DOES MARKET STRUCTURE AFFECT ACCESS TO AMBULATORY CARE?: THE RELATIONSHIP BETWEEN PROVIDER SUPPLY, INTER-ORGANIZATIONAL RELATIONSHIPS, AND AMBULATORY CARE SENSITIVE HOSPITALIZATIONS

by

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~What a long, strange trip it's been~

Grateful Dead

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TABLE OF CONTENTS

Acknowledgments ii
List of Figures viii
List of Tables ix
List of Appendices x
Abstract xi
Chapter
I. Introduction 1
Study Overview and Research Questions 3
Study Contribution 4
Organization of Dissertation 6
II. ACSH Research Limitation and Opportunities 8
Development of ACSH 8
Conceptual Framing of ACSH 11
Factors Associated with ACSH 12
Research Methods Used to Study ACSH 19
Research design 19
Measurement of ACSH 22
Assessing the effects of provider supply 23
Limitations of ACSH Research 24
Conceptual framing of ACSH 24
Factors used to study ACSH 26
Research design 29
ACSH Measurement 29
Provider Supply Measurement 30
Summary of Literature and Suggestions for Future Research 30
Limitations Addressed in the Study 32
III. Theoretical Framework and Hypotheses 35
Structure-Conduct-Performance Framework 36
Defining a Primary Care Market 37
Importance of Primary Care Organizations for Improving Access & ACSH 38
Hospitals 39
Community health centers (CHCs) 39
Physician organizations 40
Staff/group model Health Maintenance Organizations (HMOs) 40
Home health agencies (HHAs) 41
Nursing homes 42
Market Structure, Coordination, and ACSH 43
Provider supply 44

Provider capacity ... 44
Provider composition ... 47
Inter-organizational Relationships ... 49
Additional Factors ... 54
Predisposing Factors ... 54
Enabling Factors ... 55
Need Factors ... 56
Use of health services ... 56
IV. Research Design ... 57
Study Context ... 57
Population and Sample ... 58
Data Sources ... 59
Construction of the Analytic Dataset ... 63
Measurement ... 65
Outcome Variable Overview ... 65
Outcome Variable: Acute care ACSH vs. Chronic care ACSH ... 66
Outcome Variable: Aggregated ACSH ... 69
Explanatory Variables ... 69
Provider capacity ... 69
Provider composition ... 70
Inter-organizational Relationships ... 70
Control Variables ... 72
Statistical Analysis ... 75
Model Specifications ... 76
Provider Supply Models ... 77
Inter-Organizational Relationship Models ... 78
V. Results ... 80
Profile of California Primary Care Markets, 1998-2005 ... 80
Ambulatory Care Sensitive Hospitalizations (ACSH) ... 80
Provider supply ... 83
Inter-organizational Relationships ... 87
Population characteristics ... 87
Summary of Market Descriptives ... 88
Bivariate Correlations ... 89
Provider supply ... 89
Inter-organizational Relationships ... 90
Summary of Bivariate Correlations ... 91
Multicollinearity ... 92
Multivariate Models & Hypothesis Tests ... 98
Provider supply ... 98
Inter-organizational Relationships ... 104
Control Variables ... 107
Summary of Multivariate Models ... 107
Sensitivity Analysis ... 109
Summary ... 125
VI. Discussion and Conclusion ... 127

Research Questions & Explanation of Results 127
Are more providers associated with better ACSH outcomes? 127
Is provider composition associated with ACSH? 133
Is provider supply associated with ACSH when multiple provider types are considered simultaneously? 135
How do inter-organizational relationships between provider types in a market affect ACSH? 137
Summary of Findings 144
Implications for Future ACSH Research 145
Implications for Management & Policy 149
Limitations 154
Study Context 154
Research Design 158
Data and measurement 159
Conclusion 161
Appendices 163
Bibliography 166

LIST OF FIGURES

Figure 1: Behavioral Model of Access 13
Figure 2: Derivation of ACSH Rate.. 68

LIST OF TABLES

Table 1: Number of reviewed articles by year 10
Table 2: Number of reviewed articles by variable type 16
Table 3: Number of reviewed articles by 21
Table 4: Number of reviewed articles by outcome variable characteristics 23
Table 5: ACSH outcomes by year descriptives 82
Table 6: Condition-specific ACSH outcome descriptives, 1998 83
Table 7: Profile of California markets, 1998-2005 86
Table 8: Pearson zero-order correlations for provider supply 92
Table 9: Pearson zero-order correlations for inter-organizational relationships 93
Table 10: Regression results for testing multicollinearity – physician supply 96
Table 11: Regression results for testing multicollinearity – pneumonia mortality & percentage of urban residents 97
Table 12: Non-linear effects of provider capacity on ACSH 100
Table 13: Effects of provider composition on ACSH 103
Table 14: Effects of inter-organizational relationships on ACSH 106
Table 15: Sensitivity analysis of the non-linear effects of provider supply on condition-specific ACSH 112
Table 16: Sensitivity analysis of the effects of provider ratios on condition-specific ACSH 115
Table 17: Sensitivity analysis of the effects of inter-organizational relationships on condition-specific ACSH 118
Table 18: Relationship summary for condition-specific ACSH regression models 123
Table 19: Relationship summary for aggregated ACSH regression models 124
Table 20: Summary of hypothesis tests 126
Table 21: Non-linear effects of provider capacity on ACSH, rural markets only 130
Table 22: Non-linear effects of provider capacity on ACSH, urban markets only 131
Table 23: Effects of inter-organizational relationships on ACSH, hospital capitation interactions 142
Table 24: Effects of inter-organizational relationships on ACSH, inpatient revenue dependence interactions 143

LIST OF APPENDICES

Appendix 1: California Counties, 1998 163
Appendix 2: ACSH primary diagnosis codes 164
Appendix 3: Types of Physician Organizations 165

ABSTRACT

Adequate access to health services remains a fundamental challenge for the U.S. health care system. Ambulatory care sensitive hospitalizations (ACSH) are increasingly used as indicators of access in health services research. Importantly, most empirical research on ACSH has overlooked or narrowly defined the role of organizations in improving or impeding access. Using a coordination-and-control theoretical framework, this study examined whether the structural characteristics of markets such as provider capacity, provider composition, and inter-organizational relationships affect acute care, chronic care, and aggregate ACSH rates. The study used a longitudinal, pooled cross-sectional design that examined 58 California markets for the years 1998 through 2005. The unit of analysis was the market-year and the final analytic sample included 450 observations.

The most robust findings pertained to provider composition, where the ratio of home health agencies, skilled nursing facilities, and physician organizations to hospitals were significantly and negatively associated with ACSH rates. Provider capacity and inter-organizational relationships generally failed to demonstrate significant relationships with ACSH rates. Contrasting results between provider capacity and provider composition suggest that the effects of provider supply may depend upon how supply is measured.

Supplementary analysis examined these relationships on a condition-specific basis and suggested that the effects of inter-organizational relationships may be limited to specific clinical conditions. Specifically, the analysis found that the proportion of hospitals with a formal physician organization relationship was associated with higher hospitalization rates for pneumonia, angina, asthma, and congestive heart failure. In contrast, the proportion of hospitals in a market with a formal nursing home relationship was significantly associated with lower hospitalization rates for perforated appendix, angina, asthma, and hypertension. Likewise, the proportion of hospitals in a market that owned an insurance product was associated with lower hospitalization rates for congestive heart failure, chronic obstructive pulmonary disease, and uncontrolled diabetes. These results suggest that the relationship between market structure and ACSH rates may depend upon the medical condition and the type(s) of organizations under study. Overall, these findings raise questions about the appropriateness of combining clinical conditions into aggregated hospitalization rates and the conclusions of studies that use such approaches to study ACSH.

Chapter I

Introduction

Adequate access to health services remains a fundamental challenge for the U.S. health care system. Over 15 percent of Americans lack health insurance (Strunk and Reschovsky, 2004) and over 13 percent are estimated to not receive the care they need, when they need it (Strunk and Cunningham, 2004). Conceptual models of access have historically placed great emphasis on individual level or societal level factors (Anderson and Aday, 1978; Aday and Anderson, 1981). More recent theoretical and policy oriented work has called for the application of organizational frameworks to identify systemic factors that may affect access to care (Gold, 1998).

Ambulatory care sensitive hospitalizations (ACSH), defined as hospitalizations for health conditions that potentially could have been avoided with timely and effective outpatient care, are increasingly used as indicators of access in health services research (Billings, 1990; Weissman, Gatsonia, and Epstein, 1992; Institute of Medicine, 1993). For example, one commonly studied ACSH is complications related to diabetes, which in many cases can be avoided with continuous and coordinated ambulatory care. Although not all ACSH are avoidable, most are unnecessary and have significant cost implications for the U.S. health care system. It has been estimated that $29 billion was spent on 4.4 million ACSH in 2004, accounting for nearly 10 percent of total hospital expenditures

(AHRQ, 2005). Additionally, ACSH exposes patients to unnecessary risks during inpatient stays.

Studies of ACSH have grown in number considerably since beginning in 1990 and this research has documented a number of factors associated with ACSH. Despite these efforts, rates of ACSH remain higher than one might expect given what we know about these factors. For example, from 1997 to 2004, the number of potentially avoidable admissions increased by 3 percent and the total hospital costs for these admissions increased 31 percent (AHRQ, 2005). Furthermore, while ACSH have declined for some clinical conditions, they remain high and have increased for other conditions (Kruzikas et al. 2004). ACSH also exhibit considerable variation across gender (Paramore and Elixhauser 1999; Rizza et al. 2007), racial and ethnic groups (Blustein, Hanson, and Shea 1998), socioeconomic status (Billings, Anderson, and Newman 1996; Blustein, Hanson, and Shea 1998), and geographic regions (Magan et al. 2008; Parchman and Culler 1999), highlighting that much remains to be discovered about how to improve outcomes related to ACSH.

To date, most studies of ACSH have fallen into the same mold as other studies of access, primarily examining the role of individual characteristics (e.g., age, gender, race) or broad socio-economic characteristics of a market (e.g., income, education, population). One consequence of this focus is that the role of organizations has once again largely been neglected. While some access frameworks explicitly include organizations, most render them impotent to improve access, instead viewing organizations simply as points of access where patients enter the health care system.

This study argues that ACSH are about more than just simply access to care. After all, the health care literature is replete with empirical and anecdotal accounts of patients who have good access to care yet still experience suboptimal outcomes. Clearly what happens to patients once they enter the health delivery system also matters. The study uses concepts of control and coordination to complement access explanations of ACSH and shed some light on why ACSH rates may not have improved uniformly over time. It is also hoped that the use of care coordination as an integral part of the causal mechanism will help highlight the role of organizations in improving care related to ACSH.

Study Overview and Research Questions

The study is a longitudinal, market-level study that uses theoretical insights from the provider supply and inter-organizational relationship literature to examine how structural characteristics of markets such as provider capacity, provider composition, and inter-organizational relationships affect ACSH. The study examines multiple provider types in 58 California markets for the years 1998 through 2005. Several assumptions form the basis for choosing this approach. First, it is assumed that the growing complexity and fragmentation of the U.S. health care system requires coordination across multiple sectors of the health care field to meet the needs of health care consumers. Second, it is assumed that the historical, cultural, and contextual characteristics of a market will result in variation in how these different sectors relate to one another to coordinate care. Finally, it is assumed that these variations have important implications for how residents access health services. The following research questions guide the investigation:

1. Are more providers associated with better ACSH rates?
2. Is provider composition associated with ACSH rates?
3. Is provider supply associated with ACSH rates when multiple provider types are considered simultaneously?
4. How do inter-organizational relationships between provider types in a market affect ACSH rates?

Study Contribution

The growth in ACSH research over the past 15 years precedes a current emphasis in health care on eliminating or minimizing avoidable events that compromise quality improvement and cost containment efforts. The health care environment in the U.S., at least in certain sectors, is increasingly focused on getting more value for each health care dollar. For example, payers and policy makers are increasingly exploring reimbursement options that can achieve more efficient allocation of health care resources. The Center for Medicare and Medicaid Services' (CMS) decision to refuse hospital payments for 'never events' is one of the most recent efforts, and given the proportion of hospital revenue based on Medicare patients, it is one of the more significant efforts to prevent unnecessary care (Francis 2007; Rosenthal 2007). Arguably equally important is what this reimbursement change portends for future efforts to curb avoidable events. For example, CMS is currently considering expanding the list of 'never events' (Centers for Medicare and Medicaid Services 2008), medical and surgical procedures that would not have been necessary if safe and effective care had been provided initially, which may continue to put financial pressure on hospitals. Likewise, CMS is considering how similar reimbursement methodologies could be applied to other provider types, such as nursing homes and physicians (Abt Associates 2005). Although ACSH have not been specifically targeted yet, one might interpret these efforts by CMS as a sign of things to come.

Given this context, results of this study have potential implications for health care management, health policy, and health services research. From a management perspective, a better understanding of how market factors affect ACSH may help provider organizations develop strategy that responds to potential changes in their environment. For example, hospitals faced with declining reimbursement related to ACSH could consider offering new types of services or partnering with physician organizations for these services if the results indicate that these approaches lower the rate of ACSH. The market-level approach should help draw managers' attention to the complex web of relationships that surround and shape their organizations.

From a policy perspective, the focus on organizations will expand policy discussions of access beyond market and individual considerations. In doing so, it is hoped that the study will help policy makers recognize how organizations can affect access to care and the importance of expanding the research agenda in ways that explore these relationships. Another policy implication relates to the reimbursement options being considered by government payers. Medicare and Medicaid, especially when combined, remain the significant payers for most hospitals, if not most provider health care organizations in general. Results of the study may help policy makers better target their measures of access and refine reimbursement methodologies aimed at reducing potentially avoidable events such as ACSH. For example, results indicating that relationships between physicians and hospitals are associated with lower rates of ACSH might lead payers such as CMS to construct incentive programs that encourage collaborative approaches to improving access.

Finally, the results have several implications for health services researchers. First, the inclusion of a broad set of organizations recognizes that organizations are embedded in webs of competitive and cooperative relationships with other organizations. This approach also recognizes that these relationships likely have important implications for how organizations coordinate activities with each other, which is likely to have implications for access to care and ACSH. Finally, the study extends the literature by explicitly considering how organizations may improve or impede access. Like policy makers, researchers have tended to overlook the role of organizations, especially empirical research on access. Those studies that have examined the relationship between organizations and access have tended to do so in narrow ways, oftentimes looking at single organizational types. This study adds to the literature by explicitly examining the role of multiple organizational types.

Organization of Dissertation

The dissertation is organized into six chapters. This chapter introduced ACSH and described the purpose, research questions, and contributions of the study. Chapter II reviews the literature relevant to the study. Chapter II begins with an examination of the ACSH literature, focusing first on the origins and utility of ACSH as an indicator of access and then moves on to a discussion of the factors that are associated with ACSH. The second half of the chapter discusses some of the strengths and weaknesses of the extant literature as well as opportunities to expand research in this area.

Chapter III focuses on the conceptual framework used in the study. The chapter begins with a discussion of primary care markets to emphasize the importance of examining communities of organizations, and frames the analytic approach used in the study. The chapter also provides an overview of the access frameworks that are predominantly used in the literature, followed by a discussion of inter-organizational relationships to suggest an alternative explanation. The chapter concludes with a discussion of specific hypotheses that extend from these theories.

Chapter IV describes the research design, beginning with the study population and sample, followed by a description of the variables and their measurement. The chapter concludes with a description of the statistical models used to evaluate the study hypotheses.

Chapter V presents the results of the analysis. The chapter begins by presenting the univariate and bivariate analysis results, followed by a discussion of the diagnostic tests used to guide the multivariate techniques used in the study. The chapter concludes by presenting the results of the multivariate analysis and a discussion of whether these results support the proposed hypotheses.

Chapter VI concludes the dissertation with a discussion of the implications of the research for health services researchers, health care managers, and policy makers. The chapter concludes with a discussion of the study's limitations and offers suggestions for future research.

Chapter II

ACSH Research Limitations and Opportunities

Studies of ambulatory care sensitive hospitalizations (ACSH) have grown substantially in number since beginning in the early 1990s. This chapter reviews the literature related to ACSH. The chapter is organized into five sections. The first section provides a more thorough introduction to ACSH, including its development in the health services research literature and current use. The second section presents a critical review of the extant literature on the factors associated with ACSH. The third section describes the limitations of the ACSH literature, while the fourth section summarizes the literature and suggests some opportunities for future research. The final section provides an overview of how this study addresses the gaps identified in the review.

Development of ACSH

Research on ACSH grew out of early work by Rutstein and colleagues who sought to identify 'sentinel health events' that could be used to assess differences in quality of care across populations (Porell 2001; Rutstein et al. 1976). These sentinel events were believed to be preventable and could potentially serve as a signal that the quality of medical care was suboptimal (Rutstein et al. 1983). These researchers believed that the identification of sentinel events would allow researchers, policy makers, and managers to isolate the economic, political and social factors associated with these events.

Rutstein's work was reinvigorated in a slightly different form in the early 1990s. In 1990, John Billings published a paper that showed uninsured residents in Washington, D.C. reporting lower levels of outpatient access and higher rates of inpatient admissions for conditions that potentially could have been treated in an outpatient setting (Billings and Teicholz 1990). A second study by Billings and colleagues examined the effects of socioeconomic status on hospital use in New York City (Billings et al. 1993). This study found that lower income areas and areas with higher percentages of African-Americans were associated with higher rates of ambulatory sensitive admissions, concluding that "access to ambulatory care and the performance of the outpatient care delivery system may have a substantial effect on admission rates for a broad range of medical and surgical conditions" (Billings et al. 1993).

The publication of this study was important in several respects. First, it further established ambulatory care sensitive conditions as a viable stream of health services research and served as a catalyst for subsequent research in this area. Second, the study shifted the emphasis to access to care, where the stated objectives were "to determine whether small-area analysis might become a useful tool for assessing barriers to outpatient care and for evaluating the effectiveness of programs designed to improve access to care" (Billings et al. 1993). Third, the emphasis on access to outpatient care in a community opened the door to the use of small area variation techniques.

Two additional conclusions from Billing's initial studies are also notable. First, the authors called attention to the fact that a broad range of personal factors are likely to contribute to access. Second, they pointed out that the outpatient care delivery system, both the resources available and how they are organized, is likely to affect access to care and ambulatory care sensitive admissions. Both were suggested as areas of research deserving more attention. Since 1990, research on ACSH has flourished, with over 100 peer-reviewed, empirical articles using some variation of ACSH as an outcome (Table 1). This body of research has done an impressive job of identifying and expanding our knowledge of how personal factors are related to ACSH; however, the ACSH literature is somewhat lacking with respect to the second barrier - the health care delivery system. The following sections will elaborate on these gaps by describing the conceptual frameworks used to explain ACSH, the factors most often studied in the ACSH literature, and the methods used to study these factors.

Table 1: Number of reviewed articles by year

	Number of articles	% of Total
2009	1	1.0%
2008	13	12.9%
2007	12	11.9%
2006	10	9.9%
2005	7	6.9%
2004	8	7.9%
2003	12	11.9%
2002	4	4.0%
2001	8	7.9%
2000	2	2.0%
1999	6	5.9%
1998	5	5.0%
1997	4	4.0%
1996	4	4.0%
1995	1	1.0%
1994	2	2.0%
1993	1	1.0%
1992	0	0.0%
1991	0	0.0%
1990	1	1.0%
Total	**101**	**100.0%**

Conceptual Framing of ACSH

The use of ACSH as an indicator of access to outpatient care draws significantly from the small area variation (SAV) literature. One of the fundamental objectives of small area variation studies is to document and explain variations in hospital utilization across communities (Wennberg and Gittelsohn 1973; Wennberg 1984). Implicit in these approaches is a concern that variation may reflect inappropriate use of health services that unnecessarily deplete resources and expose patients to unnecessary risks associated with care (Goodman and Green 1996). Consequently, the identification of factors that contribute to variations in utilization is believed to be important for improving the quality and costs of care.

Three general explanations have been offered to explain small area variations. Early studies by Wennberg and colleagues attributed variations in utilization to physician practice style (Wennberg 1984; Wennberg, Freeman, and Culp 1987). Differences in physician practice style are believed to emerge due to differences in attitudes, values, and opinions about the practice of medicine (Hardwick et al. 1975; Rothert et al. 1984; Williams et al. 1982). These differences, combined with ambiguity surrounding the appropriate care for many clinical conditions, are associated with different norms of practice across communities, which manifest as variations in utilization (Fisher et al. 2004; Wennberg, Fisher, and Skinner 2002).

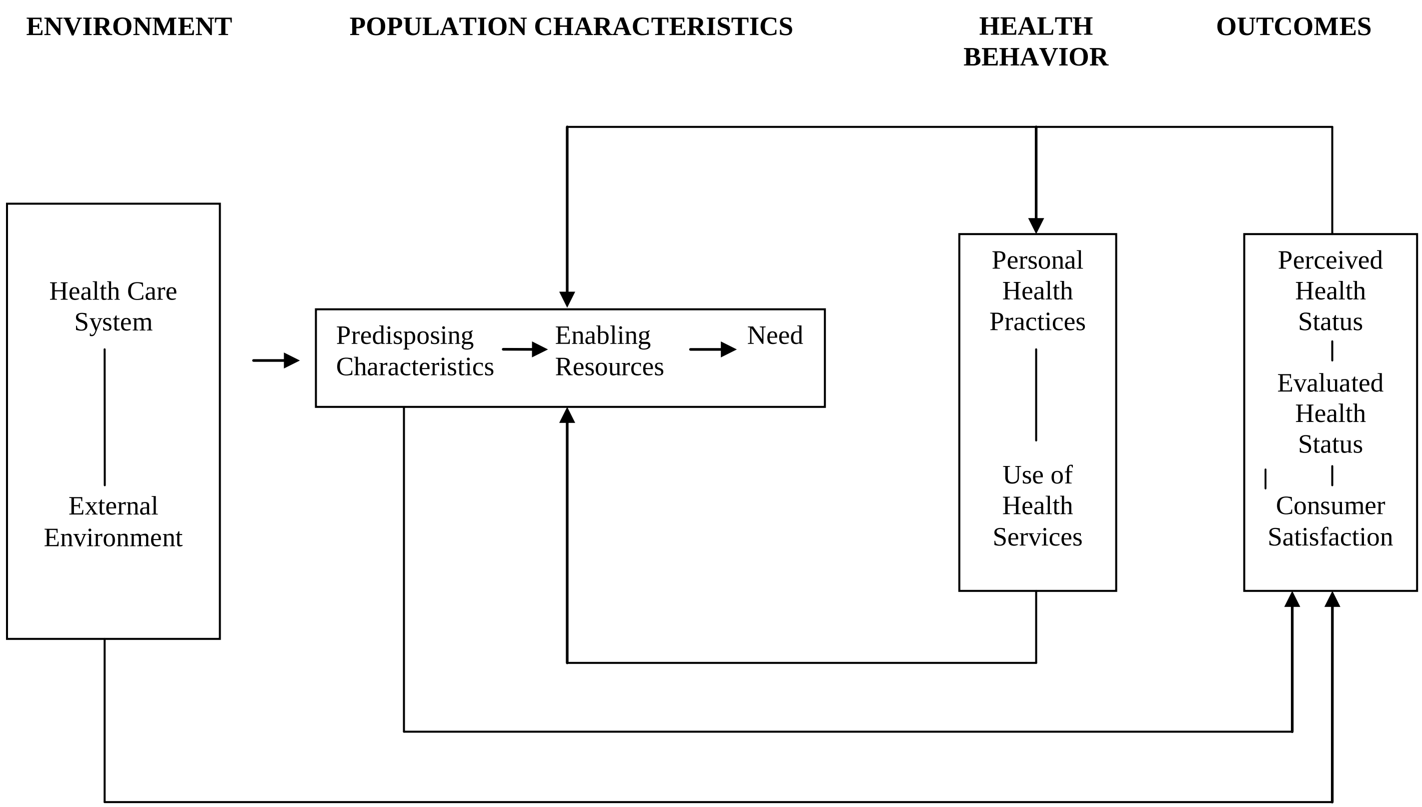
Other studies link variations in care to population characteristics such as socioeconomic status and education (Escarce 1993; Gottlieb, Beiser, and O'Connor 1995; McLaughlin et al. 1989). According to this perspective, population characteristics reflect varying degrees of need and ability to obtain health services, which in turn are associated with variations in utilization.

The third and most recent stream of research that attempts to explain small area variations relates to provider supply. In this literature, the relationship between provider supply and variations in care seems to depend upon the outcome being examined and how supply is measured. 'Generic' studies of hospital admissions often argue that provider supply increases variation due to the supply sensitive nature of many medical services such as diagnostic testing and physician visits (Fisher et al. 2004; Wennberg, Fisher, and Skinner 2002). However, most ACSH studies start with the assumption that greater provider supply improves outcomes and reduces variations because it increases the likelihood of getting care on an outpatient basis.

Factors Associated with ACSH

One of the most commonly used access frameworks is the Behavioral Model of Access, developed by Ronald Andersen in the late 1960s to explain why families use health services (Aday and Andersen 1974; Andersen and Aday 1978; Andersen 1995). The model has undergone several refinements over the years and remains one of the major frameworks used to understand health service utilization. In its most recent version, access is considered a function of four dimensions: (1) environment; (2) population characteristics; (3) health behavior; and (4) outcomes (Figure 1) (Andersen 1995). This section utilizes this framework to synthesize the factors used to study ACSH. The following discussion considers the first three dimensions in order of their prevalence in the literature.

Figure 1: Behavioral Model of Access



Source: Andersen, 1995

Population characteristics are the most frequently studied dimension of access in the ACSH literature. Population characteristics consist of predisposing, enabling, and need characteristics of the population at risk. Amongst these characteristics, enabling characteristics are the most frequently studied, with over two-thirds of all studies including some type of enabling characteristic (Table 2). Enabling characteristics refer to factors that describe a person's means or ability to seek care, such as income, insurance coverage, or geographic proximity of health care providers. Enabling characteristics are followed closely by predisposing characteristics, with two-thirds of all reviewed articles including predisposing characteristics. Predisposing characteristics refer to those attributes that affect a person's propensity to seek care, such as age, sex, race, or attitudes regarding health and illness. Need characteristics are the least frequently studied population characteristic, with approximately one-quarter of all reviewed studies including need characteristics. Need characteristics refer to a person's illness burden. Examples of need characteristics include illness severity and comorbid conditions.

In general, research has found population characteristics to be a consistent predictor of ACSH rates, although the direction of the relationships varies considerably across enabling, predisposing, and need characteristics. Enabling characteristics display the most consistent results, with characteristics that reflect greater ability to seek out health services generally associated with lower rates of ACSH. An interesting exception is insurance coverage, where studies have found newly covered Medicaid recipients to be positively associated with ACSH (Friedman et al. 1999; Saha et al. 2007). Predisposing and need characteristics display more inconsistent results, typically depending upon the characteristic being examined and how it is measured. For example, most research on race and ethnicity is relatively unambiguous, with a great majority of the studies showing minorities to have more barriers and a lower propensity to seek care, and consequently higher rates of ACSH (Correa-de-Araujo, McDermott, and Moy 2006; Friedman and Basu 2004; Laditka and Laditka 2006; Oster and Bindman 2003). In contrast, other predisposing characteristics such as age and gender exhibit conflicting relationships with ACSH rates, with studies finding these characteristics both positively and negatively associated with ACSH rates. Similarly, the relationship between need and ACSH is conflicting, often depending upon how need is assessed. Most studies find that the presence of a comorbid condition is positively associated with ACSH, while studies using specific case mix measures (e.g., Deyo-Charlson, DxCG) find a negative relationship between illness severity and ACSH.

The environment is the second most prevalent dimension in the ACSH literature. The environment dimension consists of two primary characteristics, the health care system and the external environment. The external environment refers to the economic, political, and social aspects of the health care environment; the health care system encompasses the structure and distribution of health care organizations and resources that make up the delivery system. Within the overall environment dimension, studies of health care system characteristics are most popular. Slightly more than one-third of all articles published since 1990 include some variable associated with the health care system, while only one-tenth of all studies include some external environment characteristic (Table 2).

Table 2: Number of reviewed articles by variable type

	Number of articles	% of Total
External environment	11	10.9%
Health care system	38	37.6%
Organizational characteristics	27	26.7%
Provider supply	27	26.7%
Population characteristics	81	80.2%
Predisposing	67	66.3%
Age	39	38.6%
Attitude/knowledge of health services	10	9.9%
Gender	34	33.7%
Race/ethnicity	50	49.5%
Enabling	69	68.3%
Education	10	9.9%
Employment status	4	4.0%
Geography	24	23.8%
Income	39	38.6%
Insurance coverage	42	41.6%
Marital status	6	5.9%
Need	23	22.8%
Illness severity/comorbidities	23	22.8%
Use of health services	33	32.7%
Total	**101**	

Most external environment studies focus on the policy environment, typically examining whether a change in policy (e.g., Medicaid expansion) resulted in a significant change in access, measured as ACSH. In general, these studies have found inconsistent results. For example, a recent study by Bindman and colleagues (2008) demonstrated that an extension of the Medicaid enrollment period in California was associated with an 11 percent reduction of ACSH in the two year period following implementation of the revised enrollment policy. The analysis also indicated that the decrease in ACSH was associated with approximately $17 million in hospital savings across two years. In contrast, Saha and colleagues (2007) found that the expansion of the Oregon Health Plan that extended Medicaid coverage to all adults with incomes under the federal poverty level was associated with an increase in ACSH. Additional analysis by Saha and colleagues indicated that the increase among Oregon residents was attributable to the newly insured (i.e., previously uninsured).

Similar to studies of external environment characteristics, studies of the relationship between health care system characteristics and ACSH are best described as inconsistent. This is not surprising given the broad range of characteristics included in the health care system category. However, this description applies even when study variables are broken down into more specific characteristics. Health care system variables within the ACSH literature can be grouped into two general categories: provider supply and organizational characteristics. Provider supply studies focus on the number of medical resources in a market, such as physicians per capita or hospital beds per 1,000 market residents. Studies that include organizational characteristics typically focus on attributes of the provider organizations in a market. Examples of organizational characteristics include hospital or nursing home ownership type, system or chain affiliation, and service mix of provider organizations.

Provider supply studies predominantly assume that a greater number of providers will improve ACSH rates; however, results are conflicting. Conflicting results appear to be due, in part, to different provider types that offer care in a community. In other words, the effect of provider supply often depends upon the type of provider being examined. For example, Basu and colleagues (2002) found that each additional primary care physician per 1,000 market residents was associated with 80 percent lower probability of an ACSH, while each additional specialty care physician per 1,000 market residents was associated with a 40 percent greater probability of an ACSH. Likewise, studies have found hospital supply, measured as hospital beds per capita, is both positively and nonsignificantly associated with ACSH rates, while community health center supply is consistently associated with lower rates of ACSH (Epstein 2001; Garg et al. 2003; Zhang et al. 2006).

More recent research also suggests that overall supply may not be as important as the mixture of providers. Mobley and colleagues (2006) found that markets with higher proportions of non-physician clinicians and higher proportions of international medical graduates were associated with lower rates of ACSH. The authors suggest that these provider types have traditionally been more likely to locate in underserved areas and help satisfy unmet health demands. Likewise, Laditka (2004) examined whether the racial diversity of physicians and threshold levels of physician supply were associated with ACSH among elderly living in 33 metropolitan areas. Laditka found that physician diversity was associated with lower risks of ACSH and the overall supply of primary care physicians exhibited a nonlinear relationship with ACSH, where individuals in markets with low and high primary care physician supply had high ACSH risks, while residents of markets with intermediate levels of primary care physician supply were associated with lower risks.

Studies that include organizational factors reflect even more heterogeneity than provider supply studies, at least in terms of the types of characteristics that are examined. As a consequence, there has been very little accumulation of research around specific organizational characteristics. For example, only four studies focused on ownership type, with two of these studies focused on hospitals and the other two focused on nursing homes. One hospital and one nursing home study found a significant, positive relationship between for-profit ownership and ACSH, while the remaining two studies did not find any significant relationships.

The least prevalent dimension in the ACSH literature is health behavior. Health behavior includes two characteristics: personal health practices and use of health services. Personal health practices refer to a person's lifestyle that may impact health outcomes, such as nutrition, smoking status, or alcohol use. No studies were identified that included personal health practices. Use of health services refers to the actual utilization of health care services. Examples of health service use include physician visits and preventive health services. Nearly one-third of the ACSH studies included measures of health service use. The majority of these focused on outpatient service utilization, typically measuring the number of physician visits by individuals. Contrary to most assumptions about outpatient care, most studies failed to find a significant association between outpatient utilization and ACSH. In contrast, studies of inpatient utilization displayed mixed results, with an equal number of studies exhibiting positive and negative results.

Research Methods Used to Study ACSH

Research design

ACSH studies are nearly exclusively quantitative in design, likely due to the dependence upon hospital discharge data to identify ACSH. Researchers have also relied heavily on cross-sectional designs to evaluate the effects of different factors on ACSH. Since 1990, nearly three-quarters of all studies have performed cross-sectional analyses (Table 3). Furthermore, trends indicate that the number of studies using cross-sectional designs is increasing. Both cross-sectional and longitudinal studies rely heavily on the use of population characteristics, with both types of studies using these variables in approximately 80 percent of their respective studies. Cross-sectional studies were more likely to incorporate health care system characteristics (44.4%) than longitudinal studies (20.7%). The opposite relationship exists for external environment characteristics, with only 8.3 percent of all cross-sectional studies including these characteristics compared to 17.2 percent of all longitudinal studies. Cross-sectional studies (70.8%) were slightly more likely than longitudinal studies (62.1%) to utilize outcomes aggregated across multiple clinical conditions.

Table 3: Number of reviewed articles by design and level of analysis

	Prior to 1993	% of Total	1993-1996	% of Total	1997-2000	% of Total	2001-2004	% of Total	2005-2008	% of Total
Cross-sectional	1	100.0%	8	100.0%	13	76.5%	23	71.9%	27	64.3%
Longitudinal	0	0.0%	0	0.0%	4	23.5%	9	28.1%	15	35.7%
Market-level	0	0.0%	6	75.0%	7	41.2%	15	46.9%	11	26.2%
Organization-level	0	0.0%	0	0.0%	3	17.6%	2	6.3%	3	7.1%
Patient-level	1	100.0%	2	25.0%	8	47.1%	16	50.0%	31	73.8%
Total articles	**1**		**8**		**17**		**32**		**42**	

Measurement of ACSH

Several studies have validated the use of ACSH as a measure of access by comparing ACSH rates to self-rated assessments of access (Ansari, Laditka, and Laditka 2006; Bindman et al. 1995). Likewise, a number of studies have used Delphi panels of clinical experts to identify potentially avoidable hospitalizations and these panels have identified consistent conditions (Ansari, Laditka, and Laditka 2006; Billings et al. 1993). The Agency for Healthcare Research and Quality also makes analytic tools readily available to researchers and practitioners, which creates consistency around the measurement of ACSH. Based on this work, studies generally display a high level of consistency with respect to the data sources and methods of used to derive ACSH outcomes.

The operationalization of ACSH also displays considerable consistency across the literature. ACSH is typically operationalized as an event (e.g., admission) at the individual-level of analysis or a rate (e.g., number of admissions per capita) at the market-level. There is more variation with respect to the level of analysis. Over one-half of all reviewed articles measured ACSH at the individual-level, followed by market-level analyses (39 studies) and organizational-level analyses (8 studies) (Table 4). Among the market-level studies, researchers tend to define the market differently. The county was the most common definition with nearly one-quarter of all studies using this designation to demarcate a market, followed by the zip code, the health service area, and the state. Nearly 70 percent of all studies operationalized and modeled ACSH as an aggregated outcome across multiple clinical conditions.

Table 4: Number of reviewed articles by outcome variable characteristics

	Number of articles	% of Total
Type of measurement		
Event	47	46.5%
Number	10	9.9%
Rate	43	42.6%
Level of analysis		
Market	39	38.6%
Organization	8	7.9%
Individual	58	57.4%
Clinical separation		
Acute	3	3.0%
Chronic	22	21.8%
Acute/chronic combined	75	74.3%
Outcome aggregation		
Aggregate clinical conditions	69	68.3%
Separate clinical conditions	27	26.7%
Both separate and aggregate clinical conditions	8	7.9%
Total	**101**	

Assessing the effects of provider supply

Research on provider supply has typically focused on physicians, hospitals, or community health centers. Approaches to measuring physician supply typically use some sort of physician count divided by the number of market residents (e.g., physicians per 1,000 market residents). Initial efforts used aggregated measures of physician supply that included all types of physicians. Research indicating that aggregated measures conceal differences between primary care physicians and specialist physicians has resulted in more recent research separating these types of physicians when examining the relationship between physician supply and ACSH.

Studies of hospital supply have taken an approach similar to physician supply studies by measuring supply as the number of hospital beds per capita. Studies of community health center supply have taken a simpler approach, typically measuring whether a community health center is present in a market. Only two studies were identified that looked at nursing homes; both of which looked at attributes of the nursing home as opposed to the number of nursing homes or supply of nursing home beds in a market. Studies of health maintenance organizations are present in the ACSH literature; however, these studies have focused on enrollment in different types of health insurance products (e.g., HMO vs. traditional indemnity) or HMO penetration rate in a market rather than the number or supply of HMOs per se.

Limitations of ACSH Research

Conceptual framing of ACSH

Thus far, no explanation has emerged as the definitive explanation of small area variations. Moreover, research in all three areas suggests that each explanation has merit, leading some analysts to call for evaluations that consider all three perspectives (Davis et al. 2000; Stano 1991). Evaluation of the independent and joint effects of physician practice patterns, socioeconomic status, and provider supply is important for several reasons. First, some research suggests that variations may be a mixture of these explanations that are contingent upon different factors. For example, Gittelsohn and Powe (1995) found that the rate of nondiscretionary surgery was affected more by morbidity, while the rate of discretionary surgery was affected more by provider supply. Other research has found that the effect of market and population characteristics on variations in care may depend upon the medical condition, with socioeconomic characteristics playing a stronger role than physician practice style for chronic medical conditions (Komaromy et al. 1996).

Studies using multiple perspectives are also important because the managerial and policy recommendations that flow from this type of research are likely to differ depending upon the explanation that is offered. For example, studies indicating that physician practice style is the most significant predictor of variation may result in efforts to reduce variation via utilization review or physician education. In contrast, studies indicating that provider supply is a better predictor of variation might result in policy to modify or regulate the number of providers in market or reallocate providers. Examples of such policies are certificate of need regulations and programs to increase the number of primary care providers in health professional shortage areas.

Although some work has been done to broaden the analysis in the general small area variation literature, thus far most ACSH research has not incorporated multiple perspectives. Some notable exceptions provide examples of what these studies would look like. Bindman and colleagues' (1995) examination of the relationship between perceptions of access and ACSH in California communities provides a good example from the ACSH literature that includes all three perspectives. In this mixed method study, the researchers attempted to separate the effects of physician practice style and perceptions of access while controlling for population characteristics. The results showed that both perceptions of access and physician practice style have independent effects on the rate of ACSH. Other studies in the ACSH literature that utilize multiple explanations typically focus on provider supply and population characteristics. For example, Laditka (2004) examined the effects of physician supply and physician diversity on ACSH while controlling for the predisposing, enabling, and need characteristics of market residents. Similarly, Gill and Mainous (1998) studied the association between provider continuity and ACSH while controlling for a number of population characteristics such as age, race, and gender.

While most ACSH research to date has taken a narrow perspective in its empirical investigation, a somewhat paradoxical limitation exists with respect to the conceptual work on ACSH. ACSH research is often overly broad in its framing as an issue of access. Access research encompasses a broad range of theoretical, empirical, and disciplinary traditions (Berk and Schur 1998; Gold 1998). One interpretation of the ACSH research is that its generic appeal to a broad and diffuse literature has left the field relatively void of formal theoretical explanations of how specific factors actually affect ACSH. In other words, studies often settle for identifying factors that are associated with ACSH with far less attention to exploring the underlying mechanisms by which characteristics such as provider supply affect hospitalization rates (Stano 1991; Westert and Groenewegen 1999). If research is to fulfill its promise to inform policy and managerial decision making, then there is a need to provide more focused, theoretically based explanations of the relationship between these factors and ACSH. Among the studies that actually utilize a formal theoretical perspective, the Behavioral Model of Access is the most common framework adopted. However, even this framework is broad and focuses on *what* factors are associated with access more so than *how* these factors affect access.

Factors used to study ACSH

There are a number of limitations related to the content of ACSH studies. First, these studies have predominantly focused on population characteristics. Researchers continue to explore more and more nuanced aspects of insurance coverage (e.g. uninsured vs. insured, Medicaid vs. private, continuous vs. interrupted) and whether these differences are associated with higher or lower ACSH rates. This narrow focus is problematic for several reasons. First, many of the population characteristics are immutable and the policy or managerial interventions available to address these relationships are unclear at best. For example, it is unclear what types of policy options exist to address results suggesting that males have higher rates of ACSH.

Also problematic is the fact that more nuanced examinations of population characteristics may come at the expense of exploring how other factors affect ACSH. Largely missing in the literature is the role of the delivery system. The delivery system is important because it represents an intermediate and interfacing role between the broader policy environment and the actual consumption of health services by consumers. Given this interfacing role, the structure of the delivery system is likely to have important implications for the fit between what services are offered and what services are needed by consumers.

More recent work has begun to include structural characteristics, particularly how provider supply improves or impedes access (DeLia 2003; Epstein 2001; Krakauer et al. 1996; Kronman et al. 2008). The basic theoretical argument offered in these studies is that higher levels of provider supply open up more points of access, giving consumers more opportunity to seek out care from these providers and reduce the likelihood of a medical condition escalating to the point of needing inpatient care (Laditka and Laditka 2001; Laditka and Laditka 1999). However, conflicting relationships between ACSH and physician supply suggest that the story is more complicated. Likewise, some studies of hospital supply suggest that provider supply may actually increase ACSH under some circumstances (Chang, Mirvis, and Waters 2008; Laditka, Laditka, and Probst 2005).

Another limitation of the ACSH research to date is that it has explored a very narrow set of health care system characteristics. Specifically, studies that include health care system characteristics typically examine physician supply. Such a narrow focus ignores many other types of health care providers that offer primary care in a market and ignores much of the care coordination that occurs between these providers. For instance, only four studies were identified that included nursing homes and no studies examined whether home health agencies were associated with ACSH.

Another consequence of this narrow focus is an absence of research that considers how *organizations* affect access and ACSH. Most ACSH studies include organizational characteristics as control variables, which significantly limits attempts to explore the role of health care organizations in explaining variations in ACSH. In other words, most studies are concerned with controlling for the effects of organizations with far less attention devoted to explaining how organizations might actively contribute to problems of or improvements in access. Furthermore, when controlling for organizations, researchers have typically focused on characteristics that suffer from some of the same limitations of studies focused on population characteristics. Specifically, they often focus on relatively stable characteristics such as ownership, teaching status, or geographic location. While these characteristics are not as immutable as some of the population characteristics such as race or gender, they still display a fair amount of stability over time, raising questions of how amenable these relationships may be to policy or managerial interventions. More tractable organizational options, such as service offering and strategic partnerships, are significantly underrepresented in this literature.

Research design

There are two notable and related limitations to the use of cross-sectional designs to study ACSH: causality and temporal trends. First, a number of reports have documented changing rates of ACSH over time (Kozak, Hall, and Owings 2001; Kruzikas et al. 2004). The use of cross-sectional designs may only provide a snapshot of the relationship in time and lead to spurious results. Second, cross-sectional designs have limitations with respect to causality. It is worth noting that concerns about reverse causality may not be equally distributed across the ACSH literature and will likely vary by the relationship under study. Studies of the relationship between individual, immutable characteristics such as race and gender are not likely to suffer from these issues of causality. For example, a person's race or gender cannot be changed based on the ACSH rate in a market. However, studies of more mutable characteristics, such as insurance coverage or provider supply need to attend to these issues. For example, an increasing number of ACSH might lead hospitals to increase the number of beds available in a market. As more and more studies expand beyond the immutable characteristics of individuals and markets, there is a need to utilize more rigorous, longitudinal designs to control for these issues.

ACSH Measurement

Although the literature displays remarkable consistency in its approach to measuring ACSH, there are several methodological issues that deserve attention. First, most studies tend to construct a combined rate or odds of hospitalization across multiple clinical conditions and model ACSH as an aggregated outcome. Aggregation can be problematic in several ways. If aggregation mutes underlying variation across different clinical conditions, then results may be more likely to be nonsignificant. Similarly, aggregating outcomes may conceal relationships that exist between predictors and separate clinical conditions. For example, a study by Howard and colleagues (2007) compared the rates of hospitalization between African-American and white Medicare beneficiaries in North Carolina for 8 different ambulatory care sensitive conditions across 4 years. The study found that African-American beneficiaries had higher rates for diabetes, adult asthma, urinary tract infection, dehydration, and congestive heart failure; white beneficiaries had statistically significant higher rates for chronic obstructive pulmonary disease, bacterial pneumonia, and angina. Future studies should consider if and how aggregated outcomes might obscure underlying variation.

Provider Supply Measurement

Most ACSH research has typically focused on a single provider type, such as physicians or community health centers, which means that most studies of ACSH ignore the effects of other provider types that offer primary care in a market. The complex, fragmented nature of the health care system means that comprehensive primary care likely requires services from multiple provider types. For example, an elderly adult with diabetes living independently may depend upon a primary care physician for routine services, a home health agency for support services, and an outpatient hospital for case management and laboratory services. Research is needed that reflects multiple provider types that provide care in a market.

Summary of Literature and Suggestions for Future Research

A review of the ACSH literature reveals a body of research that has experienced considerable growth over the past 20 years. This research displays remarkable consistency in its conceptualization as a phenomenon of access. However, this conceptualization appears to have had some consequences with respect to the theoretical and empirical relationships that have been examined. From a content standpoint, most research has focused on population characteristics and we know the most about how these characteristics improve and impede access to care and affect ACSH. Far less is known about how other aspects of care, such as the health delivery system, affect ACSH. Although researchers have begun to turn their attention to some aspects of the health delivery system, thus far the focus has been relatively narrow. Similarly, from a theoretical standpoint, most research heavily depends upon access frameworks that consistently appeal to greater levels of provider supply as the solution to ACSH. To date there has been little exploration of other theoretical frameworks that might explain how the structure of the health delivery system may affect access and ACSH.

In sum, this review has identified a number of limitations and gaps that future research should address. The following list summarizes these gaps as well as a number of questions that extend from these limitations.

1. Research often utilizes access frameworks that invoke overly broad causal factors and have considerably less to say about the underlying causal mechanism(s) by which these factors affect ACSH. Furthermore, research is often overly dependent upon access frameworks that emphasize greater levels of provider supply as the solution to ACSH.

    - Are there other mechanisms by which market structure may affect ACSH?

2. Predominant focus on population characteristics has led to more and more nuanced explorations of population characteristics and relatively little understanding of the effects of the health care delivery system. Among the studies that do include health care system characteristics, there is a narrow focus on physician supply. Furthermore, these studies often focus on provider supply in isolation without consideration of other provider types.
   - Does the relationship between provider supply and ACSH differ when the effects of other provider types are controlled for?
   - Are there other aspects of market structure, other than provider supply, that may be important for improving ACSH outcomes?

3. Use of aggregated ACSH outcomes may conceal significant effects of health care system characteristics.
   - Does the relationship between market structure and ACSH vary by the method of measuring ACSH?
4. Extensive use of cross-sectional designs do not account for changing ACSH rates over time.
   - Does the relationship between market structure and ACSH persist after controlling for changes in ACSH over time?

Limitations Addressed in the Study

This study addresses these gaps with a market-level analysis of the effects of primary care market structure on ACSH rates. In doing so, the study addresses two primary conceptual limitations of the extant literature on ACSH. First, it incorporates multiple perspectives that analysts have identified as important for advancing research on small area variations but are often missing in the literature. It does this by controlling for population characteristics and use of health services while examining the effects of provider supply and inter-organizational relationships on ACSH rates. The second conceptual limitation addressed in the study is the appeal to overly broad access frameworks that often lack detail regarding the underlying mechanism by which market structure may affect access and ACSH. The study addresses this limitation by specifying a 'control-and-coordination' mechanism by which provider supply and inter-organizational relationships may affect access and ACSH. This mechanism also provides an alternative to the 'more points of access' explanation typically used in the literature.

There are two primary content limitations addressed in this study. First, the focus on two health care system characteristics, provider supply and inter-organizational relationships, expands the focus beyond population characteristics that have dominated the literature to date. The focus on multiple provider types also extends the literature beyond relatively narrow examinations of physician supply. Second, the study's focus on the effects of organizations on ACSH extends previous research that simply attempted to control for the effects of organizations. Furthermore, the focus on inter-organizational relationships arguably represents a more mutable aspect of the local delivery system, one that may be more amenable to influence by local stakeholders.

Three methodological limitations that exist in the ACSH literature are addressed in this study. First, the study uses a pooled, cross-sectional time series design. Although this design does not permit as strong of a statement regarding causality as more traditional longitudinal designs (e.g., panel design), it does allow for the control of temporal trends that may confound pure cross-sectional designs. Second, the inclusion of multiple provider types in the regression models controls for the effects of other provider types that may provide competitive or complementary services in a market. Likewise, the modeling strategy used in the study allows one to isolate the effects of health care system characteristics from the effects of population characteristics and health service utilization. Finally, the study includes a supplemental analysis that examines whether aggregated ACSH rates conceal variation that exists at the level of specific clinical conditions.

The following chapter describes the theoretical perspective used in the study and develops hypotheses related to the gaps identified above. The methods chapter describes the longitudinal research design used in the study.

Chapter III

Theoretical Framework and Hypotheses

Ambulatory care sensitive hospitalizations (ACSH) have been recommended as indicators of the adequacy of the primary care system (Institute of Medicine 1996). Access frameworks have been the predominant theoretical approach used to study ACSH. This research has generally emphasized barriers to entry, often focusing on either how health care is financed for individuals (e.g., uninsured, health maintenance organization, Medicare) or demographic (e.g., race, gender) and socioeconomic (e.g., income, education) characteristics of individuals. In contrast, relatively little empirical research has examined the structural features of the health care system and how health care providers are organized. This study addresses this gap by examining two features of market structure, provider supply and inter-organizational relationships. The study utilizes a structure-conduct-performance framework and uses insights from the provider supply and inter-organizational relationships literature to supplement this framework and explain how market structure may influence care coordination and ACSH in a market.

This chapter develops formal hypotheses regarding ACSH. The chapter begins with a discussion of the structure-conduct-performance framework. The second section examines how the market is defined and the types of organizations considered in the study. The third section discusses the connection between market structure, coordination, and ACSH, followed by the development of formal hypotheses. The chapter concludes with a discussion of additional factors potentially associated with ACSH.

Structure-Conduct-Performance Framework

The structure-conduct-performance framework was developed in the industrial organizations literature in the 1930s by Edward Mason (Grimm, Lee, and Smith 2005). The fundamental premise of the structure-conduct-performance (S-C-P) framework is that the structure of an organization's external environment determines organizational behavior, which in turn dictates performance (Grimm, Lee, and Smith 2005; Hoskisson et al. 1999; Porter 1981). In its early formulation, structure referred simply to the number of buyers and sellers in an industry, conduct referred to the strategic and tactical decisions made by firms, and performance typically referred to profit. This framework was extended in the 1950s and 1960s by Joe Bain, who broadened the structure category to include things such as product differentiation, cost structure, and vertical integration in an industry (Grimm, Lee, and Smith 2005). This framework was extended further in the 1980s by Michael Porter. Porter's Five Forces framework (1980) was developed to describe the competitive structure of an industry and help firms determine a competitive strategic position vis-à-vis other firms in the industry.

Researchers using the S-C-P framework assume that strong linkages between structure-conduct and conduct-performance result in predictable relationships between an organization's environment and its performance. Therefore, empirical studies using this framework have typically examined the relationship between structure and performance (Conner 1991; Hoskisson et al. 1999). This study uses a modified S-C-P approach by evaluating the relationship between local market structure and ACSH. It differs from other S-C-P research in that it uses coordination of care to describe some of the intermediate mechanisms that might reflect how structure affects performance. The study is also differs from other S-C-P research because of its examination of market structure in multiple industries within the same study (e.g., acute care hospitals, long-term care organizations, physician organizations).

Defining a Primary Care Market

This study defines a primary care market as the set of primary care organizations in a county responsible for providing or coordinating primary care. The definition of a primary care market used in the study is more inclusive than previous definitions. Specifically, it includes multiple types of provider organizations that provide or coordinate primary care. The decision to use a more inclusive definition was based on a number of considerations. First, the definition used in the study aligns with emerging primary care frameworks that emphasize the role of health care *organizations*, either as direct providers of primary care services or as employers of health care practitioners who provide primary care services (Hogg et al. 2007; Starfield 1998, 2001). These newer frameworks can be contrasted with older frameworks that characterized primary care principally as a function of *individuals* such as physicians and non-physician clinicians who provide health care (Institute of Medicine 1996). Organizations play an important intermediary role between the socioeconomic and political environment and consumers. Organizational decisions about what services to offer and how they are offered are just a couple of the decisions that make up the structure of a primary care market and are likely to affect how people interact with the local primary care system.

Second, a more inclusive definition of a primary care market is consistent with the evolution of the health care delivery system that increasingly relies on communities of organizations (Conrad et al. 1988; Luke, Ozcan, and Olden 1995; Mick 1990). More complex and turbulent health care environments have given rise to coalitions and strategic partnerships to meet the complex health care needs of an older population facing more chronic diseases. An emphasis on communities of organizations highlights several important considerations that affect access to and outcomes of care. First, transitions in care and coordination occur between multiple provider types in a community (Hogg et al. 2007; Starfield 2001, 2008). To ignore these considerations misses an important aspect of the health care system where breakdowns in quality often occur (Coleman 2003; Coleman and Berenson 2004). Second, provider' decisions are not made in a vacuum and are based on opportunities afforded by the market and the actions of other organizations in a market. A focus on communities of organizations more accurately reflects the systemic nature of health care.

Importance of Primary Care Organizations for Improving Access & ACSH

Most research has conceptualized ACSH as reflective of access to primary care in a market (Billings and Teicholz 1990; Billings et al. 1993). Primary care refers to the level of the health system where a person can access frontline, continuous, comprehensive, and coordinated care (Starfield 1993, 1998). For purposes of this study, the set of organizations that make up a primary care market includes community health centers (CHC), group/staff model health maintenance organizations (HMO), medical groups/physician organizations (PO), nursing homes (NH), and home health agencies (HHA). These organizations were selected due to their role in providing or coordinating primary care services in a community. Although no other studies have examined these organizations collectively, with the exception of home health agencies, all organizations have been examined in previous ACSH research.

Hospitals

Hospitals have been and continue to represent one of the largest components of the health care delivery system. In 2005, over $611 billion were spent on hospital services, representing 31 percent of the total health care expenditures in the U.S. (National Center for Health Statistics 2007). Furthermore, the shift in services offered by hospitals, from inpatient to outpatient services, means that hospitals are increasingly playing an important role in improving access to care at the community level.

The hospital population is limited to all general, acute care hospitals in the state of California. Military and specialty hospitals are excluded from the analysis. General, acute care hospitals have been selected because they provide the majority of acute care services to the general population. Moreover, general, acute care hospitals also provide similar services (acute inpatient; general outpatient) and face similar regulatory and competitive pressures, making comparisons across hospitals more valid.

Community health centers (CHCs)

For purposes of this study, community health centers include federally qualified health centers (FQHC), look-alike federally qualified health centers, and free clinics. Community health centers play a critical role in a community by being the predominant provider of primary care for medically underserved populations. In 2007, approximately 6,600 CHCs across the United States accommodated over 63 million visits by 16 million patients (NACHC, 2008). California alone has nearly 800 CHCs, which provided services to over 2.3 million California residents in 2007. With nearly one in three patients being below the federal poverty level, one in four patients being low income minorities, and one in nine patients being rural residents, CHCs play a pivotal role in how community residents access the health care delivery system.

Physician organizations

A physician organization is defined as a formal organization used for the purposes of achieving clinical or administrative integration on behalf of physicians (Kongstvedt, 1997; Robinson and Casalino, 1996). In this study, physician organizations include both medical groups and independent physician associations. While physician organizations often do not directly provide patient care to patients, physician organizations help their physician constituents formally connect with other health care organizations. For example, physician organizations may negotiate and manage contracts with health plans on behalf of physician members. Likewise, physician organizations are increasingly used as a conduit to help physicians connect electronically with hospitals and other physicians in a community (Casalino et al. 2003; Gans et al. 2005). Increased emphasis on health information technology, along with the large capital costs of this technology, has given physician organizations a new facilitative role among physicians. Their ability to coordinate collective action on the part of individual physician practices makes physician organizations an integral part of the local health care community. This is particularly true in California where physician organizations tend to be better organized and more effective at representing the interests of physicians (Enthoven and Singer, 1996).

Staff/group model Health Maintenance Organizations (HMOs)

In 2006, nearly 50% of all California residents were enrolled in a health maintenance organization (HMO), the most of any state in the United States (National Center for Health Statistics 2007). This study focuses on two types of HMOs, staff and group model HMOs. A staff model HMO is an organization that delivers health services through a physician group that is employed by the HMO, while a group model HMO is an organization that contracts with one independent physician group to provide health services (InterStudy, 2000). Staff and group model HMOs were chosen for several reasons. First, group model HMOs, such as Kaiser Foundation Health Plan, are more prevalent in California than other states. This, combined with the fact that staff and group model HMOs directly provide medical care to a large number of California residents, makes them an important organizational type to consider when evaluating access to ambulatory care in a community. Finally, staff and group model HMOs differ from IPA and network HMOs in that they exclusively contract with a physician group for the provision of health services. Exclusive contracting by staff and group model HMOs allows one to isolate the physicians practicing in these settings from community health centers and physician organizations, which may hold contracts with multiple IPA and network HMOs. In other words, physicians practicing in staff and group model HMOs would not be accounted for by community health centers, independent physician associations, and medical groups.

Home health agencies (HHAs)

A push for more outpatient-based services, combined with an aging and more chronically ill population, has increased the demand for home-based services. In 2006, there were nearly 9,000 Medicare-certified home care agencies in the U.S. that made nearly 104 million visits to 3.3 million clients (National Center for Health Statistics 2007). These visits accounted for over $14 billion in health care expenditures.

Importantly, over 50% of these visits were to patients with diagnoses related to preventable conditions (Centers for Medicare and Medicaid Services 2007).

Home health agencies coordinate a wide range of health and social services in a home environment. These services range from registered nursing services for post-acute care to nursing aide services to assist with daily activities that can no longer be conducted independently. Given the wide range of services offered by these organizations, the home health agency category is defined to include only Medicare-certified home health agencies to make comparisons across agencies more valid.

Nursing homes

Over 1.4 million people were residents of nursing homes in 2004 (National Center for Health Statistics 2006). It is estimated that the U.S. health care system spent nearly $122 billion on nursing home care in 2005, approximately 6.1% of all health care expenditures (National Center for Health Statistics 2007). Grabowski and colleagues (2007) found that New York nursing home residents had over 23,000 hospitalizations related to ambulatory care sensitive conditions, accounting for over $223 million dollars in total costs in 2004. Given the increasing number of elderly and the elevated health needs of an older population, these facilities hold considerable potential to improve access by coordinating primary care and providing support services that help residents obtain medical services. For example, nursing homes may contract with pharmacists to make rounds at the nursing home and provide consultations that are not directly provided by the nursing home staff. Likewise, nursing homes may coordinate special medical services with specialist physicians or ancillary providers such as physical therapy. A nursing home's ability to provide or coordinate these services on behalf of its residents may have important effects on ACSH rates by affecting the quality and timeliness of non-hospital based care received by nursing home residents. Similar to home health agencies, the nursing home category is defined to include only Medicare-certified skilled nursing facilities.

Market Structure, Coordination, and ACSH

Market structure is defined as the supply of and relationships between organizations in a defined geographic area. Although broader than many definitions of market structure used in the health services literature, it is consistent with other work that considers structure to be made up of multiple dimensions (Luke and Walston 2003; Scott et al. 2000). The premise of the study is that provider supply and inter-organizational relationships shape the care coordination activities that occur in a market, which in turn affects ACSH. Coordination of care is defined as the set of activities that link health care providers, health services, and relevant clinical information to meet some stated health goal or patient need (Institute of Medicine 2001; Starfield 1993). Examples of coordination activities include nurse case managers that distribute information to physicians and information technology that provides diagnostic results to practitioners. Research has found care coordination to be associated with greater efficiency and improved clinical outcomes (Aiken, Sochalski, and Lake 1997; Gittell, Fairfield, and Bierbaum 2000; Knaus, Draper, and Wagner 1986; Shortell, Jones et al. 2000; Shortell et al. 1994).

It should be noted here that coordination serves as a latent, intermediate mechanism between market structure and ACSH; thus, the study does not directly measure care coordination. Instead, the study takes the position that market structure both reflects and shapes coordination in important ways that affect access and can be used as a proxy for coordination (Macinko, Starfield, and Shi 2003; Starfield, Shi, and Macinko 2005). There are several mechanisms by which market structure might affect care coordination. The following sections describe these mechanisms and develop formal hypotheses surrounding the effects of provider supply and inter-organizational relationships.

Provider supply

Provider supply is a robust area of health services research and policy development. Provider supply plays an important role in the overall health care system in part because it reflects access to care (Cunningham and Hadley 2004; Grumbach and Bodenheimer 2002; Macinko, Starfield, and Shi 2007). However, ongoing debates surrounding the existence of provider shortages (e.g., physicians, community health centers) and oversupply (e.g., certificate of need requirements for hospitals and nursing homes) call attention to the uncertainty that exists with respect to the 'right' level of provider supply (Blumenthal 2004; Cunningham and Hadley 2004; Forrest 2006). These debates and the uncertainty that they highlight also raise questions of the actual impact of provider supply on outcomes of care. Thus, the first dimension of market structure examined is provider supply. Two aspects of provider supply are examined in the study: (1) provider capacity, or supply relative to the population base; and (2) provider composition, or supply relative to other health care providers in the market.

<u>Provider capacity</u>

Consistent with most provider supply research, the effects of provider supply on ACSH have predominantly been explained in terms of access points in a market where consumers gain entry into the delivery system. These explanations propose that ‘more points of access’ in the form of greater provider supply will reduce barriers to care and allow patients to receive more timely care on an outpatient basis. Such arguments are based on supply and demand relationships that are concerned solely with the capacity of a local market to meet the basic health care needs of its residents. However, there are considerations in addition to capacity that likely affect whether care offered by these providers ultimately improves outcomes. Coordination of care is one such consideration.

From a coordination of care perspective, there may be disadvantages to a large number of providers in a market. More organizations in a market add complexity to the local delivery system. Increased complexity increases the cost and effort associated with communicating and coordinating activities across providers. A provider’s ability to cultivate relationships may decrease as markets become heavily populated with health care organizations, further diminishing communication and coordination across providers. For consumers, a proliferation of multiple, duplicative providers may also diminish their ability to navigate an already complex delivery system.

In contrast, a limited number of providers in a market may be associated with better control over how consumers and providers engage the health care delivery system and utilize resources (Provan and Milward 1995). For example, the quality of a patient referral may be enhanced if a physician is more aware of the various care options. This awareness may be diminished when the number of choices is expansive. Similarly, physicians and patients may be better able to assess the quality of provider care when there is a more manageable set of options, which in turn may enhance care seeking choices and outcomes of care.

A limited supply of providers may also enhance the effectiveness of primary care delivery by increasing the frequency and quality of interactions among providers in a market (Starfield et al. 2005). More frequent interactions are likely to create greater trust and familiarity between providers and improve the quantity and quality of shared information (Coleman 1988; Krackhardt 1992; Uzzi 1997). This is an increasingly important consideration in health care where patients often receive care from a number of different providers in a community and patient 'handoffs' are a noted problem for care coordination (Coleman and Berenson 2004; Dudas et al. 2001; Moore et al. 2003). Another benefit of frequent interactions and the trust that ensues is decreased transaction costs associated with care coordination (Pfeffer and Salancik 1978; Williamson 1981). Greater trust and familiarity decreases the costs of monitoring the behaviors of exchange partners and may result in more or better coordination across local providers. For example, primary care physicians may be more likely to make referrals if they trust specialists to refer patients back when treatment is completed or not necessary.

Given these considerations, this study examines whether the relationship between provider supply and ACSH is a combination of the 'more points of access' and 'control-and-coordination' perspectives. Based on this combined perspective, it is hypothesized that additional provider options may open up more points of access to a certain point; but beyond that point, more services compromise efforts to coordinate services and navigate the local delivery system. In other words, access to care at the extremes (too few providers and too many providers) is associated with higher rates of ACSH. At the low end, consumers may not be able to receive primary care services in a timely manner that would prevent the escalation of an illness (i.e., too few points of access). At the high end, coordination is compromised because there are too many points of access. In sum, it is expected that:

Hypothesis 1a: The rate of ACSH in a market will exhibit a U-shaped, non-monotonic relationship with community health center capacity.

Hypothesis 1b: The rate of ACSH in a market will exhibit a U-shaped, non-monotonic relationship with home health agency capacity.

Hypothesis 1c: The rate of ACSH in a market will exhibit a U-shaped, non-monotonic relationship with staff/group HMOs capacity.

Hypothesis 1d: The rate of ACSH in a market will exhibit a U-shaped, non-monotonic relationship with hospital capacity.

Hypothesis 1e: The rate of ACSH in a market will exhibit a U-shaped, non-monotonic relationship with nursing home capacity.

Hypothesis 1f: The rate of ACSH in a market will exhibit a U-shaped, non-monotonic relationship with physician organization capacity.

Provider composition

By definition, care coordination entails a relationship between two or more providers (Gittell et al. 2000; Institute of Medicine 1996; Starfield 2001). The importance of inter-organizational relationships for coordinating care suggests that provider supply relative to other organizations in a market may be another important consideration for understanding ACSH. Therefore, another feature of provider supply considered in the study is the composition or ratio of organizations in a market. Specifically, the study examines the ratio of community health centers, home health agencies, nursing homes, physician organizations, and staff/group model HMOs relative to hospitals.

Hospitals are used as the reference provider type because they differ from the other provider types in several important ways that may affect their ability or willingness to coordinate care in ways that affect ACSH. First, there is research showing hospital capacity associated with higher ACSH rates (Laditka, Laditka, and Probst 2005; Penfold et al. 2008; Schreiber and Zielinski 1997), which some have suggested is a result of conflicting financial incentives with respect to ACSH (Siu et al. 2009). ACSH undoubtedly contribute to a hospital's inpatient revenues. A reduction in ACSH could represent a significant challenge for a hospital depending upon the balance of inpatient and outpatient services and a hospital's ability to offset losses in inpatient revenue by providing more outpatient services. In contrast, other primary care organizations such as those considered in this study likely face less ambiguous incentives to provide care on an outpatient basis, sometimes even in the form of direct financial incentives to avoid these types of admissions. This contrast in financial incentives may create a 'pull-pull' dynamic between hospitals and other provider types, with hospitals seeking ways to secure inpatient stays and ambulatory provider types seeking ways to prevent them.

Hospitals also differ from other care providers in the types of relationships established with patients and the coordination opportunities that extend from these relationships. Coordination of care typically entails a continuous care relationship between a provider and a patient (Grumbach and Bodenheimer 2002; Starfield 1998; Starfield and Shi 2004). However, the organizations examined in this study are not likely to have equal ability to establish or maintain continuous care relationships with patients.

Differences emerge due to the types of services offered by providers (e.g., short-term acute care), financing mechanisms that encourage certain long-standing relationships between patients and providers (e.g., designated primary care physicians in HMOs), and even normative expectations about the care that should be provided by these different provider types. As a result, these organizations may be more likely than hospitals to establish long-term relationships with patients that allow these provider types to exercise better control over how patients access health services. In combination, it is expected that a greater supply of ambulatory provider types relative to hospitals will be associated with lower rates of ACSH.

Hypothesis 2a: The rate of ACSH in a market will be negatively associated with the community health center-to-hospital ratio.

Hypothesis 2b: The rate of ACSH in a market will be negatively associated with the home health agency-to-hospital ratio.

Hypothesis 2c: The rate of ACSH in a market will be negatively associated with the nursing home-to-hospital ratio.

Hypothesis 2d: The rate of ACSH in a market will be negatively associated with the physician organization-to-hospital ratio.

Hypothesis 2e: The rate of ACSH in a market will be negatively associated with the staff/group model HMO-to-hospital ratio.

Inter-organizational Relationships

The U.S. health care system is becoming more interconnected. Spurred by increasingly specialized environments and more complex health care needs, health care organizations are finding it increasingly difficult to maintain “go-it-alone” strategies across the service delivery continuum and recent years have witnessed a proliferation of collaborative organizational forms. Such changes raise questions of whether collaborations between organizations are having any meaningful effect on the delivery of health services. Therefore, the second dimension of market structure considered in this study is inter-organizational relationships. Two specific types of inter-organizational relationships are examined in the study: (1) horizontal integration between hospitals and (2) vertical integration between hospitals and physician organizations, nursing homes, and insurance products.

Organizations establish inter-organizational relationships for a number of reasons. Some analysts suggest that inter-organizational relationships help reduce uncertainty in the external environment (Aldrich 1979; Pennings 1981; Whetten 1981). In a related vein, inter-organizational relationships can help an organization acquire resources, both economic (e.g., clients, raw materials) and non-economic (e.g., information, legitimacy) (Aldrich and Pfeffer 1976; Pfeffer and Salancik 1978). Finally, inter-organizational relationships can help align goals and reduce transaction costs, thereby improving operational efficiency (Mick 1990; Williamson 1981).

Previous arguments suggested that provider supply is related to ACSH by means of coordination. Implicit in these arguments is the presence of a relationship between two organizations, a precursor to actual coordination. Inter-organizational relationships may provide a more proximate assessment of coordination in a market by examining whether a relationship actually exists between organizations. The general hypothesis is that markets with a greater degree of inter-organizational relationships will be associated with lower ACSH rates. Starting from the premise that care is already fragmented and divided across multiple provider types, inter-organizational relationships should facilitate greater control over care coordination activities across settings.

Horizontal integration. Horizontal integration is defined as the combination of similar organizations that changes the scale of services and operations of the integrating organizations (Chandler 1990; Clement 1988). For hospitals, horizontal integration encompasses a broad array of organizational forms, including multihospital systems, networks, mergers and acquisitions, and strategic alliances between local hospitals (Burns and Pauly 2002; Clement 1988). This study focuses on multihospital systems because of their extensive growth over the time period examined (Cuellar and Gertler 2006; Spetz, Mitchell, and Seago 2000) and their potential to improve resource coordination and control (Ermann and Gabel 1984; Zuckerman 1979).

There are several reasons to believe system affiliation will be negatively associated with ACSH. First, system affiliation is argued to increase efficiency by consolidating and centralizing administrative functions (Ermann and Gabel 1984; Luke, Ozcan, and Olden 1995; Zuckerman 1979). This centralization should help coordinate activities across system affiliated hospitals in a market. For example, some studies have found that multihospital systems are more likely to adopt health information technologies with the potential to improve communication of clinical information across affiliated hospitals (Burke et al. 2002; Furukawa et al. 2008). Others have suggested that hospitals are using new technology like electronic health records to bond physicians to the hospital (Grossman, Bodenheimer, and McKenzie 2006). If multihospital systems are more likely to invest in these technologies and use them to link with other health care providers, then markets with a larger proportion of system affiliated hospitals should be better connected overall.

Consolidation of hospitals into multihospital systems may also help organizations manage the overall complexity of the local delivery system (Alexander 1991; Dranove and Shanley 1995). Under circumstances of greater consolidation, a community of providers has more opportunities to interact and refine coordination processes. Repeated transactions between providers may facilitate trust, improve the robustness of information communicated, and result in better patient handoffs between providers (Krackhardt 1992; Uzzi 1997). These improvements should result in both fewer initial admissions and fewer readmissions related to ambulatory care sensitive conditions.

It is expected that the effects of system affiliation will pertain predominantly to hospitals that are within the same market. While some benefits of system affiliation may apply across all member hospitals (e.g., access to capital, administrative services), it is expected that clinical integration efforts are more likely to occur among hospitals that are in closer geographic proximity. In other words, opportunities to take advantage of improved coordination are likely to be limited to hospitals that are part of the same system and operate in the same market. For example, a system that shares clinical staff to offer cardiac services is likely limited to sharing these resources in a limited geographic range. Therefore, it is hypothesized that:

Hypothesis 3: The rate of ACSH in a market will be negatively associated with the proportion of system-affiliated hospitals in a market that belong to the same system.

Vertical integration. Hospitals have long recognized the important role played by physicians in securing patient resources and have established different organizational forms to affiliate with physicians. Vertical integration between hospitals and physicians received the most attention in the 1990s in the wake of managed care growth. Vertical integration was seen as a response to market and regulatory forces that created a need for organizational forms that could link services across the continuum of care with the promise of lower cost and increased quality (Budetti et al. 2002; Conrad et al. 1988; Zuckerman et al. 1998).

Relationships with physician organizations are important for aligning physician' and hospital' goals (Alexander et al. 2001). Hospitals and physicians acting in concert toward common goals can more easily find agreement on the appropriate activities to pursue those goals. One hypothesized example of such goal alignment exists for organizations with capitated risk contracts, where it is predicted that systems with integrated physician organizations will perform better due their ability to forgo high cost admissions for more cost-effective outpatient physician care. Even without capitation risk, other business opportunities, such as joint ventures for new services, demonstrate how integration and alignment are intertwined for physicians and hospitals. Greater integration and alignment also helps reduce market uncertainty by securing resources in the form of patients and providers. In doing so, physician-hospital integration may increase the frequency and quality of exchange between physicians and hospitals, thereby reducing monitoring and coordination costs associated with caring for a patient across the continuum of care. Therefore, it is hypothesized that:

<u>Hypothesis 4</u>: The rate of ACSH in a market will be negatively associated with the proportion of hospitals with a formal physician relationship.

Similar benefits have been proposed to exist for hospital ownership of insurance products and nursing homes. Vertical integration through ownership of insurance products and long-term care facilities ostensibly aligns financial and utilization goals. For example, a hospital that owns an HMO may have more control over utilization targets that favor care among hospital affiliated providers. Not only do these incentives help the hospital retain financial resources, but they may also motivate coordination across providers affiliated with the hospital. Similarly, hospitals that own a nursing home may have more control over admissions from nursing homes as well as discharges to nursing homes. In sum, it is expected that:

Hypothesis 5: The rate of ACSH in a market will be negatively associated with the proportion of hospitals that own an insurance product.

Hypothesis 6: The rate of ACSH in a market will be negatively associated with the proportion of hospitals that own a nursing home.

Additional Factors

The fundamental relationship examined in this study is the relationship between market structure and rates of ACSH. In the terms of the Behavioral Model of Access, it is focused on how attributes of the health care system are associated with an outcome of care that reflects access to primary care. Given this focus and the relationships outlined by the Behavioral Model, there are a number of characteristics that need to be considered and controlled for.

Predisposing Factors. Predisposing factors are those characteristics that reflect a person's propensity to seek out formal health care services. Three predisposing factors in particular need to be controlled for: age, gender, and race or ethnicity. In general, health care needs increase as one grows older, and age is believed to be associated with greater utilization of health services. However, conflicting empirical results have been explained differently. On one hand, an older population could be associated with higher rates of ACSH simply because there are more complex health care needs; on the other hand, an older population might be expected to utilize more health services on an outpatient basis, which presumably will result in lower rates of ACSH.

Health services researchers have extensively documented differences between males and females in both health status and care seeking behavior. Of interest for this study are findings suggesting that males tend to delay seeking care, which can result in conditions escalating to the point of hospitalization (Laditka and Laditka 1999; Magan et al. 2008; Robbins, Valdmanis, and Webb 2008).

Finally, an extensive body of health disparities research indicates that the resources available and attitudes among different racial and ethnic groups can have a profound effect on how individuals engage and interact with the health system (Weinick, Zuvekas, and Cohen 2000; Williams and Collins 1999; Williams and Rucker 2000). In general, most studies have found that minority groups face more significant barriers to access (Ash and Brandt 2006; Cable 2002; Laditka and Laditka 2006).

Enabling Factors. Enabling factors refer to a person's ability to seek out and obtain health services. Education is believed to affect the propensity to seek care through the knowledge base available to identify problems and the resources available to treat these problems (Epstein 2001; Laditka, Laditka, and Probst 2005; Zhan et al. 2004). Income is argued to affect care seeking behavior by providing or limiting the financial resources available to seek out care. In a similar manner, insurance coverage is believed to be an important component of access and is believed to mitigate some of the financial barriers to seeking out health care services. Furthermore, some types of insurance (e.g., HMO) emphasize certain types of primary care services that may affect care seeking behaviors and ACSH (Basu, Friedman, and Burstin 2002; Friedman and Basu 2001; Zeng et al. 2006). Finally, geography is believed to affect a person's propensity to seek out care. Rural residents are often more isolated and have a more difficult time obtaining access to adequate primary care (DeLia 2003; Laditka and Laditka 1999; Penfold et al. 2008).

Need Factors. A third aspect of the patient population to be considered is need. Need factors refer to characteristics that reflect a person's health and functional status. In general, greater illness burden and lower health status are associated with higher use of health services, including ACSH.

Use of health services. A final consideration is the use of health services. Patients receiving care on a timely, outpatient basis may be less likely to need more intensive inpatient services.

Chapter IV

Research Design

This chapter describes the research methods used to investigate the relationship between market structure and ACSH. The first section describes the study context, followed by a description of the population and analytic sample, including data sources and how the data are merged to create the analytic sample. The third section describes the measurement of study variables and is divided into two parts corresponding with the groups of hypotheses: provider supply and inter-organizational relationships. The fourth and final section discusses the analytic strategy used in the study, model specification, and the steps taken to test the hypotheses.

Study Context

The study examines 58 markets in California between 1998 and 2005 (Appendix 1). California markets have been selected for several reasons. First, the large geographic size of California represents an opportunity to study multiple sources of variation across markets (e.g., urban versus rural, racial and ethnic composition) while controlling for state-level factors that may influence access (e.g., differences in Medicaid coverage). Second, California tends to be an early adopter with respect to new advancements in health care. For example, California is often cited in the health services literature for the proliferation of physician organizations in the mid-1990s (Robinson and Casalino 1995, 1996). Finally, the California Office of Statewide Healthcare Planning Department

(OSHPD) collects extensive data on hospitals and other health care providers across the state, which is critical for the analytic approach adopted in this study that controls for multiple provider types. Also, the OSHPD data has been used extensively in the health services literature, including studies of ACSH, providing opportunities for external comparison of results.

Population and Sample

The study utilizes a pooled, cross-sectional dataset for the years 1998-2005. The 1998-2005 period was selected for a number of reasons. First, it coincides with increased attention to ACSH. The study of ACSH did not begin in earnest until the early 1990s (Billings, 1993; IOM, 1993) and recent research indicates that attempts to curb ACSH rates have had only modest success (AHRQ, 2004). Furthermore, this period is also characterized by increasing costs associated with ACSH as well as increasing rates of ACSH for some conditions (AHRQ, 2005). Finally, the study spans a period of time in the U.S. health care system when the relationships between provider organizations were undergoing significant change (Cebul et al. 2008).

A pooled time series design was chosen for a number of reasons. Pooled time series designs are quasi-longitudinal designs that entail “stacking” cross-sectional datasets across a period of time. Pooled time series designs are generally used when the sample of cross-sections is modest in size or the time series length is too short for conventional longitudinal techniques (Sayrs 1989). In this case, a pooled time series design was preferred over more traditional cross-sectional designs because of the organizational and ACSH changes that occurred over the study period. Specifically, a pooled time series design helps control for changes in the variables of interest as well as other secular trends that may affect the study's relationships. Admittedly, pooled, cross-sectional designs do not enjoy some of the same benefits as panel designs, especially with respect to cause-and-effect relationships. Initial attempts to apply panel design techniques (i.e., latent growth curve models) failed to converge on a solution for the models, indicating a problem with the underlying covariance structure and a potential poor fit with the data. Subsequent analysis indicated that the lack of convergence is due, in part, to insufficient variation in the outcomes across the study period. As noted above, true panel designs often require a significant number of waves (Sayrs 1989); thus, it may be that the study did not include enough years to adequately model the relationships with these panel design techniques. Given these limitations, a cross-sectional, time-series analysis was chosen instead and variables corresponding with each year of the sample are used to account for observed changes in ACSH rates over time.

Data Sources

Data for the study are drawn from nine sources: (1) annual discharge datasets from the Office of Statewide Healthcare Planning Department (OSHPD) for all California hospitals; (2) OSHPD annual utilization datasets for hospitals; (3) OSPHD annual utilization datasets for primary care clinics; (4) OSHPD annual utilization datasets for long-term care facilities; (5) OSHPD annual utilization datasets for home health agencies; (6) the American Hospital Association (AHA) Annual Survey of Hospitals; (7) the 2006 Area Resource File (ARF), (8) InterStudy Competitive Edge HMO Directory, and (9) Cattaneo and Stroud Physician Organization and Medical Group Survey.

The OSHPD annual discharge datasets contain patient-level data such as patient demographics (e.g., address, gender, race) as well as data about the types and quantity of services provided to a patient during an inpatient stay and the diagnoses that were documented at the time of admission. Discharge information is collected every six months from all licensed California hospitals, but is available for purchase on a calendar year basis. These data are used to identify discharges related to ambulatory care sensitive conditions and derive rates of discharge used as outcomes. Discharge data are available for all years of the study.

The OSHPD annual utilization datasets for hospitals contain organization-level statistics on: (1) hospital ownership; (2) geographic location, including county and health service area; (3) number of inpatient beds; (4) inpatient and outpatient utilization; and (5) personnel on payroll. California hospitals are required to submit data to OSHPD within 45 days of the conclusion of a calendar year. Hospitals submit data through an internet-based reporting system known as ALIRTS (Automated Licensing Information and Report Tracking System) to ensure that data are submitted in a standard format. Data are made publicly available following quality audits by OSPHD, which contacts report preparers and administrators when errors and inconsistencies are discovered. Data are available for all years of the study. While exact response rates are not available, the mandatory nature of reporting and its potential connection to future licensure has resulted in high response rates. More often than non-response are late responses, which are pursued directly by OSPHD staff and subsequently added to the dataset.

The OSHPD annual utilization datasets for primary care clinics contain audited, organization-level statistics for community health centers, including federally qualified health centers (FQHC), look-alike FQHCs, and free clinics. Each data file includes data on: (1) ownership and license type; (2) geographic location, including county and health service area; (3) types and number of services offered; (4) personnel; (5) patient demographics; and (6) revenues and expenses. Each clinic is required to submit data to OSHPD within 45 days of the conclusion of a calendar year. Like hospitals, clinics submit data through the ALIRTS internet-based reporting system to ensure that data are submitted in a standard format. OSHPD makes data publicly available following quality audits by OSPHD and contacts report preparers and administrators when errors and inconsistencies are discovered. Data are available for all years of the study.

The OSHPD annual datasets for long-term care facilities contain audited, organization-level statistics for all California licensed long-term care facilities, including nursing homes, residential care facilities, and continuing care retirement communities. Each data file includes data on: (1) ownership and license type; (2) geographic location, including county and health service area; (3) types of services offered; (4) number of admissions and discharges; (5) personnel; and (6) patient demographics. Similar to hospitals, each facility is required to submit data to OSHPD within 45 days of the conclusion of a calendar year. The data is also submitted through ALIRTS to ensure that data are submitted in a standard format. Data are made publicly available following quality audits by OSPHD. Data are available for all years of the study.

The OSHPD annual utilization datasets for home health agencies contain audited, organization-level statistics for all California licensed home health agencies. Although hospices are often included in this organizational category, organizations that exclusively provide hospice care are excluded from the final sample. The nature and objective of hospice care should result in very few, if any, hospital referrals from hospices. Each data file includes data on: (1) ownership and license type; (2) geographic location, including county and health service area; (3) types of services offered; (4) number of visits; (5) personnel; and (6) patient demographics. Each agency is required to submit data to OSHPD within 45 days of the conclusion of a calendar year. Agencies submit data through an internet-based reporting system known as ALIRTS (Automated Licensing Information and Report Tracking System) to ensure that data are submitted in a standard format. Data are made publicly available following quality audits by OSPHD. OSHPD contacts report preparers and administrators when errors and inconsistencies are discovered. Data are available for all years of the study.

The AHA Annual Survey of Hospitals is an annual survey of all U.S. hospitals and is commonly used in studies of U.S. hospitals. AHA Annual Survey data include: (1) hospital ownership and control type; (2) geographic location; (3) services offered by the hospital, both inpatient and outpatient; (4) inpatient beds and utilization; (5) financial expenses; and (6) personnel. Items in the survey vary from year to year, especially service-related items; however, this study utilizes only those items that are consistently available each year.

The Area Resource File (ARF) is a comprehensive dataset relating to health care utilization and resource availability in all U.S. counties. Specific data include: (1) health professionals; (2) health facilities; (3) health care utilization; (4) population; and (5) general environment (e.g. land area, climate). The ARF is a cumulative dataset that includes historical data. In other words, even though the study uses the 2006 ARF data, study variables from previous years are available in the dataset.

The InterStudy Competitive Edge HMO Directory is a well established data source used in empirical studies of health maintenance organizations (HMO). InterStudy conducts an annual survey of all HMOs in the U.S., with an annual response rate in the range of 80 to 85 percent. The Competitive Edge HMO Directory includes data on health maintenance organization (HMO) characteristics such as type of HMO, products offered, number of provider contracts, counties served, and enrollment. A county-level dataset is created by coding whether an individual HMO provided services in each California county and then aggregating these data to the county level.

Finally, a physician organization dataset is created from survey data provided by Cattaneo and Stroud, a California consulting company. Cattaneo and Stroud, in partnership with the Pacific Business Group on Health, conducts an annual survey of all California medical groups and independent physician associations that have at least 6 primary care physicians and have at least one contract with a health maintenance organization. The survey inquires about the counties served by the physician organization, number of physicians who are members of the organization, number and types of contracts, and which hospitals the organization has a formal relationship with. Similar to the HMO data, a county-level dataset is created by coding whether a physician organization provided services in each California county and then aggregating these data to the county level.

Construction of the Analytic Dataset

Data from these sources are merged to create a dataset of annual observations. To construct the dataset, first the hospital discharge data are merged with the OSHPD annual utilization data for hospitals using a unique hospital identifier assigned by OSHPD. These combined data are then merged with the AHA Annual Survey data. To merge the combined OSHPD hospital data with the AHA Annual Survey data, unique OSHPD identification numbers are linked with AHA-assigned identification numbers using hospital name and address from the respective datasets. Hospitals that cannot be matched during this 'crosswalk' process are removed from the sample. Four hospitals could not be matched by crosswalk, resulting in a loss of 14 market-year observations across all years of the study.

The combined hospital dataset is next merged with the datasets for the other organizations at the county-level. All OSHPD dataset observations include a county name indicating where the facility is located. Using these counties as identifiers, organizations are assigned to one of the 58 counties in California. This combined dataset is merged with the ARF using the federal information processing standard (FIPS) county code. All hospitals were successfully assigned to a county during this merge process.

The merge process is repeated for each year of the study and datasets are appended to each other to create a long-form dataset. Replication of the process for each year of the study results in repeated observations for markets and the final analytic dataset consists of eight years of observations. The unit of analysis is the market-year hospital discharge rate related to ambulatory care sensitive conditions.

Notably, not all markets include the primary care organizations considered in this study. For example, in 1998, one county did not have a hospital, three counties did not contain a community health center or home health agency, four counties did not have a staff/group model HMO, and seven counties did not include a skilled nursing facility. The most critical missing organization for this study is hospitals. The use of hospital discharge data to construct outcomes means that counties without a hospital cannot be included in the analysis. In 1998, there was only one county without a hospital; by 2005, there were three counties that did not contain a hospital. Across all years, 14 markets lacked hospitals and therefore lacked discharge data, resulting in a loss of 14 market-year observations. The final analytic dataset included 450 market-year observations.

Measurement

Outcome Variable Overview

The outcome variable of interest is the rate of ACSH, where ACSH are defined as hospitalizations for conditions that could potentially be cared for in an ambulatory care setting (Billings, 1993; IOM, 1993).   Outcomes are constructed from hospitalizations related to eleven conditions identified as potentially avoidable: (1) adult asthma; (2) angina without procedure; (3) bacterial pneumonia; (4) chronic obstructive pulmonary disease; (5) congestive heart failure; (6) dehydration; (7) diabetes short-term complications; (8) diabetes long-term complications; (9) hypertension; (10) perforated appendix; and (11) uncontrolled diabetes. These eleven conditions were selected based on their incidence, consensus regarding their avoidability, and their prevalence in the ACSH literature (Kruzikas et al. 2004).

Discharges are identified from the OSHPD discharge abstracts using the International Classification of Diseases, Ninth Revision (ICD-9), published by the World Health Organization. Appendix 2 is a complete list of the ICD-9 codes used to identify these hospitalizations. Calculation of ACSH rates focus on discharges with a primary diagnosis matching one of the ICD-9 codes included in Appendix 2. The use of the primary diagnosis is important to ensure that the analytic sample focuses on hospitalizations that are potentially avoidable with appropriate ambulatory care. In other words, the primary diagnosis provides greater confidence that a preventable condition was the principal cause of the hospitalization and not incidental to the hospital stay. All outcomes are calculated as the number of discharges per 1,000 market residents.

Outcome Variable: Acute care ACSH vs. Chronic care ACSH

Given the number of ambulatory care sensitive conditions to be considered, studies typically consolidate the analysis and presentation of results. One of the most common analytic consolidations is based on whether the underlying condition is acute or chronic in nature (Agency for Health Care Research and Quality 2007; Chang, Mirvis, and Waters 2008). Acute care ACSH are those admissions that are emergent but could have been treated by a health care professional on an outpatient basis. Admissions included in the acute care ACSH category relate to bacterial pneumonia, dehydration, and perforated appendix. In contrast, chronic care ACSH are admissions that result from some ongoing health issue. Chronic care ACSH admissions include angina, adult asthma, chronic obstructive pulmonary disease, congestive heart failure, diabetes with short-term complications, diabetes with long-term complications, hypertension, and uncontrolled diabetes.

The rates of acute care ACSH and chronic care ACSH outcomes are calculated as the annual number of discharges per 1,000 market residents. To construct these outcomes, discharges with a primary diagnosis related to a specific ambulatory care sensitive condition are first summed to the hospital-level (Figure 2). Next, these condition-specific discharges are summed across all hospitals in a market to derive a market-level count of discharges. Condition-specific discharges within the acute care ACSH and chronic care ACSH categories are summed across all hospitals in a market to derive market-level totals. Market-level totals are divided by the number of market residents and then multiplied by 1,000. One outcome per year is calculated for both the acute care ACSH category and the chronic care ACSH category.

Figure 2: Derivation of ACSH Rate[1]

All hospital admissions
N = 3,609,282 (2005)

Using primary diagnosis only, filter admissions by ICD-9 & DRG codes related to ACS conditions[2]

All ACSH
N = 24,421

Aggregate admissions to individual hospital (based on OSHPD ID)

Number of ACSH for an individual hospital

Sum across all hospitals in county to get market-level total.

Number of ACSH in county

Divide by number of residents in county and multiple by 1,000.

County-level Rate of ACSH

Notes

[1] These steps were applied initially across all of the 11 conditions identified as potentially avoidable. Numbers in this figure are for hypertension (most frequent condition) in 2005 (most current year in sample).

[2] This step takes into consideration exclusionary criteria for those conditions where hospitalization is likely to be clinically indicated (e.g. immunosuppressed). A complete list of ICD-9 codes is included as Appendix 2.

Outcome Variable: Aggregated ACSH

Another set of analyses examines the effects of market structure on the rate of combined or aggregated ACSH. The purpose of this analysis is to evaluate whether aggregated rates of ACSH vary with market structure in ways similar to specific clinical conditions. The aggregated ACSH outcome is simply the combined rates of acute care ACSH and chronic care ACSH. One outcome per year is calculated.

Explanatory Variables

Explanatory variables tested in the project can be grouped into two general categories: provider supply and inter-organizational relationships. All explanatory variables are time-variant across the study period.

<u>Provider capacity</u>. Provider capacity relates to the number of providers available in a market relative to the consumer resource base. Six variables for the six provider types considered in the study are constructed at the market-level (market *j*) for each year of the study (time *t*). The capacity variables are calculated as the number of health care organizations in a market divided by the market level population. For example, the total number of home health agencies in a market is divided by the total number of market residents. To facilitate interpretation and comparisons with other provider supply research, these measures are multiplied by 1,000 (e.g., number of home health agencies per 1,000 residents):

$$\left[\frac{\sum(\text{number of organizations}_{jt})}{\sum(\text{number of market residents}_{jt})}\right]*1{,}000$$

To test for a non-linear relationship between provider capacity and ACSH, all six provider capacity variables are squared to create quadratic terms.

Provider composition. Provider composition variables relate to the number of primary care organizations in a market relative to hospitals. Five ratio variables are created for community health centers, health maintenance organizations, home health agencies, nursing homes, and physician organizations. All five variables are constructed at the market-level (market *j*) for each year of the study (time *t*).

$$\frac{\sum(\text{number of organizations}_{jt})}{\sum(\text{number of hospitals}_{jt})}$$

Inter-organizational Relationships. The study focuses on two types of inter-organizational relationships, horizontal integration between hospitals and vertical integration between hospitals and physician organizations, nursing homes, and insurance companies.

Horizontal integration. Horizontal integration focuses on multi-hospital system affiliation. A market-level measure of horizontal integration is constructed as the proportion of hospitals in a market that belong to a multi-hospital system with more than one hospital in that same market. To create this measure, a dichotomous indicator is first created for all hospitals in a market that reflects whether the hospital belongs to a system and whether that system has more than one hospital in the market (1=belongs to system with more than one hospital in the market). Next, this dichotomous measure is summed across all hospitals in a market and divided by the total number of hospitals in a market.

Vertical integration. Three specific types of vertical integration are considered in the study: (1) physician-hospital relationships; (2) hospital ownership of a skilled nursing facility; and (3) hospital ownership of a health plan.

Hospital-physician relationship. The AHA Annual Survey asks respondents to indicate whether a hospital is related to any of eight different types of physician organizations: (1) independent physician association (IPA); (2) group practice without walls (GPWW); (3) open physician-hospital organization (OPHO); (4) closed physician-hospital organization (CPHO); (5) management service organization (MSO); (6) integrated salary model (ISM); (7) equity model; and (8) foundation (Appendix 3). Each item is coded dichotomously where a value of 1 indicates the hospital is related to that type of physician organization. The physician-hospital relationship variable is calculated as the number of hospitals in a market with any type of physician relationship divided by the total number of hospitals in a market.

Hospital ownership of a health plan. The AHA Annual Survey asks respondents to indicate whether a hospital has developed or holds "an equity interest" in three types of insurance products: (1) a health maintenance organization; (2) a preferred provider organization; and (3) an indemnity fee for service plan. These insurance products can be provided independently by the hospital, through an affiliation with a health system, through a network, or through some other joint venture with an insurer. A dichotomous, hospital-level variable is initially created if a hospital is engaged in any of these relationships for any of these insurance products. For example, if a hospital independently offers a health maintenance organization and partners with an insurance company for an indemnity insurance product, the hospital-level insurance variable is coded as 1. A market-level, hospital-health plan relationship variable is calculated as the number of hospitals in a market with an equity interest in a health plan, divided by the number of hospitals in a market.

Hospital ownership of a skilled nursing facility. The AHA Annual Survey asks respondents to indicate how many staffed skilled nursing home beds that the hospital had available during the year. A dichotomous, hospital-level variable is initially created if a hospital has any skilled nursing home beds set up and staffed for use during the year. A market-level, hospital-nursing home relationship variable is calculated as the number of hospitals that have at least one skilled nursing home bed set up and staffed for use during the year, divided by the number of hospitals in a market.

Control Variables

Five groups of control variables are included to account for factors identified in previous research. One group of control variables focuses on population characteristics of a local market to control for the predisposing, enabling, and need characteristics of local market residents. A second group of control variables is used to control for health service utilization in a market. A third group of control variables is used to control for physician supply in the inter-organizational relationship analysis. This third group of control variables is not included in the provider supply analysis because the effect of physician supply is captured in the explanatory variables being tested. A fourth control variable is used to control for hospital competition in the inter-organizational relationship analysis. Finally, the fifth group of control variables is included to control for temporal trends in ACSH. The fifth group is included in all regression models.

Gender. Gender differences in rates of ACSH are controlled for with one continuous variable that reflects the proportion of market residents who are male. Data from the ARF are used to construct this variable.

Race/ethnicity. Two continuous variables are included to control for differences in racial and ethnic composition across markets: the percentage of African-American residents and the percentage of Hispanic residents. Both variables are drawn from the ARF dataset.

Urban market. All models include a continuous control variable that indicates the percentage of residents living in an area of the county classified as urban. This variable is drawn from the ARF dataset.

Socioeconomic status (SES). Socioeconomic status (SES) is measured as a composite score of four different market characteristics: percentage of population older than 15 years with high school diploma, percentage of population below poverty, percentage of population unemployed, and the percentage of population that is uninsured. A composite score is used to capture the multidimensional aspects of SES while maintaining parsimony in the regression models. The composite score is constructed by first calculating a z-score for each of the four characteristics, which standardizes these characteristics by removing the units. The second step includes summing across the four z-scores to derive the composite score for each market. The percentage of population below poverty, the percentage of population unemployed, and the percentage of population uninsured are reverse scored so that higher values of the composite score reflect higher SES. All four variables used to construct the index are taken from the ARF dataset.

Health status. Four continuous variables are included as proxies for health status of market residents. First, the average mortality rate due to cardiovascular disease (e.g., hypertension, atherosclerosis) is included to control for chronic conditions related to the circulatory system. The average mortality rate is included in the ARF and is calculated as the 3-year average mortality rate at the county-level. Similar county-level controls are available for respiratory disease (e.g., COPD), influenza and pneumonia, and diabetes. All four health status variables are drawn from the ARF dataset.

Age. Three continuous variables are used to control for the effects of age: (1) the percentage of market residents between the ages of 0 to 14; (2) the percentage of market residents between the ages of 15 to 64; and (3) the percentage of market residents over the age of 65. The percentage of market residents between the ages of 0 to 14 serves as the reference group. All three variables are calculated from data from the ARF dataset.

Physician supply. The study includes two continuous physician supply variables. Primary care physician supply control is calculated as the number of practicing, office-based primary care physicians (i.e., family practice, internal medicine, pediatrics) per 1,000 market residents. Similarly, the specialist supply control variable is calculated as the number of practicing, office-based specialist physicians per 1,000 market residents. Both variables are derived from the ARF dataset.

Use of health services. A control variable for the use of health services is constructed by summing across the number community health center services, the number of outpatient hospital services, and the number of home health agency services provided by all organizations in a market in a calendar year. This total is then divided by the number of market residents and multiplied by 1,000 to derive an aggregate, outpatient services per 1,000 variable. The variable was limited to these four provider types because physician organization and staff/group model HMO utilization data were not available.

Hospital competition. The inter-organizational relationship regressions also include a control for hospital competition. The Herfindahl-Hirschman Index (HHI) was used to assess market concentration. The HHI variable is constructed as:

$$HHI = \sum P_i$$

where P_i is the market share of the *ith* hospital with respect to the total number of beds set up and staffed for use in a market. The Herfindahl Index ranges from zero to one, where a value of one indicates a completely concentrated and monopolistic market and values approaching zero indicate highly competitive markets. Data used to construct the HHI is taken from the AHA Annual Survey.

Year. Eight dummy variables are created to account for temporal trends in ACSH rates. The referent year for these dummies is 1998, the first year of the study.

Statistical Analysis

The unit of analysis for the study is the market-year discharge rate for ACSH. Study outcomes are measured as the number of ACSH per 1,000 market residents. Initial diagnostics show a normal distribution for the outcomes. However, repeated measurement of the same observations over time present problems of autocorrelation among the observations. Autocorrelation violates the OLS assumption of independence and can bias standard errors downward, resulting in overestimation of the statistical significance of the covariates. To account for these issues, the study uses generalized linear mixed models (McCullagh and Nelder 1989; Nelder and Wedderburn 1972). Linear mixed models provide an approach to modeling continuous outcome variables under conditions where the residuals are normally distributed but may not be independent or have constant variance (West, Welch, and Galecki 2007). Linear mixed models accommodate these situations by separately estimating parameter covariance. Three separate covariance structures were initially evaluated: (1) compound symmetric; (2) autoregressive order one; and (3) unstructured. The compound symmetric structure resulted in the lowest Akaike's Information Criterion (AIC) and Schwarz' Bayesian Criterion (SBC) and therefore provided the best fit for the models under consideration (Littell et al. 1996).

SAS PROC MIXED is used for all regression analyses (SAS Institute Inc. 2004).

Model Specifications

The relationship between market structure and ACSH is evaluated with two general categories of models: provider supply and inter-organizational relationships. The decision to model these relationships separately was based on several considerations. First, several of the independent variables of interest were highly collinear because they assessed different aspects of the same phenomenon (e.g., provider supply). Another methodological consideration was the number of independent variables relative to the number of observations, which affects the power of the analysis to detect significant relationships. Combining all independent variables into a single regression model would have resulted in approximately 40 predictor variables in the same model, which was concerning given that the study included only 450 market-year observations. Finally, although the overall theoretical framework was based on control and coordination, the underlying arguments for how these different sets of independent variables might affect ACSH presented a natural break and an opportunity to model these relationships more parsimoniously. Thus, two models are used to evaluate the provider supply relationship with ACSH and one model is used to assess the relationship between inter-organizational relationships and ACSH. These models are run using three different sets of outcomes: acute care ACSH, chronic care ACSH, and aggregate ACSH. In total, across both categories of models and the three sets of outcomes, nine regression models were used to assess the study relationships:

(3 models x 2 acute/chronic ACSH outcomes) +

(3 models x 1 aggregated ACSH outcome)]

The following sections describe these models in more detail. Bolded items represent the explanatory variables being tested in the study.

Provider Supply Models

The first set of provider supply models examines the non-linear relationship between provider capacity and rates of ACSH. In total, twelve provider capacity explanatory variables are tested. Six variables relate to the first-order provider capacity terms; another six variables relate to the quadratic provider capacity terms.

$$\text{Rate of ACSH}_{jt} = \boldsymbol{\beta_1(CHC_{jt}) + \beta_2(CHC_{jt}*CHC_{jt}) + \beta_3(HHA_{jt}) + \beta_4(HHA_{jt}*HHA_{jt}) + \beta_5(HMO_{jt}) + \beta_6(HMO_{jt}*HMO_{jt}) + \beta_7(HOSP_{jt}) + \beta_8(HOSP_{jt}*HOSP_{jt}) + \beta_9(NH_{jt}) + \beta_{10}(NH_{jt}*NH_{jt}) + \beta_{11}(PO_{jt}) + \beta_{12}(PO_{jt}*PO_{jt}) +} \beta_{13}(MALE_{jt}) + \beta_{14}(BLACK_{jt}) + \beta_{15}(HISP_{jt}) + \beta_{16}(URBAN_{jt}) + \beta_{17}(SES_{jt}) + \beta_{18}(CIRCDEATHS_{jt}) + \beta_{19}(RESPDEATHS_{jt}) + \beta_{20}(PNEUMDEATHS_{jt}) +$$

β_{21}(DIABDEATHS$_{jt}$) + β_{22}(PERCAGE1564$_{jt}$) + β_{23}(PERCAGEOVER65$_{jt}$) + β_{24}(OUTPT_SERV$_{jt}$) + β_{25}(YEAR99$_{jt}$) + β_{26}(YEAR00$_{jt}$) + β_{27}(YEAR01$_{jt}$) + β_{28}(YEAR02$_{jt}$) + β_{29}(YEAR03$_{jt}$) + β_{30}(YEAR04$_{jt}$) + β_{31}(YEAR05$_{jt}$)

A second set of provider supply regression models examines the relationship between ratios of 'coordinative provider organizations' to hospitals and the rate of ACSH. Five provider composition explanatory variables are tested in this model.

Rate of ACSH$_{jt}$ = **$\boldsymbol{\beta_1}$(CHC-to-Hospital $_{jt}$) + $\boldsymbol{\beta_2}$(HHA-to-Hospital$_{jt}$) + $\boldsymbol{\beta_3}$(HMO-to-Hospital $_{jt}$) + $\boldsymbol{\beta_4}$(NH-to-Hospital$_{jt}$) + $\boldsymbol{\beta_5}$(PO-to-Hospital$_{jt}$) +** β_6(MALE$_{jt}$) + β_7(BLACK$_{jt}$) + β_8(HISP$_{jt}$) + β_9(URBAN$_{jt}$) + β_{10}(SES$_{jt}$) + β_{11}(CIRCDEATHS$_{jt}$) + β_{12}(RESPDEATHS$_{jt}$) + β_{13}(PNEUMDEATHS$_{jt}$) + β_{14}(DIABDEATHS$_{jt}$) + β_{15}(PERCAGE1564$_{jt}$) + β_{16}(PERCAGEOVER65$_{jt}$) + β_{17}(OUTPT_SERV$_{jt}$) + β_{18}(YEAR99$_{jt}$) + β_{19}(YEAR00$_{jt}$) + β_{20}(YEAR01$_{jt}$) + β_{21}(YEAR02$_{jt}$) + β_{22}(YEAR03$_{jt}$) + β_{23}(YEAR04$_{jt}$) + β_{24}(YEAR05$_{jt}$)

Inter-Organizational Relationship Models

A final set of regression models is used to evaluate the relationship between horizontal and vertical integration and ACSH. All four inter-organizational relationship variables are tested in the same regression model. This set of models also adds three control variables: primary care physician supply, specialist physician supply, and hospital competition.

Rate of ACSH$_{jt}$ = **$\boldsymbol{\beta_1}$(PROP_SYS $_{jt}$) + $\boldsymbol{\beta_2}$(PROP_INS$_{jt}$) + $\boldsymbol{\beta_3}$(PROP_SNF $_{jt}$) + $\boldsymbol{\beta_4}$(PROP_PHYS $_{jt}$) +** β_6(MALE$_{jt}$) + β_7(BLACK$_{jt}$) + β_8(HISP$_{jt}$) +

$$\beta_9(URBAN_{jt}) + \beta_{10}(SES_{jt}) + \beta_{11}(CIRCDEATHS_{jt}) + \beta_{12}(RESPDEATHS_{jt}) +$$

$$\beta_{13}(PNEUMDEATHS_{jt}) + \beta_{14}(DIABDEATHS_{jt}) + \beta_{15}(PERCAGE015_{jt}) +$$

$$\beta_{16}(PERCAGEOVER65_{jt}) + \beta_{17}(PCPSUPPLY_{jt}) +$$

$$\beta_{18}(SPECIALISTSUPPLY_{jt}) \quad \beta_{19}(OUTPT\_SERV_{jt}) + \beta_{20}(HOSP\_HERF_{jt}) +$$

$$\beta_{21}(YEAR99_{jt}) + \beta_{22}(YEAR00_{jt}) + \beta_{23}(YEAR01_{jt}) + \beta_{24}(YEAR02_{jt}) +$$

$$\beta_{25}(YEAR03_{jt}) + \beta_{26}(YEAR04_{jt}) + \beta_{27}(YEAR05_{jt})$$

Chapter V

Results

This chapter presents the results of the empirical analysis. The chapter is divided into four sections. The first section is descriptive and provides a profile of California markets. The second section presents results of the bivariate analysis. The third section discusses the results of the multivariate hypothesis tests. The fourth and final section summarizes the findings of the study.

Profile of California Primary Care Markets, 1998-2005

There are 58 California counties, or primary care markets, in California. The following discussion primarily focuses on the descriptive statistics across these markets in the year 1998, the first year of the study, but also describes the changes that occurred between 1998 and 2005, the final year of the study. It is worth noting again that not all markets include the organizations considered in the study, with hospitals representing the most critical missing organization because of the use of discharge data to derive ACSH outcomes. At least one county was missing a hospital for each year of the study. Thus, the sample size for the following descriptive statistics is less than 58 observations.

Ambulatory Care Sensitive Hospitalizations (ACSH)

In 1998, there was an average of 11.78 ACSH discharges per 1,000 residents across 57 California markets (Table 5). On average, ACSH represented 13.5% of all hospital discharges in a market in 1998. Chronic care ACSH discharges were more frequent than acute care ACSH discharges, with markets averaging 6.31 chronic care ACSH discharges per 1,000 residents in 1998 compared to nearly 4.94 acute care ACSH discharges per 1,000 residents. The average discharge rate decreased over the study period by approximately 5 percent. Likewise, ACSH represented a declining percentage of total discharges over time, decreasing from 13.5 percent in 1998 to 12.2 percent in 2005. Declining ACSH rates were driven by chronic care ACSH, where the rate declined 7.6 percent over the study period. In contrast, the rate of acute care ACSH increased 3.2 percent over the eight year period.

Table 5: ACSH outcomes by year

	N	Rate of ACSH discharges	Standard deviation	Range	% of total discharges
Acute ACSH					
1998	57	4.94	2.21	1.17-11.67	5.7%
1999	57	5.34	2.14	2.18-11.24	5.6%
2000	56	4.76	1.92	1.41-10.30	5.3%
2001	56	5.16	2.08	0.29-10.56	5.6%
2002	57	5.40	1.94	1.13-10.39	5.6%
2003	57	5.62	2.17	0.86-11.54	5.6%
2004	55	4.93	1.87	1.42-10.35	5.2%
2005	55	5.10	1.83	0.95-10.80	5.4%
% change: 1998-2005		+3.2%			-0.3%
Chronic ACSH					
1998	57	6.31	2.69	0.93-15.80	7.9%
1999	57	6.25	2.41	0.93-14.84	7.2%
2000	56	5.75	2.28	1.32-13.25	6.7%
2001	56	5.89	2.33	1.15-12.17	7.1%
2002	57	6.59	2.49	0.28-12.95	7.6%
2003	57	6.57	2.59	0.55-13.20	7.4%
2004	55	6.00	2.18	1.71-10.68	6.9%
2005	55	5.83	2.10	1.00-9.93	6.9%
% change: 1998-2005		-7.6%			-1.0%
Total ACSH					
1998	57	11.78	4.85	2.49-28.33	13.5%
1999	57	12.08	4.43	3.50-26.60	12.6%
2000	56	10.97	4.22	3.09-23.10	12.0%
2001	56	11.43	4.31	1.43-23.00	12.7%
2002	57	12.34	4.36	1.41-23.66	13.1%
2003	57	12.50	4.67	2.28-23.68	12.9%
2004	55	11.23	4.00	3.20--20.95	12.0%
2005	55	11.18	3.74	1.97-19.09	12.2%
% change: 1998-2005		-5.1%			-1.3%

Rates of ACSH reflect considerable variation across clinical conditions (Table 6). At the high end, pneumonia averaged 2.24 discharges per 1,000 residents, followed by congestive heart failure (1.75 discharges per 1,000 residents) and chronic obstructive pulmonary disease (1.33 discharges per 1,000 residents). In aggregate, these three conditions constituted 5.6 percent of the total hospital discharges in a market in 1998. At the other extreme were discharges related to uncontrolled diabetes and perforated appendix, with an average of 0.08 and 0.09 discharges per 1,000 residents in 1998, respectively. The average discharge rate for perforated appendix experienced the largest increase over the study period, increasing from 0.09 discharges per 1,000 residents in 1998 to nearly 0.24 discharges per 1,000 residents in 2005. In contrast, uncontrolled diabetes experienced the largest decline over the study period, decreasing from 0.08 discharges per 1,000 residents to less than 0.01 discharges per 1,000 market residents.

Table 6: Condition-specific ACSH outcomes, 1998

Outcome	N	Rate of ACSH discharges	Standard deviation	Range	% of total discharges	% change in mean from 1998-2005
Acute care ACSH						
Dehydration	57	0.68	0.39	0-2.03	0.7%	-9.7%
Perforated appendix	57	0.09	0.08	0-0.50	0.1%	157.0%
Pneumonia	57	2.24	1.20	0.23-4.96	2.1%	1.6%
Chronic care ACSH						
Angina	57	0.35	0.26	0-1.23	0.3%	-38.1%
Adult asthma	57	0.51	0.31	0-1.67	0.7%	-10.4%
COPD	57	1.33	0.78	0-4.95	1.4%	-25.7%
CHF	57	1.75	0.82	0-3.70	2.1%	-1.7%
Diabetes, short-term complications	57	0.17	0.11	0-0.62	0.2%	11.5%
Diabetes, long-term complications	57	0.33	0.17	0-0.90	0.5%	18.8%
Uncontrolled diabetes	57	0.08	0.09	0-0.61	0.1%	-96.1%
Hypertension	57	0.47	0.29	0-1.48	0.6%	-20.4%

Provider supply

Staff/group model HMOs were the most prevalent provider type across all markets. On average, there were 0.11 staff/group model HMOs per 1,000 market residents, followed by community health centers with an average of 0.05 health centers per 1,000 market residents in 1998 (Table 7). Physician organizations were the least prevalent provider type, with an average of 0.01 organizations per 1,000 residents. Interestingly, these numbers contrast with the absolute number of organizations, where skilled nursing facilities and home health agencies are the most prevalent provider types. The divergence between the overall number of organizations and the per capita numbers is due to different distributions across urban and rural markets. The presence of HMOs and community health centers in rural markets results in large provider supplies per capita. For example, the presence of one community health center in Sierra County, with a population of 3,555 residents, equates to 0.28 CHCs per 1,000 residents in 1998.

Community health centers were the only provider type to experience per capita growth over the study period, increasing 2.1 percent from 1998 to 2005. Home health agencies experienced the largest decline, decreasing 41.7 percent between 1998 and 2005, followed by skilled nursing facilities and hospitals. The supply of physician organizations and staff/group model HMOs experienced more modest decreases across the study period, declining 11.1 percent and 4.4 percent, respectively.

Staff/group model HMOs were also the most prevalent provider type relative to hospitals, with an average of 3.73 HMOs for every hospital in 1998. Skilled nursing facilities and community health centers display similar provider supply ratios, averaging 2.52 nursing facilities and 2.32 health centers for every hospital, respectively. Physician organizations were the least prevalent type relative to hospitals with an average of 0.90 organizations for every one hospital. Skilled nursing facilities showed the largest shift in these ratios over the study period, increasing 37.7 percent to 3.47 nursing facilities for every hospital in 2005. In contrast, the HMO-to-hospital ratio and the HHA-to-hospital ratio declined 46.6 percent and 43.1 percent, respectively, over the eight year period.

Table 7: Profile of California markets, 1998-2005

	1998				2005				
	N	Mean	Std Dev.	Range	N	Mean	Std Dev.	Range	Percentage change in mean from 1998-2005
Provider supply									
Providers per 1,000 residents									
CHCs per 1,000 residents	57	0.05	0.06	0-0.28	55	0.05	0.05	0-0.29	2.1%
HHAs per 1,000 residents	57	0.04	0.03	0-0.12	55	0.02	0.02	0-0.09	-41.7%
HMOs per 1,000 residents	57	0.11	0.15	0-0.63	55	0.11	0.14	0-0.63	-4.4%
Hospitals per 1,000 residents	57	0.03	0.05	0-0.28	55	0.03	0.04	0-0.21	-16.1%
SNFs per 1,000 residents	57	0.03	0.02	0-0.07	55	0.02	0.02	0-0.06	-22.6%
POs per 1,000 residents	57	0.01	0.01	0-0.03	55	0.01	0.01	0-0.03	-11.1%
Providers per hospital									
CHC-to-hospital ratio	57	2.32	1.74	0-9.0	55	2.36	1.26	0.33-7.0	1.5%
HHA-to-hospital ratio	57	2.13	1.28	0-7.0	55	1.21	0.87	0-5.0	-43.1%
HMO-to-hospital ratio	57	3.73	2.34	0-8.0	55	1.99	1.46	0-8.0	-46.6%
SNF-to-hospital ratio	57	2.52	2.01	0-9.14	55	3.47	2.42	0-5.63	37.7%
PO-to-hospital ratio	57	0.90	0.88	0-4.0	55	0.86	0.88	0-4.0	-5.1%
Inter-organizational Relationships									
Proportion from same system	57	0.17	0.26	0-1.0	55	0.23	0.30	0-1.0	35.9%
Proportion own insurance product	57	0.18	0.28	0-1.0	55	0.12	0.20	0-0.75	-30.3%
Proportion own SNF	57	0.30	0.33	0-1.0	55	0.28	0.32	0-1.0	-5.7%
Proportion with phys. relationship	57	0.43	0.34	0-1.0	55	0.31	0.29	0-1.0	-27.9%
Controls									
% Male	57	0.51	0.02	0.48-0.63	55	0.50	0.02	0.47-0.63	-2.0%
% Black	57	0.03	0.04	0.01-0.15	55	0.03	0.03	0.01-0.15	0.0%
% Hispanic	57	0.23	0.15	0.04-0.72	55	0.21	0.14	0.04-0.66	-8.7%
% with college education	57	0.14	0.07	0.06-0.38	55	0.13	0.07	0.05-0.38	-7.1%
% Urban	57	0.70	0.29	0-1.0	55	0.65	0.28	0-1.0	-7.1%
% below poverty	57	0.13	0.05	0.05-0.23	55	0.12	0.03	0.06-0.21	-7.7%
% Uninsured	57	0.18	0.04	0.09-0.30	55	0.17	0.04	0.10-0.28	-5.6%
% Unemployed	57	0.04	0.02	0.02-0.09	55	0.03	0.01	0.02-0.09	-25.0%
3-year heart disease mortality rate per 1,000 residents	57	3.64	14.98	0.90-112.69	55	8.59	25.95	0.82-119.64	136.0%
3-year pneumonia mortality rate per 1,000 residents	57	2.47	7.69	0.27-29.17	55	3.47	7.70	0.14-50.05	40.5%
3-year respiratory mortality rate per 1,000 residents	57	1.02	3.87	0.26-29.17	55	2.17	6.33	0.21-33.64	112.7%
3-year diabetes mortality rate per 1,000 residents	57	0.18	0.07	0-0.32	55	0.19	0.06	0-0.35	5.6%
% ages 0-14	57	0.22	0.04	0.12-0.29	55	0.20	0.03	0.13-0.26	-6.8%
% ages 15-64	57	0.66	0.03	0.61-0.74	55	0.68	0.03	0.62-0.78	3.3%
% ages 65 and over	57	0.13	0.03	0.07-0.19	55	0.12	0.03	0.07-0.19	-5.6%
PCPs per 1,000 residents	57	5.46	15.07	0.11-100.51	55	9.74	19.09	0.18-103.60	78.3%
Specialists per 1,000 residents	57	4.09	11.61	0.05-69.63	55	9.54	18.74	0.07-92.75	133.5%
# of total outpatient services per 1,000 residents	57	2522.30	1232.19	835.18-6040.62	55	2321.04	1228.95	849.83-6332.18	-8.0%
Hospital Herfindahl	57	0.52	0.33	0.02-1.00	55	0.49	0.33	0.02-1.00	-5.4%

Inter-organizational Relationships

The proportion of system-affiliated hospitals that shared the market with another hospital from the same system was 0.17 in 1998 (Table 7). The proportion of same-system hospitals sharing the same market increased over the study period, increasing 35.9 percent to 0.23 in 2005. In 1998, 18 percent of all hospitals had an ownership interest in an insurance product. This number declined by 30.3 percent over the study period, and by 2005 only 12 percent of all hospitals in a market owned an insurance product. In contrast, the percentage of hospitals that owned a nursing home was relatively stable across the study period. In 1998, 30 percent of all hospitals owned a nursing home. This percentage declined 5.7 percent to 28 percent of all hospitals in 2005. Over 43 percent of all hospitals maintained some formal relationship with a physician organization in 1998. Overall, the percentage of hospitals using some form of formal relationship with physicians declined nearly 28 percent over the study period.

Population characteristics

The primary care markets included in the study were predominantly urban. On average, 70% of all market residents were classified as urban in 1998; a percentage that declined to 65% in 2005. Approximately 50% of all market residents were males in 1998 and 2005. African-Americans represented 3% of all market residents, on average, in both 1998 and 2005. The percentage of Hispanics in a market declined slightly from an average of 23% in 1998 to 21% in 2005. Less than 15% of all market residents had a college education or more for both 1998 and 2005. Approximately 13% and 4% of all market residents, on average, were below the federal poverty level and unemployed, respectively. Slightly less than 20% of all market residents were uninsured in both 1998 and 2005.

Summary of Market Descriptives

In sum, this profile presents a picture of considerable variation across California markets. This variation is most apparent in the range of provider supply and inter-organizational relationships across markets. For example, some markets had over 0.63 HMOs per 1,000 residents while other markets did not have an HMO. These markets also underwent substantial changes over the study period. For instance, four of the provider types experienced double digit decreases in provider supply over the study period. Interestingly, the only provider type to experience an increase in supply was community health centers, a provider type with a unique focus on underserved areas and populations. The set of relationships maintained by hospitals also underwent substantial changes over the study period. The proportion of same-system hospitals in a market increased over the study period while the proportion of hospitals with a formal physician relationship, an ownership interest in a nursing home, and an ownership interest in an insurance product declined over the same time period. These trends are consistent with other studies indicating a relaxation of vertical integration strategies that were prevalent in the mid to late 1990s, opting instead for more horizontally integrated strategies concentrated within the same market (Cuellar and Gertler 2006; Cuellar and Gertler 2003; Lesser and Ginsburg 2000).

Considerable variation is also observed for ACSH rates. For example, in 2005 the maximum ACSH rate for aggregated outcomes in a market was nearly ten times as large as the minimum ACSH rate. The results also highlight substantial differences in ACSH rates across clinical conditions, with the rate of pneumonia-related ACSH 28 times larger than the rate of uncontrolled diabetes-related ACSH. Also interesting is the change in these rates over the study period. For most conditions, especially chronic care conditions, the rate of discharge decreased over the study period. However, discharge rates increased for a number of conditions, with the net effect being a dampening of change over time. Contrasting patterns of change raise questions about whether aggregated rates of ACSH that combine high and low rates across clinical conditions and increasing and decreasing rates over time diminish underlying variation.

Bivariate Correlations

Bivariate correlation analysis was conducted to evaluate the baseline relationships between study variables and examine potential multicollinearity in the multivariate models due to high correlations. These results are shown in Tables 8 and 9. Correlation coefficients greater than 0.095 or less than -0.095 are significant.

Provider supply

Only two of the six provider supply per 1,000 resident variables were significantly correlated with all three outcomes (Table 8). HHAs per 1,000 residents were positively correlated with all three outcomes, while POs per 1,000 residents were negatively correlated with all three outcomes. These results suggest that an increasing supply of home health agencies is associated with higher rates of ACSH, while an increasing supply of physician organizations is associated with lower rates of ACSH. Community health centers per 1,000 residents and HMOs per 1,000 residents were significantly and negatively correlated with chronic care ACSH and aggregated ACSH, but did not reach statistical significance for acute care ACSH. Skilled nursing facilities per 1,000 residents were positively correlated with the rate of acute care ACSH and aggregated ACSH, but were not statistically correlated with the rate of chronic care ACSH.

In terms of provider composition, both staff/group model HMOs and physician organizations relative to hospitals were negatively correlated with all three ACSH rates. The community health center-to-hospital ratio was negatively correlated with the acute care ACSH rate and the aggregated ACSH rate. The home health agency-to-hospital ratio was positively correlated with the chronic care ACSH rate.

ACSH outcomes were significantly associated with many of the population characteristics. All four health status control variables and the number of outpatient services per 1,000 residents were positively correlated with all three ACSH outcomes. In contrast, socioeconomic status was negatively correlated with all three ACSH outcomes. Variables controlling for gender, race/ethnicity, age, and urban residence were weakly and inconsistently correlated with the three outcomes.

Inter-organizational Relationships

The proportion of hospitals with a physician relationship was positively correlated with all three ACSH rates (Table 9). These results suggest that the rate of ACSH increases as the proportion of hospitals with a formal physician relationship increases. In contrast, the proportion of market hospitals that own an insurance product was not significantly correlated with any of the outcomes. Similarly, the proportion of hospitals that own a nursing home was not significantly correlated with any of the outcomes. The proportion of hospitals that belong to a system with another same-system hospital in the market was negatively correlated with acute care ACSH and aggregate ACSH outcomes, but failed to reach statistical significance for chronic care ACSH.

Summary of Bivariate Correlations

Together, the bivariate correlations show that a number of factors are associated with ACSH rates and that it is important to control for these factors during multivariate analysis. For example, the bivariate results show that five provider types were significantly correlated with ACSH rates. Two of the four inter-organizational relationships were significantly associated with ACSH rates, while a number of population characteristics were significantly associated with ACSH rates. The bivariate results also suggest some divergence from the relationships predicted in the hypotheses. For instance, three provider types (community health centers, staff/group model HMOs, physician organizations) were negatively associated with ACSH rates and in the direction predicted; in contrast, two provider types (nursing homes, home health agencies) were positively associated with ACSH rates and in the opposite direction predicted. Similarly, the proportion of same-system hospitals was negatively associated with ACSH rates and in the same direction as predicted, while the proportion of hospitals with a formal physician relationship was positively correlated with ACSH rates and in the opposite direction predicted. Together, these contrasting relationships provide an early indication that the relationship between provider supply and inter-organizational relationships may be more nuanced than originally expected.

Table 8: Pearson zero-order correlations for provider supply

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
1. Acute ACSH	-																										
2. Chronic ACSH	0.83	-																									
3. Aggregate ACSH	0.95	0.96	-																								
4. CHCs per 1,000	-0.01	-0.20	-0.12	-																							
5. HHAs per 1,000	0.35	0.15	0.26	0.21	-																						
6. HMOs per 1,000	0.01	-0.19	-0.09	0.43	0.43	-																					
7. Hospitals per 1,000	0.08	-0.10	-0.02	0.58	0.24	0.65	-																				
8. SNFs per 1,000	0.12	0.08	0.10	0.10	0.12	-0.09	0.10	-																			
9. POs per 1,000	-0.28	-0.11	-0.19	-0.49	-0.36	-0.56	-0.41	-0.08	-																		
10. CHC-to-hospital ratio	-0.12	-0.05	-0.10	0.26	-0.18	-0.30	-0.33	0.01	0.02	-																	
11. HHA-to-hospital ratio	-0.03	0.10	0.04	-0.33	0.27	-0.38	-0.43	0.05	0.16	0.23	-																
12. SNF-to-hospital ratio	-0.19	0.01	-0.09	-0.39	-0.29	-0.55	-0.45	0.33	0.36	0.33	0.49	-															
13. Staff/group HMO-to-hospital ratio	-0.10	-0.27	-0.19	0.29	0.27	0.54	0.16	-0.03	-0.30	0.04	-0.06	-0.30	-														
14. PO-to-hospital ratio	-0.33	-0.12	-0.23	-0.48	-0.42	-0.54	-0.43	-0.09	0.87	0.17	0.30	0.55	-0.29	-													
15. % Male	-0.09	-0.12	-0.09	0.33	-0.06	0.24	0.06	-0.14	-0.18	0.23	-0.22	-0.29	0.24	-0.25	-												
16. % African-American	-0.12	0.15	0.03	-0.22	-0.27	-0.40	-0.30	-0.07	0.19	0.20	0.19	0.34	-0.39	0.24	0.19	-											
17. % Hispanic	-0.20	0.05	-0.07	-0.31	-0.28	-0.32	-0.31	-0.06	0.40	0.11	0.12	0.18	-0.17	0.33	0.03	0.23	-										
18. % Urban	-0.13	0.15	0.01	-0.58	-0.41	-0.75	-0.58	0.03	0.59	0.23	0.33	0.56	-0.59	0.57	-0.20	0.49	0.50	-									
19. SES index	-0.12	-0.26	-0.20	0.11	0.09	0.09	0.17	0.00	-0.05	-0.12	-0.01	-0.01	0.00	-0.01	0.03	-0.08	-0.76	-0.16	-								
20. Heart disease mortality rate	0.23	0.17	0.21	0.13	0.13	0.18	0.31	0.08	-0.22	-0.04	-0.19	-0.18	0.05	-0.19	0.23	-0.04	-0.19	-0.29	0.18	-							
21. Respiratory disease mortality rate	0.25	0.15	0.20	0.06	0.18	0.14	0.30	0.08	-0.17	-0.07	-0.13	-0.14	-0.03	-0.14	0.10	-0.04	-0.15	-0.24	0.13	0.77	-						
22. Pneumonia mortality rate	0.31	0.31	0.32	-0.01	0.13	0.06	0.32	0.12	-0.12	-0.13	-0.08	-0.09	-0.24	-0.09	0.02	0.05	-0.07	-0.15	0.10	0.81	0.72	-					
23. Diabetes mortality rate	0.21	0.25	0.24	0.00	0.08	-0.12	-0.02	0.23	-0.03	-0.06	-0.03	-0.01	-0.12	-0.13	-0.15	0.07	0.17	0.10	-0.39	-0.03	-0.02	0.00	-				
24. % ages 0 to 14	-0.08	0.11	0.02	-0.25	-0.22	-0.27	-0.23	0.01	0.24	0.04	0.17	0.21	-0.13	0.24	-0.14	0.20	0.77	0.41	-0.77	-0.24	-0.18	-0.12	0.26	-			
25. % ages 15 to 64	-0.23	-0.17	-0.20	0.10	-0.13	0.02	-0.03	-0.11	0.05	0.22	0.00	0.01	-0.10	0.03	0.41	0.16	-0.17	0.09	0.44	0.03	-0.01	0.06	-0.34	-0.35	-		
26. % ages 65+	0.34	0.05	0.20	0.37	0.54	0.44	0.49	0.19	-0.45	-0.31	-0.11	-0.32	0.22	-0.49	-0.20	-0.44	-0.65	-0.56	0.45	0.20	0.16	0.11	0.09	-0.60	-0.12	-	
27. # of outpatient services per 1,000	0.47	0.24	0.37	0.37	0.33	0.30	0.43	0.13	-0.27	-0.09	-0.29	-0.40	0.06	-0.44	0.20	-0.27	-0.37	-0.36	0.15	0.21	0.20	0.20	0.09	-0.43	0.11	0.50	-

Note: Correlations greater than 0.095 or less than -0.095 are significant at $p < 0.05$.
N = 450 market-years.

Table 9: Pearson zero-order correlations for inter-organizational relationships

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
1. Acute ACSH	-																						
2. Chronic ACSH	0.83	-																					
3. Aggregate ACSH	0.95	0.96	-																				
4. Proportion from same system	-0.19	-0.02	-0.10	-																			
5. Proportion own insurance product	-0.05	0.03	-0.02	0.27	-																		
6. Proportion own SNF	0.09	0.01	0.05	-0.24	0.08	-																	
7. Proportion with phys. relationship	0.22	0.28	0.27	0.05	0.29	0.00	-																
8. % Male	-0.09	-0.12	-0.09	-0.01	-0.12	0.04	-0.18	-															
9. % African-American	-0.12	0.15	0.03	0.38	0.39	-0.12	0.13	0.19	-														
10. % Hispanic	-0.20	0.05	-0.07	0.02	-0.06	-0.12	0.08	0.03	0.23	-													
11. % Urban	-0.13	0.15	0.01	0.45	0.29	-0.22	0.21	-0.20	0.49	0.50	-												
12. SES index	-0.12	-0.26	-0.20	0.20	0.22	0.14	-0.08	0.03	-0.08	-0.76	-0.16	-											
13. Heart disease mortality rate	0.23	0.17	0.21	-0.04	-0.11	-0.02	-0.08	0.23	-0.04	-0.19	-0.29	0.18	-										
14. Respiratory disease mortality rate	0.25	0.15	0.20	-0.04	-0.07	0.01	-0.03	0.10	-0.04	-0.15	-0.24	0.13	0.77	-									
15. Pneumonia mortality rate	0.31	0.31	0.32	0.05	-0.04	0.01	0.01	0.02	0.05	-0.07	-0.15	0.10	0.81	0.72	-								
16. Diabetes mortality rate	0.21	0.25	0.24	-0.04	-0.11	0.03	0.05	-0.15	0.07	0.17	0.10	-0.39	-0.03	-0.02	0.00	-							
17. % ages 0 to 14	-0.08	0.11	0.02	-0.03	-0.01	-0.13	0.15	-0.14	0.20	0.77	0.41	-0.77	-0.24	-0.18	-0.12	0.26	-						
18. % ages 15 to 64	-0.23	-0.17	-0.20	0.18	0.10	0.01	-0.07	0.41	0.16	-0.17	0.09	0.44	0.03	-0.01	0.06	-0.34	-0.35	-					
19. % ages 65+	0.34	0.05	0.20	-0.27	-0.07	0.23	-0.06	-0.20	-0.44	-0.65	-0.56	0.45	0.20	0.16	0.11	0.09	-0.60	-0.12	-				
20. PCPs per 1,000	0.25	0.28	0.28	0.13	-0.03	-0.05	-0.03	0.07	0.13	-0.04	-0.05	0.11	0.83	0.71	0.95	0.00	-0.13	0.07	0.07	-			
21. Specialists per 1,000	0.22	0.26	0.25	0.16	-0.02	-0.07	-0.03	0.09	0.17	-0.02	-0.01	0.10	0.80	0.68	0.91	-0.01	-0.13	0.08	0.03	0.99	-		
22. # of outpatient services per 1,000	0.47	0.24	0.37	-0.25	-0.12	0.21	-0.02	0.20	-0.27	-0.37	-0.36	0.15	0.21	0.20	0.20	0.09	-0.43	0.11	0.50	0.12	0.08	-	
23. Hospital Herfindahl Index	-0.04	-0.27	-0.16	-0.52	-0.36	0.05	-0.07	0.29	-0.43	-0.22	-0.68	-0.03	0.07	0.00	-0.20	-0.08	-0.14	-0.08	0.27	-0.24	-0.25	0.16	-

Note: Correlations greater than 0.095 or less than -0.095 are significant at $p < 0.05$.
N = 450 market-years.

Multicollinearity

Analysis of the bivariate correlations is helpful for identifying potential issues of multicollinearity that may exist in multivariate models. High multicollinearity can result in high variance and inflated standard errors and an increased likelihood of committing a Type II error (i.e., failure to reject the null hypothesis). However, multicollinearity does not always result in inflated standard errors and the actual effects require additional examination (Gujarati 1995; O'Brien 2007).

The bivariate correlational analysis highlighted fifteen correlations that were sufficiently strong (i.e., greater than 0.5 or less than -0.5) to warrant additional analysis. These correlations were limited to the control variables. Specifically, three primary care physician per 1,000 coefficients, four specialist physician per 1,000 coefficients, six percentage of urban resident coefficients, and two pneumonia mortality rate per 1,000 coefficients exceeded the 0.5 level. To test the effects of these correlations on the standard errors, two sets of regression models were run for each potentially problematic variable, for a total of eight regressions. One model included a full set of covariates, while the second model omitted the highly correlated variable. For example, two regression models for the primary care physician per 1,000 residents variable were run, one with the full set of control variables and a second model with all predictors except the primary care physician per 1,000 residents variable. If strong correlations with the primary care physician per 1,000 residents variable are creating problems of multicollinearity, then the removal of this variable should result in a substantial decrease in the standard errors for the remaining covariates in the second model. Tables 10 and 11 show the results of these eight regression models. All comparison models used the aggregated ACSH outcome. Comparisons of the models indicate that the effects of covariate correlation are minimal. The removal of the strongly correlated variables only slightly changes the standard errors and suggests that issues of multicollinearity will not substantially impact hypothesis testing. Therefore, the analysis proceeded with the full set of explanatory and control variables.

Table 10: Regression results for testing multicollinearity – physician supply

	Total ACSH						Total ACSH					
	With primary care physicians per 1,000			Without primary care physicians per 1,000			With specialist physicians per 1,000			Without specialist physicians per 1,000		
	β		SE	β		SE	β		SE	β		SE
Population characteristic controls												
% Male	0.044	**	0.018	0.044	**	0.018	0.044	**	0.018	0.044	**	0.018
% African-American	-0.015		0.015	-0.015		0.015	-0.015		0.015	-0.015		0.015
% Hispanic	-0.022	****	0.006	-0.022	****	0.006	-0.022	****	0.006	-0.023	****	0.006
% Urban	0.006	**	0.003	0.006	**	0.003	0.006	**	0.003	0.006	**	0.003
SES index	-88.616	****	16.628	-88.628	****	16.603	-88.616	****	16.628	-88.477	****	16.616
Heart disease mortality rate	-0.040	**	0.020	-0.040	**	0.019	-0.040	**	0.020	-0.040	**	0.020
Respiratory disease mortality rate	-0.021		0.018	-0.022		0.017	-0.021		0.018	-0.023		0.017
Pneumonia mortality rate	0.285	*	0.149	0.298	***	0.094	0.285	*	0.149	0.307	**	0.128
Diabetes mortality rate	-0.987		2.067	-0.973		2.061	-0.987		2.067	-0.930		2.055
% residents ages 0-14 (Referent)	-		-	-		-	-		-	-		-
% residents ages 15-64	-12.627		16.399	-12.607		16.374	-12.627		16.399	-12.659		16.394
% residents ages 65 and over	28.925		28.006	28.750		27.916	28.925		28.006	28.294		27.922
Physician supply controls												
PCPs per 1,000	0.012		0.110	-		-	0.012		0.110	-0.015		0.051
Specialists per 1,000	-0.023		0.080	-0.015		0.037	-0.023		0.080	-		-
Health service use controls												
# of outpatient services per 1,000	0.001	****	2.0E-04	0.001	****	2.0E-04	0.001	****	2.0E-04	0.001	****	2.01E-04
Hospital Herfindahl Index	-4.347	***	1.382	-4.37	***	1.37	-4.347	***	1.382	-4.34	***	1.38
Time trend controls												
1998 (Referent)	-		-	-		-	-		-	-		-
1999	-0.050		0.304	-0.045		0.302	-0.050		0.304	-0.044		0.303
2000	-0.663	**	0.309	-0.662	**	0.308	-0.663	**	0.309	-0.662	**	0.308
2001	0.329		0.317	0.327		0.316	0.329		0.317	0.321		0.316
2002	0.702	**	0.329	0.700	**	0.329	0.702	**	0.329	0.689	**	0.326
2003	0.899	**	0.353	0.894	**	0.350	0.899	**	0.353	0.876	**	0.343
2004	-0.218		0.374	-0.225		0.369	-0.218		0.374	-0.245		0.361
2005	0.133		0.400	0.129		0.398	0.133		0.400	0.113		0.393
Intercept	-23.561		19.904	-23.566		19.875	-23.561		19.904	-23.367		19.888
N	450			450			450			450		

* p < 0.10; ** p < 0.05; *** p < 0.01; ****p < 0.001

Table 11: Regression results for testing multicollinearity – pneumonia mortality & percentage of urban residents

	Total ACSH						Total ACSH					
	With pneumonia mortality rate per 1,000			Without pneumonia mortality rate per 1,000			With percent urban residents			Without percent urban residents		
	β		SE	β		SE	β		SE	β		SE
Population characteristic controls												
% Male	0.044	**	0.018	0.041	**	0.018	0.044	**	0.018	0.035	**	0.017
% African-American	-0.015		0.015	-0.012		0.016	-0.015		0.015	-0.005		0.015
% Hispanic	-0.022	****	0.006	-0.022	****	0.006	-0.022	****	0.006	-0.018	***	0.006
% Urban	0.006	**	0.003	0.005	*	0.003	0.006	**	0.003	-		-
SES index	-88.616	****	16.628	-85.859	****	16.754	-88.616	****	16.628	-71.816	****	15.074
Heart disease mortality rate	-0.040	**	0.020	-0.044	**	0.020	-0.040	**	0.020	-0.035	*	0.020
Respiratory disease mortality rate	-0.021		0.018	-0.019		0.018	-0.021		0.018	-0.021		0.018
Pneumonia mortality rate	0.285	*	0.149	-		-	0.285	*	0.149	0.220		0.150
Diabetes mortality rate	-0.987		2.067	-1.117		2.070	-0.987		2.067	-0.942		2.069
% residents ages 0-14 (Referent)	-		-	-		-	-		-	-		-
% residents ages 15-64	-12.627		16.399	-14.647		16.550	-12.627		16.399	-26.188	*	15.687
% residents ages 65 and over	28.925		28.006	28.120		28.383	28.925		28.006	4.886		26.890
Physician supply controls												
PCPs per 1,000	0.012		0.110	0.174	**	0.070	0.012		0.110	0.019		0.111
Specialists per 1,000	-0.023		0.080	-0.101		0.069	-0.023		0.080	-0.022		0.081
Health service use controls												
# of outpatient services per 1,000	0.001	****	2.0E-04	0.001	****	2.0E-04	0.001	****	2.0E-04	0.001	****	2.04E-04
Hospital Herfindahl Index	-4.347	***	1.382	-4.45	***	1.39	-4.347	***	1.382	-5.53	****	1.31
Time trend controls												
1998 (Referent)	-		-	-		-	-		-	-		-
1999	-0.050		0.304	-0.096		0.304	-0.050		0.304	-0.059		0.304
2000	-0.663	**	0.309	-0.664	**	0.309	-0.663	**	0.309	-0.657	**	0.309
2001	0.329		0.317	0.331		0.318	0.329		0.317	0.275		0.316
2002	0.702	**	0.329	0.667	**	0.329	0.702	**	0.329	0.644	*	0.328
2003	0.899	**	0.353	0.895	**	0.354	0.899	**	0.353	0.850	**	0.353
2004	-0.218		0.374	-0.215		0.375	-0.218		0.374	-0.281		0.374
2005	0.133		0.400	0.088		0.400	0.133		0.400	0.029		0.397
Intercept	-23.561		19.904	-19.389		20.017	-23.561		19.904	-0.222		17.262
N	450			450			450			450		

* p < 0.10; ** p < 0.05; *** p < 0.01; ****p < 0.001

Multivariate Models & Hypothesis Tests

The following sections describe the results of the multivariate models along with a discussion of how these results relate to the study hypotheses. Three models corresponding to the three outcomes are presented for each set of hypothesized relationships. The discussion is divided into the two aspects of market structure being evaluated: provider supply and inter-organizational relationships. Results related to the control variables conclude this section and are discussed generally across both aspects of market structure to reduce redundancy.

Provider supply

The first set of regressions test non-linear relationships between provider capacity and ACSH. The results of these regression models are shown in Table 12. Only one provider type is consistently associated with ACSH. The number of hospitals per 1,000 residents was significantly and positively associated with the rate of acute care ACSH ($\beta = 73.83$, $p<0.01$) and aggregate ACSH ($\beta=127.05$, $p<0.05$). The quadratic term for hospitals per 1,000 residents was also significantly associated with these two outcomes. The hospital capacity quadratic term was negatively associated with the rate of acute care ACSH ($\beta = -267.28$, $p<0.001$) and aggregate ACSH ($\beta = -492.92$, $p<0.01$). These results show that the rate of ACSH initially increases as hospital capacity increases; however, after a certain capacity in a market is reached, the rate of ACSH begins decreasing. The inflection point where the rate of ACSH begins decreasing is 0.13 hospitals per 1,000 market residents. In other words, increasing hospital capacity is associated with increasing rates of ACSH until markets reach an average capacity of 0.13 hospitals per 1,000 residents, after which rates of ACSH decline as hospital capacity increases. The results also show that the rate of acute care ACSH declines as community health center capacity (β= -15.87, $p<0.05$) and staff/group model HMO capacity (β= -8.04, $p<0.05$) increases.

Hypotheses 1a-1f predicted that ACSH rates would exhibit a U-shaped relationship with primary care organization capacity in a market. The rationale behind these hypotheses was that an increasing number of providers would initially open up more points of access, but at high levels of provider supply, coordination would be compromised. In this case, a hypothesis was considered supported if the first-order regression term was negatively associated with the ACSH rate and the second-order regression term was positively associated with the ACSH rate at the 0.10 significance level or smaller. The results of the analysis do not support this relationship. Furthermore, the results suggest that the opposite relationship exists for hospitals.

Table 12: Non-linear effects of provider capacity on ACSH

	Acute care ACSH			Chronic care ACSH			Total ACSH		
	β		SE	β		SE	β		SE
Explanatory variables									
CHCs per 1,000 residents	-15.87	**	7.88	-0.24		10.16	-17.74		16.81
CHCs per 1,000*CHCs per 1,000	39.25		33.69	-1.22		43.44	43.95		71.87
HHAs per 1,000 residents	-2.83		10.34	2.26		13.29	-2.16		21.91
HHAs per 1,000*HHAs per 1,000	64.22		81.78	-59.93		105.03	16.85		172.96
HMOs per 1,000 residents	-8.04	**	3.21	-3.15		4.27	-11.93		7.37
HMOs per 1,000*HMOs per 1,000	3.62		17.53	3.27		23.38	8.91		40.48
Hospitals per 1,000 residents	73.83	***	22.74	35.81		29.88	127.05	**	50.67
Hospitals per 1,000*Hospitals per 1,000	-267.28	****	77.89	-158.19		102.70	-492.92	***	174.92
SNFs per 1,000 residents	0.16		4.55	-4.16		5.83	-5.11		9.57
SNFs per 1,000*SNFs per 1,000	-21.76		21.41	-0.64		27.40	-20.38		44.95
POs per 1,000 residents	-79.21		75.58	-53.73		100.45	-133.61		172.97
POs per 1,000*POs per 1,000	1830.39		2398.01	1,667.83		3,159.30	4,294.14		5,372.07
Population characteristic controls									
% Male	0.02	**	0.01	0.01		0.01	0.03	*	0.02
% African-American	-0.01		0.01	4.4E-03		0.01	-4.4E-03		0.02
% Hispanic	-0.01	***	2.9E-03	-0.01	**	3.8E-03	-0.02	***	0.01
% Urban	2.5E-03		1.5E-03	3.6E-03	*	2.1E-03	0.01	*	0.00
SES index	-33.57	****	8.48	-35.95	***	11.32	-73.78	****	19.61
Heart disease mortality rate	-0.02	***	0.01	-0.03	***	0.01	-0.05	***	0.02
Respiratory disease mortality rate	-8.9E-04		0.01	-0.03	***	0.01	-0.03	*	0.02
Pneumonia mortality rate	0.10	**	0.05	0.20	***	0.06	0.29	***	0.10
Diabetes mortality rate	-2.03	*	1.06	0.32		1.36	-0.41		2.24
% residents ages 0-14 (Referent)	-		-	-		-	-		-
% residents ages 15-64	-4.19		7.91	-6.50		10.56	-8.10		18.30
% residents ages 65 and over	11.60		13.06	9.50		17.59	24.96		30.85
Health service use control									
# of outpatient services per 1,000	3.56E-04	****	1.0E-04	6.45E-04	****	1.3E-04	1.0E-03	****	2.2E-04
Time trend controls									
1998 (Referent)	-		-	-		-	-		-
1999	0.23		0.15	-0.32	*	0.19	-0.15	**	0.32
2000	-0.10		0.16	-0.53	**	0.21	-0.70		0.34
2001	0.54	***	0.18	-0.18		0.23	0.20		0.38
2002	0.52	***	0.17	0.28		0.22	0.59		0.36
2003	0.76	****	0.18	0.31		0.23	0.81	**	0.38
2004	0.13		0.19	-0.17		0.25	-0.30		0.41
2005	0.46	**	0.21	-0.20		0.27	-0.01		0.44
Intercept	-9.98		9.19	-3.97		12.31	-19.89		21.43
N	450			450			450		

* $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$; ****$p < 0.001$

The second set of provider supply models examined the relationship between provider composition and rates of ACSH (Table 13). Three provider types were consistently associated with the ACSH outcomes. The home health agency-to-hospital ratio was significantly and negatively associated with the rate of acute care ACSH ($\beta= -0.15$, $p<0.10$), chronic care ACSH ($\beta= -0.30$, $p<0.01$), and aggregate ACSH ($\beta= -0.50$, $p<0.01$). Similarly, the skilled nursing facility-to-hospital ratio was negatively associated with the rate of acute care ACSH ($\beta= -0.09$, $p<0.10$), chronic care ACSH ($\beta= -0.17$, $p<0.05$), and aggregate ACSH ($\beta= -0.30$, $p<0.05$). Finally, the ratio of physician organizations-to-hospitals was negatively associated with the rate of acute care ACSH ($\beta= -0.39$, $p<0.10$), chronic care ACSH ($\beta= -0.48$, $p<0.10$), and aggregate ACSH ($\beta= -0.85$, $p<0.10$).

Hypotheses 2a-2e predicted that higher ratios of ‘coordinative primary care organizations’ relative to hospitals would be associated with lower rates of ACSH. These hypotheses were considered supported if the coefficient was negatively associated with the ACSH rate at the 0.10 significance level or smaller. The results of the analysis provide support for three of the five predicted relationships. Specifically, the results support hypothesis 2b (home health agencies), hypothesis 2c (skilled nursing facilities), and hypothesis 2d (physician organizations). These results indicate that ACSH rates decrease as the number of home health agencies, skilled nursing facilities, and physician organizations increase relative to the number of hospitals in a market. The effect size and significance levels also suggest that the relationship with ACSH is strongest for chronic care ACSH and aggregated ACSH. Together, these results suggest that the composition of organizations in a market is an important consideration for improving ACSH rates, but the effect may depend upon the type of organization and the types of ACSH being considered.

Table 13: Effects of provider composition on ACSH

	Acute care ACSH			Chronic care ACSH			Total ACSH		
	β		SE	β		SE	β		SE
Explanatory variables									
CHC-to-hospital ratio	-0.11		0.07	-3.7E-03		0.09	-0.15		0.16
HHA-to-hospital ratio	-0.15	*	0.09	-0.30	***	0.11	-0.50	***	0.18
Staff/group HMO-to-hospital ratio	0.02		0.09	-0.01		0.11	0.04		0.19
SNF-to-hospital ratio	-0.09	*	0.06	-0.17	**	0.07	-0.30	**	0.12
PO-to-hospital ratio	-0.39	*	0.22	-0.48	*	0.28	-0.85	*	0.48
Population characteristic controls									
% Male	0.01		0.01	-1.9E-03		0.01	0.02		0.02
% African-American	-0.01		0.01	0.01		0.01	-2.2E-03		0.02
% Hispanic	-0.01	****	2.6E-03	-0.01	***	3.4E-03	-0.02	****	0.01
% Urban	4.9E-03	****	1.2E-03	0.01	****	1.6E-03	0.01	****	2.8E-03
SES index	-39.49	****	7.61	-38.27	****	10.04	-81.56	****	17.37
Heart disease mortality rate	-0.03	****	0.01	-0.02	**	0.01	-0.05	***	0.02
Respiratory disease mortality rate	0.01		0.01	-0.03	***	0.01	-0.02		0.02
Pneumonia mortality rate	0.12	****	0.03	0.15	****	0.04	0.26	****	0.08
Diabetes mortality rate	-2.38	**	0.97	0.06		1.20	-1.16		1.98
% residents ages 0-14 (Referent)	-		-	-		-	-		-
% residents ages 15-64	-0.80		7.28	-5.32		9.58	-4.24		16.59
% residents ages 65 and over	18.81		12.24	10.87		16.37	33.33		28.67
Health service use control									
# of outpatient services per 1,000	3.34E-04	****	9.5E-05	5.78E-04	****	1.2E-04	9.28E-04	****	1.97E-04
Time trend controls									
1998 (Referent)	-		-	-		-	-		-
1999	0.07		0.15	-0.54	***	0.19	-0.54	*	0.31
2000	-0.31	*	0.16	-0.76	****	0.20	-1.17	****	0.32
2001	0.18		0.19	-0.68	***	0.24	-0.73	*	0.39
2002	0.30	*	0.17	-0.04		0.21	0.00		0.35
2003	0.56	***	0.17	0.04		0.22	0.31		0.35
2004	-0.06		0.18	-0.42	*	0.23	-0.78	**	0.37
2005	0.21		0.20	-0.49	*	0.25	-0.57		0.41
Intercept	-11.44		8.85	-0.86		11.71	-17.46		20.33
N	450			450			450		

* $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$; **** $p < 0.001$

Inter-organizational Relationships

A final set of regression models was used to assess the effects of inter-organizational relationships on the rates of ACSH (Table 14). The proportion of market hospitals with a formal physician relationship was the only covariate significantly associated with the rate of ACSH; the proportion of hospitals with a formal physician relationship was positively associated with the rate of acute care ACSH ($\beta=0.31$, $p<0.10$) and aggregate ACSH ($\beta=0.66$, $p<0.10$). These results show that the rate of acute care ACSH and aggregate ACSH increase as the proportion of market hospitals with a formal physician relationship increases.

Hypothesis 4 predicted that a formal relationship between a hospital and a physician organization would be negatively associated with ACSH rates. In this case, the hypothesis was considered supported if the covariate was negatively associated with the ACSH rate at the 0.10 significance level or smaller. The physician-hospital relationship covariate was positively associated with all three ACSH rates and opposite of what was predicted in hypothesis 4; thus, this hypothesis was not supported by the analysis. Hypothesis 3 predicted that the proportion of same-system hospitals in a market would be negatively associated with the ACSH rates. The results of the analysis were not statistically significant and do not support this hypothesis. Similarly, hypotheses 5 and 6 predicted the proportion of hospitals with an ownership interest in an insurance product and a nursing home would be negatively associated with ACSH rates. The results of the analysis were not statistically significant and do not support either of these hypotheses.

In aggregate, the inter-organizational analysis suggests that most formal relationships between hospitals and other health care organizations do not significantly affect ACSH rates. Among the four relationships considered in the study, a formal relationship between hospitals and physicians seems to be the most important consideration. However, contrary to what was expected, a formal relationship between hospitals and physicians actually increases ACSH rates. Similar to the provider composition models, the effects of the relationship seem to differ by the type of ACSH considered, with the relationship significant only for rates of acute care ACSH and aggregate ACSH.

Table 14: Effects of inter-organizational relationships on ACSH

	Acute care ACSH			Chronic care ACSH			Total ACSH		
	β		SE	β		SE	β		SE
Explanatory variables									
Proportion hospitals-same system	-0.09		0.27	-0.02		0.34	-0.06		0.57
Proportion hospitals-own insurance	-0.16		0.33	-0.61		0.42	-0.87		0.69
Proportion hospitals-own nursing home	-0.27		0.19	-0.27		0.24	-0.62		0.40
Proportion hospitals-any phys. relationship	0.31	*	0.17	0.27		0.22	0.66	*	0.36
Population characteristic controls									
% Male	0.02	***	0.01	0.02	*	0.01	0.04	**	0.02
% African-American	-0.01	*	0.01	2.0E-03		0.01	-0.01		0.02
% Hispanic	-0.01	****	2.5E-03	-0.01	***	0.00	-0.02	****	0.01
% Urban	2.5E-03	**	1.2E-03	3.2E-03	**	1.5E-03	0.01	**	2.7E-03
SES index	-40.59	****	7.30	-41.26	****	9.50	-83.74	****	16.65
Heart disease mortality rate	-0.02	**	0.01	-0.02		0.01	-0.04	*	0.02
Respiratory disease mortality rate	2.6E-03		0.01	-0.02	*	0.01	-0.02		0.02
Pneumonia mortality rate	0.16	**	0.07	0.11		0.09	0.27	*	0.15
Diabetes mortality rate	-2.11	**	1.02	0.01		1.28	-0.78		2.12
% residents ages 0-14 (Referent)	-		-	-		-	-		-
% residents ages 15-64	-4.85		7.24	-10.65		9.38	-15.78		16.36
% residents ages 65 and over	16.49		11.97	11.55		15.67	28.47		27.80
Physician supply controls									
PCPs per 1,000	-0.06		0.05	0.10		0.07	0.03		0.11
Specialists per 1,000	0.04		0.04	-0.10	**	0.05	-0.04		0.08
Market use and competition controls									
# of outpatient services per 1,000	3.7E-04	****	9.7E-05	6.2E-04	****	1.2E-04	1.0E-03	****	2.04E-04
Hospital Herfindahl Index	-1.84	***	0.65	-2.46	***	0.83	-4.69	****	1.42
Time trend controls									
1998 (Referent)	-		-	-		-	-		-
1999	0.26	*	0.15	-0.32	*	0.19	-0.12		0.31
2000	-0.15		0.15	-0.49	**	0.19	-0.73	**	0.31
2001	0.52	***	0.16	0.00		0.20	0.37		0.33
2002	0.56	****	0.16	0.50	**	0.21	0.84	**	0.34
2003	0.74	****	0.17	0.54	**	0.22	1.01	**	0.36
2004	0.10		0.18	0.08		0.23	-0.10		0.38
2005	0.38	*	0.19	0.13		0.24	0.23		0.40
Intercept	-11.86		8.67	-5.96		11.29	-20.35		19.83
N	450			450			450		

* $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$; ****$p < 0.001$

Control Variables

The strongest and most robust results for control variables were observed for the socioeconomic status (SES) index, the percentage of Hispanic residents in a market, and the number of outpatient services per 1,000 residents. The SES index was strongly and negatively significant for all three ACSH rates across all relationships tested in the study. These results indicate that the rate of ACSH declines as the economic and educational status of individuals increases. Similarly, the relationship between the percentage of Hispanic residents and ACSH was consistently negative across all three ACSH rates. In contrast, the number of outpatient services per 1,000 residents in a market is positively associated with the three ACSH rates.

Three other control variables that displayed relatively consistent results across the outcomes were the percentage of urban residents, heart disease mortality rate, and gender. The percentage of residents living in urban areas was consistently associated with higher rates of ACSH. However, the effect size was typically small. Similarly, the percentage of male residents was consistently associated with higher rates of ACSH. In contrast, higher mortality rates for heart disease were associated with lower rates of ACSH. The hospital Herfindahl Index was also consistently and negatively associated with the rates of ACSH, indicating that as hospital competition declines, rates of ACSH decrease as well.

Summary of Multivariate Models

The findings of this study indicate that some health care system characteristics have a significant effect on ACSH rates and may play an important role in improving access. Specifically, provider composition displayed consistent results across the ACSH outcomes, with three of the five provider ratios (home health agency-to-hospital ratio, skilled nursing facility-to-hospital ratio, physician organization-to-hospital ratio) significantly and negatively associated with ACSH rates. In contrast, provider capacity did not exhibit robust results across the provider types considered in the study, nor were these relationships non-linear. These results suggest that certain aspects of provider supply may be more important for improving ACSH rates. Also notable was the pattern of results across the different outcomes, with significant relationships between market structure and ACSH rates more often related to acute care rates or aggregated rates. For example, hospital capacity was significantly and non-linearly associated with the acute care ACSH rate and aggregated ACSH rate but was not significantly associated with chronic care ACSH rates. Similarly, the proportion of hospitals in a market with a formal relationship with a physician organization was significantly and positively associated with the acute care ACSH rate and the aggregated ACSH rate but not with the chronic care hospitalization rate. This pattern suggests that the effects of some market characteristics may pertain more to certain types of ambulatory conditions.

The multivariate analysis also highlights the value of incorporating multiple perspectives when examining ACSH, which is consistent with recommendations to consider multiple explanations when explaining small area variations (Davis et al. 2000; Stano 1991). For example, the effects of the health care system characteristics were significant even after controlling for the effects of population characteristics, many of which were also significantly associated with ACSH rates. Consistent with previous research, the results support the importance of enabling characteristics, with SES being one of the most consistent and significant controls associated with lower rates of ACSH.

The results also suggest that the use of outpatient health services may actually increase inpatient utilization, a somewhat counterintuitive result that has some support in the literature (Gill, Mainous, and Nsereko 2003; Weinberger, Oddone, and Henderson 1996). Interestingly, the relationships between ACSH rates, race/ethnicity, and geographic location contrast with previous ACSH research. Most research describes minorities as having more barriers to access, which ostensibly leads to more significant health problems that manifest in inpatient stays (Cable 2002; Chang, Mirvis, and Waters 2008; Laditka and Laditka 2006). A similar relationship is argued to exist for people who live in rural areas (DeLia 2003; Laditka and Laditka 1999; Penfold et al. 2008). The results of this study suggest that larger proportions of these types of residents in a market are actually associated with lower ACSH rates.

Sensitivity Analysis

ACSH research typically combines all clinical conditions into one aggregated ACSH outcome. However, given that most of the relationships being tested in this study have not been explored in previous research, the main analysis was supplemented with a sensitivity analysis to determine whether the direction and statistical significance of the relationships vary across individual conditions and whether aggregation may obscure underlying variation.

The sensitivity analysis first entailed running the previous models using the eleven condition specific rates of ACSH as outcomes. The results of these regression models are included in Tables 15, 16, and 17. For provider capacity, the condition specific models are generally consistent with the aggregated models. Hospital capacity exhibits a non-linear relationship with the rate of perforated appendix hospitalizations and pneumonia hospitalizations. Once again, these relationships were in the opposite direction predicted, increasing initially as the number of hospitals increased and then decreasing after some level of hospital capacity was reached. Interestingly, community health center capacity displayed a non-linear relationship with several ACSH rates when examined on a condition-specific basis, whereas the aggregated models did not show any significant relationships. For dehydration and long-term complications of diabetes hospitalization rates, the relationship was in the direction predicted, declining initially as capacity increased and then increasing after some level of health center capacity was reached. In contrast, health center capacity was related to hypertension hospitalization rates in the opposite manner, increasing initially and then declining at higher levels of capacity. In sum, these results suggest that provider capacity may have a non-linear relationship with ACSH rates; however, the relationship may be limited to select clinical conditions. The results also suggest that the direction of the relationship depends upon the clinical condition. Condition-specific results for the provider composition models tell a similar story. The same provider types are generally significant in both the condition-specific models and the aggregated models; however, the significant relationships are limited to select clinical conditions, specifically angina, asthma, and congestive heart failure.

Condition-specific, inter-organizational relationship models provide an interesting contrast to the aggregated outcome models. Unlike the aggregated outcome models, where only the hospital-physician relationship was significant, the condition-specific models indicate that the proportion of hospitals that own a nursing home and the proportion of hospitals that own an insurance product are significantly associated with several condition-specific outcomes. Specifically, the proportion of hospitals that own a nursing home was negatively associated with hospitalization rates for perforated appendix, angina, asthma, and hypertension. The same proportion was positively associated with the rate of uncontrolled diabetes hospitalizations. The proportion of hospitals that own an insurance product was negatively associated with hospitalization rates for congestive heart failure, chronic obstructive pulmonary disease, and uncontrolled diabetes. In contrast, the proportion of hospitals with a formal physician relationship was positively associated with hospitalization rates for pneumonia, angina, asthma, and congestive heart failure, which is consistent with the aggregated outcome models.

Similar to the provider supply models, the condition-specific, inter-organizational relationship models highlight that significant relationships may exist, but they may be isolated to certain clinical conditions. Furthermore, positive associations for some types of relationships (e.g., hospital-physician) and negative associations for others (e.g., own an insurance product and own a nursing home) for the same clinical condition suggest that different types of relationships may present conflicting demands on hospitals. Finally, from a methodological standpoint, the sensitivity analysis suggests that strong relationships for certain clinical conditions may drive significance at an aggregated level. For instance, a strong relationship between the proportion of hospitals with a formal physician relationship and the pneumonia hospitalization rate ($\beta=0.26$, $p<0.01$) appears to be what resulted in a significant relationship at the aggregated level, given that the proportion was not significantly related to the other two acute care conditions (dehydration and perforated appendix).

Table 15: Sensitivity analysis of the non-linear effects of provider supply on condition-specific ACSH

	Acute care ACSH								
	Dehydration			Perforated appendix			Pneumonia		
	β		SE	β		SE	β		SE
Explanatory variables									
CHCs per 1,000 residents	-4.77	**	1.89	-1.33	**	0.62	-4.61		4.48
CHCs per 1,000*CHCs per 1,000	20.98	***	8.08	3.26		2.66	-3.77		19.18
HHAs per 1,000 residents	-0.49		2.49	-0.35		0.83	7.70		5.94
HHAs per 1,000*HHAs per 1,000	10.18		19.68	4.91		6.57	-11.42		47.11
HMOs per 1,000 residents	-0.53		0.75	-0.59	***	0.23	-4.15	**	1.69
HMOs per 1,000*HMOs per 1,000	1.08		4.11	0.20		1.23	-0.35		9.22
Hospitals per 1,000 residents	5.04		5.38	4.39	***	1.67	29.74	**	12.34
Hospitals per 1,000*Hospitals per 1,000	-25.92		18.39	-14.86	***	5.65	-101.74	**	41.94
SNFs per 1,000 residents	-0.63		1.10	-0.04		0.37	-1.23		2.65
SNFs per 1,000*SNFs per 1,000	-3.92		5.16	0.13		1.75	1.00		12.45
POs per 1,000 residents	-12.99		17.76	-0.98		5.34	-9.20		39.96
POs per 1,000*POs per 1,000	285.04		566.53	36.08		173.71	-173.13		1,291.18
% Male	3.3E-03	*	1.9E-03	1.7E-03	***	5.9E-04	0.01	***	4.4E-03
% African-American	-2.7E-03	*	1.6E-03	-7.2E-04		4.6E-04	-4.2E-03		3.5E-03
% Hispanic	-9.3E-04		6.6E-04	-3.8E-04	*	1.9E-04	-0.01	****	1.5E-03
% Urban	7.6E-04	**	3.6E-04	2.2E-04	**	1.0E-04	1.0E-03		7.9E-04
SES index	-5.42	***	1.99	-1.47	**	0.59	-18.51	****	4.44
Heart disease mortality rate	-4.1E-03	**	2.0E-03	-1.2E-03	*	6.5E-04	-0.01	**	4.7E-03
Respiratory disease mortality rate	1.0E-03		2.0E-03	-2.3E-03	****	6.7E-04	-0.01		4.8E-03
Pneumonia mortality rate	0.03	**	0.01	3.0E-03		3.3E-03	0.04	*	0.02
Diabetes mortality rate	-0.33		0.26	-0.22	**	0.09	-0.34		0.61
% residents ages 15-64	-1.34		1.86	-0.66		0.56	-3.97		4.16
% residents ages 65 and over	3.79		3.04	0.49		0.88	6.18		6.69
# of outpatient services per 1,000	3.7E-05		2.4E-05	-2.9E-06		8.0E-06	1.2E-04	**	5.8E-05
1999	0.02		0.04	0.02		0.01	0.36	****	0.09
2000	0.03		0.04	0.04	***	0.01	0.11		0.09
2001	0.07	*	0.04	0.11	****	0.01	0.24	**	0.11
2002	0.13	***	0.04	0.12	****	0.01	0.25	**	0.10
2003	0.13	***	0.04	0.21	****	0.01	0.36	****	0.10
2004	0.04		0.05	0.18	****	0.02	-0.03		0.11
2005	0.04		0.05	0.19	****	0.02	0.27	**	0.12
Intercept	-1.85		2.15	-0.66		0.63	-5.44		4.77
N	450			450			450		

* p < 0.10; ** p < 0.05; *** p < 0.01; ****p < 0.001

Table 15: Sensitivity analysis of the non-linear effects of provider supply on condition-specific ACSH (cont)

	Chronic care ACSH											
	Angina			Asthma			CHF			COPD		
	β		SE	β		SE	β		SE	β		SE
Explanatory variables												
CHCs per 1,000 residents	-2.74	**	1.28	1.54		1.33	-3.95		3.51	0.45		3.03
CHCs per 1,000*CHCs per 1,000	6.63		5.49	-5.50		5.69	9.32		15.02	-3.01		12.96
HHAs per 1,000 residents	1.53		1.73	0.77		1.74	-2.21		4.63	5.88		4.02
HHAs per 1,000*HHAs per 1,000	-16.08		13.80	-2.10		13.79	-14.15		36.68	-38.53		31.97
HMOs per 1,000 residents	0.25		0.44	-0.30		0.55	-1.86		1.37	1.69	*	1.12
HMOs per 1,000*HMOs per 1,000	1.99		2.38	1.29		3.01	-1.90		7.47	10.26		6.09
Hospitals per 1,000 residents	0.59		3.31	1.30		3.88	15.82		9.87	-12.53		8.22
Hospitals per 1,000*Hospitals per 1,000	-7.50		11.11	-6.99		13.31	-69.17	**	33.65	23.43		27.88
SNFs per 1,000 residents	-1.09		0.79	-1.34	*	0.77	-1.82		2.05	-0.31		1.80
SNFs per 1,000*SNFs per 1,000	2.28		3.71	4.99		3.60	5.28		9.65	-7.75		8.48
POs per 1,000 residents	2.83		10.33	10.18		12.96	-43.85		32.32	11.71		26.42
POs per 1,000*POs per 1,000	165.16		339.91	-438.49		409.57	1,317.16		1,036.45	-415.69		857.61
% Male	3.1E-03	***	1.2E-03	7.6E-06		1.4E-03	7.9E-06		3.6E-03	0.01	**	2.9E-03
% African-American	3.8E-04		8.7E-04	1.3E-03		1.2E-03	4.5E-04		2.9E-03	-2.0E-03		2.3E-03
% Hispanic	-2.4E-04		3.6E-04	-3.8E-04		4.9E-04	-1.9E-03		1.2E-03	-3.4E-03	****	9.6E-04
% Urban	-1.2E-04		2.0E-04	4.8E-04	*	2.6E-04	9.3E-04		6.4E-04	1.1E-03	**	5.2E-04
SES index	-1.68		1.14	-3.75	**	1.46	-8.00	**	3.61	-11.47	****	2.93
Heart disease mortality rate	-1.5E-03		1.3E-03	-9.4E-04		1.5E-03	-0.01		3.8E-03	-0.01	***	3.2E-03
Respiratory disease mortality rate	-1.4E-03		1.4E-03	-2.4E-03	*	1.4E-03	-0.01	**	3.7E-03	-0.01	***	3.3E-03
Pneumonia mortality rate	0.00		0.01	0.01		0.01	0.04	**	0.02	0.06	****	0.02
Diabetes mortality rate	0.60	***	0.18	0.12		0.18	-0.15		0.48	0.21		0.42
% residents ages 15-64	0.47		1.08	-0.45		1.36	0.25		3.37	-4.88	*	2.75
% residents ages 65 and over	2.25		1.67	1.73		2.25	6.85		5.48	1.00		4.39
# of outpatient services per 1,000	8.7E-06		1.7E-05	5.4E-05	***	1.7E-05	1.5E-04	****	4.5E-05	1.2E-04	***	3.9E-05
1999	-0.01		0.03	0.02		0.03	-0.20	***	0.07	0.14	**	0.06
2000	-0.01		0.03	-0.02		0.03	-0.14	*	0.07	0.04		0.06
2001	-0.08	**	0.03	-0.03		0.03	-0.17	**	0.08	0.16	**	0.07
2002	-0.11	****	0.03	0.02		0.03	0.01		0.08	0.14	**	0.07
2003	-0.08	***	0.03	0.04		0.03	3.9E-03		0.08	0.07		0.07
2004	-0.10	***	0.03	-0.05		0.03	-0.02		0.09	-0.16	**	0.08
2005	-0.10	***	0.04	-0.02		0.04	0.00		0.09	-0.15	*	0.08
Intercept	-2.17		1.21	-0.71		1.58	-1.11		3.89	-1.79		3.14
N	450			450			450			450		

* p < 0.10; ** p < 0.05; *** p < 0.01; ****p < 0.001

Table 15: Sensitivity analysis of the non-linear effects of provider supply on condition-specific ACSH (cont)

	Chronic care ACSH											
	Hypertension			Short-term complications of diabetes			Long-term complications of diabetes			Uncontrolled diabetes		
	β		SE	β		SE	β		SE	β		SE
Explanatory variables												
CHCs per 1,000 residents	2.39	**	1.19	0.94		0.62	-2.97	***	0.97	0.01		0.18
CHCs per 1,000*CHCs per 1,000	-11.43	**	5.10	-2.07		2.64	15.13	****	4.15	0.45		0.76
HHAs per 1,000 residents	1.88		1.57	1.23		0.89	1.93		1.32	0.49	*	0.29
HHAs per 1,000*HHAs per 1,000	-17.17		12.41	-13.38	*	7.41	-6.81		10.55	-3.15		2.71
HMOs per 1,000 residents	-0.26		0.48	0.25		0.18	0.31		0.32	0.05		0.05
HMOs per 1,000*HMOs per 1,000	-0.05		2.61	1.56	*	0.94	0.10		1.74	0.15		0.25
Hospitals per 1,000 residents	-0.96		3.41	-2.10		1.40	-1.26		2.45	0.05		0.39
Hospitals per 1,000*Hospitals per 1,000	4.95		11.65	4.57		4.60	-2.08		8.19	-1.12		1.26
SNFs per 1,000 residents	-1.10		0.69	-0.66		0.45	-0.84		0.61	-0.43	**	0.18
SNFs per 1,000*SNFs per 1,000	3.53		3.26	0.68		2.16	2.44		2.87	1.79	**	0.90
POs per 1,000 residents	2.15		11.26	4.27		3.97	2.21		7.54	0.63		0.97
POs per 1,000*POs per 1,000	-132.63		358.93	-111.17		133.36	-121.68		249.51	-15.18		32.90
% Male	1.4E-03		1.2E-03	-2.0E-05		4.7E-04	3.1E-04		8.5E-04	-2.1E-04		1.3E-04
% African-American	6.9E-04		1.0E-03	2.8E-04		3.0E-04	-4.0E-05		6.2E-04	9.7E-07		6.8E-05
% Hispanic	-2.9E-04		4.2E-04	-4.1E-04	***	1.3E-04	-5.4E-04	**	2.6E-04	-2.0E-05		3.1E-05
% Urban	3.2E-04		2.3E-04	1.5E-04	**	7.3E-05	5.6E-04	****	1.4E-04	2.0E-05		1.8E-05
SES index	-2.93	**	1.26	-1.00	**	0.44	-2.75	***	0.83	-0.15		0.11
Heart disease mortality rate	-3.4E-03	**	1.3E-03	-5.3E-04		6.2E-04	-5.8E-04		9.7E-04	1.5E-04		2.2E-04
Respiratory disease mortality rate	-1.6E-03		1.3E-03	1.2E-03		8.6E-04	-2.1E-03	*	1.1E-03	-3.3E-04		4.0E-04
Pneumonia mortality rate	0.02	**	0.01	2.3E-03		2.4E-03	0.01	***	4.6E-03	6.1E-04		5.9E-04
Diabetes mortality rate	0.20		0.16	0.08		0.10	-0.17		0.14	0.09	***	0.04
% residents ages 15-64	-0.74		1.18	-0.77	*	0.45	-1.19		0.79	0.06		0.13
% residents ages 65 and over	0.86		1.93	-0.25		0.61	1.02		1.20	0.14		0.15
# of outpatient services per 1,000	2.7E-05	*	1.5E-05	9.8E-06		8.1E-06	3.8E-05	***	1.3E-05	-5.4E-07		2.4E-06
1999	-0.08	****	0.02	-0.09	****	0.02	0.06	***	0.02	-0.07	****	0.01
2000	-0.11	****	0.02	-0.08	****	0.02	0.07	***	0.02	-0.06	****	0.01
2001	-0.06	**	0.03	-0.01		0.02	0.09	****	0.02	-0.08	****	0.01
2002	1.5E-03		0.03	0.06	****	0.02	0.13	****	0.02	-0.02	**	0.01
2003	0.01		0.03	0.02		0.02	0.11	****	0.02	-0.07	****	0.01
2004	-0.09	***	0.03	0.03		0.02	0.14	****	0.03	-0.07	****	0.01
2005	-0.07	**	0.03	0.02		0.02	0.15	****	0.03	-0.08	****	0.01
Intercept	-0.78		1.36	0.40		0.46	-0.07		0.88	0.05		0.12
N	450			450			450			450		

* p < 0.10; ** p < 0.05; *** p < 0.01; ****p < 0.001

Table 16: Sensitivity analysis of the effects of provider ratios on condition-specific ACSH

	Acute care ACSH								
	Dehydration			Perforated appendix			Pneumonia		
	β		SE	β		SE	β		SE
Explanatory variables									
CHC-to-hospital ratio	-0.013		0.018	-0.011	*	0.006	-0.078	*	0.042
HHA-to-hospital ratio	-0.028		0.021	-0.002		0.007	-0.022		0.050
Staff/group HMO-to-hospital ratio	-0.025		0.014	-0.002		0.005	0.000		0.049
SNF-to-hospital ratio	0.024	*	0.020	-0.002		0.006	-0.041		0.033
PO-to-hospital ratio	-0.044		0.051	0.005		0.016	-0.201	*	0.122
% Male	0.002		0.002	0.002	***	0.001	0.009	*	0.005
% African-American	-0.001		0.002	-0.001	*	4.5E-04	-0.004		0.004
% Hispanic	-0.001	*	0.001	-4.6E-04	***	1.8E-04	-0.007	****	0.001
% Urban	0.001	****	0.000	3.6E-04	****	8.3E-05	0.003	****	0.001
SES index	-5.724	***	1.760	-1.702	***	0.538	-23.538	****	4.217
Heart disease mortality rate	-0.004	**	0.002	-0.001	**	0.001	-0.013	***	0.004
Respiratory disease mortality rate	0.002		0.002	-0.002	***	0.001	-0.001		0.005
Pneumonia mortality rate	0.024	***	0.008	0.005	**	0.002	0.050	***	0.019
Diabetes mortality rate	-0.380		0.237	-0.197	**	0.080	-0.674		0.568
% residents ages 15-64	-0.553		1.691	-0.435		0.523	-0.351		4.051
% residents ages 65 and over	3.908		2.797	0.721		0.840	12.760	*	6.703
# of outpatient services per 1,000	3.3E-05		2.3E-05	-3.0E-06		7.6E-06	9.1E-05	***	5.5E-05
1999	-0.005		0.037	0.016		0.013	0.269		0.089
2000	-0.013		0.039	0.031	**	0.013	-0.023		0.094
2001	-0.019		0.047	0.102	****	0.016	0.085		0.112
2002	0.079	*	0.042	0.113	****	0.014	0.118		0.099
2003	0.076	*	0.043	0.204	****	0.014	0.242	**	0.102
2004	-0.015		0.045	0.180	****	0.015	-0.139		0.107
2005	-0.025		0.049	0.189	****	0.017	0.151		0.118
Intercept	-2.047		2.043	-0.920		0.623	-8.229		4.894
N	450			450			450		

* $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$; ****$p < 0.001$

Table 16: Sensitivity analysis of the effects of provider ratios on condition-specific ACSH (cont)

	Chronic care ACSH											
	Angina			Asthma			CHF			COPD		
	β		SE	β		SE	β		SE	β		SE
Explanatory variables												
CHC-to-hospital ratio	-0.039	****	0.012	0.013		0.012	-0.026		0.032	-0.011		0.029
HHA-to-hospital ratio	-0.018		0.015	-0.034	**	0.014	-0.129	****	0.038	-0.051		0.034
Staff/group HMO-to-hospital ratio	0.025	*	0.012	-0.010		0.015	0.012		0.038	0.033		0.033
SNF-to-hospital ratio	-0.022	**	0.010	-0.019	**	0.009	-0.037		0.025	-0.041	*	0.022
PO-to-hospital ratio	0.065	**	0.032	-0.035		0.037	-0.166	*	0.095	-0.081		0.082
% Male	0.003	**	0.001	-0.001		0.001	-0.002		0.004	0.004		0.003
% African-American	0.001		0.001	0.002		0.001	0.001		0.003	-0.001		0.002
% Hispanic	-3.0E-04		3.4E-04	0.000		4.4E-04	-0.003	**	0.001	-0.003	****	0.001
% Urban	2.3E-04		1.6E-04	0.001	***	2.1E-04	0.002	****	0.001	0.001	****	0.000
SES index	-2.131	**	1.056	-3.851	***	1.300	-9.827	***	3.339	-12.297	****	2.825
Heart disease mortality rate	-0.002		0.001	-3.7E-04		0.001	-0.003		0.003	-0.009	***	0.003
Respiratory disease mortality rate	-0.001		0.001	-0.002	*	0.001	-0.008	**	0.003	-0.009	***	0.003
Pneumonia mortality rate	0.005		0.005	0.006		0.006	0.025	*	0.015	0.062	****	0.013
Diabetes mortality rate	0.625	****	0.168	0.054		0.161	0.014		0.426	0.009		0.384
% residents ages 15-64	1.086		1.037	0.047		1.242	0.984		3.195	-3.449		2.716
% residents ages 65 and over	3.082	*	1.629	1.867		2.103	7.553		5.370	2.106		4.482
# of outpatient services per 1,000	-2.3E-06		1.6E-05	4.9E-05	***	1.6E-05	1.2E-04	***	4.2E-05	9.6E-05	***	3.7E-05
1999	-0.028		0.026	-0.010		0.025	-0.270	****	0.066	0.067		0.060
2000	-0.034		0.028	-0.058	**	0.026	-0.213	***	0.070	-0.045		0.063
2001	-0.123	****	0.033	-0.084	***	0.032	-0.284	****	0.084	-0.004		0.076
2002	-0.136	****	0.030	-0.026		0.028	-0.074		0.074	0.021		0.067
2003	-0.111	****	0.030	0.001		0.029	-0.065		0.076	-0.042		0.069
2004	-0.118	****	0.032	-0.093	***	0.030	-0.077		0.080	-0.275	****	0.073
2005	-0.125	****	0.035	-0.062	*	0.034	-0.068		0.089	-0.270	****	0.080
Intercept	-2.896		1.219	-0.461		1.514	-1.532		3.885	-1.610		3.277
N	450			450			450			450		

* $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$; ****$p < 0.001$

Table 16: Sensitivity analysis of the effects of provider ratios on condition-specific ACSH (cont)

	Chronic care ACSH											
	Hypertension			Short-term complications of diabetes			Long-term complications of diabetes			Uncontrolled diabetes		
	β		SE	β		SE	β		SE	β		SE
Explanatory variables												
CHC-to-hospital ratio	0.007		0.011	0.005		0.005	-0.004		0.009	1.1E-04		0.002
HHA-to-hospital ratio	-0.035	***	0.013	-0.002		0.008	0.002		0.011	0.001		0.003
Staff/group HMO-to-hospital ratio	0.008		0.013	-4.8E-04		0.004	-0.004		0.009	1.8E-04		0.001
SNF-to-hospital ratio	-0.015	*	0.009	-0.013	**	0.005	-0.018	**	0.008	-0.005	**	0.002
PO-to-hospital ratio	-0.034		0.032	0.010		0.011	-0.026		0.023	0.001		0.004
% Male	0.000		0.001	-2.0E-05		4.4E-04	1.2E-04		0.001	-1.5E-04		1.4E-04
% African-American	0.001		0.001	2.7E-04		2.7E-04	4.9E-04	*	0.001	3.2E-05		8.0E-05
% Hispanic	-3.9E-04		3.8E-04	-3.8E-04	****	1.1E-04	-4.1E-04	****	2.4E-04	-1.0E-05		3.2E-05
% Urban	0.001	***	1.8E-04	1.2E-04	**	5.4E-05	0.001	***	1.2E-04	1.1E-05		1.7E-05
SES index	-3.377	***	1.129	-0.902	**	0.376	-2.269		0.755	-0.181		0.121
Heart disease mortality rate	-0.003	***	0.001	-0.001		0.001	0.000		0.001	2.2E-04		2.4E-04
Respiratory disease mortality rate	-0.002		0.001	0.001		0.001	-0.002		0.001	-3.5E-04		3.8E-04
Pneumonia mortality rate	0.015	***	0.005	0.003	*	0.002	0.005		0.003	4.5E-04		0.001
Diabetes mortality rate	0.116		0.147	0.044		0.093	-0.212		0.131	0.089	**	0.037
% residents ages 15-64	-0.412		1.081	-0.602		0.414	-0.701		0.755	0.135		0.141
% residents ages 65 and over	1.396		1.807	-0.472		0.544	0.540		1.149	0.227		0.168
# of outpatient services per 1,000	1.8E-05		1.4E-05	8.5E-06		7.1E-06	2.9E-05	**	1.2E-05	-2.1E-06		2.4E-06
1999	-0.104	****	0.023	-0.092	****	0.016	0.048	**	0.021	-0.072	****	0.007
2000	-0.142	****	0.024	-0.082	****	0.017	0.042	*	0.022	-0.068	****	0.007
2001	-0.095	***	0.029	-0.025		0.019	0.030		0.026	-0.083	****	0.008
2002	-0.033		0.026	0.053	***	0.017	0.084	****	0.023	-0.022	***	0.008
2003	-0.018		0.026	0.013		0.018	0.066	***	0.024	-0.072	****	0.008
2004	-0.109	****	0.028	0.017		0.018	0.089	****	0.025	-0.075	****	0.008
2005	-0.091	***	0.031	0.009		0.020	0.098	****	0.027	-0.079	****	0.008
Intercept	-0.589		1.312	0.424		0.429	-0.059		0.870	-0.011		0.136
N	450			450			450			450		

$*$ $p < 0.10$; $**$ $p < 0.05$; $***$ $p < 0.01$; $****$ $p < 0.001$

Table 17: Sensitivity analysis of the effects of inter-organizational relationships on condition-specific ACSH

	Acute care ACSH								
	Dehydration			Perforated appendix			Pneumonia		
	β		SE	β		SE	β		SE
Explanatory variables									
Proportion hospitals-same system	-0.005		0.065	0.023		0.022	0.066		0.158
Proportion hospitals-own insurance	0.042		0.079	0.042		0.027	-0.019		0.192
Proportion hospitals-own nursing home	-0.053		0.046	-0.027	*	0.015	-0.099		0.111
Proportion hospitals-any phys. relationship	0.032		0.041	-0.003		0.014	0.259	***	0.100
% Male	0.003	*	0.002	0.001	**	0.001	0.013	***	0.004
% African-American	-0.003	*	0.002	-0.001	**	4.6E-04	-0.006	*	0.004
% Hispanic	-0.001	*	0.001	-4.0E-04	**	1.8E-04	-0.007	****	0.001
% Urban	0.001	**	2.7E-04	2.6E-04	***	8.3E-05	0.002	**	6.5E-04
SES index	-5.683	***	1.711	-1.592	***	0.524	-24.638	****	4.082
Heart disease mortality rate	-0.003		0.002	-0.002	**	0.001	-0.007		0.005
Respiratory disease mortality rate	-1.8E-04		0.002	-0.002	***	0.001	-0.002		0.005
Pneumonia mortality rate	0.030	*	0.016	0.006		0.005	0.072	*	0.038
Diabetes mortality rate	-0.280		0.244	-0.167	**	0.083	-0.766		0.591
% residents ages 15-64	-1.160		1.699	-0.461		0.528	-2.414		4.062
% residents ages 65 and over	3.139		2.796	0.558		0.840	12.894	*	6.651
PCPs per 1,000	-0.022	*	0.012	-0.002		0.004	-0.022		0.030
Specialists per 1,000	0.022	**	0.009	0.003		0.003	0.011		0.022
# of outpatient services per 1,000	4.5E-05	*	2.3E-05	-1.9E-06		7.7E-06	8.8E-05		5.6E-05
Hospital Herfindahl Index	-0.172		0.154	-0.049		0.049	-0.994	***	0.369
1999	0.033		0.036	0.023	*	0.012	0.336	****	0.088
2000	0.014		0.036	0.034	***	0.012	0.021		0.088
2001	0.050		0.038	0.110	****	0.013	0.226	**	0.092
2002	0.108	***	0.039	0.118	****	0.013	0.218	**	0.095
2003	0.088	**	0.042	0.202	****	0.014	0.319	***	0.101
2004	-0.013		0.044	0.178	****	0.015	-0.060		0.106
2005	-0.010		0.046	0.175	****	0.016	0.198	*	0.112
Intercept	-1.909		2.032	-0.710		0.620	-8.478		4.845
N	450			450			450		

* p < 0.10; ** p < 0.05; *** p < 0.01; ****p < 0.001

Table 17: Sensitivity analysis of the effects of inter-organizational relationships on condition-specific ACSH (cont)

	Chronic care ACSH											
	Angina			Asthma			CHF			COPD		
	β		SE	β		SE	β		SE	β		SE
Explanatory variables												
Proportion hospitals-same system	-0.005		0.046	2.8E-04		0.046	0.105		0.120	-0.053		0.104
Proportion hospitals-own insurance	-0.056		0.056	-0.016		0.056	-0.266	*	0.145	-0.222	*	0.127
Proportion hospitals-own nursing home	-0.077	**	0.032	-0.067	**	0.032	-0.074		0.084	-0.026		0.073
Proportion hospitals-any phys. relationship	0.085	***	0.029	0.072	**	0.029	0.183	**	0.075	0.095		0.066
% Male	0.003	**	0.001	0.001		0.001	0.003		0.003	0.007	***	0.003
% African-American	-6.0E-05		9.7E-04	0.001		0.001	-0.001		0.003	-0.001		0.002
% Hispanic	3.9E-05		3.7E-04	-2.8E-04		4.1E-04	-0.003	**	0.001	-0.003	****	0.001
% Urban	-1.4E-04		1.8E-04	3.8E-04		1.9E-04	0.001	**	0.001	0.001	***	0.000
SES index	-0.659		1.107	-3.529	***	1.190	-10.515	***	3.173	-12.562	****	2.581
Heart disease mortality rate	-0.001		0.002	-3.0E-04		0.002	-0.002		0.004	-0.004		0.003
Respiratory disease mortality rate	-0.002		0.001	-0.002		0.001	-0.007	*	0.004	-0.002		0.003
Pneumonia mortality rate	0.003		0.010	0.007		0.011	0.009		0.029	0.033		0.024
Diabetes mortality rate	0.726	****	0.173	0.060		0.171	-0.011		0.447	-0.198		0.390
% residents ages 15-64	0.285		1.114	-0.579		1.183	-0.778		3.148	-4.210		2.584
% residents ages 65 and over	1.860		1.778	1.625		1.941	7.277		5.196	3.915		4.171
PCPs per 1,000	-0.008		0.009	0.004		0.009	0.016		0.023	0.067	****	0.020
Specialists per 1,000	0.009		0.007	-0.004		0.006	-0.014		0.017	-0.070	****	0.015
# of outpatient services per 1,000	8.6E-07		1.6E-05	5.9E-05	****	1.6E-05	1.4E-04	***	4.2E-05	7.3E-05	**	3.6E-05
Hospital Herfindahl Index	-0.117		0.103	-0.175		0.107	-0.799	***	0.284	-0.303		0.237
1999	-0.016		0.026	0.019		0.025	-0.187	***	0.066	0.097	*	0.058
2000	-0.030		0.026	-0.022		0.026	-0.118	*	0.067	-0.008		0.058
2001	-0.073	***	0.027	0.000		0.027	-0.097		0.069	0.148	**	0.061
2002	-0.108	****	0.028	0.042		0.028	0.088		0.072	0.167	***	0.063
2003	-0.092	***	0.030	0.068	**	0.029	0.076		0.076	0.123	*	0.067
2004	-0.111	****	0.031	-0.026		0.031	0.056		0.080	-0.092		0.070
2005	-0.125	****	0.033	0.016		0.033	0.070		0.085	-0.089		0.074
Intercept	-1.679		1.311	-0.782		1.413	-2.353		3.769	-2.970		3.060
N	450			450			450			450		

* $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$; ****$p < 0.001$

Table 17: Sensitivity analysis of the effects of inter-organizational relationships on condition-specific ACSH (cont)

	Chronic care ACSH											
	Hypertension			Short-term complications of diabetes			Long-term complications of diabetes			Uncontrolled diabetes		
	β		SE	β		SE	β		SE	β		SE
Explanatory variables												
Proportion hospitals-same system	-0.018		0.042	-0.016		0.024	-0.025		0.035	0.003		0.009
Proportion hospitals-own insurance	-0.016		0.052	-0.012		0.032	0.035		0.044	-0.023	*	0.013
Proportion hospitals-own nursing home	-0.051	*	0.030	0.007		0.017	0.007		0.025	0.014	**	0.007
Proportion hospitals-any phys. relationship	0.039		0.027	0.004		0.017	0.008		0.023	0.007		0.007
% Male	0.002		0.001	4.0E-04		4.1E-04	0.001		0.001	-1.2E-04		1.3E-04
% African-American	0.001		0.001	2.9E-04		2.7E-04	5.6E-05		0.001	2.7E-05		8.3E-05
% Hispanic	-3.1E-04		3.5E-04	-3.6E-04	****	1.0E-04	-4.8E-04	**	2.3E-04	-1.0E-05		3.1E-05
% Urban	4.1E-04	**	1.6E-04	1.2E-04	**	5.3E-05	3.2E-04	***	1.1E-04	-8.4E-06		1.7E-05
SES index	-2.971	***	1.034	-0.999	***	0.362	-2.709	****	0.722	-0.159		0.122
Heart disease mortality rate	-0.003	*	0.001	-0.001		0.001	0.001		0.001	9.9E-05		2.6E-04
Respiratory disease mortality rate	-0.001		0.001	0.002	*	0.001	-0.002	*	0.001	-3.3E-04		3.9E-04
Pneumonia mortality rate	0.013		0.010	-1.3E-04		0.004	0.003		0.007	-0.001		0.002
Diabetes mortality rate	0.144		0.159	-0.009		0.095	-0.213		0.135	0.068	*	0.037
% residents ages 15-64	-0.961		1.038	-0.490		0.409	-0.835		0.753	0.083		0.141
% residents ages 65 and over	1.006		1.667	-0.260		0.515	0.596		1.122	0.121		0.164
PCPs per 1,000	0.005		0.008	0.009	*	0.005	-0.004		0.007	0.001		0.002
Specialists per 1,000	-0.005		0.006	-0.009	**	0.004	0.005		0.005	-1.9E-04		0.001
# of outpatient services per 1,000	2.7E-05	*	1.5E-05	5.8E-06		7.1E-06	3.2E-05	***	1.2E-05	-1.5E-07		2.4E-06
Hospital Herfindahl Index	-0.061		0.096	-0.029		0.036	-0.192	***	0.071	-0.006		0.012
1999	-0.075	***	0.024	-0.088	****	0.016	0.058	***	0.020	-0.073	****	0.007
2000	-0.106	****	0.024	-0.077	****	0.016	0.050	**	0.021	-0.068	****	0.007
2001	-0.024		0.025	0.003		0.017	0.065	***	0.021	-0.076	****	0.007
2002	0.029		0.026	0.064	****	0.017	0.086	****	0.022	-0.024	***	0.007
2003	0.044		0.027	0.027		0.017	0.064	***	0.023	-0.072	****	0.007
2004	-0.048	*	0.028	0.032	*	0.018	0.085	****	0.024	-0.075	****	0.008
2005	-0.018		0.030	0.035	*	0.019	0.093	****	0.026	-0.078	****	0.008
Intercept	-0.868		1.226	0.093		0.417	-0.291		0.851	0.029		0.138
N	450			450			450			450		

* $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$; ****$p < 0.001$

A final step in the sensitivity analysis focused on determining whether the direction and statistical significance varied when condition-specific results were compared to the aggregated results. Four mutually exclusive indicators were constructed to provide a comprehensive summary of the direction and significance of all study relationships: (1) positive-significant; (2) negative-significant; (3) positive-nonsignificant; and (4) negative-nonsignificant. Each relationship for each regression model was coded dichotomously for these four indicators. For example, if community health centers per 1,000 residents were negatively and significantly associated with the number of congestive heart failure ACSH, then the negative-significant indicator for the CHC per 1,000 residents-congestive heart failure relationship would be coded as "1" and all other indicators would be coded as zero. Next, totals were created for each of these indicators by summing across all relationships. Two sets of relationship totals were created, one for the eleven condition-specific models and another for the three aggregated ACSH models.

Across the condition-specific regression models, 22.6 percent of the explanatory variable relationships were significant (Table 18). Negative-significant relationships were more prevalent among these models (15.2%) compared to positive-significant results (7.4%). In comparison, 26.9 percent of the explanatory variable relationships in the aggregated ACSH models were significant (Table 19). In this case, 19.0 percent of the relationships were negative-significant while 7.9 percent were positive-significant.

Another issue for consideration was whether aggregation conceals contrasting directions that exist at the condition-specific level. Comparisons between the direction of the aggregated relationships and the condition-specific relationships reveal some differences in the percentage of positive versus negative relationships. Over 31 percent of the explanatory variable relationships were in the positive direction for the aggregated models; over 44 percent of these same variables were positively associated with the outcomes in the condition-specific models. The control variables exhibit relatively consistent direction across the aggregated and condition-specific models.

In sum, these comparisons suggest that aggregation of condition-specific ACSH outcomes has some effect on the statistical significance and direction of the explanatory variables of interest. In most cases, aggregation appears to suppress statistical significance, resulting in a more conservative assessment of these relationships. Comparison of the signs of the covariates indicates that aggregated outcome models show a larger percentage of negative relationships relative to the condition-specific models. In other words, variables in aggregated outcome models are more likely to take on negative values compared to models using condition-specific outcomes, indicating that covariates reverse direction when moving from a condition-specific model to an aggregated model. Specifically, nearly 13 percent of the covariates reverse direction, with most (8.5 percent) of the reversals for variables with nonsignificant relationships with ACSH rates.

Table 18: Relationship summary for condition-specific ACSH regression models

Variable	Positive-Significant	Negative-Significant	Positive-Nonsignificant	Negative-Nonsignificant
CHCs per 1,000 residents	1	4	4	2
CHCs per 1,000 residents*CHCs per 1,000 residents	2	1	4	4
HHA per 1,000 residents	1	0	7	3
HHA per 1,000 residents*HHA per 1,000 residents	0	1	2	8
HMOs per 1,000 residents	1	2	4	4
HMOs per 1,000 residents*HMOs per 1,00 residents	1	0	7	3
Hospitals per 1,000 residents	2	0	5	4
Hospitals per 1,000 residents*Hospitals per 1,000 resider	0	3	3	5
SNF per 1,000 residents	0	2	0	9
SNF per 1,000 residents*SNF per 1,000 residents	1	0	8	2
POs per 1,000 residents	0	0	7	4
POs per 1,000 residents*POs per 1,000 residents	0	0	4	7
CHC-to-hospital	0	3	4	4
HHA-to-hospital	0	3	2	6
HMO-to-hospital	1	0	5	5
SNF-to-hospital	1	7	0	3
PO-to-hospital	1	2	3	5
Proportion hospitals-same system	0	0	5	6
Proportion hospitals-own insurance	0	3	3	5
Proportion hospitals-own nursing home	1	4	2	4
Proportion hospitals-any phys. relationship	4	0	6	1
% Male	13	0	13	7
% African-American	1	5	17	10
% Hispanic	0	19	2	12
% Urban	23	0	7	3
SES index	0	27	0	6
Heart disease mortality rate	0	12	5	16
Respiratory disease mortality rate	1	12	4	16
Pneumonia mortality rate	15	0	16	2
Diabetes mortality rate	6	3	11	13
% residents ages 15-64	0	2	9	22
% residents ages 65 and over	3	0	27	3
# of outpatient services per 1,000	18	0	8	7
PCPs per 1000	2	1	4	4
Specialists per 1000	1	2	4	4
Hospital Herfindahl	0	3	0	8
1999	8	12	8	5
2000	6	13	5	9
2001	10	11	5	7
2002	16	6	8	3
2003	14	6	10	3
2004	7	12	4	10
2005	9	11	7	6
Total # of relationships	891			
Total # of explanatory relationships	231	Total # of control relationships		660
-% positive & significant	7.4%	-% positive & significant		23.2%
-% negative & significant	15.2%	-% negative & significant		23.8%
-% positive & nonsignificant	36.8%	-% positive & nonsignificant		26.4%
-% negative & nonsignificant	40.7%	-% negative & nonsignificant		26.7%

Table 19: Relationship summary for aggregated ACSH regression models

Variable	Positive-Significant	Negative-Significant	Positive-Nonsignificant	Negative-Nonsignificant
CHCs per 1,000 residents	0	1	0	2
CHCs per 1,000 residents*CHCs per 1,000 residents	0	0	2	1
HHA per 1,000 residents	0	0	1	2
HHA per 1,000 residents*HHA per 1,000 residents	0	0	2	1
HMOs per 1,000 residents	0	1	0	2
HMOs per 1,000 residents*HMOs per 1,00 residents	0	0	3	0
Hospitals per 1,000 residents	2	0	1	0
Hospitals per 1,000 residents*Hospitals per 1,000 residents	0	2	0	1
SNF per 1,000 residents	0	0	1	2
SNF per 1,000 residents*SNF per 1,000 residents	0	0	0	3
POs per 1,000 residents	0	0	0	3
POs per 1,000 residents*POs per 1,000 residents	0	0	3	0
CHC-to-hospital	0	0	0	3
HHA-to-hospital	0	3	0	0
HMO-to-hospital	0	1	0	2
SNF-to-hospital	1	1	1	0
PO-to-hospital	0	3	0	0
Proportion hospitals-same system	0	0	0	3
Proportion hospitals-own insurance	0	0	0	3
Proportion hospitals-own nursing home	0	0	0	3
Proportion hospitals-any phys. relationship	2	0	1	0
% Male	5	0	3	1
% African-American	0	1	3	5
% Hispanic	0	9	0	0
% Urban	8	0	1	0
SES index	0	9	0	0
Heart disease mortality rate	0	8	0	1
Respiratory disease mortality rate	0	4	2	3
Pneumonia mortality rate	8	0	1	0
Diabetes mortality rate	0	3	3	3
% residents ages 15-64	0	0	0	9
% residents ages 65 and over	0	0	9	0
# of outpatient services per 1,000	9	0	0	0
PCPs per 1000	0	0	2	1
Specialists per 1000	0	1	1	1
Hospital Herfindahl	0	3	0	0
1999	1	5	2	1
2000	0	6	0	3
2001	2	2	4	1
2002	5	0	3	1
2003	6	0	3	0
2004	0	2	3	4
2005	2	1	3	3
Total # of relationships	243			
Total # of explanatory relationships	63	Total # of control relationships		180
-% positive & significant	7.9%	-% positive & significant		25.6%
-% negative & significant	19.0%	-% negative & significant		30.0%
-% positive & nonsignificant	23.8%	-% positive & nonsignificant		23.9%
-% negative & nonsignificant	49.2%	-% negative & nonsignificant		20.6%

Summary

This chapter presented the empirical analysis used to assess the relationship between market structure and ACSH. In total, nine different regression models were used to assess 15 hypotheses, yielding a total of 63 explanatory covariate effects across the models. A hypothesis was considered supported if it was statistically significant at the 0.10 significance level or smaller and in the direction predicted. Fourteen of the relationships were statistically significant; however, only nine of these relationships were in the direction hypothesized (Table 20). The most consistent support was observed for the provider composition relationships (Hypotheses 2a-2e), where three of the five provider types were significantly and negatively associated with ACSH rates. In contrast, the provider capacity (Hypotheses 1a-1f) and inter-organizational relationships (Hypotheses 3-6) with ACSH rates were largely nonsignificant; in those cases where they were significant, the relationship was in the opposite direction predicted.

In general, the pattern of results suggests that the relationship between market structure and ACSH is more nuanced than initially expected and likely cannot be explained in broad strokes. The next chapter will explore some of these nuances and relate the results to the initial research questions that motivated the study. The discussion will also describe some of the managerial, policy, and research implications.

Table 20: Summary of hypothesis tests

Hypothesis	Description	Acute care ACSH	Chronic care ACSH	Aggregate ACSH
Hypothesis 1a	The rate of ACSH will exhibit a U-shaped, non-monotonic relationship with the supply of community health centers in a market.	ns	ns	ns
Hypothesis 1b	The rate of ACSH will exhibit a U-shaped, non-monotonic relationship with the supply of home health agencies in a market.	ns	ns	ns
Hypothesis 1c	The rate of ACSH will exhibit a U-shaped, non-monotonic relationship with the supply of staff/group HMOs in a market.	ns	ns	ns
Hypothesis 1d	The rate of ACSH will exhibit a U-shaped, non-monotonic relationship with the supply of hospitals in a market.	-	-	-
Hypothesis 1e	The rate of ACSH will exhibit a U-shaped, non-monotonic relationship with the number of nursing homes in a market.	ns	ns	ns
Hypothesis 1f	The rate of ACSH will exhibit a U-shaped, non-monotonic relationship with the supply of physician organizations in a market.	ns	ns	ns
Hypothesis 2a	The rate of ACSH in a market will be negatively associated with the community health center-to-hospital ratio.	ns	ns	ns
Hypothesis 2b	The rate of ACSH in a market will be negatively associated with the home health agency-to-hospital ratio.	+	+	+
Hypothesis 2c	The rate of ACSH in a market will be negatively associated with the skilled nursing facility-to-hospital ratio.	+	+	+
Hypothesis 2d	The rate of ACSH in a market will be negatively associated with the physician organization-to-hospital ratio.	+	+	+
Hypothesis 2e	The rate of ACSH in a market will be negatively associated with the staff/group model HMO-to-hospital ratio.	ns	ns	ns
Hypothesis 3	The rate of ACSH in a market will be negatively associated with the proportion of hospitals in a market that belong to the same system.	ns	ns	ns
Hypothesis 4	The rate of ACSH in a market will be negatively associated with the proportion of hospitals in a market with a formal physician relationship.	-	ns	-
Hypothesis 5	The rate of ACSH in a market will be negatively associated with the proportion of hospitals that own an insurance product.	ns	ns	ns
Hypothesis 6	The rate of ACSH in a market will be negatively associated with the proportion of hospitals that own a nursing home.	ns	ns	ns

'+': Statistically significant results in direction predicted.
'-': Statistically significant results in the opposite direction predicted.
'ns': Non-significant results for hypothesis.

Chapter VI

Discussion and Conclusion

How does market structure affect ambulatory care sensitive hospitalizations (ACSH)? That is the general research question that motivated this study. This chapter discusses the study's findings with respect to this question. The chapter also discusses the implications of these findings for future research, management, and policy. The chapter begins with a discussion of the study's results with respect to the specific research questions that guided the empirical analysis. The chapter concludes with a discussion of the limitations of the study.

Research Questions & Explanation of Results

Are more providers associated with better ACSH outcomes?

Most ACSH research has assumed a linear relationship between provider supply and ACSH. The first part of this study tested this assumption by examining whether a non-linear relationship more aptly described the association between provider supply and ACSH. The argument was that higher levels of provider supply might reflect more complex market conditions, which in turn would be associated with higher coordination costs and higher rates of ACSH. In general, the study's findings do not support this relationship. Hospitals were the only provider type with a significant non-linear relationship with ACSH rates. Furthermore, the relationship was in the opposite direction than predicted. Rates of ACSH initially increase as hospital supply increases, but after some level of hospital supply is reached, the rate of ACSH begins decreasing. The other provider types did not display significant, non-linear relationships with ACSH rates.

These results raise several questions. First, why is increasing hospital capacity initially associated with higher rates of ACSH, followed by lower rates of ACSH? One potential explanation is that the relationship between hospital capacity and ACSH rates differs across different types of markets. Although small area variation studies have generally found an increasing supply of hospital beds in a market to be associated with higher inpatient utilization rates (Fisher et al. 1994; Fisher et al. 2000; Goodman et al. 1994; Laditka, Laditka, and Probst 2005), the effects of hospital capacity may differ across urban and rural markets (Ansari et al. 2003; Laditka, Laditka, and Probst 2005; Schreiber and Zielinski 1997). And while the study did control for the percentage of urban residents in a market, it is possible that the relationship between hospital capacity and ACSH is entirely different in urban markets compared to rural markets, which would not be captured by the control variable. In other words, the mechanism by which hospital capacity affects ACSH in urban markets may be different than the mechanism in rural markets.

To examine this possibility further, the analytic dataset was split into two separate samples. One sample was made up exclusively of urban markets (37 counties), defined as those counties with at least one urban cluster of at least 10,000 residents (Bureau of Health Professions 2006). The second sample consisted of the remaining 19 rural markets, defined as those counties with no clusters of 10,000 of more residents. The provider capacity regressions were rerun using these two samples and the same variables as the combined sample, with the exception of the control variable for the percentage of urban market residents.

The results do, in fact, show different relationships between hospital capacity and ACSH rates across the two types of markets. Hospital capacity in rural markets exhibits a significant, non-linear relationship with the rate of acute care ACSH (Table 21). In this case, the first-order regression term is positively associated with the acute care ACSH rate ($\beta=100.88$, $p<0.05$), while the second-order quadratic term is negatively associated with the acute care ACSH rate ($\beta= -395.79$, $p<0.05$). These results indicate that the rate of acute care ACSH in rural markets initially increases as hospital capacity increases, but begins declining after some level of hospital capacity is reached. In contrast, hospital capacity in urban markets continues to be positively related to ACSH rates across all levels of hospital capacity (Table 22). Interestingly, several other provider types, such as staff/group model HMOs and physician organization, also display different relationships with ACSH rates across the two types of markets.

In summary, the results of this supplementary analysis are consistent with previous research that suggests the effects of provider supply on ACSH differ across urban and rural markets. It is a little surprising that the most robust results indicate that hospital capacity is associated with higher rates of ACSH, given that the findings of the main analysis, when urban and rural markets are analyzed together, indicate that ACSH rates eventually decrease as hospital capacity increases. It is possible that the relationship between hospital capacity and ACSH depends upon market factors beyond the rural-urban distinction made in this analysis. A more thorough examination of these possibilities was beyond the scope of this study. Nevertheless, the results of this analysis suggest that it is important to consider if and how different market factors may condition the relationship between market structure and ACSH. Such considerations may also provide new insights into the causal mechanisms that underlie the relationship between market structure and ACSH.

Table 21: Non-linear effects of provider capacity on ACSH, rural markets only

	Acute care ACSH			Chronic care ACSH			Total ACSH		
	β		SE	β		SE	β		SE
Explanatory variables									
CHCs per 1,000 residents	-4.19		12.29	19.47		15.98	20.13		24.59
CHCs per 1,000*CHCs per 1,000	-6.00		50.04	-84.04		64.87	-114.70		99.98
HHAs per 1,000 residents	5.84		15.72	40.42	*	20.72	41.78		31.57
HHAs per 1,000*HHAs per 1,000	-55.16		120.41	-412.62	**	159.85	-433.08	*	242.35
HMOs per 1,000 residents	-10.06	*	5.61	7.82		5.63	-1.57		10.05
HMOs per 1,000*HMOs per 1,000	85.08	**	35.04	25.03		38.26	113.67	*	64.97
Hospitals per 1,000 residents	100.88	**	46.66	-73.10		47.43	21.19		85.19
Hospitals per 1,000*Hospitals per 1,000	-395.79	**	160.12	185.71		161.68	-191.89		291.58
SNFs per 1,000 residents	-2.47		6.24	-0.83		8.44	-4.97		12.63
SNFs per 1,000*SNFs per 1,000	-10.79		27.70	-12.45		37.43	-20.31		56.05
POs per 1,000 residents	1170.88	***	432.07	326.03		427.96	1,290.90		779.68
POs per 1,000*POs per 1,000	-73752.00	***	25421.00	-27,781.00		25,912.00	-88,215.00	*	46,485.00
Population characteristic controls									
% Male	0.05		0.03	0.00		0.05	0.05		0.07
% African-American	0.00		0.06	-3.6E-03		0.07	-1.6E-02		0.12
% Hispanic	0.00		1.2E-02	0.00		1.0E-02	0.00		0.02
SES index	-91.65	****	31.31	-13.04		33.25	-111.76	*	57.46
Heart disease mortality rate	0.03		0.02	0.00		0.02	0.03		0.04
Respiratory disease mortality rate	2.8E-03		0.01	-0.02		0.01	-0.01		0.02
Pneumonia mortality rate	-0.22	*	0.12	0.08		0.14	-0.13		0.23
Diabetes mortality rate	-2.72	*	1.45	1.15		1.92	0.28		2.92
% residents ages 0-14 (Referent)	-		-	-		-	-		-
% residents ages 15-64	48.65		35.62	6.26		38.38	68.52		65.41
% residents ages 65 and over	116.71	*	59.01	27.28		58.82	157.20		105.18
Health service use control									
# of outpatient services per 1,000	2.24E-04		2.0E-04	1.18E-03	****	2.5E-04	1.4E-03	****	3.9E-04
Time trend controls									
1998 (Referent)	-		-	-		-	-		-
1999	0.06		0.28	-0.85	**	0.39	-0.74		0.58
2000	-0.78	**	0.32	-1.13	**	0.43	-1.93	***	0.64
2001	-0.26		0.35	-1.30	***	0.47	-1.72	**	0.71
2002	-0.50		0.33	-1.17	***	0.44	-1.97	***	0.66
2003	-0.17		0.37	-1.20	**	0.48	-1.74	**	0.73
2004	-1.26	***	0.43	-1.67	***	0.55	-3.35	****	0.85
2005	-0.76		0.46	-1.91	***	0.59	-3.10	****	0.91
Intercept	-87.60		45.66	-8.81		53.61	-111.69		86.94
N	144			144			144		

* p < 0.10; ** p < 0.05; *** p < 0.01; ****p < 0.001

Table 22: Non-linear effects of provider capacity on ACSH, urban markets only

	Acute care ACSH			Chronic care ACSH			Total ACSH		
	β		SE	β		SE	β		SE
Explanatory variables									
CHCs per 1,000 residents	-13.43		17.33	-9.47		21.45	-38.23		37.65
CHCs per 1,000*CHCs per 1,000	229.18		190.84	161.05		234.55	545.45		412.16
HHAs per 1,000 residents	20.52		19.01	23.48		23.29	40.00		40.95
HHAs per 1,000*HHAs per 1,000	-204.27		329.33	-398.57		401.13	-442.24		706.10
HMOs per 1,000 residents	-50.22	****	10.38	-54.06	****	14.02	-105.20	****	24.14
HMOs per 1,000*HMOs per 1,000	-6238.81	****	1227.65	-4,367.10	***	1,629.10	-10,875.00	****	2,817.27
Hospitals per 1,000 residents	251.05	****	50.17	390.74	****	61.39	643.89	****	107.96
Hospitals per 1,000*Hospitals per 1,000	22183.00	****	5247.25	12,092.00	*	6,899.09	35,324.00	***	11,952.00
SNFs per 1,000 residents	-6.98		12.50	-14.79		15.21	-21.90		26.77
SNFs per 1,000*SNFs per 1,000	351.77	*	181.84	336.62		221.36	652.75	*	389.69
POs per 1,000 residents	-162.65	**	80.29	-290.31	***	105.19	-454.85	**	182.32
POs per 1,000*POs per 1,000	5162.21	**	2280.54	8,545.57	***	2,920.91	14,205.00	***	5,089.06
Population characteristic controls									
% Male	0.01		0.01	0.00		0.01	0.02		0.02
% African-American	-0.01		0.01	8.2E-03		0.01	3.5E-03		0.01
% Hispanic	-0.01	**	2.6E-03	0.00		3.6E-03	-0.01	*	0.01
SES index	-8.31		7.43	-15.72		9.98	-25.05		17.20
Heart disease mortality rate	-0.06	*	0.03	-0.12	***	0.04	-0.17	**	0.08
Respiratory disease mortality rate	-3.1E-03		0.03	-0.01		0.03	-0.01		0.05
Pneumonia mortality rate	0.07		0.05	0.09		0.06	0.17		0.11
Diabetes mortality rate	3.10	*	1.74	0.55		2.13	3.60		3.75
% residents ages 0-14 (Referent)	-		-	-		-	-		-
% residents ages 15-64	-12.56	*	6.60	-14.68	*	8.83	-28.56	*	15.23
% residents ages 65 and over	-9.28		13.72	-1.43		18.70	-10.67		32.13
Health service use control									
# of outpatient services per 1,000	6.09E-04	****	1.1E-04	5.59E-04	****	1.4E-04	1.2E-03	****	2.4E-04
Time trend controls									
1998 (Referent)	-		-	-		-	-		-
1999	0.17		0.14	-0.22		0.18	-0.11		0.31
2000	0.18		0.15	-0.26		0.18	-0.12		0.32
2001	0.97	****	0.24	0.30		0.29	1.20	**	0.51
2002	0.94	****	0.18	0.87	****	0.21	1.73	****	0.38
2003	1.25	****	0.18	1.06	****	0.22	2.19	****	0.39
2004	0.75	****	0.19	0.47	**	0.23	1.08	***	0.41
2005	1.01	****	0.22	0.56	**	0.27	1.44	***	0.48
Intercept	6.69		8.58	9.63		11.43	14.62		19.74
N	292			292			292		

* $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$; ****$p < 0.001$

A second question raised by the provider capacity results is why more organizations did not display significant non-linear relationships with ACSH rates? One possibility is that declining provider capacity over the study period reduced the likelihood of observing a significant relationship between provider capacity and ACSH rates. The descriptive statistics show that all provider types, with the exception of community health centers, declined over the study period, in most cases double digit decreases. It is possible that a decline in provider capacity reflects a correction of the supply and demand relationships across markets. If this was the case, then these corrections may have muted the strength of the relationship between provider capacity and ACSH that were based on assumptions of high capacity and market complexity.

A second possibility relates to the market definition used in the study and the size of the provider community. Some small area variation analysts argue that larger geographic markets dampen provider supply variation and conceal its effects on variations in care (Wennberg 1984; Wennberg, Fisher, and Skinner 2002). For example, Laditka and Johnston (1999) found a significant relationship between women living in areas of high Medicaid enrollment and avoidable maternity admissions when examined at the intra-county level of analysis, but no significant relationship when examined at the county level. The dampening effects of larger market size may be heightened on activities that are inherently local in nature, such as coordination of care. Unfortunately, market structure data is not readily available at more fine-grained levels such as the zip code, which prevents empirical testing of this explanation. Nevertheless, most ACSH studies use the county as the market definition and still find significant results. Likewise, significant relationships in this study were observed in the provider composition and condition-specific regression models. Furthermore, others have directly evaluated the effects of market definition versus other design characteristics (e.g., multivariate modeling versus bivariate analyses; techniques that control for rare events) and concluded that methodological considerations have a more substantial effect on small area variation outcomes than market definition (McLaughlin et al. 1989). Based on these considerations, it does not seem likely that the market definition is responsible for the non-significant results.

Perhaps the most likely explanation is simply that increasing provider capacity is the more important consideration for ACSH, rather than control and coordination of care. In other words, the effects of increasing provider capacity, such as opening more points of access and getting more people into the system, outweigh the costs associated with coordinating care among these providers. Under such circumstances, the relationship between provider capacity and ACSH might best be characterized as linear, which is what the results of this study indicate for several provider types and conditions.

Is provider composition associated with ACSH?

Provider composition models examined a different aspect of provider supply, one less focused on supply relative to demand and more focused on supply relative to other provider organizations in a market. The premise of this analysis was that provider composition may be an important structural characteristic of markets if control and coordination costs are the mechanism by which market structure affects ACSH.

This study argues that hospitals differ in important ways that potentially make them facilitators or barriers to improving ACSH rates. Hospitals may not offer the types of services that allow them to play a coordinative role like the other provider types considered in the study, hindering their ability to improve ACSH rates. Similarly, hospitals may behave differently because of conflicting financial motivations. Arguably hospitals have the most to lose by preventing admissions related to ambulatory care sensitive conditions, with over 12 percent of all admissions in this study being ACSH and nearly $29 billion spent annually for ACSH in the U.S. (Russo, Jiang, and Barrett 2007). Studies finding hospital supply associated with higher rates of ACSH support the idea that hospitals may face constraints or have different motivations to curb admissions related to ambulatory care sensitive conditions (Laditka, Laditka, and Probst 2005; Penfold et al. 2008; Schreiber and Zielinski 1997). The findings of this study indicate that the supply of ambulatory care organizations relative to hospital supply is an important consideration for ACSH, providing additional support that hospitals may behave differently with respect to ACSH. More generally, the findings suggest that provider composition is an important consideration for understanding how provider resources can be best utilized to improve ACSH.

It is also worth noting that the pattern of results once again indicates that the effects of provider supply are limited to certain provider types. Three of the five provider composition ratios, home health agencies, skilled nursing facilities, and physician organizations, were negatively associated with ACSH rates. One explanation for the observed pattern of results relates to the competitive and collaborative dynamics that may have evolved in these markets during this time period. Competition across different provider types may hinder coordination between certain provider types that would improve ACSH. The study controlled for the effects of competition between hospitals; however, competition across industries is more difficult to control for. Measurement challenges include judgments about appropriate substitute products or services and whether the same market definition (e.g., zip code, county, MSA) is most relevant across different industries (Baker 2001). Even so, the effects of competition might be inferred from the service overlap that likely exists among the significant provider types. Two of the three significant provider types, nursing homes and home health agencies, generally are more oriented toward long-term care needs of community residents. Services offered by these organizations may be in less direct competition with the services offered by hospitals (Intrator, Zinn, and Mor 2004; Soulen, Duggan, and DeAngelis 1994). In fact, as the descriptives in this study show, hospitals often have a formal relationship with these provider types. In contrast, hospitals are increasingly offering outpatient services that compete with more traditional primary care provider types (e.g., physicians, staff/group model HMOs, community health centers) (Kohn 2000; Lesser and Ginsburg 2000; Snail and Robinson 1998). The net effect of these dynamics may be that organizations that are in more direct competition are less likely to collaborate in a market, which may have resulted in nonsignificant relationships for these provider types.

Is provider supply associated with ACSH when multiple provider types are considered simultaneously?

Another consideration in this study was whether provider supply relationships persist after controlling for the effects of other provider types. The motivation for examining multiple provider types simultaneously was to more accurately reflect the fragmented and duplicative nature of health service delivery in the U.S. Although this was not the first study to include multiple provider types simultaneously, it is the most inclusive to date. Both sets of models, those assessing non-linear relationships of provider capacity and those assessing provider composition, provide support for the idea that multiple provider types are associated with ACSH, even when modeled simultaneously.

The provider composition findings also call attention to the important role of long-term care providers in improving ACSH rates and access more generally. A growing number of elderly and chronically-ill patients in the U.S. is increasing the demand for long-term care services provided by organizations such as nursing homes and home health agencies. Long-term care organizations have traditionally played an important transitional role for patients leaving a hospital. The transitional roles of these organizations are especially relevant for researchers interested in ACSH given the types of patients most likely to utilize long-term care services as well as concerns about avoidable hospital readmissions. Therefore, it is surprising that little research has examined the relationship between long-term care provider types and ACSH, with only four studies identified that included nursing homes and no studies that included home health agencies.

A comparison between the provider capacity and provider composition models also indicates that the significance of a provider type may depend upon how supply is measured. Provider capacity models showed hospitals positively associated with ACSH rates, while community health centers and staff/group model HMOs were negatively associated with ACSH rates. In contrast, provider composition models showed home health agencies, skilled nursing facilities, and physician organizations negatively associated with ACSH rates. Such contrasts suggest that provider supply may consist of multiple dimensions and some provider types may be more important within certain dimensions. These contrasts may also reflect different mechanisms by which supply affects access to care. For instance, this study suggested that provider composition better reflects the potential for inter-organizational coordination, while provider capacity more accurately reflects patients' ability to gain access to the health system. Such distinctions may be necessary in future research to gain a more comprehensive understanding of the relationship between provider supply and ACSH.

How do inter-organizational relationships between provider types in a market affect ACSH?

Proliferation of the number and types of health care providers has given rise to greater fragmentation in health care delivery in the U.S. The challenges presented by greater fragmentation only magnify the importance of coordination for improving outcomes of care. A critical precursor to coordination is an actual relationship between providers in a market. Therefore, one of the questions asked in this study was whether inter-organizational relationships improve coordination and lower rates of ACSH.

In aggregate, the analysis did not reveal consistent results to support the role of inter-organizational relationships. The only relationship that was statistically significant was the relationship between physicians and hospitals. Contrary to what was initially predicted, the study found that formal relationships between hospitals and physicians were associated with higher rates of ACSH. There may be several explanations for why this relationship was in the opposite direction predicted. First, improvements in ACSH rates via a hospital-physician relationship are predicated on clinical integration that improves coordination of care and a number of studies have documented low clinical integration between hospitals and physicians (Burns and Pauly 2002; Conrad 1993;

Conrad and Shortell 1996; Shortell, Gillies et al. 2000). Even so, under conditions of poor integration, it seems more likely that the results would have shown a weak or nonsignificant relationship with ACSH. Another possibility is that formal relationships between physician organizations and hospitals are used for securing patient resources more so than for coordinating care, which is supported by a number of studies documenting hospital-physician integration being associated with higher hospital costs and utilization (Alexander and Morrisey 1988; Morrisey, Alexander, and Ohsfeldt 1990; Wheeler, Wickizer, and Shortell 1986).

Similar to hospital-physician relationships, objectives other than coordination of care may explain why relationships between hospitals and other organizations were not significantly associated with ACSH rates. For example, analysts have noted a number of motivations for system affiliation, such as economies of scale and scope, increased access to capital, greater control over external uncertainties, and the potential for improved coordination (Alexander 1991; Dranove and Shanley 1995; Ermann and Gabel 1984; Luke, Ozcan, and Olden 1995; Zuckerman 1979). Markets dominated by organizations that prioritize other objectives above care coordination may find efforts to coordinate care less effective. Or worse, other motivations work at cross-purposes with care coordination and undermine the effects of coordination on ACSH. For example, if horizontal and vertical integration strategies are pursued primarily to counteract pressure from competitors or payers, then it is possible that these relationships could actually increase ACSH.

It is also possible that market factors moderate the relationship between inter-organizational relationships and ACSH rates. Analysts note that the late 1990s and early

2000s were a time of transition in how health services were financed and delivered (Kohn 2000; Lesser and Ginsburg 2000; Snail and Robinson 1998). They also suggest that such changes played an important role in providing the context for competition and collaboration. Health plans were relaxing network restrictions and using less global capitation to reimburse providers. Such changes may have attenuated the strength of existing relationships or even changed the objective of these relationships.

The potential moderating effect of market characteristics on the association between inter-organizational relationships and ACSH was tested with two sets of interaction models. Moderating variables for the interaction terms were chosen based on influential changes that were occurring during the study period. One of the major drivers of change that led to the development of inter-organizational relationships during the late 1990s and early 2000s was method of payment. Specifically, the transfer of financial risk via capitation stimulated inter-organizational relationships that were believed to align interests across different types of providers. Therefore, the first set of interaction models used the average capitation risk across all hospitals in a market as the moderating variable in the interaction terms. This variable was taken from the American Hospital Association (AHA) Annual Survey and varied across all years of the study. Average hospital capitation risk was interacted with all four inter-organizational relationship variables. All interaction variables were mean centered to reduce collinearity before multiplying.

As mentioned earlier, one potentially constraining factor on hospitals is their dependence on inpatient revenue. In this case, dependence on inpatient revenue may have contrasting moderating effects. On one hand, markets where hospitals are heavily dependent upon inpatient revenue may be associated with less use and decreased effectiveness of inter-organizational relationships, resulting in higher ACSH rates. On the other hand, markets where hospitals are heavily dependent on inpatient resources may utilize inter-organizational relationships to a greater extent but for purposes of securing more inpatient admissions. To test these relationships, the second set of interaction models used the average inpatient revenue as a percentage of total hospital revenue as the moderating variable in the interaction terms. This variable was constructed from financial data provided in the annual cost and utilization reports filed with the Office of Statewide Health Planning and Development (OSHPD) and varied across all years of the study. The average inpatient revenue variable was interacted with all four inter-organizational relationship variables and all interaction variables were mean centered to reduce collinearity before multiplying.

The results of the hospital capitation interaction models suggest that the average financial risk assumed by hospitals in a market does, in fact, moderate the relationship between certain types of inter-organizational relationships and ACSH rates (Table 23). Specifically, the results show that markets with more hospital capitation risk and a higher proportion of hospitals in the same system were associated with higher chronic care ACSH rates ($\beta=0.23$, $p<0.10$). In contrast, markets with more hospital capitation risk and a higher proportion of market hospitals with an ownership interest in a nursing home were associated with lower rates of chronic care ACSH ($\beta= -0.36$, $p<0.01$) and aggregate ACSH ($\beta= -0.44$, $p<0.05$).

Similar results were observed with the interaction models testing the conditional effects of inpatient revenue dependence (Table 24). Markets with greater dependence on inpatient revenues and a higher proportion of hospitals from the same system were associated with higher rates of chronic care ACSH (β=6.67, $p<0.01$) and aggregate ACSH (β=9.37, $p<0.05$). In contrast, acute care ACSH rates were negatively associated with interaction terms for the proportion of hospitals that own an insurance product (β -4.65, $p<0.10$) and the proportion of hospitals that own a nursing home (β= -3.02, $p<0.05$).

In combination, these results suggest that although market factors such as the level of hospital capitation risk and dependence on inpatient revenues may condition the relationship between inter-organizational relationships and ACSH rates, the effects are not uniform across all types of organizational relationships. Specifically, interaction terms with the proportion of same-system hospitals in a market were generally positively associated with ACSH rates, while interaction terms with the proportion of hospitals that own an insurance product or a nursing home were negatively associated with ACSH rates. These findings suggest that market factors moderate horizontal relationships differently than vertical relationships. Future research is needed to explore whether these differences are due to hospitals using these relationships for different strategic purposes or whether they vary because of specific attributes of the moderating market factor, or some combination of both.

Table 23: Effects of inter-organizational relationships on ACSH, hospital capitation interactions

	Acute care ACSH			Chronic care ACSH			Total ACSH		
	β		SE	β		SE	β		SE
Explanatory variables									
Proportion hospitals-same system	-0.14		0.28	-0.05		0.34	-0.13		0.58
Proportion hospitals-own insurance	-0.18		0.34	-0.76	*	0.41	-1.05		0.69
Proportion hospitals-own nursing home	-0.29		0.20	-0.40	*	0.24	-0.77	*	0.41
Proportion hospitals-any phys. relationship	0.33	*	0.18	0.37	*	0.23	0.76	**	0.38
Proportion hospitals-same system x Average hospital capitation risk	-0.04		0.11	0.23	*	0.14	0.19		0.23
Proportion hospitals-own insurance x Average hospital capitation risk	0.08		0.11	-0.08		0.14	0.01		0.23
Proportion hospitals-own nursing home x Average hospital capitation risk	-0.11		0.10	-0.36	***	0.13	-0.44	**	0.21
Proportion hospitals-any phys. relationship x Average hospital capitation risk	0.03		0.13	0.20		0.16	0.22		0.27
Average hospital capitation risk	0.00		0.05	-0.10	*	0.06	-0.09		0.09
Population characteristic controls									
% Male	0.02	***	0.01	0.02		0.01	0.04	**	0.02
% African-American	-0.01	*	0.01	2.3E-03		0.01	-0.01		0.02
% Hispanic	-0.01	****	2.5E-03	-0.01	***	0.00	-0.02	****	0.01
% Urban	2.4E-03	**	1.2E-03	2.7E-03	*	1.5E-03	0.00	*	2.7E-03
SES index	-40.41	****	7.34	-40.31	****	9.55	-82.11	****	16.74
Heart disease mortality rate	-0.02	**	0.01	-0.01		0.01	-0.04	*	0.02
Respiratory disease mortality rate	2.3E-03		0.01	-0.02	*	0.01	-0.02		0.02
Pneumonia mortality rate	0.15	**	0.07	0.08		0.09	0.24		0.15
Diabetes mortality rate	-2.18	**	1.03	-0.15		1.27	-1.01		2.12
% residents ages 0-14 (Referent)	-		-	-		-	-		-
% residents ages 15-64	-4.71		7.27	-11.42		9.41	-16.55		16.43
% residents ages 65 and over	15.75		12.07	7.50		15.86	23.12		28.08
Physician supply controls									
PCPs per 1,000	-0.05		0.05	0.13	*	0.07	0.06		0.11
Specialists per 1,000	0.04		0.04	-0.13	***	0.05	-0.07		0.08
Market use and competition controls									
# of outpatient services per 1,000	3.7E-04	****	9.8E-05	6.5E-04	****	1.2E-04	1.1E-03	****	2.05E-04
Hospital Herfindahl Index	-1.85	***	0.65	-2.67	***	0.83	-4.90	****	1.42
Time trend controls									
1998 (Referent)	-		-	-		-	-		-
1999	0.25	*	0.15	-0.34	*	0.19	-0.15		0.31
2000	-0.16		0.15	-0.49	**	0.19	-0.73	**	0.31
2001	0.53	***	0.16	0.05		0.20	0.42		0.33
2002	0.54	***	0.17	0.48	**	0.20	0.81	**	0.34
2003	0.71	****	0.18	0.50	**	0.22	0.94	**	0.37
2004	0.04		0.19	0.00		0.24	-0.24		0.39
2005	0.33		0.20	0.03		0.25	0.07		0.42
Intercept	-11.55		8.72	-3.77		11.36	-17.54		19.94
N	450			450			450		

* p < 0.10; ** p < 0.05; *** p < 0.01; ****p < 0.001

Table 24: Effects of inter-organizational relationships on ACSH, inpatient revenue dependence interactions

	Acute care ACSH			Chronic care ACSH			Total ACSH		
	β		SE	β		SE	β		SE
Explanatory variables									
Proportion hospitals-same system	-0.23		0.25	-0.21		0.32	-0.40		0.52
Proportion hospitals-own insurance	-0.23		0.31	-0.57		0.39	-0.91		0.63
Proportion hospitals-own nursing home	-0.55	***	0.19	-0.39	*	0.23	-1.00	***	0.38
Proportion hospitals-any phys. relationship	0.41	**	0.17	0.35	*	0.21	0.84	**	0.35
Proportion hospitals-same system x Percentage of hospital revenue that is inpatient	2.32		2.04	6.67	***	2.54	9.37	**	4.19
Proportion hospitals-own insurance x Percentage of hospital revenue that is inpatient	-4.65	*	2.64	0.81		3.28	-4.02		5.36
Proportion hospitals-own nursing home x Percentage of hospital revenue that is inpatient	-3.02	**	1.25	1.59		1.55	-1.09		2.54
Proportion hospitals-any phys. relationship x Percentage of hospital revenue that is inpatient	1.12		0.94	0.93		1.17	1.91		1.92
Percentage of hospital revenue that is inpatient	8.13	****	1.08	12.19	****	1.34	20.94	****	2.27
Population characteristic controls									
% Male	0.03	****	0.01	0.03	****	0.01	0.08	****	0.02
% African-American	-0.02	***	0.01	-5.1E-03		0.01	-0.03	*	0.02
% Hispanic	-0.01	****	2.5E-03	-0.01	***	0.00	-0.02	****	0.01
% Urban	8.1E-04		1.2E-03	7.0E-04		1.5E-03	0.00		2.6E-03
SES index	-41.17	****	7.23	-42.68	****	8.93	-85.85	****	16.06
Heart disease mortality rate	-0.01		0.01	-0.01		0.01	-0.03		0.02
Respiratory disease mortality rate	3.8E-03		0.01	-0.02	*	0.01	-0.02		0.02
Pneumonia mortality rate	0.16	**	0.07	0.11		0.08	0.28	*	0.14
Diabetes mortality rate	-2.53	***	0.96	-0.70		1.20	-2.08		1.97
% residents ages 0-14 (Referent)	-		-	-		-	-		-
% residents ages 15-64	-8.51		7.13	-15.17	*	8.81	-25.04		15.76
% residents ages 65 and over	14.22		12.01	11.40		14.80	25.84		27.15
Physician supply controls									
PCPs per 1,000	-0.07		0.05	0.10		0.06	0.02		0.10
Specialists per 1,000	0.05		0.04	-0.11	**	0.05	-0.04		0.07
Market use and competition controls									
# of outpatient services per 1,000	3.9E-04	****	9.1E-05	7.0E-04	****	1.1E-04	1.1E-03	****	1.88E-04
Hospital Herfindahl Index	-1.84	***	0.62	-2.18	***	0.77	-4.61	****	1.32
Time trend controls									
1998 (Referent)	-		-	-		-	-		-
1999	0.28	*	0.14	-0.25		0.18	-0.03		0.29
2000	-0.08		0.14	-0.28		0.18	-0.43		0.29
2001	0.62	***	0.15	0.27		0.19	0.74	**	0.31
2002	0.68	****	0.16	0.77	****	0.20	1.25	****	0.32
2003	0.88	****	0.17	0.82	****	0.21	1.44	****	0.34
2004	0.24		0.17	0.41	*	0.22	0.39		0.36
2005	0.65	****	0.19	0.65	***	0.24	1.04	***	0.39
Intercept	-14.34		8.61	-11.13		10.63	-27.36		19.17
N	450			450			450		

* $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$; ****$p < 0.001$

A final explanation for why inter-organizational relationships were not statistically significant is found in the sensitivity analysis. Several of the inter-organizational relationships were significant and in the direction predicted when examined for specific conditions but not when aggregated into categories such as acute care and chronic care ACSH. For example, the proportion of hospitals that owned a nursing home was negatively associated with the rate of ACSH for angina, asthma, and hypertension, yet there was no significant relationship when these conditions were aggregated into a chronic care ACSH rate. Likewise, the proportion of hospitals that owned an insurance product was significantly associated with the rate of ACSH for congestive heart failure, COPD, and uncontrolled diabetes, but there was no significant relationship when these conditions were aggregated into a chronic care hospitalization rate. These results suggest that inter-organizational relationships may be important, but their effects are likely contingent on the types of organizations involved and the condition being considered. Future research is needed to explore whether there is something unique about the clinical condition, or whether certain aspects of the inter-organizational relationship and can be leveraged across other conditions.

Summary of Findings

The findings of this study reinforce analysts' recommendations that studies include and control for multiple types of factors that contribute to small area variations such as ACSH. After controlling for population characteristics and health service utilization, health system characteristics such as provider composition and certain types of inter-organizational relationships were significantly associated with ACSH rates. Results showing the supply of home health agencies, nursing homes, and physician organizations significantly associated with ACSH rates also reinforce a growing number of studies that show multiple provider types associated with ACSH, relationships that persist even after controlling for the effects of other provider types. Finally, the findings suggest that the relationship between market structure and ACSH is nuanced and contingent upon many different factors. For example, the study found that the relationship between provider supply and ACSH rates varies by how provider supply is measured, with some provider types significantly associated with ACSH rates when supply was measured relative to residents in a market and a different set of providers significantly associated with ACSH rates when supply was measured relative to other provider organizations in a market. Another nuance was highlighted by the sensitivity analysis, which indicated that relationships that exist for specific conditions may disappear when analyzed at an aggregated level. Overall, these findings highlight a number of important relationships and contingencies that should be considered in future research. The following section explores these considerations in greater detail.

Implications for Future ACSH Research

A perennial debate in health care is how to improve access to care. One of the central tradeoffs discussed in these debates is that between insurance coverage and consumer demand versus care availability and provider supply. Although intertwined and arguably complementary approaches for improving access, these options are typically framed as either-or decisions that stem, in part, from limited resources available to support both approaches. Despite recent policy efforts to encourage movement on both fronts (Cunningham and Hadley 2004), resource considerations will likely continue to constrain dual action strategies to improve access. Under such circumstances, the U.S.

health care system is presented with a situation where it may be expected to do more with fewer resources, or at least get more out of the resources that are currently available. This study has tried to highlight how the structure of primary care markets may affect ACSH, and by extension, facilitate discussion on how resources may be best configured to improve ACSH outcomes as well as access more generally. The findings of this study highlight a number of places and ways to expand the ACSH research agenda.

First, there is a need to revisit the access frameworks that guide empirical investigations of ACSH and examine other aspects of these frameworks. Studies have catalogued a number of population characteristics that affect ACSH. However, many of these characteristics are either immutable or serve as markers of underlying social conditions or behaviors that provide limited options for solutions other than broad scale policy changes such as expansion of insurance coverage. While such policy efforts may be part of the solution, a growing body of research also suggests that there is more to the story than simply more or better access, (Friedman et al. 1999; Saha et al. 2007) emphasizing the need to look at how care is organized and delivered in our communities. The results of this study are consistent with this research and provide additional support for examining the relationship between health care system characteristics and ACSH. For example, findings that the supply of certain types of ambulatory care providers relative to hospitals has a negative effect on ACSH rates indicate that the composition of providers in a market may be as important as the overall supply. These results also suggest that some types of organizations may be more important than others for improving ACSH rates, or worse, that some types of organizations may actually benefit by generating unnecessary hospitalizations. Together these findings highlight a need to explore other health system characteristics that might be deployed in more effective ways to improve outcomes of care.

In addition to exploring other dimensions of access frameworks, there is an opportunity to integrate these dimensions. One promising avenue for integrating these different dimensions was highlighted by results showing that market characteristics likely moderate the relationship between market structure and ACSH. For example, the study found that the relationship between provider capacity and ACSH varied across rural and urban markets. There are other factors that may condition the relationship and should be considered in future research. For example, are the effects of provider supply or inter-organizational relationships similar for different populations (e.g., Medicaid, uninsured, African-Americans, Hispanics)? Does the dominance of certain organizational types (e.g., not-for-profit) in a market influence ACSH?

In a similar vein, the ACSH research agenda should be expanded by refining the theoretical explanations used to explain ACSH. Studies often do not explicitly identify the mechanism by which the health system or population characteristics may affect ACSH. Too often there is a generic appeal to overly broad access frameworks and it is only when studies examine provider supply do theoretical explanations become more clearly specified (e.g., 'more points of access' that reduce disease progression). The problem with such omissions is that they tell us little about the opportunities that exist to improve outcomes related to ambulatory care sensitive conditions. Furthermore, the absence of an explicit theoretical basis limits our understanding of the generalizability of the research.

This study addressed this gap by using a control and coordination mechanism to explain how market structure may affect ACSH. For example, one set of hypotheses argued that certain provider types may provide more coordinative care and more opportunities for transitional care that minimizes hospital readmissions. These hypotheses were supported by results showing the supply of home health agencies, nursing homes, and physician organizations relative to hospitals in a market associated with lower ACSH rates. Even so, the study did not directly measure coordination, but rather the market conditions that may set the stage for coordination. Therefore, future research is needed to assess whether certain structural characteristics do, in fact, result in better or worse coordination. Furthermore, given the broad range of activities involved in coordinating care, future research is needed to assess whether certain types of coordination are more or less effective. For example, is discharge planning or case/disease management associated with lower rates of ACSH? Do new technologies that emphasize communication amongst providers improve rates of ACSH?

Another opportunity to extend the ACSH research literature is to explore whether the relationships examined in this study, as well as other health system characteristics, affect other measures of access in similar ways. This study focused on ACSH as an indicator of access; however, access research encompasses a number of access measures, such as unnecessary emergency department visits, reports of unmet need, and having a usual source of care. Relationship consistency across different access indicators not only has important implications for the management and policy recommendations that flow from these studies, but also affect the conclusions that can be drawn about these relationships that are used to inform future research. Factors that are consistently associated with multiple indicators of access may represent important leverage points for a health care system perpetually faced with scarce resource allocation decisions. Likewise, factors that are inconsistently associated with access, or even have contrasting effects on different access indicators, represent a significant opportunity to improve our understanding of places where we might expect less improvement.

A final research implication that extends from this study relates to the use of aggregated rates of ACSH. The supplemental analysis showed that the effects of market characteristics are not uniform across different ambulatory care sensitive conditions. Furthermore, the results indicate that aggregating outcomes may dampen underlying variation and obscure significant relationships. Interestingly, aggregated measures of ACSH are relatively common in the literature. It is unknown to what extent these studies conducted initial exploratory work to determine the appropriateness of aggregating these outcomes. Even so, the results of this study suggest that caution is warranted when combining conditions into aggregated outcomes. These cautions are especially justified when exploring new relationships that have little preexisting research to support aggregation. Future research should consider starting with condition-specific outcomes before aggregating.

Implications for Management & Policy

This study has emphasized the importance of examining and controlling for multiple provider types to understand access to care and ACSH. Results showing provider supply associated with ACSH rates for home health agencies, nursing homes, physician organizations, and even hospitals suggest that policy makers and managers alike would be well served by taking broader views of primary care markets. Likewise, the inter-organizational relationship models, at least when analyzed for specific conditions, show that relationships between different provider types may be facilitators (i.e., hospitals and nursing homes, hospitals and insurance companies) or barriers (i.e., hospitals and physician organizations) to access. These findings suggest that there is more than one path to improving ACSH rates and that the evaluation of problems and solutions by policy makers and managers should account for multiple provider types in the market.

That said, recommendations to consider for multiple provider types when examining primary care markets present challenges and opportunities. On one hand, multiple moving parts in the form of different provider types introduce even greater complexity into policy questions of the ‘right’ level of provider supply. On the other hand, the consideration of multiple provider types may offer additional options to fill recognized gaps in supply. Similar tradeoffs exist for managers trying to make sense of their external environment. More inclusive views of the primary care community will likely highlight a broader range of competitive threats or but may also open up new opportunities for collaboration.

It is worth noting that the arguments and findings of this study are consistent with emerging frameworks of primary care that emphasize the importance of organizations in addition to individual professionals (Hogg et al. 2007; Starfield 2001; Starfield, Shi, and Macinko 2005). The study’s findings and the recommendations that flow from them are also reminiscent of regional planning initiatives introduced in the late 1970s. History suggests that regional planning is not likely to be adopted in any widespread manner; however, one interpretation of other recent health care developments is that more comprehensive perspectives are needed to appreciate both the complexity of the problems and the solutions that are required. For example, analysts have argued for greater accountability among organizations that span traditional organizational boundaries (Fisher et al. 2009; Fisher et al. 2006). Advocates of these approaches propose that physicians and hospitals be bundled together into ‘accountable care organizations’ for the purposes of measurement and reimbursement. Likewise, community health alliances and coalitions are commonly used organizational forms for health education and health promotion in communities (Butterfoss, Goodman, and Wandersman 1993; Huxham 1996; Shortell et al. 2002; Wagner et al. 2000). These organizations evolved out of a need to engage a wide range of stakeholders to improve the health of communities.

These examples and the findings from this study highlight the need for practitioners and policy makers to look not only at the collection of organizations that make up a local health care market, but also at the manner in which these organizations may be linked to increase access, improve coordination, and enhance the overall delivery of health care in these communities. Such considerations will require practitioners and policy makers to reconsider some of the fundamental rules of the health care game. On the policy side, meaningful improvement will likely require policy makers to move on multiple fronts that alter both the organization and delivery of care as well as how that care is financed. For example, policy efforts that simply address access to care or how care is delivered fail to address financing deficiencies that weaken alignment and accountability among providers. On the practitioner side, efforts to establish greater alignment and accountability will likely require providers to change their conceptions of competition and collaboration. While often viewed as countervailing forces, in reality the relationship is more nuanced and health care providers will need to find ways to balance these forces if the health of the *community* is to take its place as a priority in the health system. The findings regarding hospital supply also raise some potential policy and managerial implications. The results suggest that a desire for broad stroke policies must be balanced against a need for focused analysis and planning, especially if the goal is to improve outcomes of care and not just access to care. For instance, the non-linear relationship between hospital capacity and ACSH rates suggests that the relationship between hospital supply may be moderated by some factor(s). The analysis also suggests that hospitals have a different relationship with ACSH than other provider types, which is consistent with emerging ACSH research (Chang, Mirvis, and Waters 2008; Zhan et al. 2004). These findings suggest that policies aimed broadly at reducing ACSH by increasing provider supply may, in fact, increase the number of providers in a market, but raise questions of whether these are the right providers for a market. Do policy changes result in the right mixture of providers for a particular market? Such considerations are critical for developing national and state policy that meets local needs.

Results of the sensitivity analysis also highlight some of the limitations of broad-based policy and management solutions. The findings indicate that certain provider types may be less adept at providing or coordinating care related to specific conditions. Likewise, certain types of inter-organizational relationships may be more important for care related to certain conditions. Although more research is needed to determine more precisely what about these provider types and inter-organizational relationships make them more or less effective, they at least suggest that ‘one size fits all’ interventions should not be expected to have equal effects on outcomes. By extension, policy makers and managers may want to proceed cautiously when considering how specific interventions affect other outcomes, including others related to access. For example, studies finding increases in Medicaid coverage associated with higher ACSH rates demonstrate that changes likely have unintended consequences (Friedman et al. 1999; Saha et al. 2007). Likewise, managers of health care organizations involved in strategic partnerships and community coalitions with an objective of getting more community residents into the health care system could very well observe higher rates of ACSH. Unintended consequences and conflicting activities are not necessarily new dilemmas for managers and policy makers, so the point here is not necessarily that these can or should be avoided. Instead, the point is that decision makers need to be aware of these possibilities and they may need to demonstrate commitment and patience with their decisions before realizing any long-term benefit.

Finally, there should be some consideration of whether the policies being developed go far enough to encourage meaningful change. Earlier it was suggested that hospitals may face conflicting financial incentives regarding ACSH. If hospitals truly do face conflicting incentives regarding ACSH, then there may also be a need for policy that aligns reimbursement in ways that attenuate these conflicts. Reductions in Medicare reimbursement related to ‘never events’ and pay-for-performance programs are two examples of ways that policy is being utilized to realign incentives (Francis 2007; Pear 2007; Rosenthal 2007; Wachter, Foster, and Dudley 2008). However, it remains to be determined whether these programs ‘have enough teeth’ to have any real impact. In other words, unless the financial benefits or penalties are significant enough to alter organizational behavior and engage in activities that impact processes and outcomes of care, then hospitals may see little need to change from the status quo. More research is needed to determine whether these conflicting incentives even exist, their significance for hospitals, whether they have any real impact on hospital decision making, and what impact these decisions may have on outcomes of care.

Limitations

Research projects are filled with decisions that present both opportunities and limitations. This study is no exception. The following discussion describes these limitations and suggests how future research may address these limitations. Three general types of limitations are described: (1) study context; (2) research design; and (3) data and measurement.

Study Context

There are two primary limitations with respect to the context of the study. First, the focus on a single state limits the external validity of the results. California was chosen because of its size, organizational demographics, and population diversity. California has also been the focus of an extensive body of health services research, including studies of ACSH. Therefore, the focus on California provided an opportunity to build upon previous research as well validate results of the study. Despite these advantages, California may be different from other states in ways that could limit the generalizability of the results. For example, physician organizations and staff/group model HMOs are more prevalent in California than in most states (Gillies et al. 2003; Rittenhouse et al. 2004). Likewise, the long-standing presence of group model HMOs like Kaiser Permanente means that the effects of these organizations may be confounded by its longevity in the market. Not only do older organizations benefit from a longer history that allows them to refine organizational processes, but they may also enjoy a greater sense of trust among consumers and other health care providers in a community.

Studies documenting different ACSH rates across states support the importance of state-level factors that should be taken into consideration when generalizing results (Friedman et al. 1999; Laditka and Laditka 2004). Studies of Medicaid coverage and program expansion provide examples of the types of state-level factors that might affect ACSH but differ across states (Bindman, Chattopadhyay, and Auerback 2008, 2008; Saha et al. 2007). Interestingly though, even these studies have produced contradictory results and suggest that factors beyond policy and insurance coverage play an important role (Friedman et al. 1999; Porell 2001). Therefore, although the organizational populations examined in this study and the prevalence of the relationships may differ across states, the importance of these relationships likely extends beyond California's borders.

A second potential contextual limitation pertains to the market definition used in the study. Consistent with most other research in this area, the county was chosen as the geographic boundary of a primary care market. However, as noted earlier, there is debate about the appropriate demarcation for a market (Baker 2001). Many small area variation analysts suggest that larger markets dampen the effects of provider supply and suggest that markets be defined at the zip code level or smaller (Wennberg 1984; Wennberg, Fisher, and Skinner 2002). If true, then the results reported in this study may be conservative.

On the other hand, smaller market definitions may make hospitalization rates more sensitive to changes, especially for small markets. Specifically, the use of a fixed market population as the hospitalization rate denominator, combined with a smaller market size, means that each hospitalization will have a greater effect on the overall hospitalization rate in a market. To control for this issue, future studies should consider directly controlling for the size of the market. Another concern that arises when using smaller market definitions is the issue of border-crossing. When markets are defined to be smaller geographic areas, it increases the likelihood that consumers will receive services from health care providers in neighboring markets. Although border-crossing can happen in either direction, generally it seems likely that consumers from smaller markets will be admitted to hospitals in larger markets due to provider supply and diversity of health service constraints imposed by smaller health care markets. An extreme example of this situation is in markets where a provider is not located in the market (e.g., no acute care hospital in the market). Assuming that most border-crossing does occur from smaller to larger markets, then estimates of larger market ACSH rates are deflated and estimates of smaller market ACSH rates are inflated in this study. Future research could control for border-crossing in several ways. First, researchers could test relationships using a larger geographic area to define the market. For example, some market-level studies use the metropolitan statistical area or even the state as the market definition. Second, researchers could directly control for border-crossing by creating a variable that reflects the proportion of admissions that occur from residents in different markets. Third, the outcome could be operationalized so that border-crossing activities are reflected in the hospitalization rate. For example, the rate could be calculated as the number of ambulatory care sensitive hospitalizations as a proportion of total hospitalizations. Using the total number of market hospitalizations as the denominator, instead of the relatively static market population, may do a better job of reflecting border-crossing activities in a market because both components of the rate reflect consumer and physician choices about which hospitals to receive care from. In other words, to the extent border crossing is occurring for admissions related to ambulatory care sensitive conditions, it should be controlled for when both the numerator and denominators of the hospitalization rate reflect these occurrences.

Another consideration with respect to the market definition is the types of organizations included in the analysis. The study focused on six organizational types that previous research has examined or empirical reports have suggested as important for ACSH. However, these organizations do not account for all care provided in a market and the study cannot make claims of exhaustiveness with respect to provider types. Even among the organizations included in the study, a decision was made to focus on similar organizational types to make comparisons across providers more valid. For example, the analysis was limited to short-term, acute care hospitals, thereby excluding specialty hospitals. Perhaps more importantly, the physician organizations included in the study were limited to medical groups and independent physician associations with more than six physicians, thereby excluding small physician practices and solo practitioners. These physicians are typically controlled for with a market-level, physician supply variable that includes all physicians in a market. However, this study was interested in distinguishing between the different organizational settings that many physicians practice in (e.g., community health centers, physician organizations, health maintenance organizations), which ruled out the use of such an inclusive control variable. Including a market-level, physician supply control variable along with the explanatory variables of interest would result in double counting of physicians in a market. Where possible, the analysis used a market-level, physician supply control variable (i.e., inter-organizational relationship regressions); however, future research should consider ways to include small and large physician settings in the analysis.

Research Design

Limitations with respect to outcome variable variation resulted in the adoption of a pooled, cross-sectional time series design. The use of this design comes at the expense of stronger claims regarding the cause-and-effect relationship between market structure and ACSH rates and more generally can raise questions of endogeneity (Campbell and Stanley 1963; Spector 1981). For example, higher ACSH rates could reflect greater morbidity among market residents, which could also affect utilization of outpatient health services, a case of omitted variable bias. Although the study attempted to control for morbidity with market-level prevalence rates for several health conditions, these controls were not specific to the patients hospitalized for an ambulatory care sensitive condition nor did they exhaustively cover all of the health conditions included in the study. Another potential endogeneity concern relates to reverse causality. An example from this study might pertain to the inter-organizational relationship analysis, where high ACSH rates could result in more organizations establishing inter-organizational relationships, either to decrease ACSH rates or capitalize on an opportunity to provide more services, instead of the other way around. Although the study accounted for temporal trends with year control variables, future research can build on the results of this study by utilizing panel designs and more rigorous longitudinal techniques. Panel studies can provide more insight into questions of how *changes* in market structure are associated with rates of ACSH. Researchers pursuing longitudinal studies are aided by more accessible data.

Hospital discharge data is now routinely collected by most states. Furthermore, over 35 states submit this data to the Agency for Healthcare Research and Quality, which in turn makes the data available for research. Although these studies will likely confront similar issues with respect to outcome variable variation over time, studies of multiple states may help overcome this limitation.

Data and measurement

The most significant data limitation relates to the dependence on discharge data to derive outcome variables. This dependence means that two things need to occur before an outcome can be calculated for a market. First, there needs to be a hospital in the market. Second, patients need to be admitted to one of the hospitals in the market for an ambulatory care sensitive condition. If a hospital is not present in a market, then an outcome variable cannot be constructed for that market, resulting in a loss of that observation. In the case of this study, the absence of a market hospital resulted in at least one market being excluded each year from the analytic dataset. The exclusion of these markets is problematic because they are on the extremely low end of the access continuum; therefore, they are important markets to study. In other words, because ACSH is intended to be a reflection of the ambulatory care available in a market, the fact that it depends upon inpatient utilization may create a gap in our understanding of how good access is or is not in these markets. Future studies that utilize hospital discharge data, or any hospital data for that matter, will confront similar challenges.

There are several options available to address this limitation. First, studies can utilize primary data collection such as surveys or interviews. For example, Bindman and colleagues (1995) used consumer surveys and physician interviews, combined with hospital data, to evaluate the relationship between provider supply, perceptions of access, and ACSH in California markets. Another possibility is the use of administrative data that is organized around populations of patients in a market, instead of just those patients that receive hospital services. Health plan data is commonly employed in these types of analysis. For example, Falik and colleagues (2001) used administrative claims data across five states to evaluate whether Medicaid beneficiaries who receive most of their care from community health centers were more likely to experience an ACSH than beneficiaries receiving most of their care from other providers in the market.

The primary measurement limitation relates to the measurement of provider supply. The study weighted each individual organization equally by using counts of organizations in a market. However, some providers may disproportionately contribute to the supply of health services in a market. For example, a 500-bed hospital in a market may offer a larger number and a broader range of services than a 50-bed hospital in the same market. The equal weight approach used in this study was chosen over weighted measurements for several reasons. First, data were not available to weight all of the organizational types considered in the study (e.g., staff/group HMOs, physician organizations). Second, for many provider types it is not clear what factor is most appropriate for weighting (e.g., number of services provided or patients seen, number of employees, revenues). This is particularly problematic for provider types that have not received the same level of research attention that more traditional provider types such as hospitals, HMOs, and nursing homes have received. Finally, from a very technical standpoint, the use of such weightings may reflect service supply more so than provider supply per se.

Conclusion

In 2007, Medicare stopped making payments to hospitals for ‘never events’. The rationale behind this policy was that these procedures were unnecessary, representing poor quality care and a drain on a health care system already stretched thin. Although not without its critics, the policy is only a recent manifestation of a longer trend in the U.S. health care system that expects more accountability from health care providers. Over the past 25 years, the U.S. health care system has experienced a number of similar changes, such as the introduction of the Prospective Payment System and the ascendance of managed care in the 1980s and 1990s. Whatever its guise, it seems that accountability is a concept that is here to stay.

A common assumption underlying these changes is that policy makers and practitioners will find ways to do more with fewer resources. Yet recommendations that extend from previous ACSH research often require more resources, typically in the form of new providers or more money to subsidize the expansion of health insurance programs. This study examined whether different aspects of market structure were associated with better ACSH outcomes. In doing so, it was hoped that we might begin to understand whether different configurations of existing health system resources might be better utilized to improve the quality of and access to ambulatory care. The study’s findings indicate that the structure of a health care market does make a difference. They also highlight that much remains to be understood about the mechanisms by which these structures affect access and the contingencies that may qualify their generalization across markets and outcomes.

These findings present a double-edged sword for those who support greater provider accountability. On one hand, the findings suggest that existing resources may be (re)configured to improve outcomes and truly achieve better outcomes with the same or fewer resources. On the other hand, the findings also indicate that simple solutions are not forthcoming and likely do not fit all markets equally. The contrast highlights the balancing act that policy makers and practitioners must strike if they are to improve access to care and outcomes in the most broad and applicable way.

Appendix 1: California Counties, 1998

County	Population	Area (square miles)	County	Population	Area (square miles)
Alameda	1,443,741	821	Orange	2,846,289	948
Alpine	1,208	743	Placer	248,399	1,503
Amador	35,100	605	Plumas	20,824	2,613
Butte	203,171	1,677	Riverside	1,545,387	7,303
Calaveras	40,554	1,037	Sacramento	1,223,499	995
Colusa	18,804	1,156	San Benito	53,234	1,391
Contra Costa	948,816	802	San Bernardino	1,709,434	20,105
Del Norte	27,507	1,230	San Diego	2,813,833	4,526
El Dorado	156,299	1,788	San Francisco	776,733	232
Fresno	799,407	6,017	San Joaquin	563,598	1,426
Glenn	26,453	1,327	San Luis Obispo	246,681	3,616
Humboldt	126,518	4,052	San Mateo	707,161	741
Imperial	142,361	4,482	Santa Barbara	399,347	3,789
Inyo	17,945	10,227	Santa Clara	1,682,585	1,304
Kern	661,645	8,161	Santa Cruz	255,602	607
Kings	129,461	1,391	Shasta	163,256	3,847
Lake	58,309	1,329	Sierra	3,555	962
Lassen	33,828	4,720	Siskiyou	44,301	6,347
Los Angeles	9,519,338	4,752	Solano	394,542	907
Madera	123,109	2,153	Sonoma	458,614	1,768
Marin	247,289	828	Stanislaus	446,997	1,515
Mariposa	17,130	1,463	Sutter	78,930	609
Mendocino	86,265	3,878	Tehama	56,039	2,962
Merced	210,554	1,972	Trinity	13,022	3,208
Modoc	9,449	4,203	Tulare	368,021	4,839
Mono	12,853	3,132	Tuolumne	54,501	2,274
Monterey	401,762	3,771	Ventura	753,197	2,208
Napa	124,279	788	Yolo	168,660	1,023
Nevada	92,033	974	Yuba	60,219	644

Appendix 2: ACSH primary diagnosis codes

Type of preventable hospitalization	ICD-9 codes	Type of ACSH
Angina	411.1; 411.81; 411.89; 413.0-413.1; 413.9	Acute
Asthma	493.00-493.02; 493.10-493.12; 493.20-493.22; 493.81-493.82; 493.90-493.92	Chronic
Bacterial Pneumonia	481; 482.2; 482.30-482.32; 482.39; 482.9; 483.0-483.1; 483.8; 485; 486	Acute
COPD	491.0-491.1; 491.20-491.21; 491.8-491.9; 492.0; 492.8; 494-494.1; 496	Chronic
Congestive Heart Failure	398.91; 402.01; 402.11; 402.91; 404.01; 404.03; 404.11; 404.13; 404.91; 404.93; 428.0-428.1; 428.20-428.23; 428.30-428.33; 428.40-428.43; 428.9	Chronic
Dehydration	276.5; 276.50-276.52	Acute
Diabetes with short term complications	250.10-250.13; 250.20-250.23 250.30-250.33	Chronic
Diabetes with long term complications	250.40-250.43; 250.50-250.53; 250.60-250.63; 250.70-250.73; 250.80-250.83; 250.90-250.93	Chronic
Diabetes uncontrolled	250.02-250.03	Chronic
Hypertension	401.0; 401.9; 402.00; 402.10; 402.90; 403.00; 403.10; 403.90; 404.00; 404.10; 404.90	Chronic
Perforated appendix	540.0-540.1	Acute

Appendix 3: Types of Physician Organizations

Type	Definition	Level of Integration
Independent Practice Association (IPA)	An IPA is a legal entity that holds managed care contracts and contracts with physicians, usually in solo practice, to provide care either on a fee-for-services or capitated basis. The purpose of an IPA is to assist solo physicians in obtaining managed care contracts	Loose
Group Practice Without Walls (GPWW)	The hospital sponsors the formation of a physician group or provides capital to physicians to establish one. The group shares administrative expenses, although the physicians remain independent practitioners.	Loose
Open Physician-Hospital Organization (OPHO)	A joint venture between the hospital and all members of the medical staff who wish to participate. The open PHO can act as a unified agent in managed care contracting, own a managed care plan, own and operate ambulatory care centers or ancillary services projects, or provide administrative services to physician members.	Loose
Closed Physician-Hospital Organization (CPHO)	A joint venture between the hospital and physicians who have been selected on the basis of cost-effectiveness and/or high quality. The PHO can act as a unified agent in managed care contracting, own a managed care plan, own and operate ambulatory care centers or ancillary services projects, or provide administrative services to physician members.	Moderate
Management Services Organization	A corporation owned by the hospital or a physician/hospital joint venture that provides management services to one or more medical group practices. As part of a full-service management agreement, the MSO purchases the tangible assets of the practices and leases them back, employs all non-physician staff, and provides all supplies/administrative systems for a fee.	Moderate
Integrated Salary Model	Physicians are salaried by the hospital or other entity of a health system to provide medical services for primary care and specialty care.	Tight
Equity Model	An arrangement that allows established practitioners to become shareholders in a professional corporation in exchange for tangible and intangible assets of their existing practices.	Tight
Foundation	A corporation, organized as a hospital affiliate or subsidiary, which purchases both tangible and intangible assets of one or more medical group practices. Physicians remain in a separate corporate entity but sign a professional services agreement with the foundation.	Tight

Source: American Hospital Association Annual Survey

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