in the analysis of hospital specialization, first examining external factors followed secondly by internal factors. The hypotheses are based on relationships derived from each set of theoretical arguments presented below.
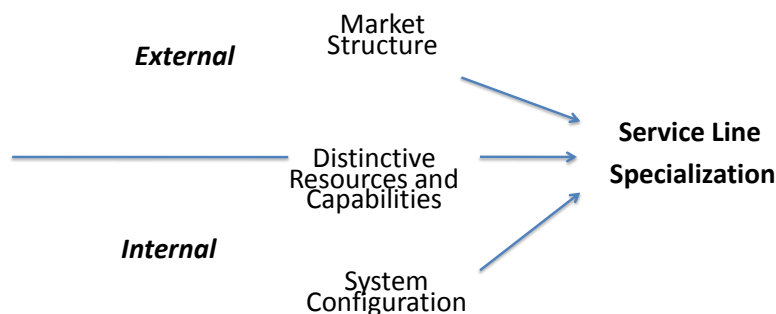
Figure 2. Determinants of service line specialization in general hospitals.

### *Characteristics of the Market Structure Representing the External Environment*

A number of market factors are likely to be associated with variations in patterns of hospital specialization. Consistent with Porter's framework on competitive positioning, these external opportunities and threats include characteristics of market structures such as competitive factors as well as characteristics of demand factors by the local populace. With regard to the latter, it is expected that certain local population characteristics are likely to be associated with the propensity of hospitals to focus on high volume, high revenue-generating service lines.

Based on the arguments from industrial organization economics, it is assumed that broad characteristics of markets are likely determinants of organizational conduct in a market context. The most important such factors represent the two sides of the market

exchange – consumers and suppliers. On the consumer side, these factors include indicators of demand differences across markets. On the supply side, the most important consideration is the degree of market concentration among hospital providers, which is assumed to represent relative levels of market competitiveness. Consumer and supply measures are discussed in this section.

*Growth*

Despite the continuing debate over the effect of hospital procedure volume versus surgeon volume on quality outcomes discussed at length earlier in Chapter Two, patient volume by whatever route is essential to supporting the caseload requirements of both a facility and a physician's practice. An example is illustrated by the study of Nathan, Cameron, Choti, Schulick and Panlik (2009) documenting that in specialty surgery, the relative contributions of hospital volume versus surgeon volume vary according to the specific procedure in question. Even for specialty hospitals, the creation and survival of hospital-owned specialty services depend on the ability to generate and sustain the required volume of referral cases (Furumoto, 1983). In addition, growth sustains the economy of a locale with an ever-increasing base of revenue for financing expanded, local hospital investment in new technology. This in turn attracts specialty physicians to a facility, potentially fueling the addition of services as discussed in Chapter One.

An empirical analysis by Strunk, Ginsburg, and Banker (2006) found evidence that aging will drive 0.74% annual growth in demand for hospital inpatient services over the decade 2005-2015, with the highest rates of growth in services used most by elderly patients. They concluded, nevertheless, that aging is a much less important factor than

local population trends such as growth and changing practice patterns attributable to advancing medical technology. Consequently, rate of growth in the local population is considered a good barometer of demand in the research, since it potentially spans all age groups and generally is associated with the strength of the local economy. Such features of a local area may influence as well diverse investment in medical technology.

On the other hand, general, community hospitals in an area with shrinking or non-growth may feel forced to cut clinical services because of the difficulty in attracting specialty physicians or in an effort to trim expenses on low-revenue generating services. The rate of population growth can affect a hospital's strategic choices in different ways, by either forcing a narrowing of services for differentiation or even survival in a low or no growth area or encouraging more diverse services for differentiation, especially within high growth urbanized areas, because of the demands placed upon the institution. For purposes of this research, it is assumed that high growth markets will support investments to expand specialized services whereas low or negative growth areas will not and thus impose a narrowing of services. Accordingly, the following hypothesis is offered:

$H_1$: Higher local population growth rate in a hospital's market is positively related to specialization as defined by an internal measure of relative narrowness of offerings in high volume, high revenue-generating service lines, other things being equal.

*Poverty*

The total number of individuals living below the poverty level as a percentage of the local population is a characteristic of external, market factors worthy of analysis for its association with general hospital specialization for several reasons. It recognizes the

strong relationship between birth rates and Medicaid recipients and obstetrical care in general (whose qualification for Medicaid depends on poverty status), as one in four children in the United States are born and raised in poverty. Medicaid recipients are more likely to be babies and older children than adults (Gold & Kenney, 1985; Guillory, Samuels, Probst & Sharp, 2003). Additionally, it reflects the strong relationships between the hospitalization of growing minority and disadvantaged groups already large in number and disproportionately covered by Medicaid (Fleishman et al., 2005), and between widely prevalent children's illnesses requiring hospitalization and Medicaid coverage (Frogel et al., 2008; Fuss, 2009). In addition, those living in poverty are also more likely to have a lower health literacy and practice inferior preventive health measures, making them more vulnerable to illnesses and recurrent, traumatic episodes requiring hospitalization due to poor disease management. Researchers have demonstrated that general hospitals have not competed for insured patients as specialty hospitals have done with their highly targeted services, but instead continued to respond to the care needs of financially vulnerable patients (Tynan, November, Lauer, Pham, & Cram, 2009). Because both inner-city urban hospitals and rural hospitals treat a patient mix that tends to be poorer and older, typical of those qualifying as Medicaid beneficiaries, a market descriptor of poverty level is not necessarily geography dependent ("The Comparative Performance of U. S. Hospitals," 1997).

Medicaid recipients expressed as a percentage of a hospital's charges is frequently used in health services research, but this statistic is not indicative of local, community demand. Instead, it reflects an individual hospital's payer contracts with its state

Medicaid agency. Therefore, poverty level statistics instead are used in the study as a socio-demographic demand factor driving hospital usage and reflective of the community being served rather than payer statistics unrelated to the research questions of this study, in an attempt to reflect characteristics of childbirth rates among the young and poor, as well as the effects of chronic, diseases of the underserved elderly and poor. Furthermore, research illustrates the difficulty of using hospital discharge data linked with Medicaid enrollment files simply on the basis of inaccuracies in coding (Chattopadhyay & Bindman, 2005). Expecting the indigent to be directed to a more narrowly focused facility, the following hypothesis is thus posited:

**H$_2$**: A greater percentage of the local population living below the federally established poverty level is positively related to hospital specialization in high volume, high revenue-generating service lines, other things being equal.

*Population Density*

Population bases in the study are mapped from Core Based Statistical Areas (CBSAs), the standard definition issued by the U.S. Census Bureau in 2000 (U.S. Census Bureau, 2008), representing both metropolitan (METSA) and micropolitan (MICSA) statistical areas. Density of population as a continuous variable provides more information for a descriptive study than a simple, dichotomous variable often used by researchers to denote rural versus urban areas. Hence, population density is considered a good indicator of the level of specialty care of hospital providers and thus the degree of specialization available to the local community.

It is believed that population density differences, even more than absolute population sizes, could affect the degree to which hospitals engage in service line specialization. Higher densities are associated with shorter distances per potential case. Clearly, greater concentrations of patients within service areas should make it easier for hospitals to capture the number of cases needed to support a highly specialized service line. In other words, a larger population base can generate sufficient admissions to make numerous, specialized services viable, but it is the density more than absolute population that more accurately reflects issues of access in matching demand with supply.

Correspondingly, rural areas with lower density of population are less likely to have hospitals offering a wide range of specialty services. For example, despite parity in outcomes, healthcare costs are shown to be lower for patients with pneumonia in rural versus urban areas for several reasons, including treatment more often delivered by a family physician than by a specialist. In such cases, there are higher controls for hospitalization severity, a lower likelihood of intensive care admissions or for a patient to be mechanically ventilated, which explains differences in access to more specialized doctors and facilities in urban areas (Lave et al., 1996). In fact, research documents higher level specialty care, in general, for those patients diagnosed and hospitalized with pneumonia with urban residential zip codes (Dean, Silver & Bateman, 2000).

Still, the study does not aim to assess the breadth of specialized services offered by a hospital, much less its costs, as an indicator of its specialization. Instead, it seeks to determine whether general hospitals are narrowing their focus on the highest volume, highest revenue-generating service lines. The findings of Zwanziger, Melnick, and

Simonson (1996), while seemingly counter intuitive, show that specialization decreases with population density.  In other words, the range of services offered by general hospitals in densely populated areas tends to increase as specialties are added, thereby decreasing specialization as defined by a disproportionate narrowness of offerings. While it is likely there are more specialists and sub-specialists in more densely populated, urban areas, this increases diversification through the addition of highly specialized services but not necessarily differentiation. It also could encourage duplication of services rather than a focused narrowing. Because of the mixed influences of urban competition among specialists and same-system, cluster hospitals, correlation analyses could be mixed. The following hypothesis is thus posed:

**H₃**: Population density in a hospital's market is negatively associated with specialization in high volume, high revenue-generating service lines, other things being equal.

*Age*

Two primary but related factors provide support for the selection of an independent variable depicting persons age 65 and older as a percentage of the local population in search of correlation with specialization by general hospitals. The first is the fact that half of all Americans are living with one or more chronic conditions and illnesses such as heart disease, osteoarthritis, and chronic pulmonary conditions (Anderson & Horvath, 2004), typically encountered in older age persons. Experts have long included congestive heart failure, heart disease, hypertension, and pneumonia among the top health topics to be examined in assessing quality of care for older people in acute care hospitals and other facilities (Fink, Sieu, Brook, Park, & Solomon, 1987).

Advances in pharmaceutical and medical device technology have allowed chronic conditions and illnesses to displace infectious diseases and accidents as the primary causes of death. Five of the six highest volume, highest revenue-generating service lines selected for study represent such conditions.

The second, but related, factor is the increasing age of Americans allowing access at age 65 to Medicare coverage of healthcare expenses including hospitalization and care by specialists. Baby boomers, those Americans born between 1946 and 1965 and numbering 78.2 million in July 2005 (U. S. Census Bureau, 2006), commence eligibility for Medicare beginning in 2011. It is logical that the hospital sector would strategically prepare for this surge in demand with such responses as specialization in targeted service lines in the immediately preceding years. The U.S. Census Bureau (2006) projects that there will be 57.8 million baby boomers living in 2030 between the ages of 66 and 84, which could place a significant demand on healthcare services and facilities that provide care for chronic illnesses and conditions. In fact, the aging of baby boomers is believed by some to be driving the current hospital building boom, the strongest since the period immediately following World War II (Robeznieks, 2008). A skewed population mix with a relatively high percentage of persons age 65 years and older (and thus qualifying for Medicare insurance coverage) in proportion to the total local population is expected to directly influence local hospitals to specialize in service lines to meet demand in the chronically ill elderly. It is worth noting that such a variable will naturally be inversely proportional to a hospital's specialization in labor and delivery serving a child-bearing segment of the population.

The rationale for not simply using Medicare discharge billings as a percentage of a hospital's total charges, as is frequently done by health services researchers, as a descriptive variable is twofold:

1. Medicare enrollment and therefore healthcare spending covers a portion of the population under age 65. Government data indicate that 14% of Medicare enrollees and 13% of its spending are for those under age 65 and thus possibly less connected to the chronic diseases and conditions associated more directly with aging, and

2. Patient charges by an individual hospital that are paid by Medicare may not necessarily represent the broad demand patterns of an entire, local community and thus would otherwise be considered a confounding variable in the data.

In other words, for a variable to represent demand patterns it must be derived from the local population as a whole and not represent the case-mix of services of any one hospital in the dataset. The following hypothesis is therefore posed:

**H4:** A greater percentage of the local population 65 years and older is positively related to hospital specialization in high volume, high revenue-generating service lines, other things being equal. Such a variable, however, will naturally be inversely proportional to a hospital's specialization in labor and delivery directly serving a patient population under age 65.

*Competitiveness*

While several means exist of quantifying the degree of competitiveness in any given market, the Herfindahl-Hirschman Index (HHI) has become the preferred means because it is derived from the market shares of all players in a single marketplace to

reflect concentration (Baker, 2001; Gresenz, Rogowski, & Escarce, 2004). The higher the index, the closer the market approaches a monopoly situation in the face of less competition. Based on standard economic theory, markets with a single, dominant hospital enjoying a relatively high share of market will depict a higher HHI representing a high degree of concentration and thus a lower degree of competitiveness. Conversely, markets with multiple rivals whose shares are equivalent will reflect a higher degree of competitiveness and a correspondingly lower HHI and thus less concentration (Zwanziger & Melnick, 1988). The classic calculation of the HHI and illustrations of these examples are provided in Appendix B.

Zwanziger et al. (1996) noted intensity and presence of competitors dampen the degree of specialization in a given market by increasing the number of services offered. In other words, hospitals in more competitive markets with less concentration tend not to differ from their local peers as services are duplicated. This finding supports the need to include a variable quantifying competitiveness, in the study as one minus the HHI, where specialization strategies may be present among general hospitals.

As discussed in Chapter Two, specialization is a non-price response to market pressures. Concentration is assumed to increase rivalry and thus translate into a positive association between the HHI and degrees of specialization. Conversely, competitiveness is equated with a negative association. Accordingly, the following hypothesis is thus posed:

$H_5$: Hospitals located in highly competitive markets are less likely to specialize in high volume, high revenue-generating service lines, other things being equal.

*Physicians*

Specialty physicians have long exerted influence on the mix of services hospitals offer. The steady growth in the science and complexity of medicine not only produced increased specialization in the medical profession but a growing need for an institutional base within which physicians could be trained and practice (Anderson, 1990). Considered a hallmark of American medicine, professional specialization has directly influenced the breadth and depth of services general hospitals offer (Starr, 1982). It also has increased greatly the dependency of hospitals on physicians, as hospitals wishing to attract patients need to please specialty physicians who are licensed to admit patients and perform revenue-generating procedures. The pursuit of physician patronage has thus contributed to high levels of service capacity duplication across local institutions (Starr, 1982).

Despite the tendency to increase complexity and duplicate services, market pressures on general hospitals have increased the need for them to reduce costs and increase revenues. Hospital specialization options that flow from these pressures include: (a) internal specialization (formation of centers or institutes within a general hospital), (b) building free-standing, specialty hospitals, and c) spinning off ambulatory-based specialty facilities, typically in collaboration with local physicians (Berenson, Bodenheimer et al., 2006).

It is well documented that physicians can strongly influence the choice of hospitals by their patients (Sarel et al., 2005; Smithson, 2003). When choosing specialists and facilities for medical procedures, most patients rely on physician referrals, with relatively few making choices based on word of mouth or rankings provided by media,

government, and private organizations (Tu & Lauer, 2008). Patient dependency on physicians thus increases the power medical specialists are able to exert over hospitals, in managed care contract negotiations and in other valuable domains (Dranove & White, 1996). Researchers have documented evidence of growing friction between hospitals and specialty physicians over competing services, in instances of newly established, physician-owned specialty hospitals and ambulatory surgery centers. As a result, increasing evidence suggests that doctors are choosing either to be in competition with hospitals or employed by them (Casalino et al., 2008).

Based on the foregoing discussion, there are factors that can influence the relationship between a local general hospital and the specialty physicians in that market to be either a positive or negative one and thereby impact a hospital's pursuit of service line specialization. Based on trends, the following hypothesis is thus posed:

**H6**: Hospitals located in markets with high concentrations of specialists in each of the six targeted service lines will positively engage in higher levels of specialization in those service lines, other things being equal.

*Characteristics of Internal, Organizational Factors*

As shown in Figure 2, of the three constructs considered to be associated with patterns of service line specialization in general hospitals, two are represented by internal, organizational factors: (a) distinctive resources and capabilities, and (b) system configuration. Consistent with Penrose's resource-based view pertaining to core competences of the organization, the study examines two organizational characteristics that are assumed to represent differing degrees of resources and capabilities in hospitals:

(a) hospital size defined by number of beds, and (b) the tax status of a hospital's ownership. With regard to system configuration, membership in clusters specifically will also be examined. Hypotheses framing these three internal, organizational factors are discussed in the section to follow.

*Hospital Size*

The resource-based view would consider size of facility to be a reflection of an institution's resources and capabilities. Breadth of specialty services is not to be confused with a focused factory approach of targeted services as a strategy of specialization. Larger hospitals, because of economies of distributing overhead costs over larger numbers of patients, are presumably better equipped to provide more complex and more specialized services. This allows an expanded breadth of services, even if these larger hospitals differentiate themselves from smaller hospitals by offering services for rarer conditions that others cannot. Conversely, smaller hospitals tend to be more specialized and focused in their offering of services. Still, patterns of specialization by service line, as a function of strategic choices, remain unknown.

Eastaugh (1992) offers a landmark study of trends in hospital specialization across the 1980s, observing a rise in specialization concomitant with a decline in unit cost per admission and improved quality of care. For the period studied, he found that specialization was highest in competitive markets and lowest in highly rate-regulated states. In considering what drives specialization, Eastaugh acknowledged Farley and Hogan (1990) for their work documenting that specialization is higher in markets with a higher density of health maintenance organizations (HMOs), more hospital beds, a higher

ratio of physicians for the population, and a greater number of long-term care units. Eastaugh (1992) found, however, that specialization is actually highest in moderately sized (100-300 bed) hospitals and subsequently declines up to 760 beds. Beyond 760 beds, he conjectured that scale allows specialization on a higher level or offers resources to support sub-specialties addressing rare conditions and diseases, experiencing low patient volumes. This, he considered, is still consistent with Farley and Hogan (1990), whose sentinel study assessed variables in five categories: (a) capacity as measured by number of beds in groupings by intervals of 100, (b) management, or ownership, (c) organizational focus, or teaching status, (d) competitive location and alternatives, and (e) state regulatory pressures because of specific research interests in cost efficiency.

However, Zwanziger et al. (1996) documented that bed size of facility has a powerful effect, with specialization actually decreasing as hospital size by bed count increases. Gu (2005) similarly found that hospital size is negatively related to service specialization for hospitals in systems. Both used exclusively the internal HHI as their sole measure of specialization and thus dependent variable. Based on this discussion and the characteristics of specialization being assessed by the research, the following hypothesis is posed:

$H_7$: Hospitals with a greater number of inpatient, acute care beds are negatively associated with specialization in high volume, high revenue-generating service lines, other things being equal.

*Ownership*

As covered earlier in Chapter One, the earliest multi-hospital systems were faith-based, not-for profit systems that were mission-driven and demonstrated a commitment to serve the broader needs of the local community (Starr, 1982). With entirely different objectives, for profit multi-hospital systems emerged in the late 1960s, and a dramatic corporate-owned expansion of multi-hospital systems ensued. Studies by Zwanziger et al. (1996), Horwitz (2007), and others demonstrated there is evidence the tax status of hospital ownership has a significant effect on the range and mix of medical services offered by a hospital.

Horwitz (2007), in particular, found significant and large differences by ownership type in services delineated by service line profitability provided by acute care hospitals. She noted that economists historically have assumed there is little difference between for profits and not-for profits in terms of overall market behavior (Schlesinger & Gray, 2006; Sloan, 2000). However, she argues that they are likely to be different, given variation in management motives, costs of capital, and sources of capital. From the perspective of this study, there is also reason to expect that differences will be observed in non-price rivalry, such as competition over quality outcomes, community reputations, and service line specialization (Cutler & Horwitz, 1998). Grouping services based on their profitability to the hospital, Horwitz (2007) found that corporate ownership plays a significant role in decisions to offer cardiac care, ranging from invasive and open-heart surgery to diagnostic cardiac catheterization. She also provided evidence that for profit

hospitals are much less likely than nonprofits and government-owned hospitals to offer low profitability services such as emergency-admission, inpatient psychiatric services.

Based largely on her research, it is believed that profit motives are likely to be associated with more specialized offerings. While for profit hospitals are known to be somewhat smaller and thus narrower in their service line offering than not-for profits, the size of the owning corporation and its ability to finance investments for specialization are not reflected in any way among the independent variables. Of course, cluster hospitals in not-for profit systems could contribute to mixed results in analysis if local cluster hospitals designate a lead hospital in one or more service lines targeted for study. Although federally owned hospitals are excluded from the dataset, it should be noted that state and county-owned, public hospitals are included. Public hospitals managed under contract by a system are therefore categorized as system hospitals and assigned their ownership identity, even though they technically remain public. The following hypothesis is posed:

$H_8$: For profit ownership (compared to not-for profit) hospitals are positively associated with specialization in high demand, high revenue-generating service lines, other things being equal.

*Cluster Lead Hospital*

Consistent with the Lawrence and Lorsch organization management perspective, it is expected that same-system hospitals collectively coordinate service line specialization in which the cluster hospitals that had in prior years played a dominant role in those areas will increase their shares over time. A cluster is defined as two or more

acute care general, community hospitals that are members of the same-system and located in the same local market. This definition is consistent with that adopted by Cuellar and Gertler (2003, 2005) and applied more recently by Luke et al. (in press). Clusters are used in the subset analysis, in which each cluster's lead hospital is compared to its respective cluster overall. A lead hospital is defined as the cluster member that has the highest share in 2007 in its cluster. To the extent that cluster hospitals are more likely to be found in urban rather than rural areas, it is reasonable that rural, freestanding hospitals are dropped from this sub-analysis. The impact of eliminating such hospitals as a category could have a material impact on findings, as research has demonstrated that organizational characteristics (ownership and size) exhibit significant impacts on rural hospital financial performance and thus their strategic options (Trinh & O'Connor, 2000).

The study seeks to determine if cluster membership is correlated with specialization, given the cluster's ability to reduce service duplication by redistributing capacity among same-system hospital members in the same, local market. In doing so, it can reduce excess capacities, improve efficiencies, avoid duplication, and enhance the quality of services delivered to the patient (Luke, Ozcan, & Olden, 1995; McCue, Clement, & Luke, 1999; Luke, 2010). The extent to which clusters are able to facilitate capacity restructuring is not known. Nor is it known whether they are able to establish the procedures and protocols needed to accommodate transfers, consultations, and related inter-hospital communications as might be needed for hospitals that do not provide the full range of services.

It is assumed that specialization could move in opposite directions for different cluster members as hospitals "trade" capacity within a cluster depending on the designated role each hospital plays. To capture such trading of capacity, it is necessary to differentiate cluster members that assume the lead role in delivering selected services in each cluster from their other cluster members. This lead hospital designation is the third organizational characteristic used in the research. In an effort to identify whether a strategy exists of focused factory specialization among same-system hospitals in a local cluster, a lead, or magnet, hospital with the highest share in each of the six targeted service lines is identified as an independent variable depicting an internal, organizational characteristic and the following hypothesis is posed:

**H$_9$**: Hospitals with a lead share of cases for their cluster in a high volume, high revenue-generating service line are positively associated with specialization, other things being equal.

## Summary of the Chapter

Chapter Three presents strategic management and connects it to the positioning school heavily influenced by Porter's framework utilizing market environment in setting strategy for the organization. This is counterbalanced by the resource-based view, also drawn from among strategic management perspectives, for its focus on the internal resources and core competences of the organization. The perspective of Lawrence and Lorsch suggests that complex organizations must balance their pursuit of external, market opportunities for differentiation with increased efforts to integrate organizational activities. On this basis, their work in organization management is thus selected as a

third, theorized grounding in support of the research, particularly for its application to the analysis of same-system hospitals functioning in clusters. Three constructs are in turn drawn from these theories, each addressing external or internal considerations. Factors depicting the external, market environment and internal organization are subsequently selected and discussed for their potential relationship with evidence of specialization in each of six high volume, high revenue-generating service lines offered by the general hospitals. For each independent variable representing descriptive characteristic, a single hypothesis is posed for quantitative analysis to be undertaken. Having decided what characteristics may influence service line specialization, the next step is to select the specific measures to be examined in this study. This next step is presented in Chapter Four.

# CHAPTER FOUR: METHODOLOGY

## Introduction

### *Overview*

Chapter Four includes a discussion of methods and corresponding data analysis. Following a restatement of research purpose and goals, the first section describes the study's design, offering a rationale for its structure and discussing its uniqueness by incorporating clusters of same-system hospitals among the variables. The rationale addresses the selection of service lines, defined according to charges (revenues) and caseload demand (volumes). Data sources are discussed in the subsequent section. The second section also presents those states for which data are analyzed and compares them as a composite to characteristics of the nation's general hospitals as a whole. The third section discusses measurement of both dependent and independent variables selected for inclusion in the analysis. Use of five different dependent variables depicting specialization by a hospital is justified as well in this section. The subsequent fourth section discusses analysis, statistical tests and procedures for interpretation. The chapter concludes with a discussion of limitations and assumptions that could negatively affect the generalizability of results, acknowledging opportunities for future research.

### *Summary of the Research Problem*

Sweeping changes in technology, market dynamics, and organizational structure

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including the formation of same-system hospitals in local clusters are pushing the general hospital to rethink the traditional concept that every general hospital must provide the same, wide variety of services to meet the chronic and acute healthcare needs of its local community. These changes come in the face of three major demands impacting strategic choices made by general hospitals: (a) improving quality and safety, (b) curbing costs to improve efficiency, and (c) confronting increased local hospital rivalry. To date, such arguments have not been applied to the quantitative analysis of the general hospital's strategies relating to high volume, high revenue-generating service lines. Moreover, the role of local clusters of same-system hospitals has not been investigated with respect to such service line specialization.

*Recapping the Purpose and Goals of the Study*

The purpose of the research is to determine if general hospitals show evidence of specializing in one or more of the nation's six highest volume, highest revenue-generating service lines and, if so, to examine identifiable organizational and local market characteristics associated with such specialization. Additionally, the research will examine how same-system hospitals in local clusters are behaving with respect to service line specialization.

Independent variables used in the analysis reflect: (a) external opportunities and threats (Porter's framework on competitive positioning), (b) distinctive internal resources and capabilities (Penrose's resource-based view pertaining to core competences of the organization), and (c) system configuration (organization management perspective as developed by Lawrence and Lorsch explaining the conditions under which same-system

hospitals might collectively engage in a coordinated scheme of service line

specialization). Figure 3 summarizes the relationships to be examined in this study.

**Market Factors**

*(External Opportunities and Threats)*

- Physicians
- Competitiveness
- Population
  - ➢ Density
  - ➢ Growth
  - ➢ Longevity
  - ➢ Poverty

**Preference for High Volume, Revenue – Generating Service Lines**

- Cardiac Surgery
- Cardiology
- Invasive Cardiology
- Orthopedics
- Pulmonary Services
- Labor and Delivery

**Specialization**

- Change (2003 – 2007)
  - ➢ In Market Share
  - ➢ In Cluster Share
- Expected Market Share
- Internal Share
- Internal Service Concentration

**Organizational Factors**

*(Distinctive Internal Resources and Capabilities and System Configuration)*

- Ownership
- Hospital Size
- Cluster Lead Hospital

Figure 3. Market and organizational factors impacting specialization by general hospitals

in highest volume, highest revenue-generating service lines.

Research Design

*Structure of the Research Design*

The study uses a retrospective, non-experimental, correlational design to examine secondary data on hospitals and their markets. A simultaneous, multiple regression is initially used to enter all independent, or predictor, variables into the equation at the same time, assuming all independent variables (IVs) are of comparable importance to the research questions (Polit & Beck, 2004). This is subsequently refined by performing a backward deletion, stepwise regression to improve the model's predictability and thus becomes the primary vehicle for analysis. The correlates being examined represent common descriptions of hospital organizations and their markets. Some multicollinearity, or redundancy, of variables may surface which, if left unaddressed, could produce unreliable results. Additional analyses will therefore help in the selection of an optimum set of variables. Justification of the variables chosen for analysis, as well as the question of endogeneity, is discussed in a later section of this chapter, and the elimination of any collinear variables will be detailed in a subsequent chapter.

It is recognized that specialization patterns, if they exist, occur over time. Some previous research on hospital specialization has used lagged independent variables in an attempt to reflect the impact of time in making strategic choices (Gu, 2005). This study, however, should be viewed in that it examines the correlates of differential patterns of specialization as a first step of understanding, with the assumption that different kinds of organizations and markets produce different strategic responses. Once it is clear what factors might be associated with specialization patterns, it would be helpful in a

subsequent study to examine how hospitals and systems might sequence specialization patterns over time. Recognizing such limitations, this study includes two dependent variables that measure the "change" that occurred between 2003 and 2007 in the percentages of cases treated (Luke et al., in press). The first of these is a **Market Change** variable that reflects an individual hospital's change in market share, measured for each of the six service lines examined in this study. The second is a **Cluster Change** variable that measures for each hospital that is a member of a cluster the change in its share among all same-system, sister hospitals that are members of its cluster for each of the six service lines examined in this study. This should provide a preliminary indication of the shifting that can occur as a result of specialization, whether by competing hospitals or among members of same-system clusters, respectively.

In spite of the above discussion, cross-sectional design is generally considered well suited for describing relationships among factors present at a chosen point in time as this study largely represents. A weakness in cross-sectional studies is their inability to establish causal relationships. Thus, findings of significant associations in the analyses should be viewed as suggestive of causality and indicative of where further research might need to be focused.

A unique feature of the research design is the examination of within-cluster patterns of specialization. As discussed in earlier chapters, this recognizes (a) the growing importance of systems and system clusters and (b) the key role clusters could play in facilitating the redistribution of patients among cluster hospitals. Such organizational

models can contribute to improved quality, greater cost efficiency, and heightened, non-price strength against rivals.

A mixed effects model allows multilevel linear modeling to assess sources of variation both within a cluster and between clusters. The model includes an additional error term associated with the effect of cluster membership of hospitals to determine if cluster effect can help explain a portion of underlying variance. In addition to estimating and testing the fixed effects, the model determines whether there is evidence that the variance of the random effects in the model is different from zero (Fox, 2002). A mixed effects model will thus be tested in the sub-analysis of hospitals in clusters.

### *Choice of General Hospitals as the Unit of Study*

This study examines general, community hospitals in 2007 because: (a) they are the most numerous in comparison to other categories of hospitals, representing 69% of all short and long term care hospitals in the United States (Schneider et al., 2008) and 86% of all hospitals registered with the AHA (AHA Hospital Statistics, 2009); (b) they represent the largest hospitals in terms of size, based on inpatient bed count, averaging 162 beds, in comparison to 104 for other hospitals listed in the 2007 AHA database (AHA Hospital Statistics, 2008); and c) they have led the movement toward the development of systems and the formation of local clusters in same-system hospitals and thus are considered at the forefront of industry-shaping strategic changes (Luke et al., 2003).

As discussed in Chapter Two, because little is known about whether the general hospital is specializing in targeted service lines to accommodate the demands for

improved quality and safety in delivering care to an aging population with multiple co-morbidities, to address the need for improved efficiencies in the face of spiraling healthcare costs, or to combat rivals with non-price tactics especially in more concentrated markets, the non-federal, general hospital is designated the unit of analysis in this study. The research methodology does not regress performance measures on strategy choice variables, seek to pass judgment on specific service line specialization strategies by weighing their costs against benefits, or account for the effect of specialization on clinical, financial, or competitive outcomes of such a choice by the hospital entity.

*Choice of Service Lines for Analysis of Specialization*

Inpatient hospital data for uniform billing purposes uses ICD-9 codes to identify diagnoses and procedures at the patient case level. Currently, CMS publishes for use approximately 14,000 ICD-9 codes. Beginning October 1, 2013, an additional 55,000 codes will be added to give payers even greater detail from providers of patient care at the individual case level. This, however, creates an overwhelming number of categories at too fine a level of detail for strategic study. To aid in the choice of service lines for the analysis, reliance is placed on national statistics derived with the help of HCUP's CCS that effectively consolidates ICD-9 codes from 14,000 to 260 diagnostic categories for aggregating and classifying data for statistical reporting and analysis, as noted in HCUP's Facts and Figures 2007 (Agency for Healthcare Research and Quality, 2007). Service lines are then assigned to the top-ranked case volumes and subsequently to the top-ranked charges by diagnostic categories to determine which service lines are most frequently

represented in both top 10 lists. This provides a logical means of selecting service lines for study as a function of how often they are among the top ranking CCS categories.

First, the selection of service lines for purposes of this research is examined using the CCS-classified diagnosis categories from HCUP data ranked by numbers of discharges (volume), the top ten of which are illustrated in Table 6.

As explained in the footnote to the table, the top six, selected categories as a percentage represent nearly one in four, or 23.8%, of all cases and 14.9% of aggregate charges for all, nationwide inpatient hospitalizations according to HCUP 2007 statistics. Most of these fit within multiple service line categories. However, after excluding general medicine and general surgery service lines (which are provided by virtually every general hospital) and excluding likely consultative services in sub-specialties such as vascular surgery and rheumatology, the highest volume service categories in the table represent the following service lines: (a) labor and delivery, (b) pulmonary services, (c) cardiology, (d) invasive cardiology, (e) cardiac surgery, and (f) orthopedics.

Hospital billing data for public or private payers are not organized by service line but rather by diagnosis code upon discharge and are comprised of procedures that may cross multiple service lines. Thus, selection of service lines is additionally determined using the CCS-classified diagnosis categories from HCUP data ranked by aggregate patient charges, the top 10 of which are illustrated in Table 7.

As shown in Table 7 and explained in the footnote, after eliminating specialty consults by sub-specialists in vascular surgery and rheumatology, the same six service lines emerge as those presiding in highest volume. (While septicemia, or blood infection,

Table 6

Top Ten Inpatient Diagnostic Categories Based on 2007 Volume of Discharges

| Diagnosis | Cases (000) | No. of Discharges | Charges ($millions) | Service Line(s) Represented |
|---|---|---|---|---|
| Liveborn | 4,542.7 | 1 | 39,624.5 | Labor and Delivery |
| Pneumonia | 1,171.5 | 2 | 29,864.3 | Pulmonary Services, General Medicine |
| Congestive heart failure | 1,024.9 | 3 | 32,312.1 | Cardiology, Invasive Cardiology |
| Coronary artherosclerosis | 963.9 | 4 | 44,868.3 | Cardiology, Invasive Cardiology, Cardiac Surgery, Vascular Surgery, General Medicine, General Surgery |
| Trauma to perineum | 867.8 | 5 | 7,322.10 | Labor and Delivery |
| Osteoarthritis | 814.9 | 6 | 33,595.1 | General Medicine, Rheumatology, Orthopedics |
| Other maternal birth complications | 810.4 | 7 | 9,671.4 | Labor and Delivery, Gynecology |
| Non-specific chest pain | 788.4 | 8 | 11,620.3 | Not determinable |
| Mood disorders | 774.3 | 9 | 11,176.5 | Psychiatric Services, General Medicine |
| Cardiac dysrhythmias | 731.5 | 10 | 20,393.2 | Cardiology, Invasive Cardiology |
| Top Six | 23.8% | | 14.9% | |

Note: Sourced from HCUP State Inpatient Databases (SID) of the Agency for Healthcare research and Quality (AHRQ). Retrieved October 24, 2009, from http://hcupnet.ahrq.gov/HCUPnet.jsp. U.S. National statistics are represented by $1,033,835.7 million in total charges and 39.5 million total cases in 2007.

Table 7

Top Ten Inpatient Diagnostic Categories Ranked by 2007 Aggregate Charges

| Diagnosis | Hospital Charges ($million) | Rank | Cases (000) | Service Line(s) Represented |
|---|---|---|---|---|
| Coronary atherosclerosis | 44,868.3 | 1 | 963.9 | Invasive Cardiology, Cardiology, Cardiac Surgery, Vascular Surgery, General Medicine |
| Liveborn infant | 39,624.5 | 2 | 4,542.7 | Labor and Delivery |
| Septicemia | 38,828.1 | 3 | 675.4 | Not determinable |
| Myocardial infarction | 33,826.7 | 4 | 624.9 | Invasive Cardiology, Cardiac Surgery, Cardiology |
| Osteoarthritis | 33,595.1 | 5 | 814.9 | Rheumatology, General Medicine, Orthopedics |
| Congestive heart failure | 32,312.1 | 6 | 1,024.9 | Invasive Cardiology, Cardiology |
| Implant complications | 30,580.3 | 7 | 623.9 | Not determinable |
| Pneumonia | 29,864.3 | 8 | 1,171.5 | Pulmonary Services, General Medicine |
| Spondylosis | 25,813.3 | 9 | 633.7 | Orthopedics |
| Respiratory failure | 23,944.0 | 10 | 385.8 | Pulmonary Services, General Medicine |
| Top 6 as a % of total U.S. | 22.6% | | 25.7% | |

Note: Sourced from the Healthcare Cost and Utilization Project (HCUP) State Inpatient Databases (SID) of the Agency for Healthcare Research and Quality (AHRQ). Retrieved October 24, 2009, from http://hcupnet.ahrq.gov/HCUPnet.jsp. National statistics are represented by $1,033,835.7 million in total charges and 39.5 million total cases in 2007.

is ranked third in charges and complication of device, implant or graft, is ranked seventh in charges, neither fits cleanly within a given service line. Blood infection can occur at any part of the body and therefore could appear in such diverse service lines as infectious disease, general medicine, and gastroenterology. Complication of device, implant or graft spans virtually every surgery service line depending on the organ or tissue receiving the implant.) When selected on the basis of revenue-generating ability, the top six selected service lines from HCUP constitute 22.6% of charges (revenue) and 25.7% of patient caseloads (volume), rendering them appropriate for study of service line specialization by general hospitals. The top six service lines broadly represent inpatient treatment of both acute and chronic diseases and conditions and span all adult ages of a local population served by their general hospitals. These six service lines also emerge as the top-ranking lines based on both charges (revenue) and patient caseloads (volume) in the sample states included in this study.

As an alternative, the study could focus on single DRGs rather than service lines. However, it is unlikely that hospital specialization strategies would be based on any single DRG, totaling approximately 500 and still in need of aggregation in number for practical relevancy to strategic decision-making. Moreover, hospitals are neither organized nor are staffs managed by DRG categories. On the other hand, it is possible that they do try to narrow their specialization choices to clinical categories that are more narrowly or specifically defined than service lines. While historically DRGs have been grouped into 25 mutually exclusive sub-groups known as Major Diagnostic Categories (MDCs) and even used by researchers in studies of hospital specialization (Gu, 2005),

each MDC corresponds to a single organ system and is no longer reflective of the increasing proportion of hospital cases with multiple diagnoses present in acute, inpatient care. The acutely ill and those dying are more likely facing multiple organ failure. Thus, it is more likely that they will focus on somewhat broader strategies that could address the complex needs of larger numbers of patients, at least in part to project a positive image of broadly serving the needs of the community as general hospitals have traditionally done (Dayhoff & Cromwell, 1993). Therefore, the focus of this study is on service lines despite their broad, somewhat elusive definition. Regardless, it is possible that categories of cases at the individual DRG-level could underlie the strategies hospitals formulate when considering specialization. Such a question remains the focus of future research aimed at determining the appropriate level at which specialization is measured.

The same arguments apply to a focus on single procedures, such as coronary artery bypass graft surgery (CABG). While such targeting – whether on the part of the facility or surgeon or both – has been the focus of some research, as discussed in Chapter Two, evidence of general hospital specialization strategies at this level as such does not appear in the literature. Instead, studies of specialization in particular procedures tend to focus on clinical patient outcomes, with the objective of directing patients to those surgeons and facilities performing high volumes of such procedures in an effort to raise quality with lower morbidity and fewer complications and to lower costs. This has been the goal of The Leapfrog Group, for instance, as discussed in Chapter Two.

Still another argument could be made for focusing on cross-cutting service lines such as hematology, which involves patient diagnoses and care among some of the

highest volume, revenue-generating case types. The difficulty with selecting such service lines is they can overlap considerably with other service lines. Cancer treatment, for example, often relies on services such as hematology, internal medicine and other services, because of the involvement of multiple organs and clinical specialties. In addition, hematology itself may represent a stand-alone service line in larger academic medical centers but not in smaller, community hospitals (where hematology could be imbedded in laboratory services that are subcontracted or even offsite).

*Choice of Time Frame*

The most recent year in which inpatient data were readily accessible for the study of general hospitals was 2007, which thus is the year chosen for study. Note that the selection of 2007 rather than an earlier year allows for a decade or so for changes to have occurred since the rapid formation of clusters in the 1990s (Luke et al., 1995; Luke, 2010; McCue et al., 1999). The year 2003 is the earliest year for which hospital admissions data are available for use in this study from the same data source. Therefore, the four-year period, 2003 to 2007, is used in this study to measure changes in market share and cluster share. While it is possible that the four-year period between 2003 and 2007 does not represent sufficient time for specialization to have occurred, it should be noted that most of the clusters were created prior to the end of the prior decade, although changes have continued since that time, albeit at a much slower pace (Luke et al., 2003). Thus, most cluster hospitals and the clusters themselves have had almost a decade to consolidate and digest their mergers and acquisitions. This suggests that the chosen period – 2003 to 2007 – should provide a sufficient span of time in which to examine possible shifts leading to

specialization. Nevertheless, this point is revisited in the discussion of limitations in the research design and opportunities for future research.

<div align="center">Identification of Databases, Data Collection, and Data Integrity</div>

<div align="center">*Databases Used for Analysis*</div>

The study uses secondary data for all measures. The discharge data are obtained from a proprietary source, Intellimed International Corporation, which is a full-service provider of software and healthcare data services used by the healthcare industry. (The study uses 2007 HCUP national statistics only as the source of information for determining the selection of the service lines to be analyzed in this study.) Intellimed relies on the same state-level sources for data as do other data vendors, including HCUP (for its state inpatient database [SID]). Like HCUP, Intellimed obtains data from state agencies that require the participation of all licensed, community hospitals. As is true for all such data, Intellimed includes service line designations that are based on the primary diagnosis for each patient upon discharge. Note that over the course of a hospital stay, the elements of a patient's care could be assigned to more than one service line. The standard procedure is for each case to be assigned to a primary service line based on the primary diagnosis upon discharge, a designation typically verified by the hospital's discharge nurse administrator.

Independent variables are measured using data obtained from a number of sources. The U.S. Census Bureau's FactFinder serves as a source of estimates of persons by CBSA living below the federally established poverty level (**Poverty**) and estimates of persons by CBSA age 65 and older (**Age**), both based on the 2005 – 2007 American

Community Survey (U.S. Census Bureau, 2008). Data depicting the ratio of specialty physicians for each of the six targeted service lines per one thousand residents (**Physicians**), population growth (**Growth**) and population density (**Density**) are obtained from the ARF, which provides population data and related statistics over the period 2000 to 2008 obtained from the U.S. Census Bureau. Census data are based on survey input and, while subject to some sampling and non-sampling errors, such errors are unlikely to have any meaningful impact on the analysis, given the levels of aggregation to metropolitan areas. The AHA 2006 Annual Survey data serve as the source for information on hospital characteristics, including hospital bed count (**Hospital Size**) and CBSA location, while the 2007 Intellimed dataset is used to calculate the HHI depicting local market concentration (**Competitiveness**). Like the U. S. Census data, AHA Annual Survey data too are subject to errors upon submission to the AHA, the consequences of which for study results are likely to be minimal, given the ranges of differences across hospitals.

The tax status of facility ownership for profit versus not-for profit designation (**Ownership**) and the system/cluster memberships, including designations of lead hospitals within clusters (**Cluster Lead Hospital**) are based on a 2007 update of AHA hospital system memberships, conducted internally by Virginia Commonwealth University's Department of Health Administration (R. D. Luke, personal communication, July 18, 2009). These data are based on original information provided by the AHA through its 2006 Annual Survey but are supplemented with information obtained from web sites, press releases, national reports, personal telephone contact with selected

hospitals to verify data, and other readily available public sources of information. These data provide the basis as well for defining clusters and thus for calculating the change in cluster share of hospitals in local system clusters as a dependent variable, or **Cluster Change**.

Merging the published and updated AHA and ARF data and U. S. Census data with the Intellimed data and eliminating hospitals with fewer than 25 beds (not considered large enough to provide general and acute care for a community's population) produced a final sample of 303 nonfederal, general, short-term, community hospitals providing acute care for three states, namely: Florida, Nevada, and Virginia. Given the diversity across the three states with respect to hospital characteristics in particular, a state dummy variable as a covariate is included in the analyses of all 303 hospitals. The analysis of cluster hospitals is performed on a subset of this database including only hospitals that are in clusters, which reduced the number of hospitals for sub-analysis for this purpose to 175, representing a total of 50 urban clusters.

*Target Population*

The study population includes all general, community hospitals with 25 or more beds that are located in one of three states: Florida, Nevada, and Virginia. AHA defines community hospitals as all nonfederal, short-term, general, and other specialty hospitals, excluding hospital units of other institutions, such as prisons and colleges (American Hospital Association, 2008). In order to ensure comparability among the hospitals, specialty hospitals as defined by the AHA (which are devoted exclusively to a single or a small number of service lines, such as psychiatric care, rehabilitation, pediatrics, and,

more recently, cardiac surgery and orthopedics) are excluded. Only those acute care hospitals with 25 or more beds are included in this study. Very small acute care hospitals (many of which are critical access hospitals), in effect, specialize in low and non-complex levels of care and are not likely to have the capabilities needed to compete with larger hospitals across most or all services lines.

### *The Three States and Generalizability*

The three states used in this research represent the only states for which data were made available by Intellimed. Thus, it is important to consider the implications for generalizability of study findings.

Florida has a well recognized, distinctive population, which could limit the generalizability of findings if these contributed to the likelihood that the hospitals in those states did or did not engage in specialization strategies. Distinctive demographic characteristics include: (a) an older population living with multiple chronic diseases and conditions; (b) a large, Medicare-age population (Florida ranks fourth in percentage among all state populations); (c) minimal regulation with respect to the corporate ownership of hospitals and therefore a relatively high percentage of for profit hospitals as well as hospitals under multi-system ownership (Robeznieks, 2008) and, therefore, formed into local clusters; (d) high density population with 296.4 individuals per square mile – 96% of its population reside inside the boundaries of a CBSA and thus have a relatively greater access to acute care hospitals; and (e) a diverse state population, over one-third or 36% that identifies itself culturally as either Hispanic or African-American. It is possible that this diversity in patient population could lead hospitals to engage in

service specialization in order to attract targeted sub-population groups. On the other hand, differentiation to accommodate demographic distinctiveness does not necessarily mean hospitals will pursue specialization strategies geared to enhancing volumes in the six service lines of interest to this study. It is also notable that Florida's population characteristics reflect many future demographic changes expected for the nation (U. S. Census Bureau, 2008).

Nevada represents another version of demographic distinctiveness that could add to the possibility that hospitals will pursue differentiation strategies, although this would not necessarily lead to strategies focused on the six service lines per se. At a growth rate of 66%, Nevada experienced the fastest rate of growth in population of any state in the decade from 1990 to 2000. Because Nevada is relatively free of state government regulations that would impose restrictions on ownership, market entrance, or referral practices, Las Vegas, in particular, has experienced significant growth in national, for profit hospital corporations, the two largest being Universal Health Services (UHS) and the Hospital Corporation of America (HCA). Together, the two corporations own and operate eight of the 13 hospitals in the Las Vegas metropolitan area (Quality Care Nevada, 2009).

By comparison to these two states, Virginia has a relatively high African-American population. While its population's mix by age mirrors that of the nation, Virginia's proximity to Washington, D. C. has produced a higher than average median family income and lower rate of poverty, which affects the average for the state as a whole. Thus, Virginia has demographic diversity geographically, in both ethnicity and

income, which could add to the need for hospitals in one region of the state to engage in competition by comparison to hospitals in other regions. Although less dramatically split between populated and unpopulated areas than Nevada, Virginia has three principal metropolitan areas that exert strong influences on the shape of the hospital markets across the state: Northern Virginia (part of the Washington, D. C. metro area), Virginia Beach, and Richmond (Ormond & Bovbjerg, 1998).

Together, these three states represent slightly over 9% of the U.S. population. Table 8 compares demographic and economic statistics for the three states to show that when they are combined and weighted by population, the three populations together are only slightly older, marginally more diversified culturally and racially, less poor, and more likely to live in an urbanized area than on average Americans overall. Otherwise, they are relatively similar to the U.S. as a whole. Composite health and mortality statistics for the three states are presented in Table 9. Again, the composite numbers track closely the nation overall. From an epidemiological perspective, the three states as a composite track the U.S. profile fairly closely, thereby minimizing the problem of generalizability to the nation as a whole. Table 10 additionally addresses generalizability in terms of the states comprising the study sample in comparison to national hospital statistics. It is here that the three states are shown to deviate from statistics describing the nation as a whole.

In combination, the three states together house 315 or 6.4% of the 4,897 total number of community hospitals in the nation, as defined by AHA's 2006 Annual Survey and updated through 2007. (Eliminating the 12 hospitals with fewer than 25 beds reduces

Table 8

Comparative 2005-2007 Demographic and Economic Statistics
for the Three-state Composite

| Statistic | FL | VA | NV | Weighted Composite | U.S. |
|---|---|---|---|---|---|
| Population as of July 2006 (millions): | 18.1 | 7.6 | 2.5 | 28.2 | 299.4 |
| Population by race: | | | | | |
| White | 76% | 71% | 75% | 74% | 74% |
| Black | 15% | 20% | 7% | 16% | 12% |
| Other | 9% | 9% | 18% | 10% | 14% |
| Hispanic | 20% | 6% | 24% | 17% | 15% |
| Population by age: | | | | | |
| Under 15 | 6% | 7% | 8% | 6% | 7% |
| 18 and older | 78% | 76% | 74% | 77% | 75% |
| 65 and older | 17% | 12% | 11% | 15% | 12% |
| Employed | 61% | 67% | 67% | 63% | 65% |
| Owner-occupied housing | 70% | 70% | 61% | 69% | 67% |
| Family income (2007 inflation adjusted $) | $55,534 | $69,609 | $62,222 | $59,929 | $60,374 |
| Population living below poverty level | 13% | 10% | 11% | 12% | 13% |
| Population in metro and micro areas | 96% | 85% | 95% | 93% | 88% |

Note: Sourced from "2005-2007 American Community Survey and FactFinder," U.S. Census Bureau.
Retrieved October 18, 2009, from http://factfinder.census.gov/home/saff/main.html?_lang=en.

Table 9

Comparative 2006 Health Statistics of the Three-state Composite
Versus the U.S. Population

| Statistic | FL | VA | NV | Weighted Composite | U.S. |
|---|---|---|---|---|---|
| Heart disease deaths per 100,000: | | | | | |
|     White | 172 | 187 | 230 | 181 | 197 |
|     Black | 219 | 233 | 278 | 249 | 258 |
|     Other | 69 | 76 | 137 | 77 | 114 |
| Cancer deaths per 100,000 | 172 | 184 | 183 | 176 | 181 |
| Hospital admissions per 1,000 | 131 | 102 | 99 | 120 | 118 |
| Disability prevalence | 12% | 11% | 11% | 12% | 13% |
| Birth rate per 1,000 | 13 | 14 | 16 | 14 | 14 |
| Community hospital beds per 1,000 | 2.8 | 2.3 | 1.9 | 2.6 | 2.7 |

Note: Sourced from National Center for Health Statistics, Centers for Disease Control and Prevention. Retrieved on August 1, 2008, from http://www.cdc.gov/nchs/.

Table 10

Comparative Hospital Characteristics of the Three-state Composite
Compared to the United States

| Statistic | FL | NV | VA | 3-State Composite | U.S. |
|-----------|-----|-----|-----|-------------------|------|
| Hospitals | 205 | 33 | 86 | 324 | 4,765 |
| Mean beds | 239 | 147 | 202 | 220 | 157 |
| σ beds | 203 | 164 | 161 | 191 | 161 |
| Minimum beds | 15 | 4 | 15 | 4 | 3 |
| Maximum beds | 1,500 | 588 | 927 | 1,500 | 1,500 |
| Range of beds | 1,485 | 584 | 912 | 1,496 | 1,497 |
| For profit | 44% | 36% | 21% | 37% | 15% |
| System member | 80% | 67% | 83% | 80% | 56% |
| Urban | 85% | 61% | 66% | 78% | 57% |
| Cluster member | 65% | 39% | 48% | 58% | 33% |
| Urban hospitals in clusters | 74% | 65% | 72% | 73% | 55% |

Note: U.S. and state data represent all nonfederal, short-term general, and other specialty hospitals, defined by AHA as community hospitals in 2006 and are sourced from AHA 2006 Annual Survey data (updated in 2007 from public data to calculate percentages in multi-hospital chains and clusters (Luke et al., in press). In the final dataset used in the study, eight hospitals in Nevada, two hospitals in Virginia, and two hospitals in Florida with fewer than 25 beds are excluded from analysis, reducing the 315 hospitals shown in the table to 303. The percentage in clusters represents percentage of urban hospitals in urban clusters, with a cluster defined as two or more same-system hospitals in the same local market. Urban is defined as either a metropolitan statistical area (METSA) or a micropolitan statistical area (MICSA), as distinguished from rural.

the 315 number of hospitals to the final sample of 303 used in analysis.) While the three states vary individually, collectively they are more likely to be for profit, in multi-hospital chains, and located in urban areas than hospitals in the nation as a whole. Table 10 thus suggests that the three states, as a composite, differ somewhat in the ownership and structural arrangements, whose differences could affect the generalizability of the results to the nation as a whole. Clearly, further research on specialization patterns, using data from other states, would be necessary to assess specialization as a general strategic response by hospitals and hospital systems nationally.

In the particular circumstance of interpreting analysis of the same-system, cluster hospitals, it is noteworthy that the 175 cluster hospitals represent over half, or 57.8%, of the 303 hospitals in this study and 70.6% of all 248 hospitals linked to multi-hospital systems in the three states being studied. Moreover, of the 175 hospitals affiliated with one of 50 clusters, 32 are under a distinctly different system owner. The 32 clusters represent 7.8% of the 412 different multi-hospital systems operating in the United States. Given the diversity across the three states in the various dimensions shown and described above, a state dummy variable as a covariate is included in the analyses. To interpret this factor, Virginia is arbitrarily selected as the reference, or "dummy," and assigned a value of zero. The *p*-value measures whether there is a significant difference between Virginia and Florida and between Virginia and Nevada.

*Sample Size and Power*

Hulley, Cummings, Browner, Grady, and Newman (2007) point out that the concepts of power and the null and alternative hypotheses do not apply to decisions

about sample size for descriptive studies such as this study. This is because studies without outcome from intervention are not comparing different groups such as in randomized clinical trials with patients. However, we assess sample size and power as they relate to issues of representativeness and generalizability. Although all of the licensed, general, community, acute care hospitals with bed counts of 25 or more in each of the three states are included, the 303-hospital dataset still constitutes only 6.2% of the 4,897 total number of general, community hospitals across the nation in 2007 (AHA Hospital Statistics, 2008). Thus, it is appropriate to address standard sampling considerations because a range of values about the sample mean is being reported in confidence intervals. The width of the confidence interval depends on the sample size.

To avoid the common problem of inadequate power, it helps to turn to published tables based on the desired level and width of confidence interval (CI) associated with examining the number of community hospitals across Florida, Nevada, and Virginia. Because sample size is fixed and a power of 80% or greater is needed to detect a reasonable size effect, minimum desired requirements call for a sample size of 246 to justify a sample selection based on the following widely accepted standards: assuming a standard deviation of five points in the dependent variable such as internal HHI measuring specialization, a W/S value of 0.25 derived from a 1.25 desired total width divided by the standard deviation of the variable, and a 95% confidence level (Hulley et al., 2007).

Compared to the desired sample size of 246, a study sample comprised of the available 303 hospitals with 25 or more beds is considered sufficient for establishing

external validity.  However, it is still acknowledged that findings about Florida, Nevada, and Virginia collectively may not necessarily be generalizable to the U. S. hospital market as a whole. Replication of this study in other states will be needed. Power analysis and effect size cannot salvage the non-representational nature of non-probability selection of these three states for study. The lack of external validity, or generalizability, thus remains a potential problem for this study and, thus, the research should be considered exploratory. Replicating the study in the future with general hospital data from additional states would be appropriate. Initial results of this study should therefore be conservatively interpreted. Such caveats notwithstanding, Polit and Beck (2004) continue to encourage a purposive sampling technique such as employed in this study, given the convenience sample of three states provided by Intellimed.

## *Data Collection*

The Healthcare Cost and Utilization Project's SID and Intellimed's inpatient hospital data follow guidelines of the National Uniform Billing Committee (NUBC) used for the billing of institutional charges to state Medicaid agencies (Centers for Medicare and Medicaid Services, 2008). The billing form UB-04 constitutes the basis for joining demographic, but de-identified, patient data with ICD-9 coded procedures and diagnoses, length of stay and billable charges.

## *Data Integrity*

Not only do states store data in varying formats and follow different definitions, there are varying levels of files for each of the 38 states submitted to HCUP, as not all states release the same level of detail (Agency for Healthcare Research and Quality,

2007). These potential problems with data integrity are avoided by using a source such as Intellimed. Its terms have been consistently defined and applied, the same levels of files have been pulled for each state, and the same calendar years have been accessed for the 303 hospitals analyzed from all three states. When feasible, Intellimed staff applies generally accepted, standardized editing procedures following explicit rules, including confirmation that data values are valid, internally consistent, and consistent with established industry norms. In addition, standard quality checks of the data are performed by the commercial enterprise, including cross-checking patient gender-specific codes, such as female gender coding for a patient receiving obstetrical services or male coding for a patient receiving services involving the prostate gland.

*Institutional Review Board (IRB) Considerations*

Because of the reliance on secondary administrative data and purposive sampling methodology, there is no patient recruitment plan or screening criteria included in this study. Nor are there procedures, materials, or protocols for data collection in connection with this research. No subject-specific identifying information has been recorded within the data sets such that the researcher or others may be able to identify a patient or retrieve additional information on a particular research participant. In accordance with the types of IRB review, the program under study is delivering a public benefit and does not involve physical invasions or intrusions upon the privacy or safety of participants whose personal data have been collected (Virginia Commonwealth University, 2007). The existing dataset is provided to this researcher in a totally unidentified format, where even the source of the data could not re-identify subjects. As the data files have already been

de-identified by the data collection entities and the unit of analysis for this study is the hospital, there is no need to further transform data files, for compliance with the Health Insurance Portability Act (HIPPA) and related governing policy. Since this study does not involve human subject research, it qualified on May 31, 2010 for exemption by the Office of Research Subjects Protection of Virginia Commonwealth University according to 45 CFR 46.101 (b) Category 4 (Virginia Commonwealth University, 2007).

<div align="center">Measurement</div>

*Selected Measures of Specialization as Dependent Variables in the Research*

Specialization of hospitals can be measured both internally, comparing procedural or service line volumes to others within a hospital or among a cluster of same-system hospitals, and externally in the marketplace, comparing the relative competitive strength of one institution to another. The former is derived from internal case mix. The latter is a reflection of the marketplace and the shape of its supply and demand patterns. This section discusses measures of specialization applying to both perspectives.

Zwanziger and colleagues distinguished between two forms of specialization – "diversification" and "differentiation" (Zwanziger et al., 1996). According to Dayhoff and Cromwell (1993), "diversification," a term used in economic literature to describe the number of different types of businesses and products a company produces, can be applied to the study of hospitals as an indicator of the breadth of product or service diversity. This, in effect, serves as an "internal" measure as it reflects an organization's product diversity. "Differentiation," as applied to the study of hospital specialization, contrasts the services offered by individual hospitals to those provided by competitors in the same

market. This form of specialization focuses on "external" distinction. Both internal and external viewpoints are reflected in measures selected for the study.

Specialization can be measured in a number of other ways as well. Using both conceptual and empirical analyses, Dayhoff and Cromwell (1993) demonstrated the sensitivity of the dependent variables used as measures of hospital specialization to standard market and organizational characteristics, supporting the use of multiple indices in evaluating hospital caseloads. Five measures are considered in this study. They are organized according to internal or external distinctions introduced above. Two of the five fit within the internal category: (a) **Internal Service Concentration**, measured by applying internally the Herfindahl-Hirschman Index to measure concentration across all of a hospital's services lines (rather than across competitors as is traditionally done when this index is applied to the study of market concentration); and (b) **Internal Share**, measured for each of the six service lines selected for study and derived as a percentage of a facility's total cases. Three measures fall within the external category: (a) **Expected Market Share**, measured in each of the six selected service lines as a hospital's variance from expected volume, with expected volume defined by the hospital's overall share in the market across all service lines; (b) **Market Change**, measured as the change between 2003 and 2007 in a hospital's market share in each of the selected service lines within its local market; and (c) **Cluster Change**, measured as the change between 2003 and 2007 in a hospital's share in each of the selected service lines within its cluster of sister hospitals. Higher values in each of these measures are considered to depict a greater

focus by the hospital on particular service lines and thus greater degree of specialization. Each measure is discussed in the paragraphs to follow.

The HHI used to measure **Internal Service Concentration** is calculated by summing the square of each service line's share of a hospital's total caseload (Zwanziger et al., 1996). The squaring of the shares exaggerates the values of the largest shares and diminishes those of smaller ones, thereby highlighting degrees of concentration. Many studies have used the HHI to measure market competitiveness in the healthcare industry (Farley, 1989; Gresenz et al., 2004; Phibbs & Robinson, 1993), but it has been much less widely applied to the study of a single hospital's service concentration (Baumgardner & Marder, 1991). Because this measure incorporates all cases within a hospital, it serves as a broad indicator of the overall pattern of specialization for each hospital in the study.

The internal HHI measure, however, suffers from a limitation that it is sensitive to the size of the unit being measured, in this case the size of the hospital (Dayhoff & Cromwell, 1993). Larger hospitals tend to admit many more cases as well as different types of cases and thus are more likely to exhibit lower HHI scores than are smaller hospitals. This thus provides an additional reason to use multiple measures for depicting hospital specialization. This point is discussed further in the section to follow covering descriptive, independent variables, including a variable representing hospital size.

The **Internal Share** measure draws on ideas developed first by Drucker (1963) who described how a company's product mix reveals the potential for future sales growth through the relative proportions of its products (or services) across an array of winners and losers. Management of an optimal mix in response to changing opportunities and

resources requires both planned deletions and additions over time on the basis of product mix and brand strategy (Kotler, 1976). Thus, the concept of measuring internal share of a service line lies at the very heart of the marketing rationale applied universally to product positioning and product line strategy.

With a focus on case-mix specialization in the hospital services market, Farley and Hogan (1990) assume an external rather than internal perspective on measuring specialization. The researchers distinguish specialization from the concept of specialized hospital services or specialized hospital units that depend on sophisticated technology and unusual professional expertise. Their approach to measuring specialization is focused on hospital variance from its marketplace norm. **Expected Market Share** can be used to depict the norm. The larger the positive variance between actual versus expected share, the greater is the indication of specialization by the hospital in the chosen service line. The calculation for this dependent variable as a measure of specialization is:

MSij – EMSjk where:

MS = a hospital's market share in a service line, and

EMS = **Expected Market Share** based on total cases across all service

lines for a hospital, with:

i = service line,

j = hospital, and

k = market

Because the key research questions of this study examine the associations between specialization by hospitals and descriptive characteristics of their markets and

organization, this study includes two change variables that compare the years 2003 to 2007: (a) a **Market Change** dependent variable that reflects an individual hospital's change in market share, measured for each of the six service lines examined in this study; and (b) a **Cluster Change** dependent variable for each of the six service lines that measures, for each hospital that is a member of a cluster, the change in its share among all same-system hospitals that are members of its local cluster (Luke et al., in press). While the application of such variables to measure the impact of change in healthcare is relatively new, the concept of measuring change is found extensively in the literature, beginning in political and other social sciences research and widely applied in longitudinal studies in healthcare over the decades (Peterson et al., 2008; Sutherland & Steinum, 2009). Although Trinh and O'Connor (2002) created study variables to measure change in hospital performance and change in strategy over several years to analyze the effect of environmental and organizational characteristics, the majority of published studies in healthcare research use longitudinal studies measuring change typically to assess clinical outcomes and a change agent of intervention. In the case of the **Cluster Change** variable, positive gains in share for a hospital functioning as part of a local, same-system cluster in each of the six service lines being analyzed are considered to indicate specialization in its cluster (Luke et al., in press). The interpretation is identical in this study when the change variable concept is applied as a measure of **Market Change**.

In sum, the five dependent variables to be examined in the regression analysis are: (a) a hospital's **Internal Service Concentration**, (b) **Internal Share**, (c) **Expected Market Share**, (d) **Market Change**, and (e) **Cluster Change**.

*Additional, but Rejected, Alternatives as Dependent Variables*

Other measures were considered for use in this study, but for various reasons will not be used in this study. Some of the more important options include: (a) the information theory index (ITI), (b) statistical measure of distance, and (c) dynamic market share.

The ITI (Farley, 1989; Farley & Hogan, 1990) is a widely discussed but infrequently used measure. First introduced in 1967 (Theil, 1967), Evans and Walker (1972) applied this measure to the analysis of hospital case mix data. It is measured as the weighted log of hospital DRG proportions compared to national DRG proportions. Observed proportions are used as weights. The index is zero if no specialization occurs and increases to a value of one if a hospital is so specialized that it serves only one DRG. The ITI has been used effectively in earlier research on specialization (Barer, 1982), although these studies and earlier work by Evans and Walker (1972) largely focused on hospital costs. Using this index, Farley and Hogan (1990) found that hospital specialization increased from 1980 through 1985 and that costs were lower in those hospitals specializing and that had the greatest incentives to reduce costs.

Farley (1989), however, notes multiple disadvantages of the ITI. It is biased upwards because the score increases with either fewer patients or more categories (which is also true of the HHI). This is because expected case mix proportions can only be approached with a finite number of patient discharges. Such biases decrease with hospital

size. This bias can be especially significant for small hospitals, meaning that they will always indicate some specialization. Consequently, Farley cautions against comparing values across hospitals, patient categories, or time periods. In addition, it suffers from a problem of interpretation. Furthermore, because the ITI does not measure differences between case mix proportions, it is difficult to assign meaning to the value of the index and thus interpret differences in the index across hospitals. Because the ITI measures deviation in a hospital's case volume from that of a "typical" hospital serving as the norm, it captures only the magnitude but not the direction of a hospital's differences at the extremes of the spectrum (Zwanziger et al., 1996). Hospitals that treat a very narrow range of cases and thus are considered to exhibit differentiation will tend to have the same relatively high index values as hospitals that treat a very broad range of cases and thus are considered to exhibit diversification. This is a serious drawback for the index's use in measuring patterns of specialization (Dayhoff & Cromwell, 1993). Because of its complexity in derivation, difficulty in interpretation and multiple disadvantages that cannot readily be overcome in its application, it will not be used in this study.

The statistical measure of distance has similar limitations. Zwanziger, Melnick, and Rahman (1990) used it as a measure similar to Farley's use of the ITI measure. It compares a hospital's case mix to those of an "average" hospital. The researchers termed it the statistical measure of distance. Unlike the ITI measure, however, it weights all diagnostic categories equally. The researchers based their measure on 48 DRG clusters that differed by complexity of treatment and physician specialty. This measure thus

shares some of the same limitations as observed with the ITI measure in that it is complex to derive and difficult to interpret and consequently will not be used in this study.

Dranove and White (1989) defined a hospital's specialization in a DRG as a situation in which there is a persistent increase in its market share for a given DRG over and above its initial average market share for all DRGs. While similar to **Expected Market Share** in concept because of its derivation from a baseline, it differs from the dependent variable chosen for this study in part because it defines specialization by DRG as opposed to an entire service line. Moreover, Dayhoff and Cromwell (1993) criticize this conceptual approach to measuring specialization because the definition potentially allows a hospital to specialize in all DRGs at once if its overall market share rises. Thus, growth is confounded with specialization. It too is rejected for use in this study, again in exchange for more simplistic, interpretable measures that do not require mathematical transformation for interpretation.

Still other alternative measures exist and have been proposed by researchers. Two examples were conceptualized by Dayhoff and Cromwell (1993) but have not been widely adopted. These generally utilize DRGs in their derivation rather than the broader concept of service lines. The first is simply the number of distinct DRGs in which the hospital treats any number of cases, representing a linear measure and one without weighting, unlike the internal HHI. Such a measure is particularly successful at distinguishing tertiary care hospitals treating a large number of different DRGs and therefore highly diversified. However, it is not a measure that captures a narrowing of services but rather one of case mix and complexity of cases, representing a dimension of

admission patterns rather than specialization as a strategy. Nor is it a measure whose derivation aids in distinguishing general hospitals from each other. Such a measure is therefore rejected for its lack of application to the study.

Another also easily calculated measure is simply the percentage of a hospital's cases in the top five most common Medicare DRGs. Since hospitals treating a higher percentage of patients in the common DRGs, by definition, treat a lower percentage of cases in other DRGs, this percentage would be indicative of fewer services and thus specialization in the form of differentiation. However, a strong rationale exists, amplified in the section to follow, for analyzing broad service lines in lieu of more narrow DRGs to view how hospitals are organized and managed, where physicians are trained and practice their specialties, and how the multidisciplinary nature of patient care is increasingly provided. Thus, a measure of specialization based on an aggregate percentage of DRG caseload is rejected for use in this study because it lacks relevancy to the increasingly complex realities of hospital management and patient care.

*Validity of Dependent Variables*

An important issue pertaining to the measurement of the dependent variables is whether they capture the essence of the central construct, hospital specialization. Few measures of specialization exist against which construct validity could be tested. The primary issue, however, is whether the particular measures reflect variations in other dimensions, other than specialization. As already noted, variations in the internal HHI are likely to be sensitive to variations in the size of a hospital. Larger hospitals, for example, tend to admit many more different types of cases purely because of their relative size and

thus exhibit lower HHI scores because there is less concentration of case types. The inclusion in the study of an independent variable for hospital size discussed in the following section should capture some of the size effect, but may not capture all of it. Although the internal HHI is the most widely used measure for specialization in the literature, face validity, content validity, criterion related validity, and construct validity may all be questioned (Polit & Beck, 2004) by the use of a hospital's internal HHI to measure specialization. Moreover, while an internal HHI may look as though it is quantifying what it purports to measure and thereby achieve face validity, it remains an interpretative judgment as to when the index is high enough to indicate that specialization has taken place. If used as the sole measure in this study, the index does not indicate whether a hospital is actually specializing in any of the six service lines to be analyzed. Therefore, the internal HHI cannot be used as the sole indicator of specialization for this study. The research draws on additional measures to supplement analysis and enhance the opportunity to reach meaningful conclusions.

Since it is defined using percentages, the **Internal Share** measure should be relatively free of a size effect. On the other hand, it is possible that the distributions of services by size of hospital could affect the percentages at the service line level. The lower case mix diversity of smaller hospitals could lead to higher service line share percentages. Again, the hospital size and other measures in the regression model related to size (e.g., ownership where for profit hospitals tend to be somewhat smaller than not-for profit hospitals as a category) should help to remove some of the influence of size.

The **Expected Market Share** measure, as it compares shares by service line to internal norms, should reflect individual hospital behaviors and not size. The two change measures, **Market Change** and **Cluster Change**, also are compared to an internal norm – the percentage share in 2003 for each hospital and service line. Change variables also tend to be influenced by other occurrences in the environment, such as changes in demographics, technology, overall business practices, clinical trends including the movement of surgery out of the hospital into ambulatory surgery centers, regulatory changes, and so on. The use of a cross-sectional design, however, removes much of this effect, since each hospital will be compared to every other hospital measured at the same moment in time.

Table 11 summarizes the measurement of specialization in the study.

*Summary of Independent Variables in the Model*

This study assesses the correlations between organizational and market characteristics and hospital specialization. Associations with nine independent variables are examined: (a) whether or not a hospital in a cluster has the leading share for each of the six service lines, referred to as **Cluster Lead Hospital**; (b) tax status based on type of hospital ownership, referred to as **Ownership**; (c) facility size based on acute care, inpatient bed count, referred to as **Hospital Size**; (d) local market population density, referred to as **Density**; (e) local market population growth rate, referred to as **Growth**; (f) the percentage of the local population age 65 and older, referred to as **Age**; (g) the percentage of the local population living below the federally established poverty level, referred to as **Poverty**; (h) market competitiveness, referred to as **Competitiveness**,

Table 11

Dependent Variables as Measures of Service Line Specialization*

| Variable | Measurement | Type of Measure | Data Source | Interpretation |
|---|---|---|---|---|
| Internal HHI **(Internal Service Concentration)** | ∑ squared shares of each hospital's service lines. | Continuous between 0 and 1 | 2007 Intellimed | Specialization increases with higher values. |
| A hospital's total cases in a single service line **(Internal Share)** | Number of cases in each of the service lines as a percentage of a hospital's total cases. | Continuous between 0 and 1 | 2007 Intellimed | Specialization increases with higher share. |
| Variance between actual and expected cases **(Expected Market Share)** | Actual minus expected cases in each of the six service lines, divided by expected cases based on a hospital's share across all lines. | Continuous, negative or positive | 2007 Intellimed | Specialization increases with higher positive values. |
| Increased hospital local market share over time in a service line **(Market Change)** | Difference in a hospital's market share between 2003 and 2007 in target service lines, divided by its 2003 share. | Continuous, negative or positive | 2003 and 2007 Intellimed | Specialization increases with higher positive values. |
| Increased hospital share of its cluster over time in a service line **(Cluster Change)** | Difference in a hospital's cluster share between 2003 and 2007 in target service lines, divided by its 2003 share. | Continuous, negative or positive | 2003 and 2007 Intellimed | Specialization increases with higher positive values. |

*Dependent variables named in parentheses.

measured using the reciprocal of the Hirschman-Herfindahl index (HHI), which is commonly used to measure market concentration; and (i) the ratio of specialty physicians per one thousand residents in a CBSA, referred to as **Physicians**. Each of these nine variables is discussed more fully in the paragraphs to follow.

*Measurement of Organizational Characteristics*

The study examines three organizational characteristics: (a) **Ownership**, (b) **Hospital Size**, and (c) **Cluster Lead Hospital**.

*Ownership*. There is evidence that the tax status implied by hospital ownership could have an effect on the mix of medical services offered by a hospital (Horwitz, 2007). In this study, the hospital ownership is measured as a binary variable, coded as "0" if a hospital is not-for profit (whether under ownership by a particular religious order such as the Catholic Church or non-religious but incorporated under the IRS code as a not-for profit entity) or coded "1" if a hospital is commercial and incorporated as a for profit. This variable is constructed from a 2007 update of the 2006 AHA database (Luke, 2010).

*Hospital size*. Hospital size is measured using total inpatient, staffed beds based on the 2006 AHA Annual Survey data for all acute care general, medical surgical hospitals located in the designated CBSAs. Because there are many small to medium sized hospitals but many fewer, larger hospitals, the distribution of size is highly skewed and thus is far from being normally distributed, which is required for use in regression analysis. This variable is therefore measured using logarithmic transformation. This shifts

the tail towards the center and improves the normalization of the data. It is a continuous variable.

*Cluster lead hospital*. A cluster is defined as two or more acute care general, medical-surgical, community hospitals that are members of the same-system and located in the same CBSA. This definition is consistent with that adopted by Cuellar and Gertler (2003, 2005) and applied more recently by Luke et al. (in press). Clusters are used in the sub-analysis, in which each cluster's lead hospital is compared to the remaining hospitals in the cluster. A lead hospital is defined as the cluster member that has the highest market share in a given service line in 2007. The lead variable is measured as a nominal dichotomous variable, coded as "0" if a hospital is not a lead and "1" if it is. Here, too, this variable is constructed from the 2006 system membership database, updated by 2007 public records.

Relevant to this sub-analysis is the fact that "urban" is defined as either a metropolitan statistical area (METSA) or a micropolitan statistical area (MICSA), as distinguished from rural. The clusters are defined by the combination of hospitals within the boundaries of U.S. Census Bureau defined urban areas including MICSAs with METSAs and known as CBSAs. There is therefore an urban exclusivity for the analysis of specialization within cluster hospitals. The CBSA is chosen to define physical confines of markets because it represents "a functionally integrated area in and around an urban center that has a population of 10,000 or more" (U.S. Census Bureau, 2008).

Although a hospital designation as an academic medical center or teaching hospital is likely to be associated with hospital specialization, there are too few such

hospitals in the three state dataset for inclusion of this variable to be reliable. Across the

three states, there are only 23 designated teaching hospitals, of which only 11 are

academic medical centers. Therefore, this is not included as an internal independent

variable in the analysis.

*Measurement of Market Characteristics*

Six market factors are measured in this study: (a) **Growth**, (b) **Density**, (c) **Age**,

(d) **Poverty**, (e) **Competitiveness**, and (f) **Physicians**.

*Growth*. The percentage of population growth reflects differences in the pace of

change in demand across the markets, which could impact local hospital strategies. This

measure is obtained from the Area Resource File (ARF) based on U.S. Census data and is

calculated as the average annual change in population between the years 2000 and 2006.

It is a continuous variable.

*Density*. Population density is measured as the population per square mile in

2006. Population density is associated with a number of market characteristics, including

distance traveled to obtain care, proximity of hospitals to one another, and percentages of

minority populations in a market. Thus, like population growth rate, it is expected to

impact demand for hospital services and the ability of hospitals successfully to engage in

specialization. As discussed in Chapter Three, hospitals are known to differ and thus be

classified by location as either urban or rural. Because the study utilizes the CBSA to

define each market, population density reflects the numbers and sizes of hospitals, their

proximity to one another (spatial competition), and the proximity of local populations to

hospitals. It is obtained from the ARF, which provides population data obtained from the U.S. Census Bureau. It is a continuous variable.

*Age.* The percentage of the total population represented by persons age 65 and older reflects the relative numbers of persons who are likely to experience high incidences of chronic and other diseases or illnesses with severities to warrant hospitalization, which could influence positively levels of inpatient demand. This is measured for each CBSA, using the 2005-2007 American Community Survey by the U.S. Census Bureau. (For smaller CBSAs for which this statistic is not available from the Survey, county population statistics from the U.S. Census Bureau are used.) The older segment of the populace is likely to be disproportionately represented in the six study service lines, given that these reflect chronic conditions and illnesses (specifically, cardiology, cardiac surgery, invasive cardiology, pulmonary services, and, to a lesser extent, orthopedics). It is noted that older populations generally require greater access to specialty physicians than do other population groups and the correlation between the specialty physician access and demand for inpatient care increases the likely importance of this measure for this study (Liu & Sharma, 2002). Expressed as a percentage, it is a continuous variable.

*Poverty*. The percentage of the total population represented by those living below the poverty level is also obtained for each CBSA from the 2005-2007 American Community Survey by the U.S. Census Bureau and serves as an indicator of demand for hospital services including obstetrics. Because the indigent are not age dependent, the variable encompasses a significant number of pregnant women and their children as well

as the elderly and is thus a demographic, independent variable that should reflect a community's demand for acute care services such as labor and delivery as well as inpatient, chronic care services. In the case of general hospitals that have contracted with state agencies to provide Medicaid-funded services to their indigent, local populace, it potentially helps to identify those service lines a hospital may target for specialization or be forced to provide. Expressed as a percentage, it is a continuous variable.

*Competitiveness*. Market competitiveness is measured using the difference between one and the Hirschman-Herfindahl index (HHI), which is commonly used to measure market concentration. The HHI has become the preferred means of measuring concentration because the index is derived from the summation of squared shares of all players in a market (Gresenz et al., 2004). Many studies have used the HHI to calculate market competitiveness or price competition, among them Farley (1989), Phibbs and Robinson (1993), and international as well as domestic studies (Chen & Cheng, 2010). The index ranges between 0 and 1, with the higher value approaching a monopoly and the lower, pure competition. Subtracting the index from one indicates lower market competition as the HHI value becomes higher.

The assumed inverse association between the HHI and market competitiveness reflects assumptions about price, rather than non-price competitive behaviors. As explained in previous chapters, non-price competitiveness, of which specialization is a particular form, could be directly related to the HHI. More concentrated markets produce smaller numbers of rivalrous competitors that could be expected to engage in specialization, a form of non-price competition. Hence, the higher the degree of

concentration, the higher the expected levels of service line specialization. The variable is calculated for each market identified as a CBSA, using the share of total cases for each hospital in the market based on the 2007 Intellimed dataset. The standard calculation of the HHI and illustrations of these examples are provided in Appendix B. It is important to reiterate a qualification on the HHI, in that its distribution is skewed, as discussed earlier.

*Physicians*. The presence of local physicians in the market is measured using equivalent service-line specialty categories. Data for this are obtained from the American Medical Association (AMA) and made available through ARF. Each service line in the study is matched with those provider specialties most closely associated with that clinical hospital service, as follows: (a) cardiac surgery – matched with thoracic surgeons; (b) cardiology – matched with cardiologists; (c) invasive cardiology – matched with three internal medicine subspecialties added together (interventional cardiology, cardiac electrophysiology, and nuclear cardiology); (d) labor and delivery – matched with general obstetricians and gynecologists; (e) pulmonary services – matched with pulmonologists; and (f) orthopedics – matched with orthopedic surgeons. The figures exclude residents and administrators and represent only active, non-retired physicians. The data are drawn from the 2008 ARF Release (2007 data). Reported by county, the data have been manually organized by CBSA and measured using physician per capita ratios. Table 12 summarizes the measurement of variables used in the study.

<div align="center">Quality Control and Data Analysis</div>

<div align="center">*Preparation of the Data for Analysis*</div>

Steps will be taken to test for missing values and to perform appropriate data

Table 12

Independent Variable Characteristics of General, Community Hospitals

| Variable | Measurement | Variable Type | Data Source |
|---|---|---|---|
| Internal/Organizational Factors | | | |
| Tax status of hospital ownership **(Ownership)** | 0 = not-for profit<br>1 = for profit | Binary: 0 or 1 | 2006 AHA (updated in 2007) |
| Bed count of the facility **(Hospital Size)** | Total staffed inpatient beds | Continuous | 2006 AHA (logarithmic) |
| Share leader of cluster **(Cluster Lead Hospital)** | 0 = non-leader<br>1 = cluster share leader | Binary: 0 or 1 | 2007 Intellimed |
| External/Market Factors | | | |
| Percentage population growth **(Growth)** | Δ population 2006-2000/ 2000 CBSA population | Continuous | 2006 ARF |
| CBSA population density **(Density)** | 2006 population/2000 CBSA square miles | Continuous | 2006 ARF |
| Competitiveness of market **(Competitiveness)** | 1 = external HHI of CBSA | Continuous | 2003 lagged Intellimed |
| Percentage of the population 65 years and older **(Age)** | American Community Survey 2005-2007 by CBSA | Continuous | U.S. Census |
| Percentage of the population below poverty **(Poverty)** | American Community Survey 2005-2007 by CBSA | Continuous | U.S. Census |
| Ratio of specialty physicians population **(Physicians)** | AMA | Continuous | 2008 ARF - to release |

cleaning. This will be done by producing a correlation matrix with estimates of missing values to determine whether line item entries can remain missing without having significant impact on analytical results. Otherwise, a statistically acceptable means of inputting missing data will be provided. This is not expected to be an issue due to the completeness of data sources.

## *Choice of Statistical Technique*

A standard, fixed effects, multiple regression model is first used to assess the relationship between the dependent and independent variables. Given the diversity across the three states, a state dummy variable is included as a covariate in the model. The regression technique was chosen because it can be applied to a dataset in which the independent variables are correlated with one another and with the dependent variable to varying degrees (Tabachnick & Fidell, 2007). The regression equation assumes the following structure:

(SPECIALIZATION) = X + $B_{CL}$ (CLUSTER LEAD HOSPITAL HOSPITAL + $B_H$ (HOSPITAL SIZE) + $B_O$ (OWNERSHIP) + $B_G$ (GROWTH) + $B_D$ (DENSITY) + $B_{CO}$ (COMPETITIVENESS) + $B_L$ (AGE) + $B_P$ (POVERTY) + $B_{PH}$ (PHYSICIANS) + $Z_S$ (STATE as a COVARIATE) where X is the intercept value of (SPECIALIZATION) when all INDEPENDENT VARIABLES and COVARIATE are zero.

To improve the quality of analysis, stepwise regression is chosen for refinement in methodology and the backward deletion method specifically is selected in an effort to determine the best fitting model. Although several approaches can be taken for the

elimination of variables, the chosen method statistically excludes independent variables one at a time if they do not contribute significantly to the results, until the required *p*-value threshold is met (in this case $p < .05$), or the Adjusted $R^2$ value decreases dramatically upon deletion of a variable. The primary benefit in this approach is it identifies a subset of independent variables that could be considered statistically helpful for predicting a given dependent variable. All other independent variables that provide little incremental predictive power are screened out (Tabachnick & Fidell, 2007). Backward, stepwise regression is thus the refined means of methodology to be employed in producing the primary analysis results of the study.

*Mixed Effects: Subset Analysis to Control for the Cluster Effect*

When a hospital belongs to a multi-hospital system and resides with same-system hospitals in proximity to each other, or cluster, whether a hospital decides to specialize or not may depend on what other hospitals do within its cluster. Therefore, all the specialization measures in this study may be correlated among the hospitals within their respective cluster. There are 50 such discrete clusters identified in the study. To be precise in trying to account for this cluster effect, "cluster" as an independent, random effect variable must be segregated and assessed to determine if this cluster effect is explaining any portion of the error term in the regression equation. A mixed effects model is therefore selected for multilevel linear modeling to assess sources of variation attributable to cluster effect. In other words, models will include an additional error term associated with the effect of cluster membership of hospitals to determine if cluster effect can help explain a portion of underlying variance. Statistical testing will determine if the

portion of the error term explained by cluster effect is different from zero and significant (Fox, 2002).

### *Adequate Ratio of Cases to Number of Independent Variables*

Although sample size has previously been discussed in the context of generalizability and a minimum of 315 cases is estimated as required for the research design to detect relationships that exist among variables (Polit and Beck, 2004), a practical issue still to be considered in the use of multiple regression technique is the ratio of cases to the number of independent variables (Green, 1991). The two most common rules of thumb are: (a) $N \geq 104 + m$ where m is the number of independent variables, and (b) $50 + (8)m$ (Tabachnick & Fidell, 2007). Applying these two rules indicate the need for 112 - 114 cases, a figure that is well exceeded by the 303 general, community hospitals with 25 or more beds in the database for the three states selected for study in the aggregate.

A higher cases-to-independent-variables ratio is advised when the dependent variable is skewed, a small effect size is anticipated, or substantial measurement error is expected from less reliable variables. In such circumstances, a ratio of 20:1 for each independent variable is recommended in a simultaneous regression and 40:1 in a stepwise regression (Polit & Beck, 2004). An excessive number of cases is ill-advised because virtually any multiple correlation will depart significantly from zero if the number of cases becomes too large (Tabachnick & Fidell, 2007). The eight descriptors in the study model (nine including Cluster Lead Hospital in the sub-analysis) would therefore require 160 cases for simultaneous regression and 320 cases for stepwise regression. The final

sample size of 303 spanning three states is in this range, although shy by 17 hospitals of the desired number for the stepwise regression. Therefore, from several different perspectives, the sample size is considered sufficient but not so large as to diminish the explanatory value of any single independent, predictor variable.

*Absence of Multicollinearity and Singularity*

To identify multicollinearity in highly correlated IVs, the squared multiple correlation (SMC) of each IV will be examined with the rest of variables serving as independent variables in multiple correlation. Variables showing signs of multicollinearity or singularity (unstableness) will be eliminated or chosen on the basis of reliability or other reasons. Generally, multicollinearity does not introduce bias in the estimates as such but does alter the statistical estimates for the collinear variables. Thus, it is important to remove those variables that are redundant and the least reliable, especially variables that are .80 and above correlated with others (Tabachnick & Fidell, 2007). This is a particular problem in the cross-sectional analysis of hospital behavior and structure, because so many factors are intercorrelated (size especially with other measures). Because of the limited inclusion of variables into the analyses, multicollinearity should not be a major problem.

*Normality, Linearity, and Homoscedasticity of Residuals*

Examination of scatterplots of residuals will be used as a pre-analysis screening procedure to assess normality, linearity, and homoscedasticity between predicted DV scores and errors of prediction to determine if further screening or transformation of data is necessary. Standard assumptions are that the residuals are normally distributed about

the predicted dependent variable scores, that residuals have a linear relationship with predicted DV scores, and that the variance of the residuals around predicted dependent variable scores is the same for all. Because extreme cases can impact regression results and can affect the precision of the regression weights, data will be examined with both statistical tests and visual inspection for the significance of multivariate outliers (Fox, 1991). If outliers are not eliminated and lack of normality is considered severe, the data will be transformed by acceptable methods such as the square root for high positive skew or a log transformation or by truncating the extreme values in circumstances of high, positive kurtosis and skewed distribution of data (Tabachnick & Fidell, 2007). Further discussion of data normality and outliers is addressed in Chapter Five.

*Endogeneity*

Variables are considered endogenous if they are predicted by other variables in the model. When an independent variable is correlated with the error term in the regression model, this reflects a biased regression coefficient. Sources of endogeneity can commonly be either an omitted variable that affects both an independent variable and the dependent variable or measurement error in an independent variable. Because firms choose strategies reflecting their internal attributes, industry conditions, and environment, those choices may be endogenous and self-selected (Shaver, 1998). In the absence of knowing which variables might be endogenous to others, one solution is to define and measure observations so as to avoid endogeneity. Another is to use a lagged independent variable as a proxy to control for possible selection biases in the correlational data (Newhouse & McClellan, 1998). Consequently, one minus the Hirschman-Herfindahl

Index as an overall measure of a hospital's market competitiveness will be lagged using 2003 rather than 2007 data in calculating the independent variable's value. While there are other methods of addressing the problem of endogeneity such as the instrumental variable approach (Newhouse & McClellan, 1998), there is no overarching guidance in econometric literature strongly promoting the use of one over another as even the source of endogeneity could also influence how it is best tested, validated and corrected.

<p align="center">*Statistical Inference*</p>

Statistical significance is considered established for variables with a *P*-value of less than 0.05. The F statistic for the analysis of variance will be used to assess the significance of the overall relationships. The F statistic is the ratio of the mean squares for regression and error, or MSR/MSE. The larger the F value, the smaller the *P*-value, and the stronger the evidence of association between the dependent variable and the independent variable (Canavos & Miller, 1999). The size of the $R^2$ will indicate how much of the variability in specialization by general, community hospitals is predicted by the variables included in the equation, using a 95% confidence limit.

<p align="center">Delimitations</p>

One full year of case activity is selected for this retrospective study. The research is not longitudinal. It is not a goal of this study to determine if change has occurred in the hospital sector over time, but rather to assess whether there is evidence specialization exists and, if so, what factors might be associated with indicators of specialization.

Nor is case volume being studied in any connection to clinical outcomes inclusive of quality or safety improvement, despite the pressure that may be exerted on hospitals to

specialize in order to improve quality or patient safety. There is no judgment of whether a hospital is performing with good or poor clinical outcomes, either comparatively or in absolute terms. Instead, case volumes are used to calculate local market share within selected service lines, based on the highest volume diagnostic categories in those service lines chosen for analysis. As such, the value of specialization by service line is not being measured or assessed in any way in this study. Nor is cost or net profit considered among variables in any way. Hence, the research is not intended to offer any financial analysis and conclusion despite the fact that patient volumes and market share strength can exert economic implications. Because payer contracts with hospital providers dictate discount percentages against billed charges and these may vary among hospital systems, markets, and hospitals themselves, it is understood that net revenue in the form of collections is not reflected in charge data. Charges are intended merely to reflect the revenue-generating capacity of a service line and not intended to imply profit performance. It is further understood that collections on hospital charges for uninsured patients are equally subject to variation and outside of the scope of this study. Similarly, the relationships with public or private payers and local physician organizations are not explicitly measured in any way. It is nevertheless recognized that the mix and concentration of payers and their contractual relationships with all providers in a local market could well affect the specialization strategies of general, community hospitals. Similarly, the strength that organized physician groups (across specialties and even including primary care doctors) might exert on local hospital specialization is acknowledged but not reflected in this study. Because the data concerns itself strictly with general, community

hospitals to the exclusion of specialty hospitals whether under physician or corporate ownership, the influence of this competitive element is also absent from analysis. It is recognized that specialization strategies undertaken by general, community hospitals may in fact be in response to the local competitive threats of specialty hospitals especially those with a focus on cardiac services or orthopedic surgery. Although an attempt is made to identify a lead hospital with the highest share in its cluster in each of the six service lines selected for study, it is recognized that this may not, in fact, reflect a strategy of specialization under the direction of the system of which it is a member. Also, a designated lead hospital may have only a marginally higher share than another same-system hospital in its cluster and thus not be distinguished in terms of cluster specialization.

## Assumptions

1. It is assumed that the data released to the public by Florida's Agency for Healthcare Administration, the University of Nevada's Center for Health Information Analysis, and Virginia's Department of Health Information represent a full and accurate accounting of each states' hospital discharges.

2. It is assumed that Intellimed, a proprietary company, has processed the data accurately and completely. In particular, it is assumed that the definition and classifications applied by Intellimed are consistent with generally accepted definitions and classifications of service lines utilized by general, community hospitals nationwide.

3. It is assumed that specialization by service line reflects a strategic response made by general, community hospitals.

4. It is assumed that the four-year interval between 2003 and 2007 represents sufficient time for hospitals and health systems to implement specialization strategies.

5. It is assumed that the service lines selected for study represent the level at which hospitals engage in service line specialization.

CHAPTER 5:  RESULTS and ANALYSIS


Chapter Overview

This chapter is divided into three sections. Section one describes the final

cleaning of data and presentation of descriptive statistics on market and hospital

organizational characteristics. It also examines correlation statistics in search of possible

multicollinearity and presents results of standard, simultaneous regressions using each of

the dependent variables described in Chapter Four. Section two offers a rationale for

further refinement in methodology, specifically focusing on the benefits of performing

backward stepwise regression, the findings of which are shared in the third section. Tests

for normality of distribution of data are also performed, followed by an assessment of

outliers and a rationale for not eliminating extreme outliers. To improve normality for

better predictability of regression models, transformation of dependent variables is

undertaken. The third section presents the results for analyses using all 303 hospitals as

well as discusses those hospitals in the cluster sub-group following application of

procedures. This section also presents the testing of all nine hypotheses. The chapter

concludes with a brief summary of findings and analysis.

Introduction

*Final Data Cleaning and Descriptive Characteristics of Hospitals*

Population data were missing from ARF for seven local markets, six of which

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were in Virginia and all too small for census data to be available from online sources. To remedy the gaps, means for population, population density, population growth, poverty level, and percentage of the population age 65 or older were calculated for populations under 10,000 in the study sample. These means were used to replace missing data.

After merging sources of data and eliminating specialty, extended care and federally-owned facilities, hospitals falling outside of CBSAs and those with fewer than 25 beds, the final study sample consisted of a total of 303 general, community hospitals residing in 87 metropolitan or micropolitan markets across Florida, Nevada, and Virginia. Hospitals treating cases in 2007 in the six service lines are shown in Table 13.

Table 13

Number of Hospitals Participating in High Volume, High Revenue-generating Service Lines

| Targeted Service Line | Hospitals in Final Study Sample Offering the Targeted Service Lines | % of Total |
|---|---|---|
| Cardiac Surgery | 245 | 80.9 |
| Cardiology | 303 | 100.0 |
| Invasive Cardiology | 243 | 80.2 |
| Orthopedics | 267 | 88.1 |
| Pulmonary Services | 269 | 88.8 |
| Labor and Delivery | 179 | 59.1 |
| All six service lines | 166 | 54.8 |

The table illustrates that only slightly over half or 54.8% of all the hospitals discharged cases in all of the six high volume, high revenue-generating service lines. Hospitals were most selective about offering labor and delivery services, with only 179 of the 303 or 59.1% hospitals discharging such cases in 2007. On the other hand, all 303 hospitals in the study sample reported inpatient cases in cardiology, reflecting the widespread prevalence of chronic cardiac disease in the general population requiring such services.

Table 14 provides descriptive statistics for continuous, independent variables. Specifically, the number of observations, mean, standard deviation, and minimum and maximum values are presented for each characteristic in order to illustrate the variety and wide range of facilities across the three states in the study sample. **Hospital Size** is most easily interpreted by observing untransformed data, as the number of beds among the 303 hospitals ranges from 25 to 1,500, with a mean of 248, median of 200, and standard deviation of 194. Data for bed counts transformed into logarithms as displayed in Table 14 and used to measure hospital size reflect a tighter distribution than the untransformed data, as expected. Market factors vary considerably among hospitals across the study sample, as demonstrated by the range between minimum and maximum values for variables. While mean population growth rate in a hospital's local market over the period 2000-2006 (**Growth**) is 11.6%, this statistic ranges from severe shrinkage by 32.1% to explosive growth of 66.7%. The age and economic prosperity of populations vary considerably as well, reflected by the percentage of the population age 65 and over in a hospital's local market (**Age**) ranging from 7.5% to 31.7%. Similarly, the percentage

Table 14

Continuous Independent Variables

| Variable | N | Mean | σ | Min | Max |
|---|---|---|---|---|---|
| Organizational Factors | | | | | |
| **Hospital Size** (log values) | 303 | 5.10 | 0.86 | 3.22 | 7.31 |
| Market Factors | | | | | |
| **Growth** | 303 | 0.12 | 0.09 | -0.32 | 0.67 |
| **Density** | 303 | 620.01 | 417.20 | 2.28 | 2812.45 |
| **Competitiveness** | 303 | 0.57 | 0.35 | 0 | 1.00 |
| **Age** | 303 | 15.97% | 4.97% pts. | 7.50% | 31.71% |
| **Poverty** | 303 | 12.79% | 3.61% pts. | 6.40% | 26.60% |
| **Physicians** | | | | | |
| Cardiac Surgery | 303 | 0.01 | 0.01 | 0 | 0.14 |
| Cardiology | 303 | 0.07 | 0.09 | 0 | 1.04 |
| Invasive Cardiology | 303 | $8.62^{e-8}$ | $6.64^{e-8}$ | 0 | $6.96^{e-7}$ |
| Orthopedics | 303 | 0.08 | 0.15 | 0 | 2.32 |
| Pulmonary Services | 303 | 0.03 | 0.03 | 0 | 0.51 |
| Labor and Delivery | 303 | 0.10 | 0.10 | 0 | 0.92 |

of the local population living below the poverty level (**Poverty**) ranges from 6.4% to

26.6%, respectively. Physician specialists (**Physicians**) do not necessarily practice in all

hospital markets, as no doctors in any of the six categories of specialists are recorded in

some of the smallest markets of hospitals. The physician ratios as a percent of the

population range widely as well, as depicted by relatively large standard deviations

compared to means.

Table 15 provides descriptive statistics for continuous variables measuring hospital specialization including number of observations, mean, standard deviations, minimums and maximum values for each dependent variable to illustrate variation across the three states in the study sample. The 303 hospitals in the study sample reflect considerable range in the extent to which they concentrate in any service lines, termed Internal Service Concentration. This is seen in both the minimum and maximum internal HHI values of 0.05 and 0.37, respectively, as well as the relatively high degree of concentration by hospitals in particular services, reaching a maximum Internal Share of 0.58 in pulmonary services for at least one hospital in the study sample. This focus is reinforced by the fact that only 54.8% of all 303 hospitals provide inpatient care in all six high volume, high revenue-generating service lines targeted by this study.

Table 15 also shows the variance in actual hospital share of cases relative to expectations in each service line relative to a hospital's share of market across all cases, termed Expected Market Share. The table shows that some hospitals exited three of the top six service lines: invasive cardiology, orthopedics, and labor and delivery. This is denoted by a variance of -1.00, representing the loss of 100% of a hospital's share of a market as it drops a service line altogether. Although not shown in the table, 14 or 7.4% of 187 hospitals stopped accepting cases in labor and delivery during the brief, four-year period, while six added the service for a net loss of eight hospitals delivering babies. Over the same period, eight of 249 hospitals or 3.2% stopped providing invasive cardiology, while two added the service for a net loss of six. Only one hospital or 0.4% eliminated orthopedics as a service line. Conversely, no hospitals dropped pulmonary

Table 15

Continuous Variables Measuring Specialization

| Variable | N | Mean | σ | Min | Max |
|---|---|---|---|---|---|
| **Internal Service Concentration** | 303 | 0.09 | 0.04 | 0.05 | 0.37 |
| **Expected Market Share** | | | | | |
| Cardiac Surgery | 303 | 0.19 | 0.32 | 0 | 1.00 |
| Cardiology | 303 | 0.11 | 0.41 | -0.88 | 1.81 |
| Invasive Cardiology | 303 | -0.16 | 0.76 | -1.00 | 6.31 |
| Orthopedics | 303 | 0.01 | 0.54 | -1.00 | 2.70 |
| Pulmonary Services | 303 | 0.18 | 0.63 | -0.53 | 6.39 |
| Labor and Delivery | 303 | -0.17 | 0.66 | -1.00 | 1.81 |
| **Internal Share** | | | | | |
| Cardiac Surgery | 303 | 0.01 | 0.01 | 0 | 0.08 |
| Cardiology | 303 | 0.12 | 0.05 | 0.01 | 0.27 |
| Invasive Cardiology | 303 | 0.03 | 0.03 | 0 | 0.26 |
| Orthopedics | 303 | 0.07 | 0.05 | 0 | 0.32 |
| Pulmonary Services | 303 | 0.11 | 0.06 | 0.04 | 0.58 |
| Labor and Delivery | 303 | 0.07 | 0.07 | 0 | 0.33 |
| **Market Change** | | | | | |
| Cardiac Surgery | 303 | 0.06 | 0.28 | -0.77 | 1.00 |
| Cardiology | 303 | -0.01 | 0.20 | -0.88 | 0.63 |
| Invasive Cardiology | 303 | $-1.59^{e-17}$ | 0.24 | -0.95 | 0.95 |
| Orthopedics | 303 | $-1.75^{e-5}$ | 0.22 | -0.95 | 0.95 |
| Pulmonary Services | 303 | $-3.45^{e-5}$ | 0.20 | -0.84 | 0.59 |
| Labor and Delivery | 303 | -0.01 | 0.23 | -1.00 | 1.00 |

services, cardiac surgery, or cardiology. In fact, 98 hospitals, increasing from 147 in 2003 to 245 in 2007 or 66.7%, added cardiac surgery over the brief, four-year period.

In addition, dramatic, positive shifts in market share positions were experienced by some hospitals over the period. This occurred, for example, in invasive cardiology in which a hospital experienced a 630.6% point variance over market share expectations and in pulmonary services, in which a hospital experienced a 639.2% point variance. Only in cardiac surgery did hospitals in the study sample gain share on average, demonstrated by a mean change in market share of six percentage points during the 2003-2007 period, termed **Market Change**. This occurred because of so many new entrants competing in the service even at small case volumes. In all other service lines, hospitals actually lost fractional share points, on average. All of this suggests functional diversity and even possibly jockeying for competitive positions among hospitals.

There are 45 different systems represented in the study sample, some of which operate facilities in multiple geographic markets. Among the 303 hospitals, 60 or 19.8% are not affiliated with any system in 2007. Of those in systems, 175 operated in clusters, defined as two or more hospitals in the same system in the same market. Together, these hospitals comprise 50 clusters operating in 25 markets in the three states. Table 16 shows that some of the cluster hospitals did not offer all six of the service lines.

Table 16 shows that only two-thirds or 64.0% of all the hospitals in the cluster sub-group of the study sample treated patient cases in all of the six high volume, high revenue-generating service lines. Still, this represents a higher percentage compared to those in the total study sample offering all six service lines to their local communities

Table 16

Cluster Hospitals Participating in High Volume, High
Revenue-generating Service Lines

| Service Line | Hospitals Offering the Cells | % in Cluster Analysis |
|---|---|---|
| Cardiac Surgery | 166 | 94.9 |
| Cardiology | 175 | 100.0 |
| Invasive Cardiology | 165 | 94.3 |
| Orthopedics | 174 | 99.4 |
| Pulmonary Services | 175 | 100.0 |
| Labor and Delivery | 116 | 66.3 |
| All 6 service lines | 112 | 64.0 |

(54.8%), probably because cluster hospitals are only urban and thus larger, on average,

than hospitals in the sample. The percentage of cluster hospitals offering labor and

delivery is about the same as in the sample as a whole, with 116 of the 175 or 66.3%

treating such cases in 2007 (compared to 59.1% of all 303 hospitals). All hospitals in

clusters provided care in 2007 in cardiology and pulmonary services, and all but one

treated cases in orthopedics. Table 17 reports the descriptive statistics for the continuous,

independent variables. The numbers show the variety and range of facilities in the cluster

sub-group of 175 hospitals.

Table 17

Continuous Independent Variables: Cluster Sub-group

| Variable | N | Mean | σ | Min | Max |
|---|---|---|---|---|---|
| Organizational Factors | | | | | |
| **Hospital Size** | 175 | 5.28 | 0.75 | 3.22 | 7.31 |
| | | | | | |
| Market Factors | | | | | |
| **Growth** | 175 | 0.13 | 0.07 | -0.06 | 0.30 |
| **Density** | 175 | 654.38 | 362.33 | 60.64 | 1066.00 |
| **Competitiveness** | 175 | 0.76 | 0.16 | 0.25 | 0.90 |
| **Age** | 175 | 16.02% | 4.91% pts. | 9.80% | 31.70% |
| **Poverty** | 175 | 11.86% | 2.36% pts. | 7.00% | 21.90% |
| **Physicians** | | | | | |
| Cardiac Surgery | 175 | 0.02 | 0.01 | 0 | 0.03 |
| Cardiology | 175 | 0.07 | 0.02 | 0.03 | 0.13 |
| Invasive Cardiology | 175 | $9.59^{e-8}$ | $3.99^{e-8}$ | $6.60^{e-9}$ | $2.83^{e-7}$ |
| Orthopedics | 175 | 0.03 | 0.01 | 0.01 | 0.07 |
| Labor and Delivery | 175 | 0.10 | 0.02 | 0.05 | 0.13 |

Descriptive statistics for the cluster sub-group shown in Table 17 reveal slightly

lower ranges between minimum and maximum values for Growth, Density, and Poverty

compared to values for all 303 hospitals. The hospitals in clusters, however, appear to be

responding to greater price competition/lower non-price competition on average, based

on the comparatively higher mean value of 0.76 for Competitiveness compared to 0.57

for the sample as a whole (see Table 14). With the exception of thoracic surgeons (the

specialty physicians associated with cardiac surgery) for whom a minimum value of zero

is displayed in Table 17, all of the cluster hospitals otherwise have access in their markets

to specialty physicians. The same cannot be said for the 303-hospital dataset, as hospitals

in 18 of the 87 markets lack access to any local, specialty physicians as defined for this study. This reflects the disproportionately higher concentration of specialists in more densely populated, urban areas.

Table 18 reports the descriptive statistics for the continuous variables measuring hospital specialization for the cluster sub-group of 175 hospitals. As reported in Table 18, cluster hospitals report the same degree of concentration, measured by the **Internal Service Concentration**, as do hospitals in the study sample as a whole (see Table 15). Except for cardiac surgery, standard deviations from means for **Expected Market Share** in each of the six service lines are also similar between the two groups. For the 175 cluster hospitals, the mean for cardiac surgery is negative (-21%), compared to positive (19%) for all 303 hospitals (see Table 15). The range of variance from market share expectations is also wider for cluster hospitals (485% or -100% to 385%) versus only 100% or 0% to 100% for all study hospitals). This could be attributable to a number of factors. Being only urban, cluster hospitals face greater competition within their markets in this particular service line, as evidenced by a higher mean **Competitiveness** pointed out in Table 17. Such statistics could also suggest less discipline on the part of same system hospitals in a cluster if some were new entrants to cardiac surgery and thus robbing share from sister hospitals in that particular service line. This is supported by a mean gain in market share in cardiac surgery between 2003 and 2007 of 1% for the 175 cluster hospitals, compared to 6% for the 303 hospitals in the study sample as a whole.

In fact, while not revealed in the tables but in the raw data, a possible illustration of this lack of cluster membership discipline is evident in the Baptist Health System –

Table 18

Continuous Variables Measuring Specialization for the Cluster Sub-group

| Variable | N | Mean | σ | Min | Max |
|---|---|---|---|---|---|
| **Internal Service Concentration** | 175 | 9% | 4% pts. | 5% | 37% |
| **Expected Market Share** | | | | | |
| Cardiac Surgery | 175 | -21% | 82% pts. | -100% | 385% |
| Cardiology | 175 | 13% | 41% pts. | -88% | 177% |
| Invasive Cardiology | 175 | -18% | 88% pts. | -100% | 631% |
| Orthopedics | 175 | 4% | 65% pts. | -100% | 270% |
| Pulmonary Services | 175 | 19% | 68% pts. | -53% | 639% |
| Labor and Delivery | 175 | -17% | 75% pts. | -100% | 181% |
| **Internal Share** | | | | | |
| Cardiac Surgery | 175 | 1% | 1% pts. | 0% | 8% |
| Cardiology | 175 | 11% | 4% pts. | 1% | 25% |
| Invasive Cardiology | 175 | 3% | 4% pts. | 0% | 26% |
| Orthopedics | 175 | 8% | 6% pts. | 0% | 32% |
| Pulmonary Services | 175 | 10% | 6% pts. | 4% | 58% |
| Labor and Delivery | 175 | 8% | 7% pts. | 0% | 33% |
| **Market Change** | | | | | |
| Cardiac Surgery | 175 | 1% | 13% pts. | -54% | 100% |
| Cardiology | 175 | 1% | 7% pts. | -16% | 82% |
| Invasive Cardiology | 175 | -1% | 3% pts. | -12% | 14% |
| Orthopedics | 175 | 1% | 4% pts. | -15% | 13% |
| Pulmonary Services | 175 | -1% | 2% pts. | -10% | 12% |
| Labor and Delivery | 175 | -1% | 3% pts. | -24% | 14% |

South Florida cluster, where in 2003 only two of the four hospitals in that cluster

discharged cardiac surgery patients. One (Baptist Hospital of Miami) enjoyed lead status

with 75.3% of the cluster's share in that service line. By 2007, however, a third hospital

in the cluster had begun offering cardiac surgery services, contributing to the lead hospital's loss of cluster share by 7.7 percentage points. At the same time, the secondary player in that cluster gained 4.9 percentage points, again at the expense of the lead player. With the two smaller players gaining ground at the expense of the lead hospital, Baptist Hospital of Miami lost status in cardiac surgery in the cluster. While over the same period the cluster gained share of market from 6.7% to 9.4%, it is not known if its gains could have been greater had its lead hospital not lost ground in cardiac surgery at a time when total cardiac surgery patient demand in the South Florida market grew from 9,769 cases in 2003 to 12,247 cases in 2007 or 25.4%.

On the other hand, such maneuvers may have actually been a defensive strategy by the South Florida cluster when inpatient cases in cardiology and invasive cardiology sharply declined by 18.5% and 18.1%, respectively. (This may have occurred if such services were increasingly being performed on an outpatient basis. Such data are not incorporated in this study.) Over the four-year period, the cluster retained its share of the two markets, without any erosion of Baptist Hospital's position in either cardiology or invasive cardiology, as cardiology as a diagnostic service in particular is considered critically important to securing follow-up cardiac surgery cases. Whether there was selfish maneuvering on the part of smaller hospitals in the cluster struggling for survival or a more planned, defensive strategy underway to protect the cluster as a whole and ultimately its lead hospital across service lines in cardiac care is not known. What is most apparent is the rapid pace of change during the period in high revenue, high volume service lines where investments in technology are large and competitive mistakes are

costly. Moreover, the scene in this vignette suggests the potential importance of analyzing movement across service lines in unison rather than separately in isolation before drawing definitive conclusions about strategic decisions or factors influencing them, whether a hospital, a cluster, or an entire system.

Table 19 provides descriptive statistics for one additional continuous variable measuring hospital specialization based on change over the period 2003-2007 in a hospital's share of its cluster's total cases in each of the six service lines (**Cluster Change**). Compared to descriptive statistics for **Market Change** for all 303 hospitals appearing in Table 15, mean values for **Cluster Change** in Table 19 exhibit smaller standard deviations and tighter ranges for all service lines. These patterns suggest greater stability or predictability among positions of hospitals inside their clusters than in the markets overall. Table 19 illustrates, however, that there is greater variation among cluster hospitals in cardiac surgery than other service lines, indicated by a standard deviation of 20% pts., which is higher than in all other service lines in the sub-group.

Table 19

Specialization by Cluster Change 2003-2007

| Variable | N | Mean | σ | Min | Max |
|---|---|---|---|---|---|
| **Cluster Change** | | | | | |
| Cardiac Surgery | 175 | 4% | 20% pts. | -51% | 100% |
| Cardiology | 175 | -159%$^{e-18}$ | 7% pts. | -23% | 23% |
| Invasive Cardiology | 175 | -1% | 6% pts. | -29% | 29% |
| Orthopedics | 175 | -1% | 9% pts. | -39% | 28% |
| Pulmonary Services | 175 | -1% | 6% pts. | -29% | 29% |
| Labor and Delivery | 175 | -2% | 12% pts. | -100% | 26% |

This is suggestive of a comparatively faster pace of change induced by technology as described in the preceding example involving Baptist Health System – South Florida – as well as the rapid influx of other general hospitals as competitors in this service line.

*Addressing Collinearity: Assessment of Correlation Between Variables*

Table 20 reports the correlation matrix for all of the independent variables. As can be seen, the highest correlation between independent variables is 0.19 between **Competitiveness** and **Poverty**. Since the estimated correlation between variables is still relatively low, multicollinearity is assumed not to be a concern for the study of the 303 hospitals. **Ownership** does not appear in the table as a continuous variable because it is a dichotomous (binary) variable with values of zero or one. For this, a point-biserial coefficient must be applied. Similar to the Pearson statistic used for correlations between two continuous variables and shown in Table 20, the point-biserial coefficient is derived from the slope of a regression, also referred to as "convergence by gradient." The strongest value for the dichotomous variable is 0.04 and is between **Ownership** and **Age**. With no r-value exceeding 0.19 for continuous or dichotomous variables, no evidence of collinearity is revealed.

The correlations are low as well for the cluster sub-group of 175 hospitals, as shown in Table 21. Had multicollinearity been a problem, it may have been necessary to eliminate redundant variables. However, the highest correlation involving independent variables in the cluster sub-group is between **Density** and **Competitiveness** with a value of only 0.49. Since independent variables for **Physicians** and **Cluster Lead Hospital** differ for each of the six targeted service lines and are entered separately into

Table 20

Assessment of Collinearity: Highest Correlations in Study Sample (303 Hospitals)

<u>Independent by Independent Variables</u>

| | **Poverty** | **Age** | **Size** | **Competitiveness** | **Growth** | **Density** |
|---|---|---|---|---|---|---|
| **Poverty** | 1.00 | 0.01 | 0.10 | 0.19 | 0.12 | 0.01 |
| **Age** | 0.01 | 1.00 | 0.01 | 0.06 | 0.02 | $1.57^{e-5}$ |
| **Size** | 0.10 | 0.01 | 1.00 | 0.22 | 0.01 | 0.01 |
| **Competitiveness** | 0.19 | 0.01 | 0.22 | 1.00 | 0.04 | 0.08 |
| **Growth** | 0.12 | 0.02 | 0.01 | 0.04 | 1.00 | 0.01 |
| **Density** | 0.01 | $1.57^{e-5}$ | 0.01 | 0.08 | 0.01 | 1.00 |
| **Physicians:** | | | | | | |
| MDCarSx | 0.05 | 0.01 | 0.10 | 0.19 | 0.01 | 0.11 |
| MDCardio | 0.01 | 0.03 | 0.01 | 0.01 | 0.03 | 0.01 |
| MDInvCar | 0.01 | 0.03 | 0.05 | 0.09 | 0.02 | 0.06 |
| MDOB/GYN | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.04 |
| MDPulSve | 0.03 | 0.02 | 0.03 | 0.01 | 0.01 | 0.01 |
| MDOrtho | 0.01 | 0.03 | 0.01 | 0.01 | 0.02 | 0.01 |

Table 21

Correlations in the Cluster Sub-group (175 Hospitals)

| | **Poverty** | **Age** | **Size** | **Competitiveness** | **Growth** | **Density** |
|---|---|---|---|---|---|---|
| **Poverty** | 1.00 | 0.01 | 0.01 | 0.01 | 0.10 | 0.01 |
| **Age** | 0.01 | 1.00 | 0.01 | 0.02 | 0.02 | 0.01 |
| **Size** | 0.01 | 0.01 | 1.00 | 0.03 | 0.01 | 0.06 |
| **Competitiveness** | 0.01 | 0.02 | 0.03 | 1.00 | $2.76^{e-5}$ | 0.49 |
| **Growth** | 0.10 | 0.02 | 0.01 | $2.75^{e-5}$ | 1.00 | 0.03 |
| **Density** | 0.01 | 0.01 | 0.06 | 0.49 | 0.03 | 1.00 |
| **Physicians:** | | | | | | |
| MDCarSx | 0.05 | 0.01 | 0.05 | 0.11 | 0.01 | 0.26 |
| MDCardio | 0.08 | 0.13 | 0.05 | 0.04 | 0.01 | 0.20 |
| MDInvCar | 0.15 | 0.09 | 0.03 | 0.01 | 0.01 | 0.17 |
| MDOB/GYN | 0.01 | 0.12 | 0.01 | 0.02 | 0.21 | 0.01 |
| MDPulSvc | 0.02 | 0.11 | 0.01 | 0.01 | 0.05 | 0.04 |
| MDOrtho | 0.01 | 0.03 | 0.01 | 0.07 | 0.21 | 0.01 |

regressions, they do not need to be assessed for multicollinearity with each other.

Neither **Ownership** nor **Cluster Lead Hospital** appears in the table because these are dichotomous (binary) variables. When the r-value (convergence by gradient) is derived, the correlation with continuous, independent variables for **Ownership** never exceeds 0.04. For **Cluster Lead Hospital**, however, the correlation is considerably

higher, ranging from 0.12 for labor and delivery to 0.25 for cardiology. Still, at this level of correlation, collinearity is not considered a statistical concern.

However, most lead hospitals are expected to be the larger hospitals within clusters and thus the **Cluster Lead Hospital** effect might be masked by the role played by inpatient bed count. Considering the fact that the mean inpatient bed count of cluster hospitals is 257, while the mean for all 303 hospitals in the study sample is 229 or 10.9% fewer, it is possible that collinearity may not have been fully revealed in the foregoing analyses. Such concern is elevated when comparing inpatient bed count statistics of lead versus non-lead hospitals in clusters, depending on their cluster leadership by service line, as shown in Table 22.

There is considerable variation between lead and non-lead hospitals throughout all six service lines, sufficient to raise continuing concern about multicollinearity between **Hospital Size** and **Cluster Lead Hospital**. Therefore, still another check for multicollinearity involves the variance inflation factor, which is calculated for each independent variable in the final regression models in order to quantify severity of multicollinearity in an ordinary least squares regression analysis (Hair, Anderson, Tatham, & Black, 2006). It measures how much the variance of an estimated regression coefficient is increased because of collinearity. The higher the variance inflation factor, the higher the likelihood of a collinearity problem. However, no evidence of collinearity emerges in any of the final models because the highest variance inflation factor never exceeds a value of two. A value of at least eight needs to be reached before strongly suspecting collinearity.

Table 22

Comparison in Bed Count Between Lead and Non-lead Hospitals
According to Service Line

| Service Line | N | Mean | σ | Min | Max |
|---|---|---|---|---|---|
| Pulmonary Services | | | | | |
| Lead | 50 | 407 | 266 | 89 | 1,500 |
| Non-lead | 125 | 197 | 127 | 25 | 757 |
| Labor and Delivery | | | | | |
| Lead | 47 | 391 | 280 | 54 | 1,500 |
| Non-lead | 128 | 207 | 134 | 25 | 757 |
| Orthopedics | | | | | |
| Lead | 49 | 419 | 261 | 89 | 1,500 |
| Non-lead | 126 | 194 | 126 | 25 | 883 |
| Cardiac Surgery | | | | | |
| Lead | 50 | 409 | 260 | 89 | 1,500 |
| Non-lead | 125 | 196 | 130 | 25 | 883 |
| Invasive Cardiology | | | | | |
| Lead | 48 | 418 | 261 | 89 | 1,500 |
| Non-lead | 127 | 196 | 130 | 25 | 883 |
| Cardiology | | | | | |
| Lead | 50 | 425 | 263 | 89 | 1,500 |
| Non-lead | 125 | 190 | 116 | 25 | 757 |

*Transformation of Dependent Variables*

Prior to analyzing the data using regression analysis, transformations of

dependent variables are necessary due to their lack of normality and thus, violation of

linear regression assumptions. The Shapiro-Wilk's test is commonly used as a goodness

of fit test, with the null hypothesis that a statistical sample comes from a normally

distributed population (Shapiro & Wilk, 1965). If the null hypothesis that the data are

normally distributed is rejected (the *p*-value is < .05), transforming a measure is justified

(Vasu, 1979). All p-values for the Shapiro-Wilk test performed on the dependent

variables in the study are < .01, indicating highly skewed data that warrant

transformation.

Taking natural log transformations (the most common approach) or calculating

square-root transformations are appropriate for size or count data, such as bed count.

However, it is not acceptable for data that range into negative values. Arcsine

transformations are commonly used for variables ranging from -1 to 1 such as is the case

for the **Market Change** and **Cluster Change** variables. For values that range from 0 to

1, the arcsine square root transformation is often employed, as it may be slightly more

powerful (McDonald, 2009). Thus, this transformation is applied to the **Internal Service**

**Concentration** and **Internal Share** variables. There is no recognized transformation

available for **Expected Market Share**, for which the values range widely below -1 and

above 1. Visually, the histogram approximates a normal distribution pattern, and so it will

not be transformed. This remains nevertheless a limitation to quantitative analysis and

interpretation. It is notable that the variables still failed the Shapiro-Wilk test for

normality, even after they were transformed – which therefore remains a limitation in the

study. Still, the transformed variables are retained in the primary analysis results because

the transformation ensures that the predicted values from the model will stay within the plausible range for the dependent variable.

*Outliers*

An outlier is an extreme value for one variable that distorts the distribution and thus overall descriptive statistics. It seems to be unattached to the rest of the distribution and thus is readily identifiable by observation using a graph, such as a histogram or box plot (Tabachnick & Fidell, 2007). In addition to such visual inspection, Mahalanobis distance, the distance of a case from the centroid of the remaining cases where the centroid is the point created at the intersection of the means of all variables, was also employed to assist with assessing for outliers (Tabachnick & Fidell, 2007). While selected outliers by visual inspection were removed temporarily to check model validity, final reported results included outliers. Their permanent removal was not statistically justified by diagnostics because in each situation the model's parameter estimates did not change dramatically without them.

Results of Standard, Simultaneous Multiple Regression

Following transformation of dependent variables and assessment of outliers for elimination, the results of standard, simultaneous regressions on each of the dependent variables depicting service line specialization in the full study sample of 303 hospitals are summarized in Tables 23 and 24. Both simple $R^2$ and Adjusted $R^2$ are displayed in the table. While $R^2$ is a statistic whose value depicts the goodness of fit of a model, Adjusted $R^2$ adjusts for the number of explanatory terms in a model. Unlike simple $R^2$, the Adjusted $R^2$ increases only if the new term improves the model more than would be

Table 23

Standard, Simultaneous Multiple Regression for Internal Service Concentration

| Variable | Parameter Estimate B | Standard Error (SE) | $p$-value |
|---|---|---|---|
| **Competitiveness** | 0.45 | 0.03 | < .01 |
| **Growth** | 0.02 | 0.04 | 0.63 |
| **Density** | <0.01 | <0.01 | <.01 |
| **Hospital Size** | -0.03 | <0.01 | <.01 |
| **Age** | - < 0.01 | < 0.01 | .97 |
| **Poverty** | < 0.01 | < 0.01 | .85 |
| **Ownership** | < 0.01 | < 0.01 | .61 |
| State - Florida | -< 0.01 | 0.01 | .72 |
| State - Nevada | < 0.01 | < 0.01 | .91 |
| **Physicians** (Cardiology) | 0.12 | 0.04 | < .01 |
| **Physicians** (Invasive Cardiology) | 35810 | 60842 | .56 |
| **Physicians** (Pulmonary Services) | -0.08 | 0.09 | .38 |
| **Physicians** (OBGYN) | -0.05 | 0.06 | .39 |
| **Physicians** (Orthopedics) | -0.03 | 0.03 | .29 |
| **Physicians** (Cardiac Surgery) | -0.73 | 0.30 | .02 |

$R^2 = 0.33$     Adjusted $R^2 = 0.29$     F value = 9.25

Table 24

Standard Fixed Effects, Simultaneous Multiple Regression for Each of Six Service Lines

| | Expected | | | | | | | | |
| | Internal Share | | | Market Share | | | Market Change | | |
| Variable | ß | SE | *p* | ß | SE | *p* | ß | SE | *p* |
|---|---|---|---|---|---|---|---|---|---|
| Cardiac Surgery | | | | | | | | | |
| **Competitiveness** | 0.01 | 0.01 | .17 | -0.51 | 0.05 | <.01 | -0.33 | 0.08 | <.01 |
| **Growth** | 0.01 | .03 | .69 | 0.03 | 0.19 | .89 | -0.38 | 0.29 | .19 |
| **Density** | -<0.01 | <0.01 | .01 | -<0.01 | <0.01 | <.01 | <0.01 | <0.01 | .02 |
| **Hospital Size** | 0.05 | <0.01 | <.01 | 0.15 | 0.02 | <.01 | 0.04 | 0.03 | .10 |
| **Poverty** | -<0.01 | <0.01 | .77 | <0.01 | <0.01 | .15 | <0.01 | <0.01 | .31 |
| **Age** | <0.01 | <0.01 | .21 | <0.01 | <0.01 | <.01 | <0.01 | <0.01 | .50 |
| **Ownership** | <0.01 | <0.01 | .23 | -0.01 | 0.03 | .67 | 0.05 | 0.05 | .26 |
| State - Florida | <0.01 | 0.01 | .80 | -0.02 | 0.07 | .80 | 0.16 | 0.10 | .13 |
| State - Nevada | 0.01 | <0.01 | .11 | -0.10 | 0.41 | .02 | -0.06 | 0.06 | .37 |
| **Physicians** | 0.68 | 0.27 | .01 | -1.24 | 1.49 | .41 | -5.96 | 2.29 | .01 |

Adjusted $R^2$ = 0.55    Adjusted $R^2$ = 0.44    Adjusted $R^2$ = 0.14

F value = 37.22    F value = 24.69    F value = 6.11

| | ß | SE | *p* | ß | SE | *p* | ß | SE | *p* |
|---|---|---|---|---|---|---|---|---|---|
| Cardiology | | | | | | | | | |
| **Competitiveness** | -0.02 | 0.02 | .22 | 0.19 | 0.09 | .03 | -0.06 | 0.05 | .20 |
| **Growth** | 0.12 | 0.05 | .03 | -0.14 | 0.03 | <.01 | -0.05 | 0.16 | .76 |
| **Density** | <0.01 | <0.01 | .34 | -0.01 | <0.01 | .18 | <0.01 | <0.01 | .73 |
| **Hospital Size** | -0.04 | <0.01 | <.01 | -0.14 | 0.03 | <.01 | 0.08 | 0.02 | <.01 |
| **Poverty** | <0.01 | <0.01 | <.01 | -<0.01 | <0.01 | .41 | <0.01 | <0.01 | .46 |
| **Age** | <0.01 | <0.01 | .12 | -<0.01 | <0.01 | .22 | <0.01 | <0.01 | .79 |
| **Ownership** | 0.03 | <0.01 | <.01 | 0.18 | 0.05 | <.01 | -0.02 | 0.03 | .48 |
| State - Florida | -0.05 | 0.02 | <.01 | -0.20 | 0.11 | 0.07 | 0.03 | 0.06 | .62 |
| State - Nevada | -0.01 | 0.01 | .42 | -0.04 | 0.07 | .55 | 0.04 | 0.03 | .91 |
| **Physicians** | 0.10 | 0.05 | .04 | -0.04 | 0.27 | .89 | -0.03 | 0.15 | .83 |

Adjusted $R^2$ = 0.30    Adjusted $R^2$ = 0.10    Adjusted $R^2$ = 0.05

F value = 13.84    F value = 4.41    F value = 2.51

Table 24 - continued

| Variable | Internal Share | | | Expected Market Share | | | Market Change | | |
|---|---|---|---|---|---|---|---|---|---|
| | B | SE | *p* | B | SE | *p* | B | SE | *p* |
| Invasive Cardiology | | | | | | | | | |
| **Competitiveness** | 0.19 | 0.02 | 0.25 | -0.41 | 0.16 | 0.01 | -0.07 | 0.06 | .27 |
| **Growth** | 0.05 | 0.06 | 0.38 | <0.01 | 0.56 | 0.99 | -0.06 | 0.21 | .78 |
| **Density** | -<0.01 | <0.01 | <.01 | <0.01 | <0.01 | 0.2 | <0.01 | <0.01 | .75 |
| **Hospital Size** | 0.06 | <0.01 | <.01 | 0.35 | 0.05 | <.01 | 0.09 | 0.02 | <.01 |
| **Poverty** | -<0.01 | <0.01 | 0.22 | 0.03 | 0.01 | 0.04 | <0.01 | <0.01 | .48 |
| **Age** | <0.01 | <0.01 | 0.3 | <0.01 | <0.01 | 0.52 | <0.01 | <0.01 | .73 |
| **Ownership** | 0.02 | <0.01 | 0.01 | 0.17 | 0.09 | 0.06 | -0.09 | 0.03 | <.01 |
| State - Florida | -<0.01 | 0.02 | 0.76 | 0.16 | 0.2 | 0.41 | 0.05 | 0.07 | .47 |
| State - Nevada | 0.02 | 0.01 | 0.12 | -0.03 | 0.12 | 0.8 | 0.25 | 0.05 | .59 |
| **Physicians** | 74909 | 72512 | 0.3 | -203485 | 696334 | 0.77 | -103927 | 257127 | .68 |
| | Adjusted $R^2$ = 0.45 | | | Adjusted $R^2$ = 0.12 | | | Adjusted $R^2$ = 0.05 | | |
| | F value = 25.93 | | | F value = 5.00 | | | F value = 2.74 | | |
| Orthopedics | | | | | | | | | |
| **Competitiveness** | 0.02 | 0.02 | .20 | None significant | | | -0.10 | 0.05 | .06 |
| **Growth** | 0.02 | 0.07 | .75 | | | | -0.02 | 0.19 | .19 |
| **Density** | -<0.01 | <0.01 | <.01 | | | | <0.01 | <0.01 | .61 |
| **Hospital Size** | 0.03 | <0.01 | <.01 | | | | 0.12 | 0.02 | <.01 |
| **Poverty** | -<0.01 | <0.01 | <.01 | | | | <0.01 | <0.01 | .30 |
| **Age** | <0.01 | <0.01 | <.01 | | | | <0.01 | <0.01 | .93 |
| **Ownership** | 0.01 | 0.01 | .33 | | | | -0.12 | 0.03 | .58 |
| State - Florida | -<0.01 | 0.02 | .89 | | | | 0.03 | 0.07 | .55 |
| State - Nevada | -0.01 | 0.01 | .49 | | | | 0.01 | 0.04 | .77 |
| **Physicians** | 0.02 | 0.03 | .63 | | | | 0.04 | 0.10 | .67 |
| | Adjusted $R^2$ = 0.23 | | | | | | Adjusted $R^2$ = 0.10 | | |
| | F value = 10.10 | | | | | | F value = 4.36 | | |

Table 24 - continued

| | Internal Share | | | Expected Market Share | | | Market Change | | |
|---|---|---|---|---|---|---|---|---|---|
| Variable | ß | SE | $p$ | ß | SE | $p$ | ß | SE | $p$ |
| **Labor and Delivery** | | | | | | | | | |
| **Competitiveness** | -0.03 | 0.04 | .40 | -0.24 | 0.15 | .11 | None Significant | | |
| **Growth** | -0.04 | 0.13 | .75 | 0.09 | 0.51 | .87 | | | |
| **Density** | -<0.01 | <0.01 | .38 | <0.01 | <0.01 | .61 | | | |
| **Hospital Size** | 0.06 | 0.01 | <.01 | 0.11 | 0.05 | .03 | | | |
| **Poverty** | -<0.01 | <0.01 | .04 | <0.01 | <0.01 | .93 | | | |
| **Age** | -<0.01 | <0.01 | .04 | -<0.01 | <0.01 | .71 | | | |
| **Ownership** | -0.04 | 0.02 | .04 | -0.16 | 0.08 | .05 | | | |
| State - Florida | 0.04 | 0.05 | .35 | 0.08 | 0.19 | .67 | | | |
| State - Nevada | -0.03 | 0.03 | .26 | -0.03 | 0.12 | .79 | | | |
| **Physicians** | <0.01 | 0.11 | .98 | -0.17 | 0.43 | .70 | | | |

Adjusted $R^2 = 0.16$    Adjusted $R^2 = 0.01$
F value = 6.96    F value = 1.25

| | Internal Share | | | Expected Market Share | | | Market Change | | |
|---|---|---|---|---|---|---|---|---|---|
| **Pulmonary Services** | | | | | | | | | |
| **Competitiveness** | -0.04 | 0.02 | .01 | 0.33 | 0.14 | .02 | -0.07 | 0.05 | .13 |
| **Growth** | -0.04 | 0.05 | .41 | -0.34 | 0.47 | .47 | -0.08 | 0.17 | .65 |
| **Density** | <0.01 | <0.01 | .01 | -<0.01 | <0.01 | .38 | <0.01 | <0.01 | .73 |
| **Hospital Size** | -0.05 | <0.01 | <.01 | -0.24 | 0.05 | <.01 | 0.09 | 0.02 | <.01 |
| **Poverty** | <0.01 | <0.01 | <.01 | -0.01 | 0.01 | .36 | <0.01 | <0.01 | .47 |
| **Age** | <0.01 | <0.01 | .82 | -0.01 | <0.01 | .07 | <0.01 | <0.01 | .80 |
| **Ownership** | -<0.01 | <0.01 | .36 | -0.07 | 0.07 | .32 | <0.01 | 0.03 | .08 |
| State - Florida | -0.01 | 0.02 | .55 | -0.06 | 0.17 | .73 | 0.04 | 0.06 | .52 |
| State - Nevada | <0.01 | 0.01 | .82 | 0.15 | 0.10 | .14 | 0.01 | 0.04 | .70 |
| **Physicians** | -0.09 | 0.12 | .47 | 0.63 | 1.09 | .56 | -0.20 | 0.38 | .59 |

Adjusted $R^2 = 0.44$    Adjusted $R^2 = 0.08$    Adjusted $R^2 = 0.07$
F value = 24.27    F value = 3.60    F value = 3.39

expected by chance (Steel & Torrie, 1960). The use of this latter statistic, considered most useful in model development stages and particularly for sample data as opposed to population data, is considered a refinement that lends itself to regression analysis and interpretation.

For **Internal Service Concentration**, a standard, multiple regression on all 303 hospitals produces the following results shown in Table 23 with all of the independent variables entered simultaneously in the equation. For subsequent measures of specialization for each of the six service lines, results from initially applying standard fixed effects, simultaneous regression to all 303 hospitals and transformed measures of specialization appear in Table 24.

Although none of the models displays Adjusted $R^2$ values greater than 0.55 (**Internal Share** – cardiac surgery), there are several results worth noting. The **Internal Share** measure generated the highest Adjusted $R^2$ values of all models, producing a mean value of 0.36, ranging from 0.16 for labor and delivery to 0.55 for cardiac surgery. While models for labor and delivery are the weakest by any measure, models, on average, for cardiac surgery are the strongest.

A second observation is the predominance of models (16 of 19) where Hospital Size is a statistically significant factor with a p-value < .05, although only in five of the 16 models is the direction negative as hypothesized. This finding is not surprising, given the role of hospital size in determining clinical function. Note that it is consistently a statistically significant term for the first two measures – **Internal Service Concentration** and **Internal Share** – which may be the two that are most likely associated with internal

considerations of size. For similar reasons, **Internal Share** is likely to vary across hospitals based on size. Interestingly, **Competitiveness** and **Density** (each in seven of 19) also are frequently significant terms in the models. **Competitiveness**, in particular, appears in the models where external, market conditions are most likely to have an impact – **Expected Market Share** and **Market Change**. Competitiveness is most often negatively associated with specialization, as reflected in five of seven models in which it is significant. Models in which **Density** is significant find the variable for **Density**, as hypothesized, to be in mixed directions, equally positive and negative.

All descriptive characteristics serve as a factor with statistical significance in at least one model, although **Physicians** serve as significant terms only in cardiology (**Internal Share**) and cardiac surgery (**Internal Share** and **Market Change**). Additionally, model fit is acceptable with at least one significant factor for all of the measures for each of the six service lines except for orthopedics (**Expected Market Share**) and labor and delivery (**Market Change**).

Primary Analysis Results: Backward Deletion, Stepwise Regression

Although stepwise regression can be performed in various ways, the backward deletion method is chosen as a refining methodology in an effort to determine the best fitting model. Although several approaches can be taken for the elimination of variables, the chosen method excludes independent variables one at a time if they do not contribute significantly to the results, until the required *p*-value threshold is met (in this case $p < .05$), or the Adjusted $R^2$ value decreases dramatically upon deletion of a variable. The primary benefit in this approach is it identifies a subset of independent variables that

could be considered statistically helpful for predicting a given dependent variable. All other independent variables that provide little incremental predictive power are screened out (Tabachnick & Fidell, 2007).

While sometimes considered a controversial procedure because of its reliance on statistical criteria for determining the order of entry of variables in a model, the risk of overfitting data with stepwise regression is best avoided by drawing on a large and representative sample and not relying exclusively on chance on which variables to include (Tabachnick & Fidell, 2007). The stepwise regressions performed in this analysis were executed manually rather than menu-driven so that subjective judgment could be exercised appropriately.

The ability of backward stepwise regression to eliminate redundant or superfluous variables renders the method helpful for identifying measures to include in future research. Sometimes the inclusion of too many independent variables can mask the effects of other variables that would otherwise be important. Backward stepwise regression determines which variables are having a meaningful effect and which are being masked or distorted by the inclusion of too many variables. Unlike standard, simultaneous regression, backward deletion, stepwise regression directly addresses the overarching mandate to seek parsimony in multivariate statistics by obtaining the best fitting model with the fewest variables possible. In sum, the method achieves better precision for parameter estimates, allows ease of interpretation with fewer variables, eliminates variables that are not influential, and gives a better model fit overall to achieve improved predictability.

Primary analysis results are thus presented first for **Internal Service Concentration** in Table 25 applying backward deletion, stepwise regression, followed by results for the remaining measures of specialization for each of the six service lines in Table 26. As in the results for standard, simultaneous regression, **Internal Service Concentration** and **Internal Share** are both transformed by arcsine square root, **Market Change** is transformed by arcsine, and **Expected Market Share** remains untransformed. A comparison of Table 25 to Table 23 for **Internal Service Concentration** demonstrates that the quality of the model is enhanced by more selectively entering variables into the equation, as highlighted by a strengthening in the F value from 9.25 to 27.58. Adjusted $R^2$ improves only slightly from 0.29 to 0.31 because Adjusted $R^2$, by definition, takes into account the number of independent variables of significance in the equation and penalizes for insignificant variables.

Table 25

Primary Analysis Results of Backward, Stepwise Regression – Internal
Service Concentration

|  | ß | Standard Error | $p > |t|$ *p*-value |
|---|---|---|---|
| **Internal Service Concentration** | | | |
| **Density** | 0.01 | 0.01 | <.01 |
| **Hospital Size** | -0.03 | 0.01 | <.01 |
| **Physicians** (Cardiology) | 0.12 | 0.04 | <.01 |
| **Physicians** (Orthopedics) | -0.06 | 0.02 | <.01 |
| **Physicians** (Cardiac Surgery) | -0.07 | 0.28 | <.01 |
| Adjusted $R^2$ = 0.31    F value = 27.58 | | | |

Table 26 shows primary analysis results utilizing backward, stepwise regression for each of the three remaining measures of specialization for each of the six service lines, as the fourth measure among service lines used only in a sub-analysis of 175 hospitals in clusters – **Cluster Change** – showed no cluster effect. Although 175 of the 303 hospitals in the data sample belong to the same system and reside in proximity to each other, a sub-analysis showed no cluster effect and therefore is not presented.

Models using backward deletion, stepwise regression (Table 26) for the remaining three measures of service line specialization strengthen without exception in all six service lines, as indicated by at least a doubling in the F-statistic. It often triples in size with backward, stepwise regression compared to the earlier standard, simultaneous regression (Table 24). The F value, an indicator of how much variation is attributable to the linear relationship versus random error, is higher when the *p*-value is smaller. In all but two cases (**Expected Market Share** and **Market Change** for labor and delivery), the F value exceeds 11.

Since the only reason for proposing the sub-analysis on the 175 hospitals organized in clusters was to control for the cluster effect and since one fails to emerge in mixed effects analysis, it is not presented. It is therefore not meaningful to report on results with **Cluster Change** as a measure of specialization, as its usefulness only related to the sub-analysis. Other variables may exist that are not used in the study to better explain the any variance in service line specialization due to cluster effect.

To put these results in a context for the testing of hypotheses in the next section to follow, Table 27 presents a summary organized in a matrix by dependent variables as

Table 26

Primary Analysis Results of Backward, Stepwise Regression by Service Line

| | Internal Share | | | Expected Market Share | | | Market Change | | |
|---|---|---|---|---|---|---|---|---|---|
| Variable | B | SE | $p$ | B | SE | $p$ | B | SE | $p$ |
| **Cardiac Surgery** | | | | | | | | | |
| **Competitiveness** | 0.02 | 0.01 | .02 | -0.55 | 0.05 | <.01 | -0.36 | 0.07 | <.01 |
| **Growth** | | | | | | | | | |
| **Density** | -0.01 | 0.01 | .01 | -0.01 | 0.01 | <.01 | 0.01 | 0.01 | .04 |
| **Hospital Size** | 0.05 | 0.01 | <.01 | 0.15 | 0.02 | <.01 | | | |
| **Poverty** | | | | | | | | | |
| **Age** | 0.01 | 0.01 | .01 | 0.01 | 0.01 | <.01 | | | |
| **Ownership** | | | | | | | | | |
| **Physicians** | 0.79 | 0.27 | <.01 | | | | -5.82 | 2.21 | <.01 |
| State - Florida | | | | -0.03 | 0.06 | .60 | | | |
| State - Nevada | | | | -0.09 | 0.04 | .02 | | | |
| | Adjusted $R^2$ = 0.54 | | | Adjusted $R^2$ = 0.44 | | | Adjusted $R^2$ = 0.13 | | |
| | F value = 73.32 | | | F value = 40.61 | | | F value = 16.65 | | |
| **Cardiology** | | | | | | | | | |
| **Competitiveness** | | | | -0.18 | 0.07 | <.01 | -0.07 | 0.04 | .05 |
| **Growth** | 0.13 | 0.05 | .01 | | | | | | |
| **Density** | | | | | | | | | |
| **Hospital Size** | -0.04 | 0.01 | <.01 | -0.13 | 0.03 | <.01 | 0.07 | 0.01 | <.01 |
| **Poverty** | 0.01 | 0.01 | <.01 | | | | | | |
| **Age** | | | | | | | | | |
| **Ownership** | 0.03 | 0.01 | .01 | 0.17 | 0.05 | .01 | | | |
| **Physicians** | 0.11 | 0.05 | .02 | | | | | | |
| State - Florida | -0.06 | 0.02 | <.01 | | | | | | |
| State - Nevada | -0.01 | 0.01 | .43 | | | | | | |
| | Adjusted $R^2$ = 0.29 | | | Adjusted $R^2$ = 0.10 | | | Adjusted $R^2$ = 0.07 | | |
| | F value = 18.87 | | | F value = 12.40 | | | F value = 12.09 | | |

Table 26 - continued

| Variable | Internal Share | | | Expected Market Share | | | Market Change | | |
|---|---|---|---|---|---|---|---|---|---|
| | B | SE | *p* | B | SE | *p* | B | SE | *p* |
| **Invasive Cardiology** | | | | | | | | | |
| **Competitiveness** | 0.04 | 0.01 | -0.39 | 0.14 | <.01 | | | | |
| **Growth** | | | | | | | | | |
| **Density** | -0.01 | 0.01 | <.01 | | | | | | |
| **Hospital Size** | 0.07 | 0.01 | <.01 | 0.34 | 0.05 | <.01 | 0.07 | 0.02 | <.01 |
| **Poverty** | | | | 0.03 | 0.01 | .03 | | | |
| **Age** | 0.01 | 0.01 | .01 | | | | | | |
| **Ownership** | 0.02 | 0.01 | <.01 | 0.17 | 0.08 | .05 | -0.09 | 0.03 | <.01 |
| **Physicians** | | | | | | | | | |
| State - Florida | | | | | | | | | |
| State - Nevada | | | | | | | | | |
| | Adjusted $R^2$ = 0.45 | | | Adjusted $R^2$ = 0.13 | | | Adjusted $R^2$ = 0.07 | | |
| | F value = 49.60 | | | F value = 11.99 | | | F value = 11.83 | | |
| **Orthopedics** | | | | | | | | | |
| **Competitiveness** | | | | No significant terms | | | -0.11 | 0.04 | <.01 |
| **Growth** | | | | | | | | | |
| **Density** | -0.01 | 0.01 | <.01 | | | | | | |
| **Hospital Size** | 0.03 | 0.01 | <.01 | | | | 0.11 | 0.02 | <.01 |
| **Poverty** | -0.01 | 0.01 | <.01 | | | | | | |
| **Age** | 0.01 | 0.01 | <.01 | | | | | | |
| **Ownership** | | | | | | | | | |
| **Physicians** | | | | | | | | | |
| State - Florida | | | | | | | | | |
| State - Nevada | | | | | | | | | |
| | Adjusted $R^2$ = 0.24 | | | | | | Adjusted $R^2$ = 0.12 | | |
| | F value = 24.70 | | | | | | F value = 21.04 | | |

Table 26 - continued

| Variable | Internal Share | | | Expected Market Share | | | Market Change | | |
|---|---|---|---|---|---|---|---|---|---|
| | B | SE | $p$ | B | SE | $p$ | B | SE | $p$ |
| **Pulmonary Services** | | | | | | | | | |
| **Competitiveness** | -0.04 | 0.01 | <.01 | 0.39 | 0.11 | <.01 | -0.08 | 0.04 | .03 |
| **Growth** | | | | | | | | | |
| **Density** | 0.01 | 0.01 | <.01 | | | | | | |
| **Hospital Size** | -0.05 | 0.01 | <.01 | -0.23 | 0.04 | <.01 | 0.08 | 0.02 | <.01 |
| **Poverty** | 0.01 | 0.01 | <.01 | | | | | | |
| **Age** | | | | | | | | | |
| **Ownership** | | | | | | | | | |
| **Physicians** | | | | | | | | | |
| State - Florida | | | | | | | | | |
| State - Nevada | | | | | | | | | |

Adjusted $R^2 = 0.44$  Adjusted $R^2 = 0.08$  Adjusted $R^2 = 0.08$
F value = 60.39  F value = 14.37  F value = 14.86

| Variable | Internal Share | | | Expected Market Share | | | Market Change | | |
|---|---|---|---|---|---|---|---|---|---|
| | B | SE | $p$ | B | SE | $p$ | B | SE | $p$ |
| **Labor and Delivery** | | | | | | | | | |
| **Competitiveness** | | | | -0.23 | 0.12 | .05 | | | |
| **Growth** | | | | | | | 0.39 | 0.18 | .03 |
| **Density** | | | | | | | | | |
| **Hospital Size** | 0.06 | 0.01 | <.01 | 0.11 | 0.05 | .03 | 0.04 | 0.02 | .05 |
| **Poverty** | -0.01 | 0.01 | .07 | | | | | | |
| **Age** | -0.01 | 0.01 | .05 | | | | | | |
| **Ownership** | -0.04 | 0.02 | .04 | -0.16 | 0.08 | .04 | | | |
| **Physicians** | | | | | | | | | |
| State - Florida | 0.04 | 0.04 | .27 | | | | | | |
| State - Nevada | -0.05 | 0.02 | .05 | | | | | | |

Adjusted $R^2 = 0.17$  Adjusted $R^2 = 0.03$  Adjusted $R^2 = 0.02$
F value = 11.30  F value = 3.81  F value = 4.77

Table 27

Testing of Hypothesis: Matrix Organized by Dependent Variable

| | Internal Service Concentration | Internal Share | Expected Market Share | Market Change | f |
|---|---|---|---|---|---|
| Independent Variable-$H_o$ Direction | | | | | |
| **Growth** - Positive | ns | Positive | ns | Positive | 2/19 |
| **Poverty** - Positive | ns | Mixed | Positive | ns | 5/19 |
| **Density** - Negative | Negative | Mixed | Negative | Positive | 7/19 |
| **Aging** - Positive[a] | ns | Positive | Positive | ns | 5/19 |
| **Competitiveness** - Negative | ns | Mixed | Mixed | Negative | 12/19 |
| **Physicians** - Positive | Mixed | Mixed | ns | Negative | 4/19 |
| **Hospital Size** - Negative | Negative | Mixed | Mixed | Mixed | 17/19 |
| **Ownership** - Positive | ns | Mixed | Mixed | Negative | 6/19 |
| State as a Covariate | ns | Yes | Yes | ns | 3/19 |

[a]Hypothesized to be positively associated with specialization, except in Labor and Delivery because of obvious age factor limitations on fertility and thus demand for services.

measures of specialization. Its companion summary, Table 28, follows with a matrix organized by service line.

Regardless of how results are displayed for analysis and interpretation, it is apparent from Tables 27 and 28 that directions (positive or negative coefficients) are frequently mixed among measures of specialization and among service lines. Table 27 demonstrates the directions of hypotheses by measure and highlights the strength of **Internal Service** in particular as a measure of specialization. Table 28 illustrates the strength of cardiac services in general, with cardiac surgery reflecting the highest number of significant market and organizational variables as well as the highest mean Adjusted $R^2$.

<div align="center">Summary of Hypotheses Testing</div>

The hypotheses are assessed, first by examining external, market characteristics and then by assessing internal, organizational factors. These assessments are based on results after all methodological refinements were performed, including transformations of dependent variables as measures for specialization and use of backward, stepwise regression.

*Characteristics of the Market Structure Representing the External Environment*

$H_1$ states that higher local population growth rates in hospital markets are likely to be positively related to specialization. The analysis found a positive and statistically significant association between likelihood of specialization in cardiology and higher population growth rate with an Adjusted $R^2$ of 0.29 in a model for **Internal Share**. In a weak model for **Market Change**, **Growth** is also positively associated with labor and

Table 28

Testing of Hypotheses: Matrix Organized by Service Line

| | Cardiac Surgery | Cardiology | Invasive Cardiology | Orthopedics | Pulmonary Services | Labor and Delivery |
|---|---|---|---|---|---|---|
| Independent Variable-$H_o$ Direction | | | | | | |
| **Growth** - Positive | ns | Positive | ns | ns | ns | Positive |
| **Poverty** - Positive | ns | Positive | Positive | Negative | Positive | Negative |
| **Aging** - Positive[a] | Positive | ns | Positive | Positive | ns | Negative |
| **Competitiveness** - Negative | Mixed | Negative | Mixed | Negative | Mixed | Negative |
| **Physicians** - Positive | Mixed | Positive | ns | ns | ns | ns |
| **Hospital Size** - Negative | Positive | Mixed | Positive | Positive | Mixed | Positive |
| **Ownership** - Positive | ns | Positive | Mixed | ns | ns | Negative |
| State as Covariate | Yes | Yes | ns | ns | ns | Yes |
| f of significant variables | 12 | 10 | 11 | 6 | 8 | 9 |

[a]Hypothesized to be positively associated with specialization, except in Labor and Delivery because of obvious age factor limitations on fertility and thus demand for services.

delivery. **Growth** is otherwise not a significant factor. Consequently, the hypothesis is

supported but limited to a few models.

$H_2$ states that percentage of the local population living below the federally established poverty level is positively related to hospital specialization. Analysis finds a statistically significant, positive association between **Poverty** and specialization in pulmonary services and in cardiology with Adjusted $R^2$ values of 0.44 and 0.29, respectively, in models for **Internal Share**. It is also positively associated with specialization in invasive cardiology in the model of **Expected Market Share** with an Adjusted $R^2$ of 0.13. However, in the models for **Internal Share** examining orthopedics and labor and delivery, **Poverty** is negatively related to specialization with an Adjusted $R^2$ of 0.24 and 0.17, respectively. Thus, the hypothesis is supported in some service lines but not others.

$H_3$ states that population density in a hospital's market is negatively associated with specialization. Analysis finds a marginal, positively related association of **Density** to the **Internal Service Concentration** measure, suggesting that general, community hospitals in more urban areas may be inclined to concentrate services in the form of specialization to establish uniqueness in a market comprised of more competitors. In the 2003-2007 period examined, hospitals are entering rather than exiting the service line for cardiac surgery presumably because of demand and profitability. Consequently, **Density** is also positively associated with **Market Change** as new entrants acquire market share. With a greater number of hospitals competing in cardiac surgery in more urban areas, it is logical that a negative association is seen for **Internal Share** in cardiac surgery, as the number of cases discharged by a hospital in cardiac surgery represents a smaller portion of its total patient volume with demand for cardiac surgery being met by a greater

number of hospitals. Correspondingly, with more hospitals competing in cardiac surgery in more urban areas, hospitals underperform relative to their overall share of a market and thus values for **Expected Market Share** decrease when **Density** increases and vice versa. Hence, a negative association of **Density** to the measure is seen. No similar patterns emerge to help explain why **Internal Share** for invasive cardiology and orthopedics are also negatively associated with **Density** but not for pulmonary services. Nor is there an obvious explanation for why **Cluster Change** for orthopedics and labor and delivery is positively associated with **Density**. As with the findings for **Poverty**, it should be noted that these parameter estimates are very small, and although the relationship is statistically significant at $p < .05$, the magnitude may be of little consequence. Due to the mixed directions of correlation, the hypothesis of **Density** not necessarily being directionally associated is only partially supported.

$H_4$ states that as the percentage of the local population 65 years and older increases, it is positively associated with evidence of hospital specialization. In the stronger models for **Internal Share**, **Age** is positively associated with hospital specialization in cardiac surgery, invasive cardiology, and orthopedics with Adjusted $R^2$ values of 0.54, 0.45, and 0.24, respectively but negatively associated with specialization in Labor and Delivery with an $R^2$ of 0.17, due as expected to the inherent demographics of demand mentioned earlier. Additional support for the hypothesis is found in **Expected Market Share** for cardiac surgery. Thus, the hypothesis for **Age** is considered well supported except for the obvious service line labor and delivery, as fertility rates biologically drop precipitously with age.

H$_5$ states that hospitals located in highly competitive markets are negatively associated with specialization in high volume, high revenue-generating service lines. **Competitiveness** is a significant factor in 12 primary results models for specialization, and analysis finds a negative association between service line specialization and **Competitiveness** in nine of these models. It is consistently negative in cardiology but inconsistent from one measure of specialization to the next in cardiac surgery, pulmonary services, and invasive cardiology, with consistency lacking in the strongest models where Adjusted R$^2$ values exceeds 0.30. In other words, direction shifts between positive and negative. As with other hypotheses, H$_5$ is considered supported for some service lines and with some measures of specialization but not all. To summarize, **Competitiveness** is positively associated in cardiac surgery and invasive cardiology with **Internal Share** as the measure of specialization and in pulmonary services with **Expected Market Share** as the measure. For the remaining nine models, it is negatively associated in all service lines except labor and delivery.

H$_6$ states that hospitals located in markets with a high concentration of physician specialists in each of the six targeted service lines are positively associated with specialization. Three different categories of physician specialists influence specialization in the model for **Internal Service Concentration** but in different directions, as orthopedic surgeon and thoracic surgeon ratios are negatively associated with specialization whereas cardiologist ratios are positively associated with specialization. (Since the highest correlation between any two physician specialists is 0.50 and it is between orthopedic surgeons and obstetricians whose services do not typically overlap,

multiple variables for **Physicians** may statistically coexist in a backward stepwise regression model without redundancy.) In the models for Internal Share, the independent variable for Physicians is positively associated in cardiac surgery and cardiology. In a weaker model with lower Adjusted $R^2$ values, the variable for **Physicians** is negatively associated with specialization in cardiac surgery, as measured by **Market Change**. In other words, higher concentrations of thoracic surgeons, used as a measure for specialists in cardiac surgery, are negatively associated with gains in market share. This possibly suggests that as the density of surgeons performing cardiac surgery relative to overall population increases, they may demonstrate less loyalty to any single hospital as they seek to accommodate patient wishes to secure cases, making it more difficult for hospitals to exert discipline over physicians, such as described earlier for the Baptist Health System - South Florida. Due to the mixed direction of coefficients in models, the hypothesis for **Physicians** is considered only partially supported in fewer than half of the service lines studied.

*Characteristics of Internal, Organizational Factors*

$H_7$ states that hospitals with a greater number of inpatient acute care beds are negatively associated with specialization in high volume, high revenue-generating service lines. While **Hospital Size** is significant in its influence on hospital specialization in 17 of the 19 models among final results, only in five is it negatively associated. Results are therefore mixed and disproportionately so. Analysis finds a negative association between a narrowness of service line offerings depicted by the overall measure **Internal Service Concentration** and **Hospital Size**. This is also true for cardiology and pulmonary

services in models for **Internal Share** and **Expected Market Share**. However, the opposite is true for the other four service lines in models for **Internal Share**: cardiac surgery, invasive cardiology, orthopedics, and labor and delivery, all which exhibit positive parameter estimates for **Hospital Size**. This suggests that larger hospitals are perhaps more likely to specialize in higher technology, higher risk, more highly acute care represented by these four service lines and by smaller ones in the more chronic care areas. Regardless, the hypothesis is not considered supported due to the mixed directions without consistent patterns.

$H_8$ states that for profit ownership (as opposed to not-for-profit ownership hospitals) is positively associated with specialization. Positive associations are indeed seen in models for **Internal Share** and **Expected Market Share** for both cardiology and invasive cardiology. However, models for these same measures of specialization in labor and delivery reveal a negative association with **Ownership**, suggesting specialization in this service line is more likely associated with not-for-profit owned hospitals. As with other hypotheses, the direction of the relationship of influence on specialization in the case of Ownership varies with service line and the measure for specialization. **Ownership** is positively correlated in regression analyses of two of three measures for specialization in invasive cardiology, specifically **Internal Share** and **Expected Market Share.** Although the hypothesis is considered not supported because of mixed results, such findings may be consistent with the extensive work by Horwitz (2007) in which significant and large differences by ownership type were found in services provided by acute care hospitals, with for profits more likely to specialize in service lines with higher

profitability such as invasive cardiology but not in lower profitability service lines such labor and delivery.

H$_9$ states that hospitals with a lead share of cases for their cluster in a high volume, high revenue-generating service lines are positively associated with specialization. As explained earlier, it is not meaningful to report on results with **Cluster Change**, as its usefulness only related to the sub-analysis for identifying cluster effect. Moreover, as a dichotomous variable, **Cluster Lead Hospital**, like **Ownership**, brings lower information content to any model than variables with continuous type of measurement and thus is less useful, all else being equal (Hulley et al., 2007). Its contribution may be strengthened if replaced with a continuous measure. Otherwise, **Cluster Lead Hospital** is a candidate to consider dropping from future studies. It is illogical to report negative or positive associations with the state variable because the negative or positive associations are using Virginia as a reference since state as a covariate is set up as a dummy variable. Thus, a "negative" association for Florida means that the outcome is smaller or less for Florida than for Virginia. A "positive" association means that the outcome for Florida is larger or greater than for Virginia. Similar interpretations can be made for Nevada. This relativity of terms explains why in results from backward, stepwise regression, one state with a p-value exceeding .05 will appear in the model alongside another state whose p-value is significant at < .05.

Only in two models is the state covariate statistically significant and therefore included. In the model using **Expected Market Share** and with an Adjusted $R^2$ of 0.44, specialization in cardiac surgery is less in Nevada than in Virginia (and hence, the

negative ß coefficient). Specialization in cardiology using **Internal Share** as its measure is less in Florida than in Virginia. Specialization in labor and delivery as measured by **Internal Share** is less in Nevada than in Virginia. This may reflect the very different demographics of the two states.

Chapter Summary

Slightly over half or 54.8% of all 303 hospitals in the study sample discharged patient cases in 2007 in all of the six service lines examined in this study. Such restriction in the highest volume, highest revenue-generating service lines identified nationally already signals specialization by general, community hospitals in the study. Hospitals were most selective about offering labor and delivery services, with only 179 of the 303 or 59.1% treating such cases in 2007. On the other hand, all 303 hospitals reported inpatient cases in cardiology, reflecting the nationwide prevalence of chronic cardiac disease in an aging population requiring inpatient care.

The hospitals also demonstrate considerable variation in the extent to which they concentrate in any service lines. During the brief period between 2003 and 2007, some hospitals exited three of the six service lines: invasive cardiology, orthopedics, and labor and delivery, with some entering while others were exiting two of these three service lines. None discontinued cardiac surgery services, pulmonary services, or cardiology. In fact, 98 hospitals, from 147 to 245 or 66.7%, added cardiac surgery over the brief, four-year period. In addition, dramatic, positive shifts in market share positions were experienced by some hospitals over the period, especially in pulmonary services and invasive cardiology. Regardless of what variables might be associated with such changes,

because these are high volume, high revenue-generating service lines and a number of the changes occurred in market share, such changes may reflect choices by many hospitals as part of their competitive strategy.

Hospitals in the cluster sub-group were more likely to discharge cases in the targeted service lines than hospitals in the study sample as a whole. Still, among the 175 cluster hospitals, only 64.0% discharged cases in all six service lines compared to 54.8% of all 303 hospitals in the study sample as a whole. As suggested earlier, this is likely because the clusters are all urban and are larger in size with 12.2% more beds on average than those in the 303 study sample covering both metropolitan and smaller, micropolitan areas. All of this suggests that the general hospital as a full-service provider of a wide range of costly and complex services may be undergoing some transformations.

There is indeed evidence that specialization is occurring within hospitals, although the explanation for why this is happening is yet to be determined. This study points to some possible factors that are associated with variations in specialization among hospitals, but the mixed findings both within and across the six service lines suggest that much more investigation is needed.

Market and organizational factors vary considerably among hospitals across the study sample. Physician specialists do not necessarily practice in all hospital markets, as no doctors in any of the six categories of specialists are recorded in some of the smallest markets with hospitals. The physician ratios as a percentage of the population range widely, as reflected in the relatively large standard deviations compared to means. On the

other hand, all hospitals in clusters have access to local physician specialists, except in cardiac surgery.

Backward deletion, stepwise regression provides a refinement in methodology over standard, simultaneous regression for improving the predictability of models, the precision of parameter estimates, and ease of interpretation with fewer variables. It also helps to eliminate variables that are not influential, usually resulting in better fitting model and unmasking variables otherwise hidden. Strengthening of models using backward deletion, stepwise regression over standard, simultaneous regression is best illustrated by the substantial increases in F values, a statistic that indicates how much variation is attributable to the linear relationship versus random error.

The backward stepwise regression also substantiated the influence of identified, specialty physicians in hospital specialization patterns. High concentrations of thoracic surgeons were found to be negatively associated with **Market Change** in cardiac surgery and even **Internal Service Concentration** as a general, compositive measure, suggesting possibly that as the market concentration of thoracic surgeons increases the less likely local hospitals witness market share gains in cardiac surgery service and, therefore, the less able hospitals are to gain distinctive positions in this clinical arena. They were positively associated with specialization as measured by **Internal Share**, reflecting more hospitals adding the service line over the period of study. The methodological refinements also helped to highlight the influence of states, as differences appeared in the analyses of cardiac surgery, cardiology, and labor and delivery.

**Hospital Size** was consistently statistically significant in the majority of the models. While **Hospital Size** is significant in its influence on hospital specialization in 17 of 19 models, only in five models is it negatively associated. Results are therefore mixed in both directions. The importance of hospital size (inpatient bed count) has been observed in numerous studies, so this finding is not surprising. Interestingly, it appears from this study that smaller hospitals tend to concentrate in cardiology and pulmonary services as specialization strategies, whereas larger hospitals tend to focus on higher risk, more highly acute care, and higher technology services, including cardiac surgery, invasive cardiology, orthopedics, and labor and delivery.

**Competitiveness** and **Density** also surfaced as significant factors in the models, and like **Hospital Size**, not consistently in the same direction. A lower degree of market competitiveness is significantly associated with specialization consistently in cardiology, orthopedics, and labor and delivery. Cardiac surgery, invasive cardiology and orthopedics are generally negatively associated with **Density** but not pulmonary services in the model measuring specialization by **Internal Share**. This is logical in that more densely populated, urban areas are more likely to have the diversity of population to demand more services in complex, more acute services requiring higher technology represented by the former than the latter.

Since the only reason for proposing the sub-analysis on the 175 hospitals organized in clusters was to control for the cluster effect and since such effect fails to emerge in the mixed effects model, it is therefore not meaningful to report on results with **Cluster Change**, as its usefulness only related to the sub-analysis. The analysis showed

no significant cluster effect. Other variables may exist that are not used in the study to better explain any variance due to cluster effect.

While the explanatory power exhibited in the models is generally strong, the Adjusted $R^2$ values only once exceeded 0.50 (0.54 for **Internal Share** in cardiac surgery). This suggests that significant but unexplained variation among hospitals remains and that unidentified factors may be affecting the results. It is also probable that random variations attributable to patterns of disease in the population, local political climate and economy, organizational and market diversity and other factors could dampen the explanatory power of any of the models. Of course, some variation and low R-squares are also attributable to data and methodological limitations (e.g., non-normality, lack of fully successful transformations, small sample sizes, and the presence of outliers).

# CHAPTER SIX: CONCLUSIONS AND RECOMMENDATIONS

## Overview

The purpose of this study was to determine if general, community hospitals show evidence of specializing within the nation's six highest volume, highest revenue-generating service lines and to identify market and organizational factors that correlate with such a strategy. To address these two research questions, hypotheses were developed from strategic management and organization theory as well as from work by Lawrence and Lorsch (1967). The study first transformed dependent variables to address problems with normality and then assessed outliers before applying standard, simultaneous regression. Backward deletion, stepwise regression was subsequently employed to improve the fit of models with the fewest, significant variables, and a mixed effects procedure was pursued to evaluate a possible lack of independence in strategies among same system cluster hospitals. After no evidence of cluster effects was found, final results from regression models for each of the six service lines were interpreted to test support for hypotheses. This final chapter presents the major findings and their implications and offers recommendations for future research, concluding with a summary of limitations.

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Summary and Interpretation of Major Findings

The analyses of hospitals in the study sample produced a number of key findings, among which are:

1. The study hospitals range widely in the extent to which they concentrate services and change their levels of service concentration. This is suggestive of functional diversity across hospitals as well as across markets. In the interval between 2003 and 2007, a number of hospitals exited three of the top six service lines – invasive cardiology, orthopedics, and labor and delivery – with some exiting while others entered. All 303 hospitals reported inpatient cases in the cardiology service line throughout the period, reflecting the nationwide prevalence of chronic cardiac disease in an aging population. This finding suggests that inpatient specialization in cardiology might not be easily achieved across hospitals within markets. This may be due to the place and method of hospital admission for patients discharged from the cardiology service line, the majority of which likely entered hospitals via the emergency department (ED), a factor not examined in this study. Importantly, this contrasts with the other cardiac service lines – cardiac surgery and invasive cardiology – to which most patients are believed to be admitted via physician referrals. If the cardiac diagnosis is known, a procedure for treatment is planned and scheduled, and admission is arranged by the referring physician or physician to perform the procedure. Physician referrals as a channel for admissions render such service lines considerably more adaptable to patient channeling, a key capability hospitals are likely to need for them strategically to engage in specialization within those service lines. (Specialization in other service lines, such as burn units, may

depend heavily on both emergency admissions and even transfers from nearby hospitals.) Clearly, source of admission and physician referral patterns warrant further analysis as a factor for studying specialization by general, community hospitals.

2. The contribution of clusters to service line specialization remains inconclusive, based on the results of this study. Application of a mixed effects procedure to the sub-analysis of clusters produced no evidence that the variance of the random effects in regression models is significantly different from zero. Hence, we were left to rely solely on the fixed effects in backward, stepwise regression for statistical findings and interpretation. It is possible that some clusters designated more than one cluster member to expand within given service lines in order to combat moves made by local competitor hospitals in their markets. If this were true, the cluster as a whole might gain share within the market, but the positive gains of one hospital's share could be cancelled out by losses of another cluster member's share. Additionally, as stated in Chapter Five, other variables may well exist that are not used in the study that could better explain the variation in change in cluster share for hospitals in each of the service lines. Alternatively, a different measure for service line choices by cluster members may permit variance associated with random cluster effects to be quantified for analysis.

It is also possible that within-cluster specialization patterns are sufficiently complex and dependent on a number of distinctive structural and configurational characteristics for each cluster, such that within-cluster specialization might not be easily examined using statistical analyses. A case study approach might therefore be needed for the cluster strategies to be isolated and examined. The Baptist Health System example

gives some indication of how highly individualistic a cluster can be, varying in the numbers of hospitals, sizes, spatial distributions, service capacities, contractual arrangements with insurers, and other local considerations including patient demand. Accordingly, each hospital within a cluster has unique considerations such as different physician loyalties and expectations, admission mix and referral patterns, community expectations, and political histories. In sum, specialization might best be understood by studying individual clusters in a case study format in order to understand how and why changes in patient distributions within a cluster did or did not occur.

3. The influence of the covariate for states suggests that variations may exist among markets because of epidemiological, environmental and demographic considerations that have a direct bearing on demand for inpatient care and therefore specific hospital service lines. A dummy variable for state alone, however, may not reflect complex differences among the states (such as in mortality rates, household incomes, ethnicities, and education) that reflect such diversity. It may be necessary to dig further into the regional or even local context of service line specialization. Hospitals from the three states comprising this study's sample data should not be considered representative of the nation's general, community hospitals as a whole because of differences between study and national distributions, as discussed earlier.

4. Because of the diversity across even the high volume, high revenue-generating service lines, this study demonstrates the usefulness of examining service lines separately when assessing hospital specialization, rather than using a single, composite indicator of service concentration. With the best fitting models having been generated for cardiac

surgery (mean Adjusted $R^2$ of 0.37), it is notable that all of the descriptive factors identified for study surfaced as statistically significant at least once in models for the 303 hospitals. The fact that coefficients for the same characteristic (for example, **Density**) were in contrary directions across models for a given service line (for example, negative for **Internal Share** but positive for **Market Change** in cardiac surgery) suggests that the dependent variables may be measuring different facets of specialization if not something separate from specialization altogether. This raises the question of how best to measure service line specialization.

Undoubtedly, measurement needs to take place at the service line level or lower rather than at a macro hospital level. The latter approach is more common in the literature – such as in previously referenced studies by Eastaugh (1992), Zwanziger et al. (1996), Gu (2005) and others who have looked at specialization using single, aggregate measures of service concentration. As this study has shown, however, once one transcends to more disaggregated levels of analysis, the results become more diverse and specific to particular service lines, which is suggestive of differences among disease categories and thus not easily summarized into general patterns. Failure to disaggregate tiers of analysis risks producing results that combine strategies potentially moving in opposite directions, thereby cancelling each other out and even possibly producing misleading results. On the other hand, reducing analysis of specialization to the level of a single procedure might fail to address hospital management considerations at the strategic level, at which resource requirements are orchestrated and investment decisions are made.

5. A particularly perplexing outcome from the study was the difficulty encountered in fitting a model for labor and delivery, for which the mean Adjusted $R^2$ was only 0.07 (and never greater than 0.17 in any single model). Factors other than those included in the study may offer greater predictive power, such as considerations relating to risks of litigation, lack of profitability, declines in the number of specialists practicing obstetrics due to threats of malpractice lawsuits, and so forth. Labor and delivery is clearly the most restricted service line among the six in this study, in terms of the numbers of hospitals providing that service. Although considerable specialization is occurring in labor and delivery, few of the variables examined in this study appear to be associated with a hospital's decision to provide that service. Still, it should be noted that most variables that were significant in the models tended to have parameter coefficients in consistent directions (especially **Hospital Size** and **Ownership**). Therefore, even though the fit of models for labor and delivery was not strong, compared to those for the other five service lines, results were relatively consistent across the characteristics examined in the models. Clearly, labor and delivery needs more specific and detailed analysis, with additional factors included, before conclusions regarding specialization in this service line can be drawn.

6. Despite the fact that contrary associations in all but **Age** and **Growth** make it difficult to reach strong conclusions regarding the hypotheses, all hypotheses were supported in at least some models. The many differences across service lines and the factors influencing specialization reflect the ambivalence included in some of the hypothetical statements included in Chapter Three. Although the analyses produced many

mixed parameter estimates, **Hospital Size** surfaced as a statistically significant factor in all but two models (**Market Change** in cardiac surgery and **Expected Market Share** in orthopedics), confirming its role in explaining service line specialization by general, community hospitals. This is not an unexpected finding, of course, as larger facility sizes are often required for hospitals to have the resources and the patient volume needed to engage in many forms of specialization. Smallness of size can, however, restrict diversity of services, however, as noted by the negative association of **Hospital Size** with **Internal Service Concentration** as a measure of specialization, as well as **Internal Share** in pulmonary services and cardiology.

*Theoretical Implications*

Two broad bodies of literature – strategic management and organization theory – provide perspectives within which this study was framed. More specifically, a market structure framework (Porter 1980) and resource-based (Penrose, 1959) views from strategic management were combined to identify factors external and internal to organizations that might influence hospital specialization. In a sub-analysis, the study also used the work by Lawrence and Lorsch (1967, 1969) applying the concepts of integration and differentiation to characterize the likely consequences that consolidation of hospitals might produce locally for specialization. As an extension of Lawrence and Lorsch, the study incorporated the "focused factory" concept to characterize the efforts clusters might make to rationalize service line capacities and functions across local cluster members.

Support for Porter's emphasis on market concentration is revealed in the fact that Competitiveness in particular was an influential factor in models generated in the study. It characterizes market concentration and thus market structure. Although there is inconsistency among service lines and in the direction of parameters depicting such association relative to hypothesized expectations, the first construct – that of Porter's theory regarding the relevance of market structure to specialization – is sustained.

The other two constructs both draws on internal, organizational factors. Consistent with Penrose's resource-based view pertaining to core competences of the organization, the study examined two organizational characteristics that are assumed to represent differing degrees of resources and capabilities in hospitals: (a) hospital size defined by number of beds, and (b) the tax status of a hospital's ownership. With **Hospital Size** surfacing with significance in models across all six service lines studied and **Ownership** significantly associated with specialization in three service lines, the importance of incorporating internal, organizational considerations with external, market factors in searching for elements shaping a hospital's choices in service line specialization is considered demonstrated.

There could be additional competitive advantages in specialization beyond the foregoing market and organizational arguments, such as the hospital's unique relationships with local physicians and multispecialty practice groups including new configurations known as accountable care organizations (ACO), its membership in group purchasing organizations, and its role within the strategies of broader multi-hospital systems. Hypotheses surrounding the significance of relationships could draw on further

conceptual development of core competences and market positioning as factors potentially impacting specialization. These remain yet to be quantified and explored.

While the third construct – system configuration – generated inconclusive results, future research may need to explore other perspectives than that of Lawrence and Lorsch (1967, 1969) to explain patterns of specialization within hospitals. For instance, social exchange theory might be re-examined for its use in evaluating negotiated exchanges between parties involved in making major decisions that would restructure clinical capacities across members in complex, inter-organizational arrangements such as hospital clusters. As described earlier in Chapter Two, the theory of social exchange posits that all relationships are formed by the use of subjective cost-benefit analyses and comparisons of alternatives (Homans, 1958; Thibaut & Kelley, 1959). By tapping into the theory's study of power, equity, and the creation of commitment during bargaining processes (Emerson & Cook, 1978), such perspectives could possibly be used to frame the processes by which "understandings" among same-system, cluster hospitals are reached regarding service line strategies. This may be especially true in clusters where large, lead hospitals exert dominance. Despite its historical application to vertical relationships, there may be a novel place for social exchange theory to be applied within the wider realm of organization theory in explaining service line decisions by hospitals in same-system clusters.

In conclusion, given the diversity across local markets and organization types, it is imperative that researchers draw on a combination of strategic management and organization theories to explain patterns of specialization among hospitals locally, as this

study attempted to do. While the models, even with refinements in methodology, did not reveal clear patterns, for example, of a focused factory approach to service line specialization among cluster hospitals, the Lawrence and Lorsch (1967, 1969) rationale for differentiation and integration as well as that for focused factories still seem a reasonable basis for conceptualizing why hospitals might wish to engage in this activity. This might not be an issue, therefore, of conceptual framing, but of research design (e.g., selection of the period of time to study, measurement issues, longitudinal versus cross-sectional designs, use of a more qualitative, case study approach in lieu of, or supplementary to, a quantitative study to name a few), as discussed in the following section. Until this is demonstrated by research, whether quantitative or qualitative, such a rationale remains conjectural.

*Methodological Implications*

Refinement of methodology, including use of backward deletion, stepwise regression, improves the quality of analysis and strengthens the predictability of models for specialization. However, such refinement does not generate more conclusive results or aid substantially in more definitively supporting hypotheses. Only a few, new variables, such that they emerged as significant factors in selected models and specifically in labor and delivery, became known. Skewed distributions of data persisted despite transformations of specialization measures. Removal of outliers had little impact. No evidence of random variation due to cluster effect was found from mixed effects analysis. Chapter Five explored why the estimated directions for the parameter

coefficients could be mixed, as for example for **Hospital Size**, but the reasons were not always self-evident.

All of the foregoing complicate the search for explanation and call for further investigation of alternative measures and design strategies. It is possible that dichotomous measures for **Cluster Lead Hospital** and **Ownership**, for example, should be replaced with either continuous variables or that a different study design, as discussed above, might be needed in future research (e.g., a combination design or case study approach altogether). Even variables for which somewhat consistent results were attained – such as for **Competitiveness** – warrant further exploration of just what the measure might be measuring. It is not known, for instance, whether one minus the HHI is a measure of non-price or price competition, whether it is or is not more a correlate of market size rather than of market concentration, or, in general, just how variations in the measure translate into changes in specialization. It would also be important to understand what role payer contracts and or state regulations (e.g., certificate of need) might play in shaping specialization patterns among hospitals and influencing the freedom of choice they possess in making such decisions. All in all, the findings of this study suggest that specialization patterns might be not only highly complicated, perhaps even idiosyncratic to individual facilities and markets, but also possibly not strongly or directly associated with the kinds of marketplace incentives and organizational structures commonly examined in studies of hospital behavior. This is especially true in labor and delivery, for which the adjusted $R^2$ remained low regardless of measure for specialization.

*Policy Implications*

As discussed in Chapter One, specialization and coordination of clinical capacities among hospitals has been a focus of policy for nearly a century in this country. It represents an important approach to rationalizing the distributions of clinical capacities across hospitals, while improving quality, efficiencies, and overall provider performance. While the purpose of this study is not to argue for or against service line specialization by general, community hospitals, but rather to determine if there is evidence of its existence, certain policy considerations emerge from the study findings and deserve additional attention. At least six policy issues surface from this study.

First, the study reinforces the need to better understand **Hospital Size** as a variable in determining patterns of hospital specialization. Interestingly, size has long been a focus of policy, stemming back to the Committee on the Cost for Medical Care in the late 1920s, the Hill-Burton legislation in the 1940s and 1950s, and the regional planning efforts in the 1960s and 1970s (Starr, 1982). Throughout this period, policy sought to improve the coordination between larger referral hospitals and smaller, often rural facilities that needed backup support. And, with respect to individual institutions, the country is today experimenting with the so-called "critical access hospitals," which are limited to 25 beds or fewer, in an effort to limit capacity to small hospitals and encourage the transfer of patients that need greater levels of care to larger facilities (Basu & Mobley, 2010; Casey & Moscovice, 2004; Scalise, 2004). As technology evolves and systems have become a central organizational unit in delivering services, however, it is less clear just what role size should play in service specialization. It is possible, for

instance, for smaller hospitals to specialize, especially if they have back-up relationships with other hospitals and providers in their local communities. Penrose's emphasis on internal resources and capabilities may serve to bridge gaps in our understanding of how hospital size affects hospital choices and patterns of specialization.

Second, the study highlights possible difficulties in rationalizing service capacities across cluster members, although clusters may be the one organizational form that conceivably can facilitate coordinated choices by hospitals among service lines. Unfortunately, insufficient consideration has been given at the policy level to encouraging hospital cluster formation or to facilitating their coordinated engagement in specialization. Also, little attention has been given to how specialization within clusters might best be structured, what role the so-called "lead" hospitals might play, and how to coordinate inter-facility transfers of patients and those that might need care exceeding local facility capabilities. This study did not find evidence of a cluster effect on specialization, a finding that either reflects an inadequate effort on the part of systems to engage internally in coordinated specialization, or a general lack of incentive provided by markets or policy design, or the need for a different approach to study design (as discussed above).

This leads to a third policy issue. The study highlights the limited and unclear roles that market competition and other environmental factors play in stimulating or discouraging specialization. Such findings suggest that decisions to specialize might be much more complex and, perhaps, more idiosyncratic to the specifics of hospitals than initially believed. Thus, rather than examining traditional external, market and internal,

organizational factors, it is possible that the specifics of each hospital might be highly important in explaining patterns of specialization, including for example distinctive hospital capabilities, locations, historical roles in the communities, mixes of physicians and related referral configurations, third party relationships, and so forth. Clearly, there is a need for more research to inform policy on how best to influence patterns of system rationalization in local markets and systems. Additionally, in a much broader sense, the limited findings point to the critical need for policy to balance conflicting policy objectives, such as between competition and the need to rationalize system capabilities locally.

Fourth, the findings feed specifically into the literature covering the relationship between volume and quality, which has generated a major policy debate over the argument for concentrating clinical functions through specialization in hospital markets. Results of this study illustrate that some service lines – particularly those requiring substantial investment in high technology, support equipment and highly trained specialists – are positively associated with larger hospitals. An example is cardiac surgery. Hospitals discharging cases in cardiac surgery (N = 245) have a mean inpatient bed count of 266. Hospitals in the dataset not managing inpatient cases in cardiac surgery are far smaller, with a mean inpatient bed count of 76 (N = 58). Similar contrasts surface for invasive cardiology, in which hospitals discharging cases have a mean bed count of 265 (N = 243), contrasted to those without such cases showing a mean bed count of 85 (N = 60). Such differences between groups of hospitals are considered significant. Still, the jury is out on the question of whether higher patient volume is directly correlated with

improved clinical outcomes, as evidenced by a retrospective study of 1.4 million interventions on patients involving multiple organs in 144 clinical categories and a variety of structural hospital characteristics in which there is not support for the volume/quality argument (Eggli, Halfon, Meylan, & Taffé, 2010). Although an increase in mortality rates was feared with more hospitals starting new cardiac surgery programs in the face of declining demand for coronary artery bypass grafting (CABG) procedures (Wilson, Fisher, Welch, Slewers, & Lucas, 2007), the counterintuitive finding of lower mortality rates in the setting of reduced CABG volume has been found in data spanning 1988 to 2003 (Ricciardi et al., 2008). This suggests that procedure volume is an insufficient predictor of outcome on which to base regionalization strategies of rationalizing services.

A more disturbing sub-issue emerged in the process of conducting this study – the exiting of community hospitals as providers of labor and delivery services, with choice and ease of access being compromised for community residents by the relatively low number of hospitals discharging patients (N = 179 of 303 or 59.1%) in this service. This has occurred despite the fact that labor and delivery represents a service where consumers traditionally seek care more locally, at least by comparison to the other five inpatient services examined in this study. Childbirth is not considered a disease and, therefore, mothers tend to prefer delivering their babies conveniently closer to home. Yet, the percentage of hospitals providing care in this service line is the lowest of any service line examined in the study. It is probable that this pattern is less one of planned specialization than a consequence of other factors not examined in this study. For instance, it is likely

that risk of litigation is a major consideration by hospitals in this particular service line. With or without tort reform with respect to litigation concerns, this finding raises the policy question of whether there should be limits on specialization by general, community hospitals, as specialization juxtaposes travel costs and inconvenience against possible gains (such as in quality and efficiencies) attributable to service centralization.

An obvious related question is why hospitals are leaving this service line and what may be the implications for loss of access to labor and delivery for a community's residents. Low profit-generating service lines are not identified as a variable in this study nor are even low revenue-generating service lines examined for comparison purposes. Upon further analysis of the data, it appears that 119 or 66.5% of the 179 hospitals providing labor and delivery services in 2007 are not for profit, while 120 of the 187 hospitals or 64.2% providing the service in 2003 were not for profit. These percentages approximate the proportion of not for profit hospitals among the 303 hospitals in 2007, constituting 188 or 62.0% of the total study sample. Thus, the tax status of ownership fails to offer immediate insight about hospitals exiting labor and delivery.

However, the incentives from for profit ownership do offer possible insight into why hospitals are entering cardiac surgery over this same period. Cardiac surgery may be a far more lucrative service line than labor and delivery. Fifty-one of the 98 hospitals or 52.0% entering cardiac surgery were for profit, disproportionately higher than the 38.0% representing for profit hospitals in the total study sample. It may therefore be service line profitability that is driving entry into this area. It may also be influenced by the financial incentives for specialty physicians and the pressures they exert on local hospitals to add

cardiac surgery services. In this latter example describing the rapid influx of general, community hospitals into the business of providing cardiac surgery services, the impact could very well be positive from a patient access point of view, yet carrying possible negative implications with respect to outcomes, efficiencies, and hospital overhead costs. It is not inconsequential that the number of CABG procedures nationwide actually peaked in 1996 and declined 20.0% by 2003, while the number of hospitals performing CABG increased steadily (Wilson et al., 2007). Percutaneous coronary intervention, known as angioplasty, with or without stents and performed by interventional cardiologists instead of surgeons, increased over the period by 128% (Ulrich, Brock, & Ziskind, 2003). From a policy point of view, the bigger issue reflected by the still wider availability of cardiac surgery services across a greater number of general, community hospitals in just four years in the face of declining demand is the continued oversupply of higher paid specialists and shortage of primary care physicians especially in rural areas. The influence on the healthcare system of professional specialization that has remained a hallmark of American medicine seemingly continues unabated despite the call for changes.

Sixth, policy must confront the issue of market competition versus coordination. Specialization presumably reduces patient choice among hospitals, if coordinated among clusters. Thus, hospitals facing highly competitive markets may specialize in order to increase competitive advantage, as three of the six service lines in this study demonstrate. As mentioned previously, perhaps the inconsistency in direction by service line is actually a reflection of the fact that **Competitiveness** is more a reflection of a hospital's

market size than actual competitive pressures in the market. One of the underlying premises of this study – especially the sub-analysis of clusters - is that coordination is beneficial in supporting specialization. It was symbolized by the variable for **Cluster Lead Hospital**. In the end, the factors intended to characterize either competition (**Competitiveness**) or its antonym depicting coordination (**Cluster Lead Hospital**) may fail to go far enough to capture behavioral elements of individual hospitals such that the value of one or the other can be determined and correlated readily with service line specialization. Further investigation is needed to determine whether inpatient service line specialization has been the strategic response, as expected, in reply to the greatly increased market concentration that occurred over the prior two decades. Going forward, opportunities for coordination of services and shared accountability for a patient's healthcare in same-system hospitals organized in geographical clusters may be valuable to proving the merits of a more physician-centered organization emerging from health reform concepts such as accountable care organizations.

<div align="center">Limitations</div>

This research focused on the correlates of hospital specialization at a given point in time – 2007. However, it is clear that specialization involves long-term strategic and investment decision-making that could take years to be fully realized. Determinants of such change themselves could occur over a period of years, followed by a period in which the decisions to specialize are implemented. This study attempted to examine changes over time using two of the dependent variables – **Cluster Change** and **Market Change** – although a full longitudinal design was not implemented. It would be

important in future research to examine specialization shifts more completely in the context of time. It would be insightful to determine whether or not the 2003-2007 period of study offered sufficient time for systems to have invested in service line changes or is the best interval within which to assess the digestion by systems of mergers and acquisitions that occurred in a prior decade. Thus, the lack of a full, longitudinal design represents a limitation of the study.

This research made no judgment regarding any impacts of specialization on patient outcome, efficiencies or access or on the performance of the markets themselves. Yet, as discussed above, specialization choices could have important impact on any of these factors. Thus, future research needs to address more explicitly the relationships between specialization and organizational and market performance.

While relationships with payers and local physician organizations are not explicitly measured, the analyses do assess the relationship between specialty physician concentrations in markets and patterns of specialization. Specialization by hospitals obviously is affected by many organizational entities other than hospitals, including especially payers, physician groups, rivals, and regulators as well as insurers for risks and malpractice. It would be important, therefore, to examine the broader organizational and competitive context of specialization.

A unique contribution of this study was the attempt to isolate specialization within clusters of hospitals at the market level. An attempt was made to identify lead hospitals (with the highest share per cluster) in each cluster for each of the six service lines, but the results did not entirely confirm the expectation that the so-called lead hospitals further

concentrated services within their clusters. It is possible that lead hospitals might in some cases not truly represent the dominant hospital within a given cluster designated to lead in specialization. Future research needs to examine clusters more directly and completely. It might be especially important for this to be done first using qualitative case studies of key clusters across the country in order that the often-complex patterns and strategies clusters use to rationalize service capacity distributions across their members might be identified. As a corollary, future research should also assess whether clusters as a whole are gaining or losing overall shares within service lines compared to competitors.

The restriction of data to the three states – Florida, Nevada, and Virginia – also constitutes a study limitation. As discussed earlier, this research should as a result be considered exploratory. It would be important to replicate the study using community hospital data from other states, as a study of the nation as a whole would not be feasible, given the lack at present of a nationwide database on all hospital discharges.

This research is not intended to prove or disprove the merits or pitfalls of competitive differentiation by specialization. Nor is it intended to serve as an argument for or against specialty hospitals, as no comparison between general, community and specialty hospitals was conducted. The exclusions of specialty hospitals (and, depending on the service lines, of ambulatory care and same-day surgery centers) in local markets represents a limitation of the study.

It is also possible that the study of specialization is best done at some other level of aggregation or disaggregation than service line. While it was assumed that hospitals plan specialization strategies generally at the level of broad service lines, the reliance on

selected specialists and other specific strategies could lead to specialization that might only be clearly observed at a much lower level of measurement, such as at the level of DRGs. This consideration might vary further in its importance by service line. With the definition of service differing among hospitals and among systems, there is also opportunity for variation in the classification of patient cases by service line, contributing to error. To the extent that this is true, it could account for the limited findings for some service lines and weakly predictive models. Clearly, more refined approaches to measurement and design are needed in order isolate the actual patterns of specialization that are occurring. Again, this may call for either the application of case studies or for the assessment of more hospitals in more states.

Lastly, it is possible that some of the difficulty in explaining the variation and thus the low Adjusted $R^2$ values in the final models may be attributable to measurement errors, such as violation of assumptions of normality, lack of proper transformations, and extreme outliers. Such obstacles linger as limitations to the study.

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APPENDIX A

DEFINITION OF KEY TERMS

APPENDIX A

Definition of Key Terms

*Defining Community Hospitals*

The American Hospital Association defines community hospitals as all non-Federal, short-term, general, and other specialty hospitals, excluding hospital units of other institutions, such as prisons. Government-owned hospitals, such as those under the Veteran's Administration, are explicitly excluded. Reference to general, community hospitals therefore excludes non-Federal, long-term, and specialty hospitals (American Hospital Association, 2008).

*Defining Hospital Specialization*

Hospital specialization represents a community hospital's focus on one or more clinical service lines. This is not a new phenomenon but more a function of strategy, branding, and resource allocation. When pursuing specialization in a clinical discipline, a hospital may include claims of distinction, using widely publicized terms such as "center of excellence" as a symbol of superiority over rivals. Implicit in the concept is some element of comparative advantage. The selected measure for measuring and thus demonstrating quantitative evidence of specialization for use in this research is an index that corresponds to the difference between actual versus Expected Market Share in a selected service line.

*Defining Local Market*

Local market will be defined as a Core Based Statistical Area (CBSA), the current standard definition issued by the Office of Management and Budget in 2000. It designates metropolitan and micropolitan statistical areas and is applied to U.S. Census data (U.S. Census Bureau, 2008). On average nationwide, 93% of a state's entire population is covered by the data housed for all of its CBSAs, according to the Bureau's web-based "About Metropolitan and Micropolitan Statistical Areas."

*Defining Market Share*

Share of market is represented as the quotient derived arithmetically by dividing the sum total of a market's size into that portion owned or controlled by a single player in the market. The sum of percentage shares of all players in a market equals 100%. If there is only one player in a market, it is understood to be a monopoly and that player controls 100% share of the market.

The boundaries of a market define the size of the market and can be geographical, technological, or by other defined borders. In the case of this study, borders of a local market are defined in geographical terms as a Core Based Statistical Area (CBSA). The market is defined in terms of inpatient case volumes for each diagnostic classification being studied. A hospital's market share is determined by the percentage of total like cases it has treated over the entire year 2006. A federal government classification term for a region surrounding an urban center with a population of 10,000 or more, use of CBSA has replaced the Metropolitan Service Area (MSA) as the standard for defining a local market.

*Defining Multi-hospital System (MHS)*

Sometimes referred to as a multi-hospital chain, a MHS represents two or more hospitals owned, leased, sponsored, or contractually managed by a central organization (AHA, 2007). Such affiliations may be among government-owned facilities, such as the Veterans' Health System of VA hospitals, investor-owned and thus for profit hospitals, or not-for profit organizations. They may be short-stay or long-term hospitals, general or specialty in nature. Unlike networks or alliances, they are centrally controlled and imply financial ownership and binding obligations among entities.

*Defining Service Line*

Researchers have struggled in their analysis of service lines because service lines are somewhat loosely defined and vary among institutions. The definition can vary from hospital to hospital. A general, community hospital can have as many as 35 service lines. They typically reflect the teaching disciplines for medical training and supportive hospital services. An example is Labor and Delivery, inclusive of all obstetrical services. Ideally, they are managed as profit centers, meaning that they represent domains within a hospital receiving patient revenue for services provided and through which expenses for payroll, supplies, and other needs are tracked and recorded. Service line management is an organizational structure designed to meet customer needs, largely growing out of product line management thinking and experience (Westphal, 2005). The Clinical Classification Systems (CCS) of HCUP aids in the framing of service lines around diagnostic categories and thus selection of highest volume and highest revenue-

generating service lines targeted for analysis in this study (Agency for Healthcare Research and Quality, 2007).

### *Defining Specialty Hospital*

Specialty hospitals are typically those treating patients with specific medical conditions or those in need of specific medical or surgical procedures. The former category, and one more diagnostic in nature, is exemplified by psychiatric care, spinal cord rehabilitation, and children's care. The latter is procedurally focused. Examples are hospitals where only certain procedures are performed such cardiac or orthopedic surgery. They represent the essence of niche marketing because of a specialized set of services that are provided only to certain types of patients (Rakich, Beaufort, & Longest, 1992).

APPENDIX B

EXTERNAL HERFINDAHL-HIRSCHMAN INDEX (HHI)

APPENDIX B

External Herfindahl-Hirschman Index (HHI)

Considered the best measure of competition because it captures relative size of all firms competing in a market.

Widely used in a variety of diverse industries as an established, validated instrument.

Represents a value between 0 and 1. The closer the index is to 1, the stronger the dominance of a competitor over pricing, negotiating, and thus power in the market. The closer the index is to 0, the more the marketplace reflects pure competition among all competitors and thus no dominance by any one player.

Derived from the sum of the squared market shares of each individual hospital competing in a selected service line in a single market. Examples of calculations are shown below:

Example of high competition: There are 5 hospitals in a market and each has an equal share of the total case volume, or 20% share. The HHI $= (.20)^2 + (.20)^2 + (.20)^2 + (.20)^2 + (.20)^2 = .200$.

Example of a single dominant hospital in a market: There are 5 hospitals in a market. One has 80% of the market while the remaining four each have only 5% share. The HHI $= (.80)^2 + (.05)^2 + (.05)^2 + (.05)^2 = (.05)^2 = .650$.

Example of a market with two players who dominate others but who lack sufficient volume to dominate the other: There are 5 hospitals in a market. Two each have 44% share. The remaining three hospitals each has only 4% share of market. The HHI $= (.44)^2 + (.44)^2 + (.04)^2 + (.04)^2 + (.04)^2 = .392$.

VITA

Nancy Jeanne Muller was born on November 17, 1953, in Houston, Texas, and is an American citizen. She graduated, salutatorian, from Ashley Hall School, in Charleston, South Carolina, in 1971. She received her Bachelor of Arts, magna cum laude, in French Studies from Duke University, Durham, North Carolina in 1974. She received her Master of Business Administration from the Darden School of Graduate Business at the University of Virginia, Charlottesville, Virginia in 1977. She worked for 15 years for W. R. Grace & Co. in New York City and in Duncan, South Carolina in corporate finance, marketing, and international sales management from 1977 to 1992. For two subsequent years, she worked in medical products marketing for Span America, Inc. in Greenville, South Carolina from 1992 to 1994, and subsequently consulted for American and European clients in healthcare and retail strategy from 1994 to 2000. Since 2000, she has been employed as executive director of the National Association For Continence, a 501 (c) 3 corporation in public education and patient advocacy, headquartered in Charleston, South Carolina. She has lived abroad in France and The Netherlands and traveled extensively in dozens of countries worldwide throughout her extended career.