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The Impact of Medicaid Disproportionate Share Hospital Payment on the Provision of Hospital Uncompensated Care and Quality of Care

Hui-Min Hsieh
Virginia Commonwealth University

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

This is to certify that the dissertation prepared by Hui-Min Hsieh, "*The Impact of Medicaid Disproportionate Share Hospital Payment on the Provision of Hospital Uncompensated Care and Quality of Care*", has been approved by her committee as satisfactory completion of the dissertation requirement for the degree of Doctor of Philosophy.

Committee:

Director of Dissertation
School of Allied Health Professions

Committee Member
School of Allied Health Professions

Committee Member
School of Allied Health Professions

Committee Member
School of Business

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

Dean, School of Graduate Studies

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The Impact of Medicaid Disproportionate Share Hospital Payment on the Provision of Hospital Uncompensated Care and Quality of Care

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

by

Hui-Min Hsieh
Master of Business Administration (M.B.A)
National Chung Cheng University, Taiwan, 2001

Director: Gloria J. Bazzoli, Ph.D.
Bon Secours Professor
Department of Health Administration

Virginia Commonwealth University
Richmond, Virginia
May 2010

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ABSTRACT

The Impact of Medicaid Disproportionate Share Hospital Payment on the Provision of Hospital Uncompensated Care and Quality of Care

by Hui-Min Hsieh, Ph.D.

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

Virginia Commonwealth University, Richmond Virginia, May 2010

Director: Gloria J. Bazzoli, Ph.D.
Bon Secours Professor, Department of Health Administration

Medicaid Disproportionate Share Hospital (DSH) payment is one of the major funds supporting health care providers as they treat low-income patients. However, Medicaid DSH payments have been targeted for major budget cuts in many health policy reforms. This study examines the association between the changes in Medicaid DSH payments resulting from the BBA policy changes and hospital outcomes, in terms of hospital provision of uncompensated care and quality of care.

Economic theory of non-profit hospital behavior is used as a conceptual framework, and longitudinal data for California short-term, non-federal general acute care hospitals for 1996-2003 are examined. California was especially affected by DSH changes because it is one of the states with highly concentrated DSH payments and high uninsured rate. Economic theory suggests that hospitals would change their uncompensated care provision as well as quality of care when confronted with a

reduction in public payments. Hospital uncompensated care costs and percent of operating costs devoted to uncompensated care are used to measure the provision of hospital uncompensated care. Six AHRQ's Patient safety indicators (PSIs) and one composite measure are selected to measure hospital quality of care provided for Medicaid and uninsured patients as well as privately insured patients. The key independent variable is Medicaid DSH payments received by individual hospitals. This study also includes control variables such as other governmental financial subsidies, market characteristics, and hospital characteristics.

The primary data sources include the detailed hospital annual financial data and Medicaid annual report data at the county level from California Office of Statewide Health Planning and Development, Healthcare Cost and Utilization Project (HCUP) state inpatient data (SID), American Hospital Association Annual Survey, Area Resource File, Interstudy HMO Data and Medicare cost report data.

After controlling for different factors, the study findings suggest that not-for-profit hospitals may reduce their provision of uncompensated care in response to reductions of Medicaid DSH payments. The results, however, do not support the hypotheses that for-profit hospitals may reduce uncompensated care by a smaller degree than not-for-profit hospitals for a comparable DSH decline. With respect to quality of care model, the overall study findings do not strongly support there is an association between net Medicaid DSH payments and patient adverse events for both Medicaid/uninsured and privately insured.

CHAPTER 1: INTRODUCTION

Specific Aims

A growing number of individuals in the U.S. do not have health insurance. Census Bureau data indicate the number of uninsured increased dramatically from 31 million in 1987 to 45.7 million in 2007. In the U.S. health system, the uninsured often rely on hospitals to provide charity care, or more broadly defined uncompensated care (Bazzoli, Lindrooth, Kang, & Hasnain-Wynia, 2006; Davidoff, LoSasso, Bazzoli, & Zuckerman, 2000; Lo Sasso & Seamster, 2007; Mann, Melnick, Bamezai, & Zwanziger, 1997). One study estimated the overall amount of hospital uncompensated care costs was about 23.6 billion in 2001 (Hadley & Holahan, 2003). In order to offset the burden from this type of care, hospitals need to get various types of public and private financial support from federal, state, local governments or private philanthropy (Fishman & Bentley, 1997; Hadley, Cravens, Coughlin, & Holahan, 2005; Hadley & Holahan, 2003).

The Federal and State Medicaid Disproportionate Share Hospital (DSH) payment is one of the major funding sources for uncompensated care, accounting for approximately 7.8% of total Medicaid expenditures in 1997.[1] It supported about 36%

[1] The percentage of inpatient hospital Medicaid DSH to total Medicaid expenditures decreased after 1997 Balanced Budget Act. In 1997, the percentage was about 7.8%. In 2000, it became 5.9%. In 2005, it was about 4.5%. In the Obama health reform plan, from 2010 to 2019, cutting Medicare and Medicaid DSH budget is one of the major ways planned from financing health reform. http://www.kff.org/healthreform/upload/healthreform_tri_full.pdf

of total uncompensated care costs for hospitals in 2001 (Fagnani, Tolbert, & Fund, 1999; Fishman & Bentley, 1997; Hadley et al., 2005; Hadley & Holahan, 2003; Lo Sasso & Seamster, 2007). In the early 1990s, Medicaid DSH payments expanded rapidly. Medicaid DSH spending grew from less than $1 billion in 1990 to more than $ 17 billion in 1992. In order to limit this dramatic growth, Congress implemented two major reforms to cap the amount of DSH spending by limiting the source of state matching funds and also by limiting DSH payments for individual hospitals, requiring hospitals that received Medicaid DSH have at least one percent of their patients covered by Medicaid (Wynn, Coughlin, Bondarenko, & Bruen, 2002). One reform bill was the Medicaid Voluntary Contribution and Provider-Specific Tax Amendments of 1991, which became effective in federal Fiscal Year 1993 and the other was Omnibus Budget Reconciliation Act of 1993 (OBRA`93), which became effective in 1995.

In 1997, the Balanced Budget Act (BBA) further limited Medicaid DSH payments by reducing state specific federal allotments[2] by $10.4 billion over the 1998 and 2002 period (CBO, 1997). These substantial DSH reductions constituted the major sources of federal Medicaid savings, specifically accounting for 61 percent of total Medicaid gross savings over five years. After the BBA, Congress passed the Balanced Budget Refinement Act (BBRA) in 1999. This law eliminated the BBA DSH cuts for Federal Fiscal Year (FFY) 2001 and FFY 2002 and also provided relief by setting 2001 state-specific allotments at 2000 levels adjusted for inflation and setting 2002 allotments at

[2] State specific DSH allotment, also called DSH payment limit or DSH funding cap, is a specified amount of DSH payment adjustment for each state for each Federal fiscal year (FFY) (Federal Register, 62(178), pp.2).

2001 levels adjusted for inflation. However, the Benefit and Improvement Protection Act (BIPA) of 2000 let the full BBA DSH reductions become effective in FFY 2003 (Mechanic, 2004).

In the U.S. health care reform debates of 2009 and 2010, one of the approaches that Congress and the Obama administration proposed for financing expanded health care coverage was to redirect of funds currently used to support safety net hospitals so that subsidies could be provided for individual's purchasing health insurance. Medicaid DSH payment is one of the major sources of funds that would be redirected for these purposes.

Most existing empirical studies have examined the effects of Medicaid DSH payments, which increased dramatically during the 1990s, on hospital uncompensted care provisions as well as patient quality of care. Very few studies examined the impact the reduction of Medicaid DSH payment resulting from the BBA policy at the hospital level. This study examines the association between the changes in Medicaid DSH payments resulting from the BBA policy changes and hospital outcomes, in terms of hospital provision of uncompensated care and quality of care. Through this study, we will gain a better understanding of past health policies as well as a better ability to anticipate the impact of future policies.

Conceptual Framework

A primary concern of this study is whether the reduction of Medicaid Disproportionate Share Hospital (DSH) payment affected the provision of hospital uncompensated care and quality of care for Medicaid and uninsured patients. The underlying conceptual framework in this study derives from the Newhouse (1970)

economic theory of not-for-profit hospital behavior and theoretical extensions from Hoerger (1991), Frank and Salkever (1991) and other researchers. Specifically, this study focuses on theoretical discussions of how hospitals, in particular not-for-profit hospitals, respond when confronted with changes in governmental policy or other exogenous factors (i.e., the reduction of public payments). This study primarily examines the associations between Medicaid DSH payments and hospital provision of uncompensated care. For the quality of care analysis, this study investigates whether the reductions in Medicaid DSH payments affected the quality of care for Medicaid/uninsured. This study also examines changes in the quality of care for privately insured patients, given the public good /private good theoretical perspectives of quality of care.

In order to control for other potential factors that may also affect the provision of hospital uncompensated care and quality of care, this study includes other governmental financial subsidies, market characteristics and hospital-specific characteristics as control variables. The graphical depiction in Figure 1 presents the conceptual framework of the effect of Medicaid Disproportionate Share Hospital payment on the provision of hospital uncompensated care and quality of care.

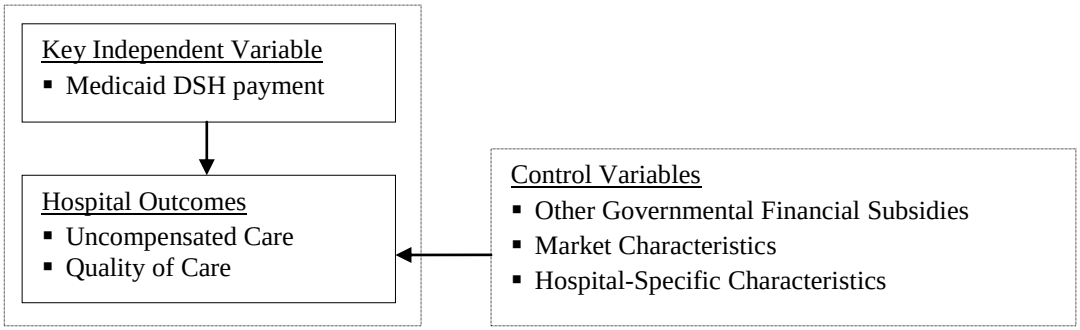


Figure 1. Brief Schematic of the Conceptual Framework of the Effects of Medicaid Disproportionate Share Hospital Payment on the Provision of Hospital Uncompensated Care and Quality of Care.

Research Questions

Medicaid DSH payment is a major funding source from Federal and State governments that offsets costs for those hospitals providing large amounts of care to Medicaid and uninsured patients. Budget cuts in Medicaid DSH payment after the BBA reduced hospital net revenue. Hospitals that depend most on Medicaid DSH payments were most affected in this regard. Economic theory generally predicts that reductions in the subsidies for the uninsured may lead to reductions in the provision of uncompensated care and quality of care provided to the uninsured (Davidoff, LoSasso, Bazzoli, & Zuckerman, 2000; Frank & Salkever, 1991; Hoerger, 1991; Newhouse, 1970). This study addresses these concerns and will answer the following research questions:

- Research Question I*:* What impact did the reductions of Medicaid DSH payments have on hospital provision of uncompensated care, in particular for not-for-profit hospitals?
- Research Question II*:* How do the reduced Medicaid DSH payments affect hospitals' patient quality of care for both Medicaid/uninsured and privately insured patients?
- Research Question III*:* Is quality of care a private good or a public good?

A set of testable hypotheses discussed in the Chapter 3 are developed based on the economic theory to answer these research questions.

Scope and Approach

A longitudinal panel study is developed using unbalanced annual panel data for short-term, non-federal general acute care hospitals in California from 1996 to 2003, which is a study period that includes observations from both before and after the passage

of the BBA. There are several reasons for examing this state: first, California has a higher uninsured rate than the nation as a whole. Second, California receives a high proportion of Medicaid DSH payments each year (Hearne, 2004). Third, the audited financial report data contain relatively complete information regarding the Medicaid DSH payments hospitals received and the uncompensated care hospitals provided.

Study data are drawn from several databases, including (1) annual hospital financial data from the Office of Statewide Health Planning and Development (OSHPD) in California; (2) Healthcare Cost and Utilization Project (HCUP) state inpatient data (SID); (3) the American Hospital Association (AHA) Annual Survey; (4) the Area Resource File (ARF); (5) the Health Leader-Interstudy HMO enrollment data; (6) Medi-Cal annual statistical reports; (7) Medi-Cal Managed Care Annual Statistical Reports; (8) Medicare Cost Reports; and (9) Hospital case-mix index data from OSHPD.

Several analytical approaches are applied in this study. For the uncompensated care models, this study primarily uses fixed effects modeling, adjusting for heteroskedasticity-robust and intra-cluster standard errors. For the quality of care models, this study stratifies patients into two groups by insurance status when examining patient safety outcome measures: one group consists of the privately insured and the other those insured by Medicaid or uninsured. Risk-adjusted patient safety indicator (PSI) measures for both Medicaid/uninsured and privately insured patients are constructed separately at the hospital provider level. Random effects modeling with heteroskedasticity-robust standard error adjustment is used to take account of unobserved hospital specific factors.

Significance of the Study

The study contributes to the body of knowledge in several ways. For the uncompensated care model, this study uses audited hospital financial data from OSHPD to assess the extent to which hospital uncompensated care provision was affected by declining Medicaid DSH payments during the period 1996 to 2003. The advantage of using audited hospital financial data is that Medicaid DSH payment and other state and local governmental financial subsidies are measured explicitly by the dollar amounts that hospitals recive. As such, this study provides information on how additional Medicaid DSH payments are associated with the provision of hospital uncompensated care, holding other governmental subsidies, market and hospital characteristics constant. This study also explores the effects of other federal and state policies, in addition to Medicaid DSH payments, on hospital uncompensated care provision, such as Medicare DSH payments.

With respect to the quality of care model, this study uses hospital inpatient discharge data from Healthcare Cost and Utilization Project (HCUP) State Inpatient Data (SID) and audited hospital financial data to assess the extent to which hospital quality of care was affected by reductions in Medicaid DSH payments during the period 1996 to 2003. This study examines hospital quality of care for both Medicaid/uninsured and privately insured patients between the ages 18 and 64. This study also investigates the public or private good nature of quality of care from the theoretical perspectives.

Summary of Remaining Chapters

This chapter briefly summarizes the purpose of this study as well as the conceptual framework, scope and analytical approach that are used in this study. More

detailed information is discussed and elaborated on in subsequent chapters. Chapter 2 reviews the background of the changes of Medicaid Disproportionate Share Hospital payment policy and prior empirical studies, particularly the effect of public payment on hospital uncompensated care provision and the effect of public payment on quality of care. This review highlights gaps in the existing empirical literature.

Chapter 3 establishes a conceptual framework based on the organizational economic theory, and discusses a set of testable hypotheses. Chapter 4 discusses research methodologies used in this study, including research design, data sources, variable measurements, econometric issues encountered, and analytical approaches. Chapter 5 presents study findings, including descriptive analysis, regression models and sensitivity analysis. Chapter 6 summarizes the results based on the hypotheses and discusses the implications and limitation of this study.

CHAPTER 2: LITERATURE REVIEW

This chapter includes three major sections. In the first section, the study provides an overview regarding the background of the changes of Medicaid Disproportionate Share Hospital (DSH) payment policy, which is the key independent variable in this study. In the second section, the study reviews how previous studies measured several key dependent variables, including uncompensated care provision, and quality of care. The third section discusses two general issues that have been examined empirically: the effect of public payment on hospital uncompensated care provision and the effect of public payment on quality of care. This study will also include summary tables for uncompensated care and quality of care measurements and empirical evidence from existing literature. In general, this chapter provides information on the current body of knowledge from prior studies that is related to this research. Through literature review, this study identifies the gaps among current studies and will identify a proceeding plan for this study.

Medicaid Disproportionate Share Hospital Payment Policy

The Federal and State Medicaid Disproportionate Share Hospital (DSH) payment is one of the major funding sources for uncompensated care, accounting for 36% of total funds for hospitals care of the uninsured (Fagnani et al., 1999; Fishman & Bentley, 1997; Hadley et al., 2005; Hadley & Holahan, 2003; Lo Sasso & Seamster, 2007). Medicaid

DSH payment was enacted after Omnibus Budget Reconciliation Act (OBRA) of 1981. At that time, Congress required states to "take into account the situation of hospitals which serve a disproportionate number of low income patients with special needs" (Fishman & Bentley, 1997). Then, in the Budget Reconciliation Legislation of 1987, Congress established minimum criteria for designing and paying DSH hospitals so that individual states could have more generous criteria in calculating DSH payment for hospitals in that states, either using Medicare existing formula or making an adjustment to hospitals with a high proportion of Medicaid utilization rate (Fagnani et al., 1999; Fishman & Bentley, 1997; Hearne, 2004; Schwartz, Genshan, Weil, & Lam, 2006; Wynn et al., 2002).

In the early 1990s, Medicaid DSH payment expanded quickly. The Medicaid DSH spending grew from less than $1 billion in 1990 to more than $ 17 billion in 1992. As a result of this dramatic expansion, Congress implemented two major reforms to cap the amount of DSH spending in order to limit the growth of the Medicaid DSH expenditure. One was the Medicaid Voluntary Contribution and Provider-Specific Tax Amendments of 1991and another was the Omnibus Budget Reconciliation Act of 1993 (OBRA`93). These reforms limited the source of state matching funds, limited DSH payments for individual hospitals, and required hospitals to have a Medicaid utilization rate of at least one percent in order to qualify for Medicaid DSH payments need (Wynn et al., 2002).

The Balanced Budget Act (BBA) of 1997 further limited Medicaid DSH payment by reducing state specific federal allotments by $10.4 billion over the 1998 to 2002

period (CBO, 1997). These substantial DSH reductions constituted the major sources of federal Medicaid projected savings, specifically accounting for 61 percent of total Medicaid gross savings over five years. [3] After the BBA, Congress passed the Balanced Budget Refinement Act (BBRA) in 1999. The laws eliminated the BBA's DSH cuts for Federal Fiscal Year (FFY) 2001 and FFY 2002 and also provided relief by setting 2001 state-specific allotments at 2000 levels adjusted for inflation and setting 2002 allotments at 2001 levels adjusted for inflation. However, the Benefit and Improvement Protection Act (BIPA) of 2000 let the full BBA DSH reductions become effective in FFY 2003 (Mechanic, 2004).

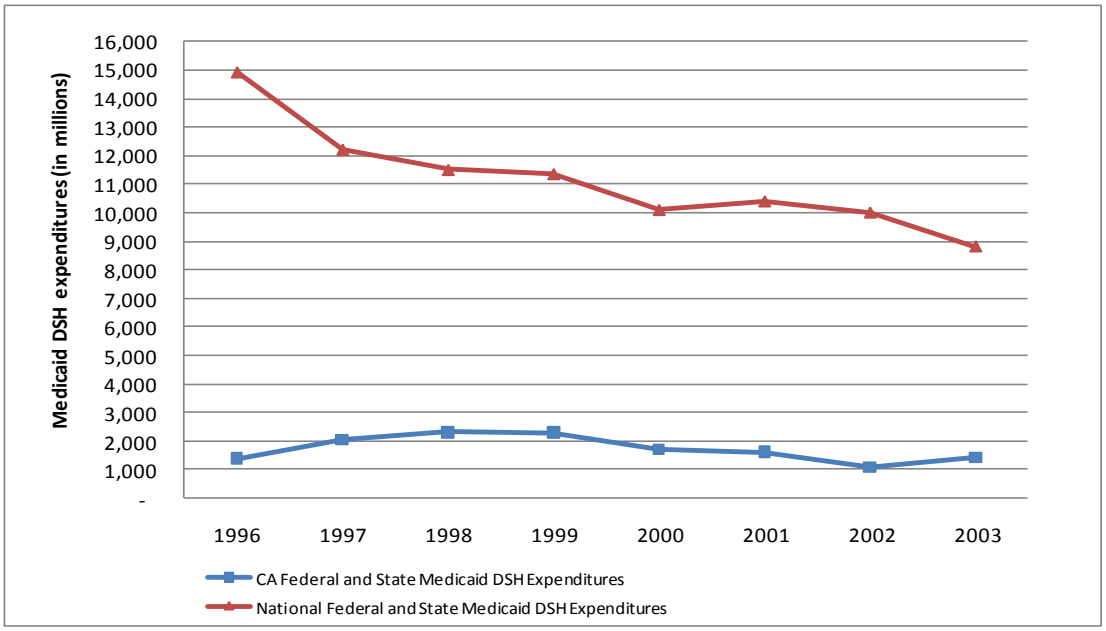
Figure 2 reflects the historical national and California trends of Federal and State inpatient hospital Medicaid DSH expenditures for the years 1996 through 2003. The trend lines of the combined federal and state share of Medicaid DSH expenditure reflect the association of DSH expenditures and policy changes.

Measurement of Key Study Variables

Uncompensated Care Provision

Uncompensated care provision is often used to measure hospital charitable care provided to uninsured or underinsured individuals. It is normally defined as "…the sum of charity care (for patients who are qualified for charity care and are deemed unable to pay after meeting certain criteria) and bad debts (for patients who presumably can afford to pay, but do not)" (Weissman, 1996). Although one may argue that charity care is a precise measure, many researchers found that variations do exist across hospitals in

[3] See Schneider, A. (1997), Overview of Medicaid Provisions in the Balanced Budget Act of 1997, P.L.105-33, from http://www.cbpp.org/908mcaid.htm (Access Date: Feb 20, 2008).



Note:

1. The data primarily reflects inpatient hospital Medicaid DSH payments. These data have been adjusted by the consumer price index to 1996 dollars.
2. Data Source: Health Care Financing Administration (HCFA) Form 64 annual reports; Fagnani and Tolbert. (1999).

Figure 2. 1996-2003 Trends of Federal and State Inpatient Hospital Medicaid DSH expenditures for California and National total (in millions, adjusted by CPI to 1996 dollar)

hospital accounting for charity care and bad debt (Bazzoli, Kang, Hasnain-Wynia, & Lindrooth, 2005; Bazzoli, Lindrooth, Kang, & Hasnain-Wynia, 2006; Davidoff et al., 2000; Gaskin, 1997; Kane & Wubbenhorst, 2000; Rundall, Sofaer, & Lambert, 1988; Sanders, 1993; Sutton & Stensland, 2004; S. Zuckerman, Bazzoli, Davidoff, & LoSasso, 2001). Rundall et al. (1988) commented that hospitals may report their indigent care service as charity care or bad debt, depending on their ownership status. Because of tax consideration, for-profit hospitals tend to report their indigent care as bad debt whereas not-for-profit hospitals prefer to report as charity care. Kane and Wubbenhorst (2000), on the other hand, indicated that if hospitals are able to identify the relevant information

about the patient's financial information, some of what is classified as bad debt might be re-classified as charity care. Given the reporting inconsistencies, many empirical studies have combined charity care and bad debt into the measure of uncompensated care generally.

There are three common ways to calculate uncompensated care provision operationally in the literature. One is to measure in total dollar amounts. The second is to measure it as a ratio. The third is to measure in volume. These are described below with detail shown in Table 1.

Table 1. Measurements of the Provision of Hospital Uncompensated Care

Author	Data source /year(s)	Unit of Analysis	Definitions and Measurements	Notes
Measure in Total Amounts (Expenses/Costs)				
Sheingold and Buchberger (1986)	AHA survey data/ 1980-1981	Hospital level/ all national hospitals	The sum of bad debt and charity charges	Adjusted by the ratio of gross charges to expenses
Thorpe and Phelps (1991)	Audited cost reports from the New York State Department of Health	State data/ hospital level	Natural logarithm of the sum of (inpatient and outpatient) uncompensated care costs per bed	
Sanders (1993)	AHA survey data/1987	National data/ hospital level	The sum of the costs of pure charity care and bad debts.	
Campbell and Ahern (1993)	California Health Facilities Commission/ 1983 and 1987	State data/ hospital	Charity care expenditures plus bad debt expenditures less designated subsidies	Adjusted total UC charges by using hospital mark up
Mann et al. (1995)	California OSHPD/ 1980-1989	State data/ hospital level	Natural logarithm of the sum of charity care plus bad debt costs minus any gifts and subsidies for indigent care.	Adjusted charity care charges by using cost to charge ratio

Table 1 (continued)

Author	Data source /year(s)	Unit of Analysis	Definitions and Measurements	Notes
Davidoff et al. (2000)	AHA survey data/ 1990-1995	National data/ hospital level	Natural logarithm of the sum of charity care plus bad debt cost	• Charity care and bad debt are reported as hospital revenue in AHA survey • Adjusted revenue by using cost to charge ratio (total cost-bad debt cost)/(gross patient revenue+ other operating revenues)
Zuckerman et al. (2001)	AHA survey data/ 1990	National data/ hospital level	The sum of charity care and bad-debt expenses	• Charity care and bad debt are reported as hospital revenue in AHA survey • Adjusted revenue by using cost to charge ratio (total cost-bad debt cost)/(gross patient revenue+ other operating revenues)
Blewett et al. (2003)	Minnesota cost report/ 1992-1996	State data/ Aggregate to county level	The sum of bad debt and charity care expenses on a per capita	
Garmon (2006)	Florida and Texas inpatient discharge and hospital financial data/ 1999 and 2002	State data/ hospital level	• Inpatient charity care and bad debt costs • Outpatient charity care and bad debt costs	Adjusted charity care and bad debt charges by using cost to charge ratio
Bazzoli et al. (2006)	AHA survey data/ 1996-2000	National data/ hospital level	Natural logarithm of the sum of charity care plus bad debt costs	Adjusted charity care and bad debt charges by using institutional cost to charge ratio
Lo Sasso and Seamster (2007)	AHA survey data/ 1990-2000	National data/ Aggregate to State level	The sum of bad debt and charity care costs per capita	Adjusted charity care and bad debt charges by using cost to charge ratio
Measure in Total Amounts (Charges)				
Dunn and Chen (1994)	New Jersey data/ 1979-1987	State data/ hospital level	Total inpatient and outpatient hospital charity and bad debt charges	

Table 1 (continued)

Author	Data source /year(s)	Unit of Analysis	Definitions and Measurements	Notes
Sheingold and Buchberger (1986)	AHA survey data/ 1980-1981	Hospital level/ all national hospitals	The sum of bad debt and charity charges	
Measure in Portion of Expenses/Costs				
Campbell and Ahern (1993)	California Health Facilities Commission/ 1983 and 1987	State data/ hospital	The percentage of charity care expenditures plus bad debt expenditures less designated subsidies, divided by total expenses	Adjusted total UC charges by using hospital mark up
Rosko (2001)	Pennsylvania cost report data/ one year 1995	State data/ hospital level	The percentage charity care and bad debt expense subtract Medicare and Medicaid DSH payments, divided by total operating expenses other than uncompensated expenses	• [(adjusted uncompensated care expenses)/(total operating expense-adjusted uncompensated care expense)*100] • Adjusted uncompensated care equal to bad debt plus charity care charges adjusted by cost to charge ratio, then minus DSH payments
Thorpe et al. (2001)	AHA survey data/1991-1997	National data/hospital level	The sum of charity care and bad debt charges divided by total expenses	Adjusted by cost to charge ratio
Clement et al. (2002)	California OSHPD/ one year 1995-1996	State data/ hospital level	Natural logarithm of the percentage of charity care and bad debt costs to operating expenses	Adjusted total UC charges by using cost to charge ratio
Bazzoli et al. (2006)	AHA survey data/ 1996-2000	National data/ hospital level	The percentage of hospital expenses that are uncompensated	
McKay and Meng (2007)	Florida financial reports/ 1998-2002	State data/hospital level	The percentage of charity care and bad debt costs to operating expenses	Adjusted total UC charges by using the ratio of operating expense to gross patient-care revenue
Measure in Portion of Charges				
Buczko (1994)	Washington financial report/ 1987	State data/ hospital level	The sum of charity care and bad debt charges, divided by total revenue	

Table 1 (continued)

Author	Data source /year(s)	Unit of Analysis	Definitions and Measurements	Notes
Atkinson et al. (1997)	Seven state financial data/ 1994-1996	State data/ hospital level	The sum of bad debt and charity care charges, divided by total charges	
Needleman et al (1999)	Florida financial reports/ 1981-1996	State data/ hospital level	The sum of bad debt and charity charges, divided by total charges	
Magnus et al. (2004)	Merritt Research LLC data/1997	National data/ hospital level	The sum of charity care charges and bad-debt, divided by total operating revenue	
Measure in Volume				
Frank and Salkever (1991)	Maryland financial hospital data/1980-1984	State data/ hospital level	• Natural logarithm of equivalent uncompensated care admissions • Natural logarithm of equivalent uncompensated care admissions adjusted hospital case mix index	Uncompensated care admissions is divided the dollar amount of uncompensated care (bad debts and charity care expenses) by the hospital's gross inpatient revenue per admission.
Gaskin (1997)	New Jersey audited hospital financial data/ 1986-1990	State data/ hospital level	Natural logarithm of adjusted uncompensated care admissions	Adjusted uncompensated care admissions equal total uncompensated care charges divided by the hospital's average charge per admission
Banks et al. (1997)	California OSHPD/ 1981-1989	State data/ hospital level	The sum of charity care and bad debt charges, divided by inpatient days, then divided by hospital bed size	
Rosko (2004)	Pennsylvania cost data/ 1995-1998	State data/ hospital level	Adjusted uncompensated care admissions	Adjusted uncompensated care admissions equal total uncompensated care charges (bad debt plus charity care) divided by the hospital's average charge per adjusted admissions.

Total Uncompensated Care Dollar Amounts

Several studies have examined the total amount of charity care and bad debts. One study calculated uncompensated care measured in charges (Dunn and Chen, 1994). However, many researchers have argued that uncompensated care should be measured in other ways because hospitals have different markups (Sanders, 1993; Campell and Ahern, 1993). Many researchers have used cost-based measures as a solution for this problem. Most studies converted uncompensated care charges to costs using a hospital cost-to-charge ratio (RCC) (Bazzoli et al., 2006; Campbell & Ahern, 1993; Davidoff et al., 2000; Garmon, 2006; Lo Sasso & Seamster, 2007; Mann, Melnick, Bamezai, & Zwanziger, 1995; Sanders, 1993; S. Zuckerman et al., 2001).

There are some advantages and disadvantages of measuring total amounts of charity care and bad debts. One advantage is that this type of measure allows for more flexibility in functional form. Since the distribution of the amount of hospital uncompensated care provision across hospitals is often skewed, it is helpful to use a natural log transformation of total uncompensated care dollar amounts. Many researchers, such as Mann et al. (1995), Davidoff et al. (2000) and Bazzoli et al. (2006), employed Natural logarithm of the sum of charity care and bad debt costs as the measure of uncompensated care provision at a hospital level. In addition, it also allows for aggregating to a higher level of unit of analysis. For example, Blewett et al. (2003) used aggregated uncompensated care data at a county level and Lo Sasso and Seamster (2007) aggregated uncompensated care data to a state level.

However, this measure does not capture or adjust for hospital size or scale if doing simple descriptive comparisons across hospitals. Many studies have shown that uncompensated care is unevenly distributed across hospitals and much of the burden is concentrated within public, teaching or some not-profit hospitals (Bazzoli et al., 2006; Cunningham & Tu, 1997; Mann et al., 1995; Mann, Melnick, Bamezai, & Zwanziger, 1997; Weissman, 1996; S. Zuckerman et al., 2001). The use of hospital-specific data may result in heteroskedasticity (Thorpe & Phelps, 1991). For example, assume that there is a hospital A and hospital B. Hospital A has 1,000 dollars of total revenue and provides free care of 100 dollars from its total revenue. Hospital B has 200 dollars of total revenue and provides free care of 50 dollars from its total revenue. So, hospital A contributes 0.1 dollars (=100/1000) to charity care from its total revenue; for hospital B, on the other hand, it contributes 0.25 (=50/200) dollars to charity care from its total revenue. In this case, hospital B is more burdened by charity care than hospital A. Empirically, Thorpe and Phelps (1991) used the approach by using uncompensated care costs divided by the number of hospital beds. Because they were still concerned that the distribution of the variable remained skewed, they further used natural log transformation in advance analyzing regression model.

Uncompensated Care Measured as a Ratio

Given the disadvantage of the measures based on the total dollar amount of uncompensated care, many researchers defined an alternative uncompensated care measure as a proportion of total expenses or total revenue. This type of measure allows for controlling the differences in the scale if doing single descriptive comparisons across

hospitals. Moreover, the use of this measure controls for year-to-year changes and does not require adjustment for price inflation when doing research longitudinally (Atkinson, Helms, & Needleman, 1997). As Table 1 presents, Rosko (2001), Thorpe et al. (2001), Clement et al. (2002), Bazzoli et al. (2006) and McKay and Meng (2007) examined measures of uncompensated care as a proportion of total expenses. They first adjusted the sum of charity care and bad debt charges to costs by using hospital cost-to-charge ratios, and then divided this sum by either total expenses or total operating expenses.

Magnus et al. (2004) argued that it is preferable to use charge-based ratio measures than cost-based ratio measures because charity care and bad debt are often measured as forgone charges and also biases may result if one uses an overall institutional cost-to-charge ratio to measure individual charges from different service lines and departments. Researchers such as Buczko (1994), Atkinson et al. (1997), Needleman et al. (1999) and Magnus et al. (2004) used the sum of charity care and bad debt charges, divided by total revenue or total operating revenue when they measured uncompensated care provision.

Uncompensated Care Measured in Volume

The third approach that researchers often used to measure hospital uncompensated care provision is volume of care delivered (Banks, Paterson, & Wendel, 1997; Frank & Salkever, 1991; Gaskin, 1997; Rosko, 2004). Usually, it equals the sum of charity care and bad debts charges, divided by the hospital's average charge per admission. Some researchers considered patient severity across hospitals and thus adjust hospital admission

by the hospital's case-mix index (Frank & Salkever, 1991; Rosko, 2004). Banks et al. (1997), on the other hand, measured as uncompensated care days per bed.

There are several advantages and disadvantages using this approach. Similar to uncompensated care ratio measures, this approach allows year-to-year comparisons without having to adjust for inflation when doing longitudinal research. The disadvantage of this type of measure is that it is also an approximation. Specifically, this measure has been calculated from charges to admission by using a hospital's average charges per admissions.

Overall, three approaches are commonly used in the literature to measure hospital uncompensated care provision and each approach has its advantages and disadvantages. Another point regarding the measurement of uncompensated care is the data sources for constructing these measures. Looking at the Table 1, some studies used national data sources and some used state data. Most studies in the literature employ the information from individual state audited financing data (Atkinson et al., 1997; Banks et al., 1997; Blewett et al., 2003; Buczko, 1994; Campbell & Ahern, 1993; Clement et al., 2002; Dunn & Chen, 1994; Frank & Salkever, 1991; Garmon, 2006; Gaskin, 1997; Mann et al., 1995; McKay & Meng, 2007; Needleman et al., 1999; Rosko, 2001, 2004). As Kane and Magnus (2001) noted, there are at least fifteen states with audited financial data that allow researchers to measure charity care and bad debt. National sources are mostly from AHA survey data (Bazzoli et al., 2006; Davidoff et al., 2000; Lo Sasso & Seamster, 2007; Sanders, 1993; Thorpe et al., 2001; S. Zuckerman et al., 2001). However, the AHA survey information for hospital charity care and bad debt are considered confidential and

not widely available to researchers outside of the AHA. Another source of national data is the Medicare Cost Reports, but these data are only available after fiscal year 2004.[4]

Quality of Care

Quality of care has been widely discussed in the health care literature since 1970s (Stiles and Mick, 1994). The most common and authoritative definition of quality of care comes from IOM (Institute of Medicine, 1990) : "The degree to which health services for individuals and populations increase the likelihood of desired health outcomes and are consistent with current professional knowledge". There are various ways to capture this conceptual definition in the existing literature. In general, health service researchers frequently use patient outcomes to quantify quality of care (Donabedian, 2005; Hearld, Alexander, Fraser, & Jiang, 2008; Mitchell & Shortell, 1997; Sari, 2002; Stiles & Mick, 1994).

Patient outcome measures represent the result of medical interventions in terms of patient survival and recovery of functional status (Donabedian, 2005; Stiles & Mick, 1994). The outcome indicators used in the existing literature include: **mortality** (Alexander, Weiner, Shortell, & Baker, 2007; Cutler, 1995; Encinosa & Bernard, 2005; Kahn, Keeler et al., 1990; Mark, Harless, & McCue, 2005; Mark, Harless, McCue, & Xu, 2004; McCue, Mark, & Harless, 2003; Mukamel, Zwanziger, & Tomaszewski, 2001; Mutter, Wong, & Goldfarb, 2008; Rogers et al., 1990; Ross et al., 2007; Sari, 2002; Seshamani, Schwartz, & Volpp, 2006; Seshamani, Zhu, & Volpp, 2006; Shen, 2003;

[4] The Balanced Budget Refinement Act of 1999 established the requirement that short-term, acute care hospitals report uncompensated care costs as part of their Medicare cost reports beginning with periods ending on or after April 30, 2003. The uncompensated care related information is in CMS-S10 form.

Volpp, Ketcham, Epstein, & Williams, 2005; Volpp, Konetzka, Zhu, Parsons, & Peterson, 2005; Volpp et al., 2003); **patient adverse events** (Bazzoli, Chen, Zhao, & Lindrooth, 2008; Burstin, Lipsitz, Udvarhelyi, & Brennan, 1993; Clement, Lindrooth, Chukmaitov, & Chen, 2007; Encinosa & Bernard, 2005; Mark et al., 2004; Mutter et al., 2008; Sari, 2002); **length of stay** (Kahn, Rogers et al., 1990; Mark et al., 2005); or **hospital readmission** (Cutler, 1995; Kahn, Rogers et al., 1990). Table 2 includes several empirical studies that generally examine the impact hospital external and internal characteristics on quality outcomes. Overall, mortality and patient adverse events are most prevalently used to measure quality of care. In the following section, relevant literature for these two outcome measures will be reviewed.

Table 2. Measurements of Quality of Care

Quality Measures Examples	Authors	Data Source /year(s)	Measures and Definitions
Outcome Measures of Quality			
Mortality	Kahn et al. (1990)	Medical records/ Health Care Financing Administration claim file/ 1981-1982 and 1985-1986	• In-hospital mortality • 30-day postadmission mortality • 180-day postadmission mortality
	Langa and Sussman (1993)	CA hospital discharge abstracts from OSHPD/ 1983, 1995, 1988	• Inpatient mortality
	Cutler (1995)	Medicare and Social Security death records in six New England states /1981-1988	• In-hospital mortality rate • Post hospitalization mortality rate (30, 180, 365 days)
	Duggan(2000)	CA hospital discharge abstracts from OSHPD/ 1990 and 1995	• Infant mortality rates at zipcode level
	Baicker and Staiger(2005)	Area Resource File with National Center for Health Workforce Analysis and Medicare Claim data/ 1988-1990 and 1998-2000	• 28-day Infant mortality at county level • 90-day Post hospitalization heart attack mortality at county level
	Mukamel et al. (2001)	Medicare Hospital Information Reports/ 1990	• Risk-adjusted 30 days post-admission mortality (considering 6 conditions: observed and expected mortality rates)
	Sari (2002)	HCUP-NIS/1992-1997	• HCUP QIs: In-hospital mortality

Table 2 (continued)

Quality Measures Examples	Authors	Data Source /year(s)	Measures and Definitions
	McCue et al. (2003)	HCUP and Medstat / 1990-1995	• Risk-adjusted in-hospital mortality (considering all cases observed and expected mortality rates)
	Shen (2003)	Medicare Claim data and Social Security death records/ 1985-1994	• Post-admission AMI mortality rates (7 days, 30 days, 90 days, 1yr, 15months, 2 yrs)
	Volpp et al. (2003)	New Jersey and New York hospital discharge data/ 1990-1996	• Risk-adjusted AMI patient in-hospital mortality rate
	Mark et al. (2004)	HCUP and Medstat/1990-1995	• Risk-adjusted in-hospital mortality (considering all cases observed and expected mortality rates)
	Mark et al. (2005)	HCUP and Medstat / 1990-1995	• Risk-adjusted in-hospital mortality (considering all cases observed and expected mortality rates)
	Encinosa and Bernard (2005)	HCUP-SID for Florida/ 1996-2000	• Risk-adjusted In-hospital mortality during surgery (IQIs)
	Volpp et al. (2005a)	National Registry of Myocardial Infarction(NAMI)/1996-2001	• Risk-adjusted AMI patient in-hospital mortality rate •
	Volpp et al. (2005b)	New Jersey and New York hospital discharge data/ 1990-1996	• Risk-adjusted In-hospital mortality (IQIs) for several conditions: AMI, hip fracture, stroke, gastrointestinal bleeding, congestive heart failure and pneumonia •
	Seshamani et al. (2006a)	Pennsylvania State discharge data and death certificate records from Pennsylvania department of Health/ 1997-2001	• Risk-adjusted Patients Mortality rate within 30 days of hospital admissions, including Hip fracture, stroke, AMI, gastrointestinal bleeding
	Seshamani et al. (2006b)	Pennsylvania State discharge data and death certificate records from Pennsylvania department of Health/ 1997-2001	• Surgical patients Mortality rate within 30 days of hospital admissions
	Alexander et al. (2007)	Medicare Inpatient Database/ 1997 and 1998	• Risk-adjusted Inpatient hospital mortality for CABG, AMI, CHF, stroke and pneumonia
	Ross et al. (2007)	MEDPAR/ CMS-Quality Alliance/ 2002-2003	• AMI patients hospitalization:hospital-specific risk-standardized 30-day all-cause mortality rates (RSMRs)
	Mutter et al. (2008)	HCUP-SID for 22 states/1997	• 18 Risk-adjusted in-hospital mortality rates (IQIs)

Table 2 (continued)

Quality Measures Examples	Authors	Data Source /year(s)	Measures and Definitions
Adverse Events	Burstin et al. (1993)	Medical record review-New York/ 1984	• Negligence adverse events
	Sari (2002)	HCUP-NIS/1992-1997	• Obstetrical complications • Adverse/iatrogenic complications • Wound Infections • Major Surgery Complications
	Mark et al. (2004)	HCUP and Medstat /1990-1995	• Complication ratio for decubitus ulcers, pneumonia and urinary tract infections
	Encinosa and Bernard (2005)	HCUP-SID for Florida/ 1996-2000	• Nursing-related PSIs • Surgery-related PSIs • All likely patient safety events
	Bazzoli et al. (2008)	HCUP-SID for 11 states/1995-2000	• Death in low mortality DRGs • Nursing-related PSIs • Surgical-related PSIs
	Clement et al. (2007)	HCUP-SID for 11 states/1995-2000	• Risked-adjusted PSIs (PSI3-decubitus ulcer, PSI7-infection resulting from medical care, PSI9-postoperative hemorrhage or hematoma, PSI12-postoperative pulmonary embolism or deep vein thrombosis)
	Mutter et al. (2008)	HCUP-SID for 22 states/1997	• 20 PSIs
Length of Stay	Kahn et al. (1990)	Medical records/ Health Care Financing Administration mater file/ 1981-1982 and 1985-1986	• Length of stay
	Mark et al. (2005)	HCUP and Medstat / 1990-1995	• Risked adjusted ratio of observed and expected length of stay
Readmission	Kahn et al. (1990)	Medical records/ Health Care Financing Administration mater file/ 1981-1982 and 1985-1986	• 180-day postadmission mortality or readmission • 365-day postadmission readmission
	Cutler (1995)	Medicare and Social Security records in six New England states /1981-1988	• Post hospitalization readmission rate (30, 180, 365 days)
Others: Service intensity	Dranove and White (1998)	CA OSHPD/ 1983 and 1992	• Service intensity

Table 2 (continued)

Note:

n/a: not available
HCUP-SID: Hospital Cost and Utilization Project-State Inpatient Data
HCUP-NIS: Hospital Cost and Utilization Project-Nationwide Inpatient Sample
OSHPD: the office of Statewide Health Planning and Development in California
MEDPAR: Medicare Provider Analysis and Review File
CMS: Center for Medicare and Medicaid Services
JACHO: the Joint Commission on Accreditation of Healthcare Organization
AHA: American Hospital Association
IQIs: Inpatient Quality Indicators, which is a product of Agency of Healthcare Research and Quality
PSIs: Patient Quality Indicators, which is a product of Agency of Healthcare Research and Quality
DRGs: Diagnostic-Related-Groups
AMI: Acute Myocardiac Infarction
CABG: Coronary Artery Bypass Graft Surgery
CHF: Congestive Heart Failure

Mortality Measures

Mortality is often defined as deaths that occurred during patient hospitalization, which is denoted as short-term mortality, or deaths after patient hospitalization, which is denoted as medium-term or long-term mortality (Kahn, Keeler et al., 1990). The majority of literature use in-hospital mortality (Alexander et al., 2007; Encinosa & Bernard, 2005; Mark et al., 2005; Mark et al., 2004; McCue et al., 2003; Mutter et al., 2008; Sari, 2002; Volpp, Ketcham et al., 2005; Volpp, Konetzka et al., 2005; Volpp et al., 2003). Alternatively, some researchers use mortality within 30 days after admission. The latter one may eliminate any potential bias due to length of stay differences across hospitals and over time (Mechanic, 2004; Ross et al., 2007; Seshamani, Schwartz et al., 2006; Seshamani, Zhu et al., 2006). As to medium-term or long-term mortality measures, some studies use post hospitalization mortality for a certain range of days (i.e., 30 days, 180 days) (Cutler, 1995; Kahn, Keeler et al., 1990; Shen, 2003).

Data resources for constructing mortality measures typically derive from administrative data sets (i.e., inpatient discharge data), medical chart review, or other data (i.e., death certificates). Administrative data, such as inpatient discharge data from individual states, are most frequently used. [5] One of disadvantages of using administrative data to measure patient outcomes, as researchers argued, is that it does not capture all patients' risk characteristics, which are available in a medical chart and could be obtained through review (Romano, Chan, Schembri, & Rainwater, 2002). However, use of existing administrative data is less expensive than data extraction from medical charts. Also, due to high costs, researchers are usually limited to only a few hospitals when using medical chart data rather than more representative hospital samples in administrative data.

Nevertheless, researchers use multiple data sources (i.e., administrative data sets or medical chart records) based on the availability of data for their research purpose. For example, Kane et al. (1990) linked medical records to Medicare Part B files of physician bills and constructed post-admission mortality for almost 2,800 people with congestive heart failure (CHF), acute myocardiac infarction (AMI), pneumonia, cerebrovascular accident, and hip fracture diseases. Culter (1995) and Shen (2003) matched Medicare claim data with death records to construct patient post-admission mortality in their research. Seshamani et al. (2006) and Seshamani et al. (2006) used Pennsylvania State inpatient discharge data and also death certificate records from Pennsylvania Department of Health to identify patients who died within 30 days of hospital admissions.

[5] In U.S., the not-for-profit institution, Agency for Healthcare Research and Quality (AHRQ), have generated Healthcare Cost and Utilization Project (HCUP) state inpatient date from many states.

There are several issues that researchers confront when they study mortality across hospitals (Mukamel et al., 2001; Romano & Mutter, 2004; Sari, 2002). First, patient severity of illness varies widely across providers. To overcome this issue, risk adjustment methods are often used in the literature when constructing mortality indicators (Alexander et al., 2007; Encinosa & Bernard, 2005; Mark et al., 2005; Mark et al., 2004; McCue et al., 2003; Mukamel et al., 2001; Mutter et al., 2008; Volpp, Ketcham et al., 2005; Volpp, Konetzka et al., 2005; Volpp et al., 2003)[6]. The most common approach to account for patient risk factors is to calculate excess mortality, which is the deviation between expected and observed mortality (Mark et al., 2005; Mark et al., 2004; McCue et al., 2003; Mukamel et al., 2001). Expected mortality is essentially based on individual patient-level risk-adjusted models that predict the probability of death conditional on individual risk factors.

The Agency for Healthcare Research and Quality (AHRQ) has developed approaches to measure excess mortality and has developed a set of inpatient quality indicators (IQIs), which uses patient age, gender, severity score calculated by 3M's all patient refined diagnosis related group (APR-DRG) as patient risk factors. Not only adjusting patient risk factors, AHRQ IQIs also adjusted for the trend over time and adjusted for within-provider correlation (AHRQ, 2007). AHRQ's IQIs softward have been frequently used in many recent studies (Alexander et al., 2007; Encinosa & Bernard, 2005; Mutter et al., 2008; Seshamani, Schwartz et al., 2006; Seshamani, Zhu et al., 2006;

[6] AHRQ (2007) also calculated risk-adjusted rate at the provider-level is further adjusted by the observed National Average rate to compare mortality across hospitals. See AHRQ Quality Indicators Guideline http://www.qualityindicators.ahrq.gov/downloads/iqi/iqi_guide_v31.pdf and http://www.qualityindicators.ahrq.gov/listserv_archive_2006.htm#Oct13 (Access Date: May 24, 2009).

Volpp, Ketcham et al., 2005; Volpp et al., 2003). Others agencies, such as the Health Care Financing Administration (HCFA)'s risk-adjusted mortality measures (Mukamel et al., 2001) and Medstat's Disease Staging Methodology (Mark et al., 2005; Mark et al., 2004; McCue et al., 2003), are also used and reported in the literature.

A second issue that researchers confront is that mortality is only a relevant outcome for certain severe patient conditions (Sari, 2002). Therefore, instead of monitoring overall hospital mortality, many researchers have focused on certain types of diseases or procedures to examine the effect of various factors on patient outcomes (Sari, 2002). For example, some articles study AMI patient mortality rates (Alexander et al., 2007; Mutter et al., 2008; Seshamani, Schwartz et al., 2006; Shen, 2003; Volpp, Ketcham et al., 2005; Volpp, Konetzka et al., 2005; Volpp et al., 2003). Two articles focus on mortality among surgical patients (Encinosa & Bernard, 2005; Seshamani, Zhu et al., 2006). Some study other conditions, such as hip fracture, stroke, gastrointestinal bleeding, congestive heart failure, pneumonia (Alexander et al., 2007; Mutter et al., 2008; Seshamani, Zhu et al., 2006; Volpp, Konetzka et al., 2005). The AHRQ IQIs allow researchers to study several in-hospital mortality measures for certain types of diseases, such as AMI, CHF, stroke, GI hemorrhage, hip fracture, and pneumonia.

In addition, mortality is not a sensitive quality indicator, in particular to outpatient treatments and hospitalization involving younger patients because of low number of deaths (Sari, 2002; Silber & Rosenbaum, 1997). Alternatively, researchers suggest using adverse event measures (i.e., complication rates, failure-to-rescue or patient safety

indicators) as a solution to solve this concern (Silber & Rosenbaum, 1997; Silber, Rosenbaum, Schwartz, Ross, & Williams, 1995).

Adverse Event Measures

Adverse events refer to serious complications and other iatrogenic events resulting from medical management (Burstin et al., 1993; Clement et al., 2007; Silber et al., 1995). The examples of adverse event measures used in the literature that examine the relationship between organizational factors and outcomes include negligent adverse events (Burstin et al., 1993), complications for certain conditions (Mark et al., 2004; Sari, 2002), and AHRQ's patient safety indicators (PSIs) (Bazzoli et al., 2008; Clement et al., 2007; Encinosa & Bernard, 2005; Mutter et al., 2008). Among the diversity of adverse event measures, AHRQ's PSIs are commonly applied in the literature. The PSIs of AHRQ are a set of indicators derived from administrative data.[7] The PSI algorithms were developed by the University of California, San Francisco-Stanford Evidence-Base Practice Center (EPC), with collaboration from the University of California at Davis, under funding from AHRQ. The algorithm flags patients safety events based on the International Classification of Disease, Clinical Modification (ICD-9-CM) codes found in the diagnosis and procedure variables from each discharge (Encinosa & Bernard, 2005). The method for calculating risk-adjusted PSIs measures is conceptually similar to those used in other studies that examined excess mortality (Bazzoli et al., 2008; Mark et al., 2005; Mark et al., 2004; McCue et al., 2003; Mukamel et al., 2001). However, patient

[7] *Patient Safety Indicators Overview.* AHRQ Quality Indicators. February 2006. Agency for Healthcare Research and Quality, Rockville, MD. http://www.qualityindicators.ahrq.gov/psi_overview.htm

risk adjusted factors in PSIs are slightly different from those used in AHRQ-IQIs, including patient age, gender, modified DRG categories, co-morbidities, and interactions of age and gender.[8]

AHRQ's PSIs module contains 20 types of adverse event measures, including death in low-mortality DRG, the occurrence of decubitus ulcer, selected infections due to medical care, post-operative hip fracture, anesthesia complications, foreign body left in patient during procedure, post-operative hemorrhage or hematomy, hip fracture, physiologic and metabolic derangement, pulmonary embolism or deep vein thrombosis, respiratory failure, sepsis, or wound dehiscence, accidental puncture or laceration during procedure, birth trauma, and obstetric trauma.[9]

With respect to the applications of PSIs, some studies select several individual PSIs to capture potential signals of the occurrence of patient adverse events in their studies, while some researchers examine the composite measures. For example, Clement et al.(2007) selected 4 individual PSIs (PSI3, PSI7, PSI9 and PSI12) in their study because these individual PSIs provided information on the higher incidence of population at risk in a hospital. With respect to the composite measures, Encinosa and Bernard (2005) and Bazzoli et al.(2008) sought to capture the underlying construct of quality from multiple PSIs and thus classified into two broader composite measures (nursing-related

[8] Specific information on the covariates used in risk adjustment for each PSI can be found as follows: http://www.qualityindicators.ahrq.gov/downloads/psi/psi_covariates_v31.pdf (Access date: May 26, 2009).

[9] More detailed about the definition of individual PSI can be found as follows: *Version 4.1 technical documentation* AHRQ Quality Indicators. December, 2009. Agency for Healthcare Research and Quality, Rockville, MD. http://www.qualityindicators.ahrq.gov/TechnicalSpecs41.htm (Access Date: Feb 13, 2010).

PSIs and surgical-related PSIs). Alternatively, AHRQ released a new version of composite measures in March 2008, which reflects the most common patient safety adverse events occurring in a hospital. To the best of the knowledge, there is no existing empirical study using the new version of AHRQ-PSIs composite measure as a quality outcome.

To summarize, mortality and adverse events are frequently used to measure patient outcomes in the literature. This section reviewed these two quality measures from different perspectives. There are various quality measures that can be used in health services research studies. Researchers may need to consider multiple quality indicators when conducting their analyses (Hearld et al., 2008; Mitchell & Shortell, 1997; Sari, 2002; Silber & Rosenbaum, 1997).

Empirical Research

This study is interested in the research question: whether the reductions of Medicaid DSH payment affected hospitals' behaviors, in terms of the provision of hospital uncompensated care and quality of care? This section summarizes the existing literature examining the ways and extent to which hospitals respond to changes in public payment. This review will help to identify the insights provided by existing research that could inform the research questions of this study and the gaps this study could address. Two subsections of empirical studies will be presented: the effect of public payment policy changes on hospital uncompensated care and the effect of public payment policy changes on quality of care. Tables that summarize existing empirical studies will follow each subsection.

The Effect of Public Payment Changes on Uncompensated Care Provision

Several studies have examined the effect of changes in public payment policy on hospital uncompensated care provision. As Table 3 shows, some studies have focused on Medicare payment changes. For example, Sheingold and Buchberger (1986) examined the changes of hospital uncompensated care provision in response to the direct effect of the Medicare Prospective Payment System (PPS) in terms of hospital financial margins. They estimated ordinary least square (OLS) models using cross-sectional data from national hospital sample in 1981 and controlled for the baseline level of individual hospital uncompensated care (i.e., UC_{1980}) and hospital supply and demand factors. This study found that the Medicare's prospective payment system (PPS) may affect hospitals' financial resources for providing uncompensated care. Campell and Ahern (1993) studied the cost containment efforts that resulted from the Medicare prospective payment system (PPS) in California. Campell and Ahern primarily used ordinary least square (OLS) models and examined separate regressions for hospital uncompensated care costs and the percent of uncompensated costs to total expense between 1983 and 1987. They found cost containment pressure may adversely affect the provision of hospital uncompensated care. Mann et al. (1995) examined California hospitals data using ten-years of panel data (from 1980 to 1989) with random effect specification and found that hospitals with greater fiscal pressure from Medicare PPS provided a greater level of uncompensated care than less pressured hospitals.

Focusing on state policy reforms, Thorpe and Phelps (1991) examined the changes of hospital uncompensated care between pre-reform period (1981-1982) and

Table 3: Empirical Studies of the Effect of Public Payment Changes on Hospital Uncompensated Care Provision

Authors	Data Sources/year (s)	Unit of analysis/ Study Sample/Statistical technique	Public Payment policy/ policy effects	Theoretical Perspective	Payment change measures	Uncompensated Care Measures	Results
Medicaid DSH payment on Uncompensated Care Related Studies							
Lo Sasso and Seamster (2007)	AHA survey data and HCFA-Form 64/ 1990-2000	State level/ all national short-term general hospitals/ Fixed effect model	Medicaid DSH payment Spending/ no specific	Economic theory of organizational behavior	Real Medicaid DSH payment per capita (monetary units)	The sum of bad debt and charity care expenses per capita	NS
Davidoff et al. (2000)	AHA survey data/ 1990-1995	Hospital level/all national short-term general hospitals/ Fixed effect linear regression with one error component	Medicaid payment generosity (including Medicaid DSH)/ increasing incentives to hospitals	Economic theory of organizational behavior	Hospital-specific ratio of Medicaid payment to costs	Natural logarithm of the sum of charity care plus bad debt costs	S(+)
Bazzoli et al. (2006)	AHA survey data/ 1996-2000	Hospital level/ national hospitals/ fixed effect model	1997 The Balance Budge Act/ reducing Medicaid DSH reimbursement effect	Economic theory of organizational behavior	Medicaid Fiscal pressure index	• The percentage of hospital expenses that are uncompensated • Natural logarithm of the sum of charity care plus bad debt costs	S(-)
Changes of Public Payment or Subsidies on Uncompensated Care Studies							
Sheingold and Buchberger (1986)	AHA survey data/ 1980-1981	Hospital level/ all national hospitals/ Cross-sectional Ordinary Least Square regression	Medicare PPS/ cost containment effort	n/a	Changes in Hospital financial margin	Change in uncompensated care	S(-)
Thorpe and Phelps (1991)	Audited cost reports from the New York State Department of Health	Hospital level/ New York state hospitals/ First-differenced models	1983 New York Prospective Hospital Reimbursement policy/ assist hospitals providing charity care	Economic theory of organizational behavior	Pre-post design with time trend in regression model	Natural logarithm of the sum of (inpatient and outpatient) uncompensated care costs per bed	S(+)

Table 3 (continued)

Authors	Data Sources/year (s)	Unit of analysis/ Study Sample/Statistical technique	Public Payment policy/ policy effects	Theoretical Perspective	Payment change measures	Uncompensated Care Measures	Results
Campbell and Ahern (1993)	California Health Facilities Commission/ 1983 and 1987	Hospital level/ CA state hospitals/ Cross-sectional Ordinal Least Square regression	1983 CA Medicare PPS and Medi-Cal reform in 1982/ cost containment effort	Economic theory of organizational behavior	• The proportion of revenue to contractual adjustments • Medicare share	Natural logarithm of the sum of bad debt and charity care expenses minus designated subsidies	S(-)
Dunn and Chen (1994)	Audited financial report from State of New Jersey Department of Health/ 1979-1987	Hospital level/ New Jersey hospitals/ Multivariate Ordinal Least Square Regression/ Fixed effect/ Random effect	1980 New Jersey DRG-Based Reimbursement reform/ increase hospital incentives to provide indigent care	n/a	Pre-post design with a binary variable to indicate policy effective	Total inpatient and outpatient hospital charity and bad debt charges	Ns
Mann et al. (1995)	California OSHPD/ 1980-1989, 10 years data	State data/ hospital level/ Random effect model with one random error component estimation	1983 CA Medicare PPS and Medi-Cal reform/ cost containment effort	Economic theory of organizational behavior	• Pre-post research design • Medicare pressure index • Medi-Cal pressure	Natural logarithm of the sum of charity care plus bad debt costs minus any gifts and subsidies for indigent care	S(+)
Gaskin (1997)	New Jersey audited hospital financial data/ 1986-1990	Hospital level/ New Jersey hospitals/ Random effects models	1987 New Jersey Uncompensated care trust fund/increase hospital incentives to provide indigent care	Economic theory of organizational behavior	Pre-post design with a binary variable and time trends to indicate policy effective	Natural logarithm of equivalent uncompensated care admissions	S(+)

Table 3 (continued)

Note:

- S(-): Significant negative relationship between public payment changes on uncompensated care provision
- S(+): Significant negative relationship between public payment changes on uncompensated care provision
- Ns: No significant relationship between public payment changes on uncompensated care provision
- Mixed: Mixed relationship between payment changes on uncompensated care provision
- n/a: not available
- CHSPR: the Center for Health Services and Policy Research of Northwestern University
- DRGs: Diagnostic-Related-Groups
- DSH: Disproportionate Share Hospital Payment
- PPS: Prospective Payment System
- HCFA: Health Care Financing Administration
- BBA: The Balance Budget Act
- DSH: Disproportionate Share Hospital Payment
- AHA: American Hospital Association

post-reform period (1983-1984) when New York state implemented a reimbursement program to assist hospitals providing charity care. They found the uncompensated care payment rates (i.e., price effect) was positively associated with the provisions of hospital uncompensated care, but did not find evidence showing a relationship between funding supports from state uncompensated care pool (i.e., income effect) and the provisions of uncompensated care. Dunn and Chen (1994) studied whether New Jersey DRG-based reimbursement reform in 1980 provided hospitals with an incentive to provide more indigent care. They used a pre and post design and fixed effect model to assess the impact of the introduction of uncompensated care payment between 1979 and 1987. They did not find evidence of a relationship between policy intervention and the provision of uncompensated care. Gaskin (1997) used a random effect panel model with study year from 1986 to 1990 to examine how the initiation of the New Jersey Uncompensated Care Trust Fund in 1987 affected hospital provision of indigent care and found that hospital provision of uncompensated care increased.

In relation to Medicaid DSH programs, an article by Lo Sasso and Seamster (2007) used a fixed effect model to examine the effect of changes in state Medicaid DSH spending on uncompensated care provision between 1990 and 2000 while controlling for other policy effects. They used real Medicaid DSH payment per capita as a direct measure of Medicaid DSH payment change; and used uncompensated care expenses per capita to measure uncompensated care provision. This article did not find an association between Medicaid DSH payments and hospital uncompensated care. Two additional articles related to Medicaid DSH payments are by Davidoff et al. (2000) and Bazzoli et

al. (2006). Davidoff et al. (2000) used a fixed effect model to examine the effect of changing state policy (i.e., payment generosity) on provision of hospital uncompensated care for the period 1990 to 1995 at the hospital level. They found a positive association between Medicaid payment generosity and uncompensated care provision among NFP hospitals during a period when Medicaid DSH increased incentives for hospitals to provide indigent care during the early 1990s. Bazzoli et al. (2006) studied how the level of hospital uncompensated care provision was affected by the Medicaid pressure resulting from the Balanced Budget Act (BBA) budget cuts. They found core safety net hospitals reduced their uncompensated care in response to Medicaid financial pressure.

There are several gaps in existing research relevant to the study questions. First, among these DSH related studies, only Bazzoli et al. (2006) specifically examined the BBA impact regarding the reduction of Medicaid DSH payment. Second, the unit of analysis in Lo Sasso and Seamster (2007) is the state. It is unclear from aggregated state level information to know how individual hospitals responded to the change in payment. Third, Davidoff et al. (2000) used a hospital-specific ratio of Medicaid payments to costs to measure Medicaid payment generosity, which includes DSH payments. Bazzoli et al. (2006) used a Medicaid Financial Pressure Index[10] to measure financial pressure induced when the BBA was first implemented in 1998. However, Medicaid DSH payment was not explicitly measured in these two studies. It is unclear the specific effect of changing

[10] Medicaid financial pressure index used in Bazzoli et al. (2006) was measured as: in year t by using Medicaid costs per adjusted admission in year (t-1) minus Medicaid revenues per adjusted admission in year t, then multiple by an estimate of Medicaid adjusted admissions in year (t-1), and then divided by total hospital expenses in year (t-1).

Medicaid DSH payments on the provision of hospital uncompensated care from these two articles.

The Effect of Public Payment Changes on Quality of Care

Several empirical studies have investigated the effect of public payment change on quality of care. Table 4 presents a summary of the empirical studies related to the effect of public payment changes on quality of care. Many studies focus on Medicare payment changes. For example, Culter (1995) and Shen (2003) both examined the impact of the Medicare Prospective Payment System (PPS) on quality of care. For example, Culter (1995) assessed a logistic regression model, analyzing Medicare claim data and social security records in six New England states from 1981 to 1988; and Shen (2003) used long-difference regressions with instrumental variables to analyze all short-term, acute care urban hospitals that have AMI patients between 1985 and 1994.They employed different measures for quality of care and PPS pressures and also used different samples to study the research question, but both reached similar results that the price reduction resulting from the PPS adversely affected health outcomes.

Volpp, Konetzka, Zhu, Parsons, and Peterson (2005) constructed a BBA impact index[11] to evaluate the impact of payment reduction after the BBA on acute myocardial infarction (AMI) in-hospital outcome measures, but did not find an association between the BBA cost-saving efforts and AMI outcomes. Seshamani, Schwartz, and Volpp (2006) used linear probability methods similar to Volpp et al. (2005) to study patient mortality

[11] BBA impact index is a simulator which is created by Volpp et al. (2005b) and Seshamani et al. (2006) to calculate the financial impact of the BBA using actual Medicare revenue. The index is equal to the difference between the estimated reimbursement under BBA/BBRA and the estimated reimbursement without BBA, and then multiplied by the percentage of net patient revenue from Medicare reimbursement in the baseline of 1997.

Table 4: Empirical Studies of the Effect of Public Payment Changes on Quality of Care

Authors	**Data Sources/year(s)**	**Unit of analysis/ Study Sample/Statistical technique**	**Public Payment policy/ policy effects**	**Theoretical Perspective**	**Payment change measures**	**Quality Measures**	**Results**
Medicaid DSH payment on Quality of Care Related Studies							
Duggan (2000)	CA hospital discharge abstracts from OSHPD/ 1990 and 1995	Zip code level /Medicaid New born infants/ Ordinary least square regression	1990 California Medicaid DSH program/ increasing incentives to treat indigent patients	Economic theory of organizational behavior	DSH per Medicaid newborn within each zip code (monetary units)	Infant mortality rates at zipcode level	Ns
Baicker and Staiger (2005)	Area Resource File with National Center for Health Workforce Analysis and Medicare Claim data/ 1988-1990 and 1998-2000	County level /not specific/ Ordinary least square regression and control for state fixed effects	Effectiveness of Intergovernmental matching grants mechanism in States / No specific	Economic theory of state government behavior	DSH per capita at county level (monetary units)	• 28-day Infant mortality at county level • 90-day Postheart attack mortality at county level	S(-)
Changes of Public Payment or Subsidies on Quality of Care Studies							
Langa and Sussman (1993)	CA hospital discharge abstracts from OSHPD/ 1983, 1995, 1988	Patient level /Age 35 through 64 Medicaid patients with specific diagnostic codes/ Logistic regression	1983 State Medicaid cost-containment policy/ reducing reimbursement level	n/a	n/a	Inpatient mortality	S(-)
Culter (1995)	Medicare Claim data and Social Security records in six New England states /1981-1988	Patient level/ elderly population (+65)/ Logistic regression	1983 Medicare Prospective Payment System policy/ reducing reimbursement level	Economic theory	DRGs price change to measure marginal and average reimbursement effects (monetary units)	• In-hospital mortality rate • Post hospitalization mortality rate • Readmission post-discharge	S(-)

Table 4 (continued)

Authors	**Data Sources/year(s)**	**Unit of analysis/ Study Sample/Statistical technique**	**Public Payment policy/ policy effects**	**Theoretical Perspective**	**Payment change measures**	**Quality Measures**	**Results**
Shen (2003)	Medicare Claim data and Social Security death records/ 1985-1990, 1990-1994	Hospital level/ Medicare AMI patients/ Long-difference regressions with instrumental variable	1983 Medicare Prospective Payment System policy/ reducing reimbursement level	Economic theory of organizational behavior	PPS pressure (monetary units)	AMI mortality rates	S(-)
Volpp et al. (2003)	New Jersey and New York hospital discharge data/ 1990-1996	Patient level/ AMI patients/ Difference-in-differences linear probability panel model	1993 New Jersey Health Care Reform Act/ reducing hospital subsidies for the uninsured	n/a	No specific variable measures of policy changes ; use interaction terms	AMI in-hospital mortality during the initial hospitalization provided LOS <=30 with risk adjustment.	S(-)
Volpp et al. (2005a)	New Jersey and New York hospital discharge data/ 1990-1996	Patient level/ For specific diagnosis and under age 65 non-Medicare patients/Linear probability models with fixed effect	1993 New Jersey Health Care Reform Act/ reducing hospital subsidies for the uninsured	Economic theory of organizational behavior	No specific variable measures of policy changes ; use interaction terms	Risk-adjusted In-hospital mortality for AMI, CHF, stroke	S(-)
Volpp et al. (2005b)	National Registry of Myocardial Infarction(NAMI)/1996-2001	Patient level/ AMI patients for all patients/ Logistic regression	1997 The Balance Budget Act/ reducing payment level	n/a	BBA impact factor	AMI in-hospital mortality and process outcomes	NS
Seshamani et al.(2006a)	Pennsylvania State discharge data and death certificate records from Pennsylvania department of Health/ 1997-2001	Patient level/ all patients and uninsured patient under 65/ probit regression	1997 The Balance Budget Act/ reducing payment level	Economic theory of organizational behavior	BBA impact factor and time trend	Patients Mortality rate within 30 days of hospital admissions	NS

Table 4 (continued)

Authors	Data Sources/year(s)	Unit of analysis/ Study Sample/Statistical technique	Public Payment policy/ policy effects	Theoretical Perspective	Payment change measures	Quality Measures	Results
Seshamani et al.(2006b)	Pennsylvania State discharge data and death certificate records from Pennsylvania department of Health/ 1997-2001	Patient level/ surgical patients/ probit regression	1997 The Balance Budget Act/ reducing payment level	n/a	BBA impact factor and time trend	Surgical patients Mortality rate	S(-)
Clement et al.(2007)	HCUP-SID for 11 states/1995-2000	Hospital level/ all types of patients/ fixed effect linear regression	1997 The Balance Budget Act/ reducing payment level	n/a	Time trend and post-BBA dummy	Risked-adjusted PSIs	Mixed

Note:

- S(-): Significant negative relationship between public payment changes on quality (Worse)
- NS: No significant relationship between public payment changes on quality of care
- Mixed: Mixed relationship between payment changes on quality of care
- n/a: not available
- BBA: The Balance Budget Act
- PPS: Prospective Payment System
- DSH: Disproportionate share hospital payment
- HCUP-SID: Health Cost and Utilization Project-State Inpatient Data
- OSHPD: the Office of Statewide Health Planning and Development in California
- AHA: American Hospital Association
- AMI: Acute Myocardial Infraction

within 30-days of hospital admission and reached similar conclusions about the lack of an effect of the BBA on health outcomes for privately insured and uninsured patients. Another study also by Seshamani, Zhu, & Volpp (2006) used BBA impact index to study the BBA effect on surgical patients in Pennsylvania state between 1997 and 2001, and found surgical patient in-hospital mortality rate increased particularly in the high-impact hospitals. Clement et al. (2007) also studied the impact of BBA and utilized fixed effect model to analyze 11 states between 1995 and 2000. They found that effect of the BBA affected Medicare patient outcomes adversely for some patient safety indicators (PSIs) but not others. In addition, they did not find an effect of the BBA on uninsured patient safety outcomes.

Focusing on the Medicaid program and state policy reforms, Langa and Sussman (1993) and Dranove and White (1998) studied the effect of California's Medi-Cal cost-containment policies in 1983 on patient outcomes. Dranove and White (1998) found a reduction in service intensity after Medicaid reimbursement cutbacks, in particular for Medicaid patients in hospitals with a large Medicaid patient caseload. Langa and Sussman (1993) found the utilization of cardiac revascularization for Medicaid patients decreased as Medicaid payment declined. Volpp et al. (2003) and Volpp, Ketcham, Epstein, and Williams (2005) examined the effect of the New Jersey Health Care Reform Act in 1993, which substantially reduced subsidies for hospital care for the uninsured. These two studies reached similar conclusions that reductions in subsidies were associated with adverse health outcomes, especially for uninsured patients.

Few existing studies examine Medicaid DSH programs. Duggan (2000) examined the extent to which increasing hospital financial payments from California's Medi-Cal DSH program affected infant mortality, but did not find that the incentives improved health outcome for low-income patients. Baicker and Staiger (2004) studied the impact of Medicaid DSH spending on 28-day infant mortality and 90-day post-heart attack mortality between the periods of 1988-1990 and 1998-2000. Their unit of analysis was the county and they found that an additional $100 per capita in DSH payment reduced the infant mortality rate by 0.062 percentage points and reduced post-heart attack mortality rate by 1.17 percentage points.

There are several gaps in the existing literature in relation to the research questions of this study. First of all, the unit of analysis in Duggan (2000) is at the zip code level while it is at county level in Baicker and Staiger (2004). As such, the measures of DSH payments in Duggan (2000) and Baicker and Staiger (2004) are both aggregated to either zip code level or county level. From these studies, it is unclear how individual hospitals responded to the change in Medicaid DSH payments. The data are too aggregated to provide clear insights. Second, these two studies only examined quality outcomes that affect a limited group of patients (i.e., elderly or young children). For example, the data for constructing the AMI mortality rate that Baicker and Staiger (2004) examined was focused on Medicare beneficiaries. In addition, Duggan (2000) and Baicker and Staiger (2004) focused on infant mortality. To the best of our knowledge, since 1997, low-income newborn and children under 18 years old are likely covered under Medicaid or State Children Health Insurance Program (SCHIP); and patients who

are over age 65 are eligible for Medicare since 1965. It is still unclear from these two studies how Medicaid DSH payment changes affect the health outcomes for low-income patients between the ages 18 and 64.

Summary

In Chapter 2, this study reviews the background of Medicaid DSH payment program, how previous studies measured key dependent variables and also discussed existing literature that is related to the effect of public payment on the provision of hospital uncompensated care and quality of care. Through this review, this study identifies the gaps among current studies that are still unfolded for answering study questions specifically. This review process helps to recognize the proceeding plan for the next chapter.

CHAPTER 3: CONCEPTUAL FRAMEWORK

A primary concern in this study is whether the reduction in Medicaid Disproportionate Share Hospital (DSH) payments affected the provision of hospital uncompensated care and the quality of care for Medicaid and uninsured patients. The underlying conceptual framework in this study derives from Newhouse (1970) economic theory of not-for-profit hospital behavior and from theoretical extensions by Hoerger (1991), Frank and Salkever (1991), and other researchers. The theoretical framework developed by Newhouse (1970) and other researchers has been applied to study hospital responses to governmental payment policy changes (Sloan, 2000). This study will start with an overview of organizational economic theory and then derive the hypotheses from this theoretical perspective. Following that, a discussion related to other control variables that might affect the provision of uncompensated care and the quality of care will be presented. Finally, a graphical depiction of the conceptual framework will be presented. The main effect of interest is the association between the changes in Medicaid DSH payments and the provision of hospital uncompensated care and quality of care.

Ownership Types and Hospital Behavior

There has been a long debate among health economists about the differences in organizational missions and behaviors of for-profit (FP) and private not-for-profit (NFP) health care providers. FP hospitals are legally allowed to distribute some proportion of

profits to their stakeholders and they can issue stock, which is another source of capital that enables them to meet financial needs. In simple microeconomic models, FP hospitals are assumed to maximize profits and set their outputs at the level where marginal revenue equals marginal cost. Specifically, as Friedman (1984) described, a FP hospital considers "…all production alternatives and chooses the one which will maximize its profits, subject to the constraints of factor prices and the demand for its output".

NFP hospitals, on the other hand, are expected to meet a broader set of needs by providing charity care services, community benefits, or teaching as part of their organizational missions (Friedman, 1984; Gray, 1986; Hansmann, 1987; Marsteller, Bovbjerg, & Nichols, 1998; Sutton & Stensland, 2004; Yoder, 1986). NFP hospitals are not legally allowed to distribute surplus to those who control the organization, but they can retain earnings for internal reinvestment (Friedman, 1984). This type of hospital does not maximize profit but maximizes utility in terms of the quantity and quality of services produced subject to break-even constraints (Newhouse, 1970). Under financial constraint due to public payment policy changes, NFP hospitals may alter hospital resources used to produce the quantity and quality of outputs.

Public hospitals often play an important role as the "last resort" for people who cannot pay for their care and these institutions typically receive financial subsidies from government sources to support their activities (Chen, Bazzoli, & Hsieh, 2009; Friedman, 1984; Mann et al., 1995; Shen, 2002). Public hospitals are thought to be substantially different from private FP and NFP hospitals (Duggan, 2000; Kornai, 1986; Mann et al., 1995; Niskanen, 1971). Public hospitals are typically owned by the government and they

are expected to continue to operate even if they consistently face financial deficits because government sponsors will prevent them from going out of business. On the other hand, they are not allowed to retain earnings if they have surplus because government may use divert or expropriate the surplus for other uses (Kornai, 1986; Shen & Eggleston, 2008). Public hospitals are expected to provide the levels of output production so as to exhaust their budgets. So they are typically modeled as budget maximizers (Friedman, 1984). Therefore, if governmental budgets to public hospitals decline, one can expect that public hospitals to reduce the provision of hospital care. Since the organizational objectives and behaviors of public hospitals are distinct from private hospitals (namely private FP and NFP hospitals), this study will focus on theoretical discussions of differential FP and NFP hospital response when confronted by changes in government policy or other exogenous factors (i.e., the reduction of public payments).

How do NFP and FP hospitals respond if there is an exogenous reduction in payments given their distinct ownership types? Hoerger (1991) expanded upon Newhouse model and predicted that NFP hospitals may reduce the quality or the provision of free care and act more like FP hospitals when their net revenues decline. Hoerger's model suggests that, when an exogenous factor becomes unfavorable, a NFP hospital "cushions the impact on profits by reducing outputs and acting more like a profit-maximizing hospital". A FP hospital, on the other hand, will "choose the output that takes it to the peak of the profit function" and may have less variability than NFP hospitals in its quality/quantity response to the external changes (Hoerger, 1991). Many existing studies have applied the Hoerger theoretical framework to assess the effects of

payment change on hospital provision of uncompensated care and hospital quality of care. These studies are reviewed in the next two subsections.

Theoretical Relationship of Public Payment Changes to Uncompensated Care Provision

In relation to the provision of uncompensated care specifically, many researchers suggest that NFP and FP hospitals should be considered separately given their distinct organizational motivations (Banks et al., 1997; Davidoff et al., 2000; Frank & Salkever, 1991; Frank, Salkever, & Mitchell, 1990; Gray, 1991; Gruber, 1994; Mann et al., 1995). Frank and Salkever (1991) modeled NFP hospital decision-making regarding the delivery of uncompensated care. A NFP hospital's utility is a function of net revenues and the level of unmet need in the community for indigent care. As the Frank and Salkever (1991) model predicted, the reduction in hospital net revenues because of exogenous price reductions (holding total needs for indigent care constant) may lead NFP hospitals to reduce uncompensated care for indigent patients, depending on the relative magnitudes of substitution and income effects (Davidoff et al., 2000; Frank & Salkever, 1991). Specifically, the substitution effect suggests that, when the payment rate increases (i.e., Medicare payment rate), hospitals have more incentives to provide care for Medicare patients and thus may reduce the volume of care for other types of patients, including Medicaid patients and the uninsured. On the other hand, a countervailing income effect exists, when payments increase for one payer, hospitals may have more financial resources to subsidize the costs of providing uncompensated care. Thus, the provision of uncompensated care may increase due to this income effect (Davidoff et al., 2000). Alternatively, if Medicaid DSH payments for low-income people increase, the income

and substitution effect operate in the same direction providing hospitals with more resources to treat Medicaid and uninsured patients.

With respect to FP hospitals, Gray (1991) and Banks et al. (1997) indicated that the supply of uncompensated care for these institutions is one of the costs of doing business. FP hospitals may suffer a loss of business if they do not meet community expectations of providing at least some indigent care. FP hospitals may offset the costs of this care from the net revenues generated by insured patients (Banks et al., 1997; Gray, 1991). Therefore, as the theory predicts, even when confronted with the fiscal pressures, FP hospitals may not substantially change their provision of uncompensated care because community expectations of their role in providing indigent care may be unaffected by changes in payment policies (Banks et al., 1997; Davidoff et al., 2000).

Many empirical studies have applied these theoretical frameworks to examine the effect of public payment changes on uncompensated care for hospitals with different ownership types. For example, Campbell and Ahern (1993) applied the Newhouse model and suggested that changes in Medicare and Medi-Cal reimbursement policy adversely affected hospital uncompensated care. By including the interaction terms for ownership type and profit level in the study, they found that public and NFP hospitals were more likely to increase their indigent care when their profits increased, relative to FP hospitals. Thorpe and Phelps (1991) also applied the Newhouse model and found that hospitals increased charity care by approximately 1.7 percent for each 10 percent increase in payment from the uncompensated care pool in New York State. Consistent with the theoretical predictions by Frank and Salkever (1991) and Banks et al. (1997), Davidoff et

al. (2000) found NFP and public hospitals increased the provision of uncompensated care in response to increased Medicaid payment generosity. Bazzoli et al. (2006) found that core safety net hospitals, which were mostly public or NFP hospitals, reduced their provision of uncompensated care in response to Medicaid financial pressures while non-safety net hospitals, mostly FP hospitals, did not have similar responses. Likewise, Mann et al. (1995) found Medi-Cal fiscal pressure caused the most pressured hospitals to alter their provision of uncompensated care relative to the least pressured hospitals. Given our research questions, this study will use the theoretical perspectives of Newhouse (1970), Hoerger (1991)and other researchers as the primary conceptual framework to study the impact of Medicaid DSH payment reduction on the provision of hospital uncompensated care.

Theoretical Relationship of Public Payment Changes to Quality of Care

There is still no theoretical or empirical consensus on the perceived quality differentials between NFP and FP hospitals (Glaeser & Shleifer, 1998; Hansmann, 1987; Hoerger, 1991; Marsteller et al., 1998; Mitchell & Shortell, 1997; Newhouse, 1970; Shen, 2002; Shortell & Hughes, 1988; Sloan, Picone, Taylor, & Chou, 2001). Some health economists suggest that NFP hospitals would produce a high level of quality because the hospital utility functions contain quality as a primary objective (Hoerger, 1991; Newhouse, 1970). Consistently, Hansmann (1996) and Glaeser and Shleifer (1998) also suggest that due to an information asymmetry, consumers would choose NFP hospitals because of anticipated superior quality. As to FP hospitals, quality is not so much as a goal as it is a constraint. These theoretical perspectives suggest that a NFP hospital may

produce a higher level of quality than a FP hospital. However, Marsteller et al. (1998) argued that, because of the greater number of NFP hospitals in a market, quality "norms" are usually set by NFP hospitals and thus FP hospitals must provide quality of care at the same level as NFP hospitals in order to compete with them. From an empirical standpoint, some existing studies found that NFP hospitals provide better health outcomes than FP hospitals (Shen, 2002; Sloan et al., 2001), while others found no significant difference in quality among different ownership types (Mitchell & Shortell, 1997; Shortell & Hughes, 1988).

However, when confronted with a reduction in public payments, not only the Newhouse (1970) and Hoerger (1991) models, but also Spence (1975) predicted that hospitals would reduce the quality of care regardless of ownership types. Spence (1975) suggested that hospitals would select a particular level of quality to produce based on the value that consumers are willing to pay and the costs of producing quality. That is, when price to cost margins are high, as Dranove and White (1998) noted, "…firms prosper by increasing sales. Thus, it pays hospitals with high margins to boost quality". Conversely, if any exogenous factors cause the profit margin to decline, hospitals will reduce the quality of care. Dranove and White (1998) and many other researchers have discussed that the effect of cutbacks on quality may also depend on whether quality is a public good or private good (Dranove & White, 1998; Glazer & McGuire, 2002; Spence, 1975).[12] If quality is a private good, a payment decline for one payer (i.e., Medicaid) may cause a

[12] If quality is a private good, hospitals are able to adjust quality to provide different levels of quality for different patients. If quality is a public good, however, hospital cannot make such patient-specific adjustments and thus provide the same quality of care to all patients.

hospital to reduce quality for Medicaid patients, but maintain or increase quality for privately insured patients (Dranove & White, 1998; Gertler, 1989). On the other hand, if quality is a public good, as many researchers have argued because there are substantial commonalities (i.e., the same health staff, equipment, surgical and lab facilities) in a hospital, quality produced may be similar for different payer patients (Dranove & White, 1998; Glazer & McGuire, 2002). Therefore, when a payment decline for one payer (i.e., Medicaid payment), it may affect hospital quality of care for both Medicaid patients and patients with other payers.

Several empirical studies have applied these theoretical frameworks to examine the effect of public payment changes on hospital quality of care. For example, Dranove and White (1998) applied the Spence (1975) model and observed a reduction in service intensity for Medicaid patients, in particular for patients of Medicaid-dependent hospitals, in the face of substantial Medicaid reimbursement cutbacks in the early 1990s. Similarly, Bazzoli et al. (2008) used Spence (1975) and Newhouse (1970) theoretical frameworks to study the effects of declining hospital financial condition on patient quality and suggested that a hospital with profound financial problems may provide lower quality of care to its patients. Shen (2003) also applied the Newhouse (1970) model in her study and found hospital financial pressures resulting from the Medicare Prospective Payment System policy had adverse effects on short-term health outcomes. Likewise, Volpp et al. (2005) used this theoretical framework, and found results that the reduction in hospital subsidies through the New Jersey Health Care Reform Act in 1993 resulted in lower quality of care. Given our research questions, this study will rely on Newhouse (1970), Hoerger

(1991), Spence (1975) and other researchers' theoretical frameworks as the primary conceptual framework to study the impact of Medicaid DSH payment reduction on hospital quality of care.

Hypotheses

Medicaid DSH payment is a major funding source from both Federal and State government to offset costs for those hospitals providing greater amounts of care to Medicaid and uninsured patients. As hospital net revenue decline from the budget cuts of Medicaid DSH payment after the BBA, hospitals that depended on Medicaid DSH support may be especially affected. Economic theory generally predicts that reductions in the subsidies for the uninsured may lead to reductions in the provision of uncompensated care provided to the uninsured (Davidoff et al., 2000; Frank & Salkever, 1991; Hoerger, 1991; Newhouse, 1970). In this case, both the substitution and income effects of a payment change operate in the same direction. Specifically, if Medicaid DSH subsidies for the low-income patients decline, hospitals may substitute care for other types of patients and thus reduce care for low-income patients (i.e., the substitution effect). Additionally, due to the reduction in DSH subsidies, hospitals may receive less financial resources to offset costs of care for low-income patients (i.e., the income effect). Given that both income and substitution effects work the same way, this study hypothesizes that the decline in DSH may lead to a reduction in the provision of hospital uncompensated care.

H1: Reductions in Medicaid DSH payment will be negatively associated with the provision of hospital uncompensated care in NFP hospitals, all other things being equal.

Given the theoretical models of Hoerger (1991), Frank and Salkever (1991), Gray (1991) and Banks et al. (1997), NFP and FP hospitals may have different motivations for providing uncompensated care in response to a reduction in Medicaid DSH payments. Besides, FP hospitals may provide less care for low-income patients and thus receive smaller DSH subsidies than NFP hospitals. In that case, the decline in Medicaid DSH may have a larger financial impact on NFP hospitals than FP hospitals. As such, NFP hospitals tend to reduce their provision of uncompensated care to indigent patients while FP hospitals may have comparatively smaller changes. Therefore, this study hypothesizes that:

H2: Compared to NFP hospitals, FP hospitals will make smaller cuts in uncompensated care in response to Medicaid DSH payment reductions, all other things being equal.

With respect to quality of care, there is still no theoretical or empirical consensus on the perceived quality differentials between NFP and FP hospitals (Glaeser & Shleifer, 1998; Hansmann, 1987; Hoerger, 1991; Marsteller et al., 1998; Mitchell & Shortell, 1997; Newhouse, 1970; Shen, 2002; Shortell & Hughes, 1988; Sloan et al., 2001). However, when confronted with a reduction in public payments, not only the Newhouse (1970) and Hoerger (1991) model but also Spence (1975) predicted that hospitals would change the quality of care they produced. Dranove and White (1998) suggested that if quality were a private good, hospitals may reduce quality for Medicaid and uninsured patients while maintaining or increasing quality for patients with other insurance status if DSH payments fall. On the other hand, if quality is a public good, hospitals may reduce

their quality of care for all patients regardless of their insurance status. Given these theoretical predictions, this study hypothesizes that:

H3a: If quality of care is primarily a public good, reduced Medicaid DSH payments will have a negative association with hospital quality of care for both Medicaid/uninsured and privately insured patients, all other things being equal.

H3b: If quality of care is primarily a private good, reduced Medicaid DSH payments will have a negative association with hospital quality of care for their Medicaid/uninsured patients, while having no or a positive association with quality of care for privately insured patients, all other things being equal.

Control Variables

In addition to the changes in Medicaid DSH payments, several other factors may be associated with the provision of hospital uncompensated care and with the quality of care provided to Medicaid and uninsured patients and thus should be incorporated in the model as control variables. These variables include other governmental financial subsidies (Z_{it}), market characteristics (M_{it}), and hospital-specific characteristics (H_{it}).

Other Governmental Financial Subsidies (Z_{it})

In addition to Medicaid DSH payments, several funding sources are important for hospitals that treat a large share of low-income patients, including Medicare DSH and State and local governmental financial subsidies (Fishman & Bentley, 1997; Hadley et al., 2005; Hadley & Holahan, 2003). The primary consideration for including other funding sources as control variable is to hold hospitals' subsidies from other major sources constant while the amount of Medicaid DSH payment they received declines.

Medicare DSH payment is under the Medicare Prospective Payment System (PPS) program. Medicare DSH payments were enacted in 1986 and were expected to compensate hospitals for higher operating costs as they treated disproportionately large number of low-income patients. The BBA cut Medicare DSH payments by an estimated total of $0.6 billion between 1998 and 2003 (Wynn et al., 2002).

State and local governmental financial subsidies are also important in that they help hospitals to cover the revenue shortfalls arising from the costs of Medicaid below-market payments and to make up the deficits for caring uninsured patients (Baxter & Mechanic, 1997; Fishman & Bentley, 1997; Hadley et al., 2005; Hadley & Holahan, 2003; Lo Sasso & Seamster, 2007; Meyer, Legnini, Fatula, & Stepnick, 1999; Thorpe & Phelps, 1991; Stephen Zuckerman, Coughlin, Len Nichols, & Ormond, 1998). These state or local financing sources include state or county tax appropriations, district assessment revenue, and restricted donations or subsidies for indigent care (Hadley & Holahan, 2003; Lo Sasso & Seamster, 2007). State or county tax appropriations are payments that hospitals receive from state and local governments and often treated as an offset to uncompensated care expenses by the Medicare Payment Advisory Commission (MedPAC) (Hadley & Holahan, 2003). Local governmental subsidies (i.e., restricted donations for indigent care or district assessment revenue) are allocated by county governments from tobacco or property taxes and provide non-operating revenue to hospitals to compensate for revenue lost when providing indigent care.

Market Characteristics (M_{it})

Some market characteristics may affect hospitals' ability to continue providing care to low-income populations. For example, expansions of public insurance coverage (i.e., expanded Medicaid eligibility) in a market will reduce the number of uninsured people and thus the provision of hospital uncompensated care will be expected to decline (Blewett et al., 2003; Davidoff et al., 2000; Dubay, Norton, & Moon, 1995; Lo Sasso & Seamster, 2007). With respect to the association between hospital quality of care for low-income individuals and Medicaid expansion, Currie and Gruber (2001) suggested that medical utilization and quality of care may improve for low-income individuals who are uninsured prior to becoming Medicaid-eligible because this group of people may be expected to access medical service at an early stage. However, there may be a countervailing effect on the individuals who had private insurance before becoming Medicaid-eligible (Busch & Duchovny, 2005; Currie & Gruber, 2001).

Medicaid managed care penetration and private HMO penetration in a market also may affect hospital provision of uncompensated care and quality of care to low-income individuals (Banks et al., 1997; Davidoff et al., 2000; Lo Sasso & Seamster, 2007; Meyer et al., 1999; Norton & Lipson, 1998; Stephen Zuckerman et al., 1998). Managed care may heighten competition and create financial pressures for hospitals for their Medicaid and privately insured patients. Under managed care, hospitals need to control costs given the discounted prices they negotiate with health plans. They may also need to deal with lower rates of patient utilization as managed care organizations steer patients to other settings (Frank et al., 1990; Gruber, 1994; Mann et al., 1995; Rosko, 1999; Davidoff et al,

2001; McKay and Meng, 2007; Thorpe et al., 2001; Lo Sasso and Seamster, 2007; Bazzoli et al., 2006; Shen, 2003).

Lower hospital market concentration among providers may also increase price competition and lead to fewer excess revenues to support uncompensated care provision (Gaskin, 1997; Gruber, 1994; Thorpe et al., 2001; Weissman, Gaskin, & Reuter, 2003). In relation to hospital quality of care, some prior studies argued that competition among hospitals might mitigate the effect of financial pressures on hospital quality (Kessler & McClellan, 2000; Pope, 1989). Gaynor (2006) and Chen (2008), on the other hand, suggested that the effect of hospital competition on quality of care is dependent on how price is set. Specifically, when price is set by public payers (i.e., Medicare), hospitals have to focus on improving quality of care to attract patients in a highly competitive market. Alternatively, increases in competitive pressures in the private insurance market may have a negative effect on hospital quality of care because managed care organizations (MCOs) focus more on price than on quality of care. In this circumstance, one would expect that market competition may decrease quality of care for privately insured individuals. However, since prior research studied the effects of regulated price on quality of care primarily for Medicare patients (Chen, 2008; Gaynor, 2006; Gowrisankaran & Town, 2003), it is still unclear what implications these studies have for Medicaid and uninsured patients.

Other market factors may affect the provision of hospital uncompensated care and hospital quality of care provided to low-income patients. For example, prior studies suggested that the presence of many FP hospitals in a market may affect the behavior of

private NFP hospitals and that NFP hospitals may mimic FP behavior when confronted by financial constraints under these circumstances (Cutler & Horwitz, 1998; Duggan, 2002). Therefore, if a NFP hospital is located in a market with a high portion of FP hospitals, that NFP hospital may reduce its uncompensated care or quality of care more than NFP hospitals located in markets with fewer FP hospitals. In addition, the existence of public and teaching hospitals in a market area are associated with lower uncompensated care provision at other hospitals in that market (Bazzoli et al., 2006; Campbell & Ahern, 1993; Davidoff et al., 2000; Hsieh, Clement, & Bazzoli, 2010; Thorpe & Phelps, 1991). Traditionally, public and teaching hospitals provide large amounts of care for the uninsured or low-income populations, and this may reduce the demand for indigent care at other institutions (Campbell & Ahern, 1993; Davidoff et al., 2000; Duggan, 2002; Gaskin, 1997; Hsieh et al., 2010). Some market factors related to the demand for indigent care are also included, such as median household income, unemployment rate, and percent of poverty at the county level. As the number of uninsured increases, one would expect that hospitals would need to provide care for more indigent patients.

Hospital Characteristics (H_{it})

This study also includes hospital-specific characteristics that may influence hospital provision of care to indigent patients. For example, hospital capacity (i.e., bed size, labor force) also needs to be considered because hospitals with larger capacity will have more ability to serve low-income patients. Also, many studies have shown a positive association between registered nurse (RN) staff and quality of care (Lindrooth,

Bazzoli, Needleman, & Hasnain-Wynia, 2006; Mark et al., 2005; Mark et al., 2004). Therefore, this study will include hospital bed size and the labor force size (i.e., the number of RN) in both the uncompensated care and quality of care models.

Medicare share will also be included in both models as a proxy for Medicare fiscal pressure. Medicare typically represents the largest revenue source for a hospital. The Balanced Budget Act of 1997 (BBA) was expected to produce $112 billion in Medicare savings in the first five years (federal fiscal years 1998 through 2002), by reducing the projected annual growth rate in program spending from an 8.8 percent baseline in 1995 to 5.6 percent in 2002. This may bring greater financial pressures on a hospital if that hospital serves a large share of Medicare patients. With respect to the association between Medicare share and the provision of uncompensated care in NFP hospitals, if the income effect dominates, hospitals may have less slack financial resources to subsidize uncompensated care cost when Medicare payment pressure increases. If the substitution effect dominates, the effect of Medicare financial pressure on hospital uncompensated care may depend on the relative magnitude between Medicare pressure and Medicaid DSH payment reductions. That is, if Medicare financial pressure is larger than pressure resulting from the cuts of Medicaid DSH payments, hospitals may increase or may not change their provisions of uncompensated care. Regarding the association between Medicare share and quality of care, when Medicare fiscal pressure increases, hospitals may not have the financial resources to invest in quality improvements for their Medicare beneficiaries and the effect may spillover to other payers (i.e., Medicaid and uninsured) if quality of care is a public good.

In theory, when faced with reductions in Medicaid DSH, NFP hospitals are expected to reduce their provision of uncompensated care while FP hospitals may have relatively smaller changes. To examine the second hypothesis in this study, a FP dummy variable will be included in the uncompensated care model (NFP hospitals are the reference group). In addition, this study will also include a county hospital dummy and a district hospital dummy variable because these hospitals face different financial constraints. [13]

Teaching hospitals often receive indirect medical education (IME) payments from Medicare and other sources of financial support that may allow them to provide more uncompensated care (Rosko, 2004). In addition, teaching hospitals are expected to provide teaching, research and clinical services. As a result, these hospitals often adopt the latest technologies and have highly specialized staff to provide high quality care. As such, this study will include a teaching variable in both models. This study also included controls for a hospital's system status given research by Lee, Alexander, & Bazzoli (2003) which suggested that hospital system affiliations could affect hospital involvement in meeting community needs. In addition, hospital system affiliations may be associated with quality outcomes (Chukmaitov et al., 2009; Cuellar & Gertler, 2005; Ho & Hamilton, 2000).

Given the deliberations from prior studies that hospitals that providing more high-tech services are able to deliver better quality care, following Bazzoli et al. (1999), this

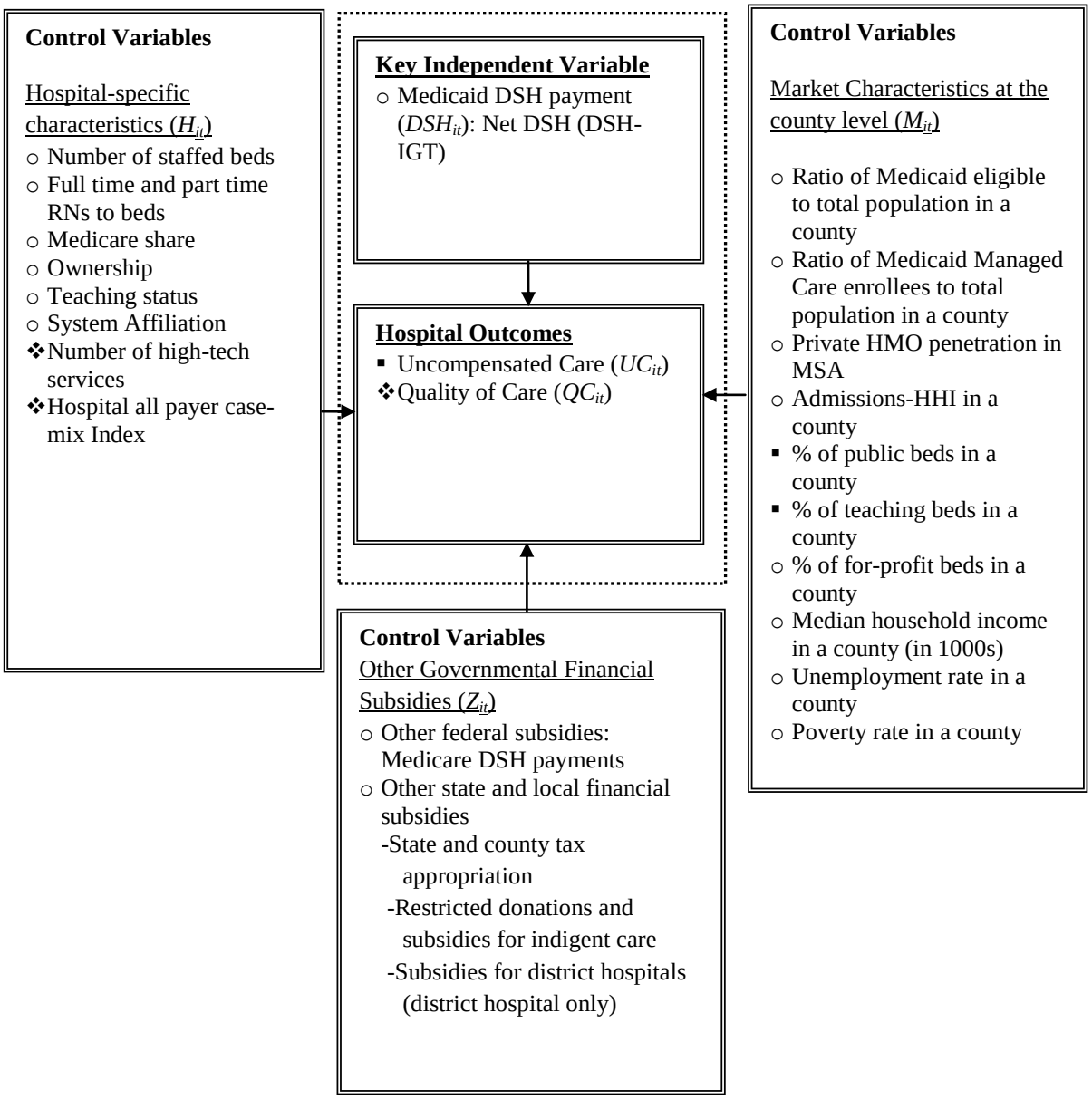
[13] California Health Care Foundation (2007). The Financial Health of California Hospitals. http://www.chcf.org/documents/hospitals/HospitalFinancialHealthFullReport.pdf (Access Date: 18 Nov 2009).

study controls for hospitals that provide the numbers of high-tech services above 75th percentile nationwide in the quality model. Hospital all payer case-mix is also included in the quality model because hospitals treating patients with more severe illnesses may require resources and health staff (Chukmaitov et al., 2009; Rosko & Carpenter, 1994).

Conceptual Framework

Figure 3 presents a graphical depiction of the conceptual framework drawn from economic theory and the literature discussed above. This study examines whether the changes in Medicaid DSH payment resulting from the BBA have impacts on the provision of hospital uncompensated care and on the quality of care provided to Medicaid and uninsured patients. This study first examines the associations between Medicaid DSH payments and hospital provision of uncompensated care. Specifically, this study is interested in knowing whether, as economic theory predicts, the reductions of Medicaid DSH due to the BBA have a negative effect on the provision of hospital uncompensated care. In addition, this study examines the association between hospital ownership and the provision of uncompensated care. As regards quality of care, this study investigates whether the reductions in Medicaid DSH also affect quality of care for Medicaid/uninsured and privately insured patients, given the public good /private good theoretical perspectives of quality of care.

In order to control potential variables that may affect the provision of hospital uncompensated care and quality of care provided to low-income patients, this study includes other governmental financial subsidies, market characteristics and hospital-specific characteristics as control variables in the model.



Note:

▪ : Variables used in uncompensated care model specifically.
❖ : Variables used in quality of care model specifically.
○ : Variables used in both uncompensated care model and quality of care model.

Figure 3. Conceptual Framework of the Effect of Medicaid Disproportionate Share Hospital Payment on the Provision of Hospital Uncompensated Care and Quality of Care.

Summary

This chapter developed a conceptual framework and a set of testable hypotheses by integrating economic theory to examine the impact of the reductions in Medicaid DSH payment on the provision of hospital uncompensated care and on the quality of care provided to Medicaid and uninsured patients. Chapter 4 will discuss research methods, including research design, data sources, sampling, variable measurements, and the overall analytical approach used to test these hypotheses.

CHAPTER 4: METHODOLOGY

The research methodologies used in this study to empirically examine the research questions and to address the theoretical hypotheses discussed in Chapter 3 will be discussed and explained in this chapter. In chapter 4, this study includes research design, data sources, variable measurements, econometric issue encountered, and final choice of analytical approach.

Research Design

The purpose of this study is to examine the association between the BBA induced changes in Medicaid DSH payments during the late 1990s and early 2000s and hospital outcomes, specifically hospital provision of uncompensated care and quality of care. BBA policy provides a natural experimental environment for this study to observe the impact of policy implementation on hospital behavior. In addition, not all hospitals receive Medicaid DSH payment supports. These two factors provide this study with a way to conduct a pre and post quasi-experimental analysis with control and treatment groups. This type of design will allow comparisons between control and treatment groups and the resulting effects from the BBA policy changes in Medicaid DSH payments.

Longitudinal unbalanced panel data for California hospitals from 1996 to 2003 are utilized to implement the reseach design. There are several reasons for examing this state: first, California has a higher uninsured rate than the national level. In 2008, the uninsured rate in California was 18.6 percent while the national uninsured rate

was 15.4%. [14] Second, California receives a high proportion of federal Medicaid DSH payments each year (Hearne, 2004). Third, the audited financial report data contains relatively complete information regarding the Medicaid DSH payments hospitals received and the uncompensated care hospitals provided. [15]

Data Sources

Study data are drawn from several databases. First, annual hospital financial data from the Office of Statewide Health Planning and Development (OSHPD) in California were used. This dataset includes state audited financial statements for all California hospitals, such as balance sheets and income statements. Hospital charity care, bad debt and Medicaid DSH information are obtained from this dataset. Second, Healthcare Cost and Utilization Project (HCUP) state inpatient data (SID) offers clinical (i.e., patient primary diagnosis, discharge status) and non-clinical information (i.e., expected insurance status) for each hospital admission at the patient level. This study applies AHRQ-PSI software to assess the inpatient discharge data to construct patient safety indicators for each hospital. Third, the American Hospital Association (AHA) Annual Survey contains hospital structural data, such as ownership, bed size, hospital services and utilization. Fourth, the Area Resource File (ARF), which is compiled by the Bureau of Health Professions, has extensive information on hospital market structure, community demographics, and socioeconomic attributes at the county level. Fifth, HealthLeader-

[14] Data information is from Census Bureau. http://www.census.gov/hhes/www/hlthins/historic/index.html (Access Date: Oct12, 2009)

[15] Other states also have high uninsured rate and "high DSH" status, like Florida and New York. However, the financial reports from other states were not able to provide sufficient information for this study to examine DSH payment impacts.

Interstudy provides data on HMO enrollment at the MSA level, which is used to compute private HMO market share. Sixth, Medi-Cal annual statistical reports provide statistical data on California Medi-Cal program services, expenditures, and eligibles for this study. Seventh, Medi-Cal Managed Care Annual Statistical Reports provide public information about the managed care programs rendering care to Medi-Cal beneficiaries. Eighth, the Medicare Cost Report, also called the CMS-2552-96 report, provides data on the Medicare DSH payments that hospitals received. Ninth, the overall hospital case-mix index data from OSHPD in California are used. To calculate the overall hospital case-mix index, OSHPD applies Medicare Severity-Diagnosis Related Groups (MS-DRG) and their associated weights to all patient discharge data by hospitals in California.

Study Sample

This study includes only short-term, non-federal general acute care hospitals in California. Kaiser hospitals, which constitute 25 hospitals in each study year, are excluded because they do not report data to OSPHD. In addition, this study includes only hospitals that could be matched across the major databases used in the study. It's about 7% of hospitals that had to be excluded as a result of this restriction. There are a total of about 2,547 hospital-year observations, representing 376 hospitals that report data in one or more years. Since nearly eight percent of hospitals changed or experienced operating status (i.e., hospital closure or ownership conversion) during study years, this study will do a sensitivity analysis to see if there is any difference including or excluding these hospitals from the analysis.

Between 1996 and 2003, 145 hospitals received Medicaid DSH payments in one or more years, and about 50 percent of DSH hospitals received Medicaid DSH continuously for more than six years. Among these DSH hospitals, namely those hospitals that received Medicaid DSH payments, about 12% are district hospitals, 22% are county hospitals, 36% are not-for-profit (NFP) hospitals and 30% are for-profit (FP) hospitals.

For patient safety outcome measures, this study draws data from Healthcare Cost and Utilization Project (HCUP) State Inpatient Data (SID) for California from 1996 to 2003. Following Volpp, Ketcham et al.(2005), this study excludes patients who: were younger than 18 or older than 64[16]; were enrolled in Medicare[17]; stayed in the hospital longer than 30 days[18]; were residents of a state other than California; were discharged alive in less than 1 day because these patients either were miscoded or had conditions not requiring a hospital stay; or had specific exclusions defined by the Agency of Healthcare Research and Quality (AHRQ). This study stratifies patients into two groups by insurance status: one group represents the privately insured and the other those insured by Medicaid or uninsured. Overall, privately insured individuals represent about 55% of the total patient sample and Medicaid/uninsured the remaining 45%. Through the algorithm of the patient safety indicators (PSIs) software provided by AHRQ, risk-adjusted PSIs measures

[16] Many low income children under 18 receive health insurance coverage from Medicaid or State Children's Health Insurance Program (SCHIP). Individuals age 65 or above will be covered by Medicare.

[17] Patients who are under age 65 with certain disabilities or people of all ages with End-Stage Renal Disease (permanent kidney failure requiring dialysis or a kidney transplant) will be eligible for Medicare coverage. http://www.cms.hhs.gov/MedicareGenInfo/ (Access Date: 13 Oct, 2009)

[18] From the descriptive analysis for the patient length of stay for the patient age between 18 and 64 in each year, 99 percentile of length of stay is 30 days.

for both Medicaid/uninsured and privately insured patients are constructed separately at the hospital provider level.

Variable Measurements

Dependent Variables

Uncompensated Care Provision

This analysis examines how changes in Medicaid DSH payment affect the provision of hospital uncompensated care. Following Campbell and Ahern (1993) and Bazzoli et al. (2006), two measures of uncompensated care will be used in this study. The first one is the sum of charity care plus bad debt charges adjusted by the hospital specific cost-to-charge ratio and then divided by one million for purposes of interpretation. The other variable is the percentage of total operating expense devoted to charity care and bad debt expense (after adjustment by hospital specific cost-to-charge ratio).

Quality of Care

In relation to quality measures, this study aims to examine the effects changes in hospital Medicaid DSH payments on hospital quality of care among Medicaid and uninsured patients as well as privately insured patients. In terms of quality of care measures, this study used PSI software (version 4.0, released on June 2009 by AHRQ) to construct individual patient safety indicators and one PSI composite measure.

The new AHRQ-PSI composite measure includes 11 PSIs as described in Chapter 2. The composite measure is a weighted average of the scaled and reliability-adjusted ratios for the component indicators. The reliability-adjusted ratio is weighted average of the risk-adjusted ratio and the reference population ratio. An example of the procedures

of how to construct composite measure, which is published by AHRQ on March, 2008, shows in Table 5. The reliability-adjusted ratio (column D) considers both provider level risk-adjusted rate (column B) and reference population risk-adjusted (column C) rate as well as the degree of reliability for the indicator (column A). After constructing reliability-adjusted ratio, a PSI composite measure (column F) is constructed. A PSI composite measure is a weighted average of the eleven individual PSI indicators based on the reliability-adjusted ratio and component weight for each individual PSI. The component weight (column E) is determined based on the purpose of use of the composite measure, as AHRQ indicates in its PSI composite measure documentation.

A denominator weight method is used to measure the component weights. The denominator weights are determined by the average number of the frequencies of patients at risk for each individual PSI. In general, a denominator weight reflects the amount of risk of experiencing the outcome of interest in a given population. If a PSI has higher frequency of patients at risk, it will be given a higher weight. Since this study focuses on patients who are age between 18 and 64, this study uses data from a nationwide comparative data published by AHRQ (2007) to determine the denominator weights when constructing the composite PSI measure for both Medicaid/uninsured and privately insured patients who are age between 18 and 64. Table 6 presents the frequencies of patients at risk for patient aged 18-39 and 40-64 and the specific parameters of component weights used in this study. The sum of the component weights among the 11 PSIs equals one.

Table 5. An Example of the Calculation for PSI Composite Measure

Columns	A	B	C	D	E	F
	Reliability Weight	Risk-adjusted Ratio	Reference Population Ratio	Reliability-adjusted ratio (RAR) [a]	Component weight	Composite Measure [b]
PSI03 Decubitus Ulcer	0.951	1.190	0.983	1.180	0.076	0.089
PSI06 Iatrogenic Pneumothorax	0.768	2.784	0.963	2.361	0.225	0.530
PSI07 Selected Infection Due to Medical Care	0.903	1.543	0.938	1.484	0.186	0.277
PSI08 Postop Hip Fracture	0.088	1.868	1.020	1.094	0.047	0.052
PSI09 Postop Hemorrhage or Hematoma	0.742	1.247	1.003	1.184	0.071	0.084
PSI10 Postop Physio and Metabol Derangmts	0.708	0.859	0.910	0.874	0.034	0.030
PSI11 Postop Respiratory Failure	0.960	0.773	0.965	0.781	0.028	0.022
PSI12 Postop PE or DVT	0.967	1.304	0.982	1.293	0.071	0.092
PSI13 Postop Sepsis	0.799	1.711	0.936	1.555	0.009	0.013
PSI14 Postop Wound Dehiscence	0.492	0.462	1.004	0.738	0.015	0.011
PSI15 Accidental Puncture or Laceration	0.966	1.348	0.926	1.333	0.238	0.317
					1.000	1.518

Note:

This data example of constructing composite measure is from page 8 and 9 in the Patient Safety Indicators (PSI) Composite Measure Workgroup Final Report, March 2008. *Patient Safety Indicators Download.* AHRQ Quality Indicators. March 2007. http://www.qualityindicators.ahrq.gov/psi_download.htm or http://www.qualityindicators.ahrq.gov/downloads/psi/AHRQ_PSI_Workgroup_Final.pdf

[a] RAR=[risk-adjusted ratio*reliability weight]+[reference population ratio*(1-reliability weight)]

[b] Composite Measure=[indicator1 RAR* component weight1]+ [indicator2 RAR* component weight2]+…+[indicator11 RAR*component weight11].

Table 6. The Component Weight Used in This Study.

	Age18-39 Denominator	Age 40-64 Denominator	Average Denominator age 18-64	Component weight [a]
PSI03 Decubitus Ulcer	928,685	2,805,708	1,867,197	0.0593
PSI06 Iatrogenic Pneumothorax	3,821,116	9,765,963	6,793,540	0.2157
PSI07 Selected Infection Due to Medical Care	6,444,382	6,585,254	6,514,818	0.2069
PSI09 Postop Hemorrhage or Hematoma	1,204,216	3,542,177	2,373,197	0.0754
PSI10 Postop Physio and Metabol Derangmts	569,546	2,094,105	1,331,826	0.0423
PSI11 Postop Respiratory Failure	544,539	1,747,936	1,146,238	0.0364
PSI12 Postop PE or DVT	1,206,942	3,531,754	2,369,348	0.0752
PSI13 Postop Sepsis	94,734	454,161	274,448	0.0087
PSI14 Postop Wound Dehiscence	323,798	823,265	573,532	0.0182
PSI15 Accidental Puncture or Laceration	2,970,117	10,309,169	6,639,643	0.2109
			31,489,470	1.0000

Note:
The PSI Comparative Data for provider level was published by AHRQ. The statistical information is generated from 2004 nationwide Inpatient Sample. More detailed information about this nationwide comparative data can be found at the linkage as http://www.qualityindicators.ahrq.gov/archives/psi/psi_provider_comparative_v31.pdf (Access date: Feb 13, 2010). Or see *Patient Safety Indicators Archive.* AHRQ Quality Indicators. March 2007. Agency for Healthcare Research and Quality, Rockville, MD.
http://www.qualityindicators.ahrq.gov/psi_archive.htm
[a] The component weight presented here is used in this study.

Following Clement et al. (2007), several criteria are examined for selecting PSIs in this study. First, because patient adverse events are rare events, a random occurrence for a hospital with a low volume of patients at risk would yield a high rate of incidence (Bazzoli et al., 2008; Clement et al., 2007) . Therefore, each indicator is constructed for an individual hospital only if it had a population of 30 or more at risk for the event associated with the indicator, as recommended by AHRQ. Second, to ensure enough observations to achieve generalizability across California hospitals, PSI indicators for

both Medicaid/uninsured and privately insured are selected only if 75% or more of California hospitals reported having 30 or more patients at risk during hospitalization for a given PSI (Clement et al., 2007). Based upon the preliminary results in this study, six individual PSIs and one PSI composite score are selected to measure quality of care in this study. The six PSIs consist of death in low mortality DRGs (PSI02), iatrogenic pneumothorax (PSI06), selected infections due to medical care (PSI07), post-operative hemorrhage or hematomy (PSI09), post-operative pulmonary embolism or deep vein thrombosis (PSI12), and accidental puncture or laceration during procedure (PSI15). In this study, these six individual risk-adjusted PSIs are multiplied by 100 and interpreted as percentages, as recommended by AHRQ.

Key Independent Variable

Many researchers have noted that the Medicaid Disproportionate Share Hospital Program is essentially a complicated financing system (Coughlin & Liska, 1997; Ku & Coughlin, 1994; Mechanic, 2004). It is necessary to know how the financing mechanism works in order to construct accurate measures of the Medicaid DSH payments that individual hospitals received.

The majority of state governments used intergovernmental transfers to generate matching federal funds for DSH payments. Taking the California State's Medicaid DSH program (also called the SB855 DSH program) as an example, Figure 4 shows that the state collects funds through intergovernmental transfers (IGTs) from public entities, including counties, local district hospitals, and the University of California. Then, the federal government matches the state's funds at the California federal Medicaid matching

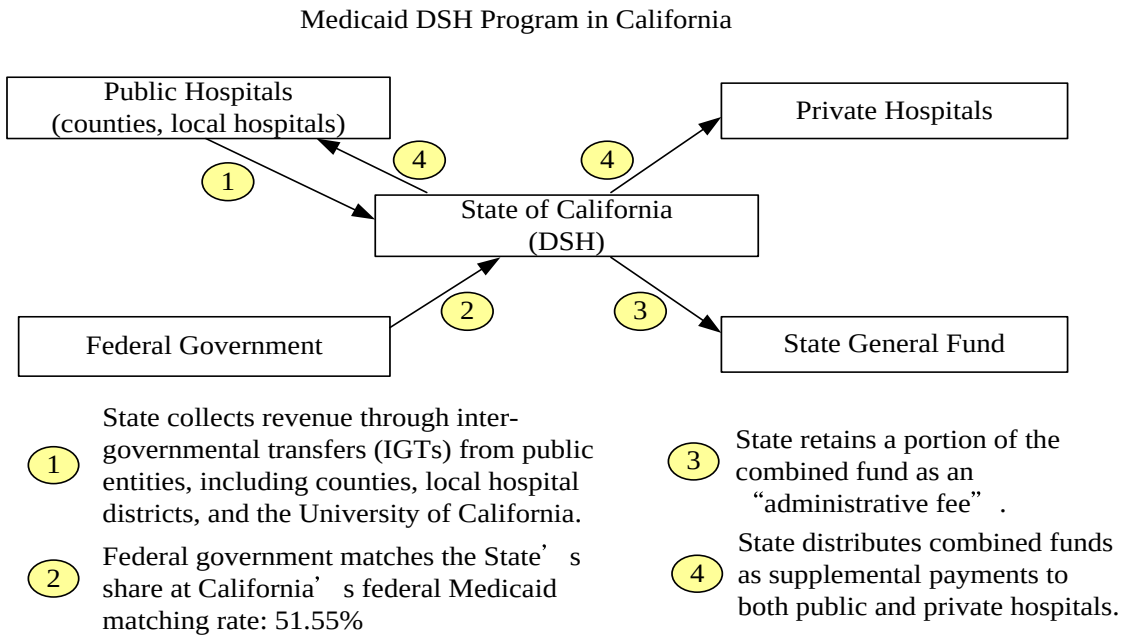


Figure 4. The Graphical Depiction of the Mechanism of Intergovernmental Transfer to Generate Federal DSH Matching Funds.

rate of 51.55%. After that, the state retains a portion of the combined funds in its state General Fund and distributes the other portion of the combined funds to both public and private hospitals (Coughlin & Liska, 1997; Huen, 1999; Ku & Coughlin, 1994; McCue & Draper, 2004; Mechanic, 2004). Knowing how the Medicaid DSH financing mechanism works, McCue and Draper (2004) and Baicker and Staiger (2004) have argued that the Medicaid DSH payments received by counties, district and public hospitals should take into account the part used as intergovernmental transfer to match federal funds. That is, the DSH payment in public hospitals will be net of IGTs so that net DSH=DSH-IGTs.

Alternatively, private hospitals do not pay IGTs. So the net DSH payment for private hospitals is simply the DSH amount so that net DSH=DSH.

Following McCue and Draper (2004) and Baicker and Staiger's (2004) suggestions, this study uses net Medicaid DSH payments in millions of dollars. Net Medicaid DSH in million equals the real amount of gross Medicaid DSH dollar minus the amount used to match federal Medicaid DSH funds through intergovernmental transfer to counties, district and public hospitals, then divided by one million. This study obtains DSH variables from hospital annual audited financial report data published by the Office of Statewide Health Planning and Development (OSHPD) in California.

An additional item is worth noting regarding the process of distributing Medicaid DSH payments to eligible hospitals in California. It may not affect the measurement of the DSH variable, but may be subject to some autoregressive process since the Medicaid DSH payments for a hospital in year t depend upon the one or two year lagged Medicaid and uninsured patient load at that hospital. Taking California as an example, the Department of Health Care Services (DHCS) in the California state of Health and Human Service Agency first decides which hospitals are eligible to receive DSH funds and then distribute the program funds to eligible hospitals. Two criteria are used to decide which hospitals are eligible to receive Medicaid DSH payments according to prior two calendar year (CY) hospital annual cost report data[19]: (1) the hospital's number of Medi-Cal inpatient days must be at least one standard deviation above the statewide mean; (2) the

[19] See "Adjustment in payment for inpatient hospital services furnished by disproportionate share hospitals" in Social Security Act, from http://www.ssa.gov/OP_Home/ssact/title19/1923.htm (Access Date: April10, 2008)

hospital's revenues from low-income utilization (including Medi-Cal and uncompensated care) must account for 25% or more of its total revenues. Then, an eligible hospital will receive DSH funds in year *t* based on 80% of the prior calendar year (*t-1)* Medi-Cal inpatient days multiplied by a DSH per diem amount.[20] This study will address this autocorrelation issue in the methodology section.

Control Variables

Other Governmental Financial Subsides (Z_{it})

To accurately assess the impact of the decline in DSH payments had upon uncompensated care and quality of care, it is important to control for any other compensation provided to cover Medicaid and uninsured patients. Two measures are included. The first one is state and local governmental financial subsidies, which is the sum of several state and county funding amounts, including state and county tax appropriations, restricted donations and subsidies for indigent care, and subsidies for district hospitals. Information on these state and local financial data is provided in the hospital annual audited financial report data published by OSHPD in California. The second alternative funding measure is Medicare DSH payments, which is the amount that hospitals receive from Medicare. The amount of Medicare DSH payments is determined by a complex formula and each hospital's DSH percentage. The hospital's DSH percentage is derived as the sum of two ratios: the proportion of all Medicare days that are attributable to beneficiaries of Supplemental Security Income (SSI), a cash benefit

[20] More detailed information about SB855, Medi-Cal Disproportionate Share Hospitals Payment Program can be found from accounting manual of Medi-Cal Supplemental Payment at http://www.ucop.edu/ucophome/policies/acctman/h-576-57.pdf (Access Date: Jan, 2009).

program for aged and disabled people, and the proportion of all patient days for which Medicaid is the primary payer. The Medicare DSH payment data are obtained from Medicare Hospital Cost Report.

Market Characteristics (M_{it})

Several market factors are controlled in this study, including ratio of Medicaid eligibles to total population, ratio of Medicaid managed care enrollees to total population, private HMO penetration, the Herfindahl-Hirschman Index of hospital concentration, the presence of public hospitals within the county, the presence of teaching hospitals within the county, the presence of for-profit hospitals within the county, and demand-related factors (i.e., median household income, unemployment rate, and poverty level). In terms of Medicaid eligibility, this study uses data from 1996-2003 Medi-Cal Annual Statistical Reports to construct the ratio of the number of average monthly Medi-Cal eligible individuals to the total population at the county level.[21] Medicaid managed care is measured as the ratio of the number of Medicaid managed care enrollments to the total population at the county level. This variable is derived from 1996-2003 Medi-Cal Managed Care Annual Statistical Reports. [22]

This study uses a Herfindahl-Hirschman Index (HHI) calculated on the basis of hospital admissions to measure market competition at the county level. In calculating

[21] County Welfare Departments in California determine eligibility for all Medi-Cal eligible with the exception of Supplemental Security Income/State Supplementary Payment (SSI/SSP) eligibles. See Table 25 in the Medi-Cal annual statistical reports: http://www.dhcs.ca.gov/dataandstats/statistics/Pages/AnnualStatisticalReports.aspx(Access Date: Jan13. 2009)

[22] Medi-Cal Managed Care Annual Statistical Reports http://www.dhcs.ca.gov/dataandstats/statistics/Pages/ManagedCareAnnualStatisticalReports.aspx (Access (Access Date: Jan13. 2009)

HHI, this study combines hospital admissions for those hospitals in the same system within the same county and treats the system as if it were one organization. This study uses the percentage of public beds to total hospitals beds within the county to measure the presence of public hospitals at the county level. Likewise, the presence of teaching hospitals is measured as the percentage of teaching hospital beds to total hospital beds within the county and the presence of for-profit hospitals is measured as the percentage of for-profit hospital beds to total hospital beds within the county. The hospital bed data are from the AHA annual survey data.

Ideally, it would be best to measure uninsured demand directly by using the number of uninsured and low-income individuals in the county. However, there are no publicly available data that allow measuring this variable over time.[23] Hence, this study uses median household income, the unemployment rate and the ratio of persons in poverty to the total population for each county as proxy variables to capture uninsured demand. These demographic data are from the Area Resource File from 1996 to 2003.

Hospital Characteristics (H_{it})

Several hospital characteristics are measured in this study, including ownership types, hospital system affiliation, teaching status, hospital bed size, hospital nurse labor force, whether located in an urban area, hospital Medicare share, provision of high technology services, and hospital overall case mix index. Hospital ownership types consist of three dummy variables to identify for-profit hospitals, county hospitals, and

[23] Existing uninsured estimates by county are only available for the year 2000 from U.S. Census Bureau, Data Integration Division, Small Area Estimates Branch, http://www.census.gov/hhes/www/sahie/index.html (Access Date: Dec 2008)

district hospitals (not-for-profit hospital is the omitted category). Ownership data are from the hospital annual audited financial data published by OSHPD in California. These ownership dummy variables are then interacted with DSH variables in the uncompensated care model. This study includes a system affiliation variable that identifies whether a hospital is a member of a multihospital system. Two dummy variables are used to identify hospitals' teaching status, including major teaching hospital if a hospital is the member of the Council of Teaching Hospitals and Health Systems (COTH) (majteach=1) and minor teaching hospital if a hospital is not a COTH member but has resident/physician training programs (minteach=1). This study includes the natural logarithm of the number of hospital staff beds to measure hospital bed size in order to diminish heteroskedasticity among different hospital size. Hospital nurse labor force is measured as the sum of the number of full time registered nurses and part time registered nurses, divided by total hospital staffed beds. A binary variable, urban, is used to indicate if a hospital is located in a metropolitan statistical area (MSA). This study defines Medicare share as Medicare inpatient days divided by total inpatient days.

This study uses a binary variable called high-tech to identify whether a hospital's count of tertiary services exceeds the 75^{th} percentile of this count for the national distribution of the number of tertiary services owned or provided by the general acute care hospitals.[24] This study follows Bazzoli et al. (1999) to identify the list of services included in the high-tech measure. These hospital characteristics are constructed from the

[24] Tertiary services are specialized, highly technical level of health care. Specialized intensive care units, advanced diagnostic support services and highly specialized personnel are usually characteristic of tertiary health care.

AHA annual survey. This study also includes hospital case-mix index for all patients published by OSHPD. Additionally, annual dummy variables are included to identify the study years, with 1996 being the referent category. Table 7 provides summary information on the variable and data sources.

Table 7. Variables, Definition, and Sources

Variable	Comments	Data Source and Year
Dependent Variables		
▪ Uncompensated care provision (UC_{it})	1. The sum of charity care plus bad debt costs (adjusted by specific hospital cost to charge ratio). This variable is measured in millions. 2. The ratio of charity care and bad debt charges (adjusted by specific hospital cost to charge ratio) to total operating expenses, and then multiplied by 100 as percent.	CA OSHPD, 1996-2003
❖ Quality of care (QC_{it})	Patient safety indicators for Medicaid and uninsured patients and privately insured patients. This set of variables contains six individual PSIs (PSI02, PSI06, PSI07, PSI09, PSI12, and PSI15) and also one composite PSI indicator. For more detailed information regarding variable construction, please refer to in AHRQ QI (http://www.qualityindicators.ahrq.gov). Six individual PSIs are measured as percentage. The composite PSI is a continuous value.	CA HCUP-SID, 1996-2003
Key Independent Variables		
o Net Medicaid DSH payment ($DSH_{it} - IGT_{it}$)	Real dollar amount of Medicaid DSH that a hospital received minus the dollar amount of IGTs that a hospital paid to state through intergovernmental transfers (in particular for public hospitals). This variable is measured in millions.	CA OSHPD, 1996-2003
Control Variables		
o Other governmental financial subsidies (Z_{it})	This study attempts to measure governmental financial sources other than Medicaid DSH used to support hospital costs for caring Medicaid and uninsured patients. Two measures are constructed: 1. State and local governmental financial support included state tax appropriations, county tax appropriations, district assessment revenue and restricted donations and subsidies for indigent care 2. Medicare DSH payments: the amount of Medicare DSH payments that hospitals receive from Medicare.	CA OSHPD, 1996-2003 Medicare Hospital Cost Report, 1996-2003

Table 7 (continued)

Variable	Comments	Data Source and Year
Market Characteristics at the county level (M_{it})		
○ Ratio of Medicaid eligibles to total population	The ratio of the number of average monthly Medi-Cal eligible individuals to total population at that county.	Medi-Cal annual statistical reports, 1996-2003
○ Ratio of Medicaid managed care enrollees to total population	The ratio of the number of Medicaid managed care enrollees to total population at that county.	Medi-Cal Managed Care Annual Statistical Reports, 1996-2003
○ Private HMO penetration in MSA	The ratio of population enrolled in HMOs in MSA.	HealthLeader-Interstudy, 1996-2003
○ Herfindahl-Hirschman Index	Sum of squared market share based on hospital admissions. In calculating HHI, this study combined hospital admissions for those hospitals in the same system within the same county and treats the system as if it were one organization.	AHA, 1996-2003
❖ Presence of public hospitals in county	The percentage of total hospital beds that are public hospital beds in the county	AHA, 1996-2003
❖ Presence of teaching hospitals in county	The percentage of total hospital beds that are teaching hospital beds in the county	AHA, 1996-2003
❖ Presence of for-profit hospitals in county	The percentage of total hospital beds that are for-profit hospital beds to in the county	AHA, 1996-2003
○ Median household income	Median household income in the county (in 1000s)	ARF, 1996-2003
○ Unemployment rate	Unemployment rate in the county	ARF, 1996-2003
○ Poverty rate	The ratio of persons in poverty to total population at that county	ARF, 1996-2003
Hospital Specific Characteristics (H_{it})		
○ Ownership types	Dummy variables identifying FP, county hospital, district hospitals. These variables are interacted with DSH variables in uncompensated care model.	CA OSHPD, 1996-2003
○ System affiliated	A dummy variable for identifying hospitals that are affiliated with a multi-hospital system.	AHA, 1996-2003

Table 7 (continued)

Variable	Comments	Data Source and Year
○ Teaching status	Two dummy variables that identify hospitals teaching status, including major teaching hospital if a hospital is COTH member (majteach=1) and minor teaching hospital if a hospital has resident/physician training program but is not a COTH members (minteach=1).	AHA, 1996-2003
○ Bed size	Natural logarithm of the number of hospital staffed beds	AHA, 1996-2003
○ Full time and part time RN to bed	Ratio of full time and part time registered nurses to staffed beds	AHA, 1996-2003
○ Medicare Share	Medicare inpatient days divided by total hospital inpatient days	AHA, 1996-2003
○ Medicare Share interacted with PostBBA dummy variable	The interaction variable of Medicare share with a dummy variable indicating post BBA (year 1996 and 1997 are pre BBA period).	AHA, 1996-2003
❖ Urban	A Dummy variable to identify whether a hospital is located in urban area.	AHA, 1996-2003
❖ High-tech service	A dummy variable to identify whether a hospital's count of tertiary services exceeds the 75th percentile of this count for the distribution of the count of tertiary services for hospitals nationwide. This study used definitions of Bazzoli et al. (1999) to identify high-tech services.	AHA, 1996-2003
❖ Case-Min Index	Case-mix index for all patients in a hospital.	CA OSHPD case-mix index, 1996-2003
Year dummy variables (Yr_{it})	Year dummy variables for 1997-2003 (1996 as reference group)	

Note1:

- ✓ CA-OSHPD: State audited hospital annual financial reports from the Office of Statewide Health Planning and Development (OSHPD)
- ✓ CA-OSHPD case-mix index: http://www.oshpd.ca.gov/HID/Products/PatDischargeData/CaseMixIndex/default.asp (Accessed: Nov10, 2009).
- ✓ Medicare Hospital Cost Report: http://www.cms.hhs.gov/CostReports/02_HospitalCostReport.asp#TopOfPage (Accessed: Oct 08, 2007)
- ✓ Medi-Cal annual statistical reports: http://www.dhcs.ca.gov/dataandstats/statistics/Pages/AnnualStatisticalReports.aspx(Accessed: Jan13. 2009)
- ✓ Medi-Cal Managed Care Annual Statistical Reports: http://www.dhcs.ca.gov/dataandstats/statistics/Pages/ManagedCareAnnualStatisticalReports.aspx (Accessed: Jan13. 2009)
- ✓ HCUP-SID: Healthcare Cost and Utilization Project-State Inpatient Data
- ✓ AHA: American Hospital Association Annual Survey
- ✓ ARF: Area Resource File

Note2:

- ■ : Variables used in the uncompensated care model specifically.
- ❖: Variables used in the quality of care model specifically.
- ○ : Variables used in both the uncompensated care model and the quality of care model.

Empirical Specification and Methodology

This study uses longitudinal data from 1996 to 2003 to examine the effects of changes in Medicaid DSH payment on the provision of hospital uncompensated care and quality of care, controlling for hospital characteristics, other governmental financial subsidies, and market characteristics that influence these outcome measures. Since the two dependent variables yield some different econometrics considerations, each will be discussed separately below.

Uncompensated Care Model

The basic empirical specifications used to examine the first and second sets of hypotheses relevant for the hospital uncompensated care model are presented in reduced form equations (1) and (2). In addition, the reduced form equation (2) adds a vector of interaction terms for ownership status and the net Medicaid DSH payments (NFP as reference group) to examine the second set of hypotheses.

$$UC_{it} = \beta_0 + \beta_1 netDSH_{it} + \beta_2 Z_{it} + \beta_3 M_{it} + \beta_4 H_{it} + \beta_t Yr + \alpha_i + \mu_{it} \quad (1)$$

$$\begin{aligned} UC_{it} = {} & \delta_0 + \delta_1 netDSH_{it} + \delta_2 Z_{it} + \delta_3 M_{it} + \delta_4 H_{it} + \delta_5 (FP_{it} \times netDSH_{it}) \\ & + \delta_6 (CNTY_{it} \times netDSH_{it}) + \delta_7 (DISTRIC_{it} \times netDSH_{it}) + \delta_t Yr + \tau_i + \upsilon_{it} \end{aligned} \quad (2)$$

where i= an individual hospital; t=year; UC_{it} indicates the provision of hospital uncompensated care for hospital *i* in year *t*; netDSH_{it} represents net Medicaid DSH payments, which was measured as gross Medicaid DSH minus the amount of intergovernmental transfers from public hospitals; Z_{it} indicates a vector of state or local governmental financial support measures for indigent care. M_{it} indicates a vector of market characteristics. H_{it} represents a vector of hospital characteristics. *Yr* represents a

vector of year dummy variables. FP_{it} represents a dummy variable for for-profit hospitals. $CNTY_{it}$ is a dummy variable for county hospitals. $DISTRIC_{it}$ is a dummy variable for district hospitals. α_i and τ_i indicate hospital specific error components for the uncompensated care model. μ_{it} and υ_{it} indicate random error terms for the uncompensated care model.

The dependent variable in equations (1) and (2) are measured in two ways as uncompensated care costs in millions and as the ratio of uncompensated care costs to total operating expenses. The coefficient estimations of *netDSH* from equation (1) (i.e., β_1 in equation (1)) should capture the effect of changes in net DSH payments on hospital provision of uncompensated care for study hospitals overall, holding constant other year, hospital, and county specific effects. Unlike equation (1), ownership and net Medicaid DSH payment are interacted in equation (2) and, as noted, not-for-profit hospitals are the reference group. The equation (2) allows this study to test study Hypothesis 1 and Hypothesis 2. Alternatively, the coefficient estimations of *netDSH* from equation (2) (i.e., δ_1 in the equation (2)) should capture the effect of changes in net DSH payments on not-for-profit hospital provision of uncompensated care specifically. The coefficient signs are expected to be positive and significant because NFP hospitals may reduce the provision of uncompensated care provided to low-income patients in response to reductions in Medicaid DSH payment. In addition, as proposed in Hypothesis 2, FP hospitals may have smaller reductions in uncompensated care provision relative to NFP hospitals (Banks et al., 1997; Hoerger, 1991). The total effects of *netDSH* payment for for-profit hospitals are expected to be significantly different from zero but smaller than

the coefficient estimates of net DSH payment for not-for-profit hospitals. Specifically, this study expects the sum of the coefficient estimates δ_1 and δ_5 in equation (2) are less than δ_1, and both are expected to be significantly different from zero.

Given the nature of the unobserved effects and the different model assumptions, several statistical alternatives for analyzing panel data are considered, including pooled ordinary least squares (OLS), random effects (RE), fixed effects (FE) and first-difference (FD) estimators. Pooled OLS assumes that the explanatory variables affect each hospital randomly and that the error structure does not have a hospital-specific component. An alternative analytical technique for panel data is a random effect model that has more restrictive assumptions than those of a pooled OLS. Random effect models assume the error structure has a hospital-specific component and the error components and that the explanatory variables are strictly exogenous (Woodridge, 2002). The pooled OLS and random effect models can be compard using the Breusch-Pagan Lagrangian Multiplier Test. This test tests the null hypothesis that the error structure does not have a random hospital-specific component (Woodridge, 2002).

A fixed effect (FE) model, on the other hand, allows for arbitrary correlation between the unobserved effect and the observed explanatory variables but does not allow estimation of the influence of time-invariant regressors. The FE panel technique eliminates the unobserved effect (i.e., α_i and τ_i) that may affect parameter estimates through within transformation process. To compare the RE and FE models, Hausman tests are often utilized to test the null hypotheses whether or not the RE model yields consistent estimates of the parameters given the assumption that the hospital-specific

error component and regressors are uncorrelated. Additionally, to compare pooled OLS and FE model, F-test are often used to test the null hypotheses from restricted and unrestricted models to check whether or not the error component has a fixed effect hospital specific component.

As with the fixed effect (FE) model, the first-differencing model also eliminates the unobserved error component, in this case through first-differencing. FE model estimators essentially measure the association between individual-specific deviations of regressors from their time-demeaned values and individual-specific deviations of the dependent variable from its time-demeaned value over time. The first-differences (FD) estimators, on the other hand, measure the association between individual-specific one-period changes in regressors and individual-specific one-period changes in the dependent variable (Cameron & Trivedi, 2005). To compare FE and FD models, Wooldridge (2006) suggested one could test for serial correction in the idiosyncratic errors, u_{it}. Although both FE and FD techniques yield unbiased parameter estimates, when the u_{it} in equation (1) or υ_{it} in equation (2), for example, are serially uncorrelated with $u_{i,t-1}$ or $\upsilon_{i,t-1}$, FE estimation is more efficient than FD. If the u_{it} or υ_{it} follow a positive serial correction, then FD will be more efficient (Woodridge, 2006).

Table 8 presents the results from the comparisons of several model specification tests. Fixed effect method is used in this study because it yields more consistent and efficient estimates than other alternatives. This is the case for both versions of the model with uncompensated care costs and percentage of uncompensated care to total operating expense as dependent variables.

Table 8. Results for Comparisons of Model Specification Tests: Identifies Preferred Model for Each Test

Model Comparisons	Specification Tests	Uncompensated care costs (in millions)	Percent of uncompensated care costs to total operating expense (%)
OLS vs. FE	F-test for no fixed effects	FE	FE
OLS v.s. RE	Breusch and Pagan Lagrangian multiplier test	RE	RE
FD v.s. FE	Serial correlation tests developed by Woolridge	FE	FE
RE v.s. FE	Hausman Test	FE	FE
	Preferred Model	FE	FE

Note:
OLS: Pooled Ordinal Least Square
FE: Fixed Effect Model
FD: First Differencing Model
RE: Random Effect Model

The uncompensated care econometric models presented in this study are complicated by four factors: individual hospital heterogeneity, county-level clustering of observations, an explanatory variable that may be subject to autoregressive issue and the fact that hospital ownership was observed changing during the course of the study thus impacting the sample. First, the use of hospital-specific data may result in heteroskedasticity. The presence of heteroskedasticity, while not affecting bias or consistency in coefficient estimates, influences the efficiency of standard errors. To account for unequal error variances between individual hospitals in the uncompensated care model, this study uses heteroskedasticity-robust standard error adjustment in the fixed effect model. Second, because some of our policy variables measure county-level variation in Medicaid program characteristics and demand characteristics, there may exist intra-county error correlation that could bias downward the estimated standard errors (Davidoff et al., 2000). As such, the estimated covariance matrices of the fixed effect

models are also adjusted with the Huber-White correlation to account for the specific intra-county effect. Third, the uncompensated care model may take on some characteristics of an autoregressive process since the Medicaid DSH payments that a hospital received in time t depend upon low-income patient utilizations lagged one or two years. The issue of autocorrelation in the models may cause bias in standard errors and reduce efficiency (Drukker, 2003; Thorpe & Phelps, 1991; Woodridge, 2002). To account for this issue, this study conducted a test for serial correlation in the panel models using methods discussed by Wooldridge (2002).[25] These test results indicate that a potential serial correlation issue existed in the model.

To the best of our knowledge, there is an alternative model to deal with the autocorrelation problem in the fixed effect model. The first step of this approach is to estimate the degree of autocorrelation (rho) between the error term in time *t* and time *t-1*. Given an estimate of rho, one can do a Cochrane-Orcutt transformation, which is one of the methods that is used to transform the data for removing autocorrelation components, and then do the within transformation to remove the hospital specific fixed-effects as is usually done in the fixed effect model (Wooldridge, 2006; Stata manual, 2007: pp. 423).[26] However, the disadvantage of this approach is that one loses one year of data in the transformation process, and thus, decreases the degrees of freedom. This study will do a sensitivity analysis to check if the coefficient estimates regarding the relationship between net Medicaid DSH and uncompensated care provision change substantially when

[25] This study will use a new Stata commend *xtserial*, which implements the Wooldridge test for serial correlation in panel data (Woolridge, 2002, p.483).

[26] This study used Stata SE 10.0 version command *xtregar* to correct autocorrelation in fixed effect models.

correcting for this serial correlation. Finally, since some California hospitals experienced ownership changes (i.e., hospital closure or ownership conversion) during the study years, this study also conducts a sensitivity analysis to check if the results are sensitive to the presence of such hospitals. The result section that follows focuses primarily on the fixed effect models corrected for heteroskedasticity and intra-county variability.

Quality of Care Model

The basic empirical specification for the hospital quality of care model is presented in reduced form equations (3).

$$QC_{it}^{jk} = \gamma_0 + \gamma_1 netDSH_{it} + \gamma_2 Z_{it} + \gamma_3 M_{it} + \gamma_4 H_{it} + \gamma_5 FP_{it} + \gamma_6 CNTY_{it} + \gamma_7 DISTRIC_{it} + \gamma_t Yr + \lambda_i + \varepsilon_{it} \quad (3)$$

where *i*= an individual hospital; *t*=year; *j*=0 for Medicaid/uninsured and 1 for privately insured patients; *k*=1 to 7 for the 7 distinct PSI measures; and QC_{it}^{jk} represents quality of care for Medicaid/ uninsured patients and privately insured *j* patients, which are measured as *k* patient adverse events, for a hospital *i* in the year *t*. $netDSH_{it}$ is net Medicaid DSH payment, which is measured as gross Medicaid DSH minus intergovernmental transfers of public hospitals; Z_{it} is state or local governmental financial support for indigent care; M_{it} is a vector of market characteristics; H_{it} is a vector of hospital characteristics; *Yr* represents a vector of year dummy variables; FP_{it} is a dummy variable for for-profit hospitals; $CNTY_{it}$ is a dummy variable for county hospitals; $DISTRIC_{it}$ is a dummy variable for district hospitals; λ_i is a hospital specific error component; and ε_{it} is a random error term for the quality of care model. This equation is used to examine the third set of hypotheses.

Hospital quality of care are measured by six individual patient safety indicators (PSIs) and one PSI composite measure separately for Medicaid/uninsured and privately insured, with a total of fourteen regressions estimated. PSIs are used to measure patient adverse events. Therefore, given the third hypothesis, the coefficient signs of *netDSH* (i.e., γ_1) in the PSIs regressions are expected to be negative and significant for both Medicaid/uninsured and privately insured patients, if quality of care is a public good. Specifically, if quality of care is public good, when confronted with reductions of Medicaid DSH payments, hospitals will reduce the quality of care they provide to both Medicaid/uninsured and privately insured patients so that the incidence of patient adverse events may go up. On the other hand, if quality of care is a private good, hospitals may reduce their quality of care provided to Medicaid/uninsured patients, but may not change or may improve the quality of care provided to privately insured patients. In this case, this study would expect a negative and significant sign to *netDSH* (i.e., γ_1) in the PSIs regressions for the Medicaid/uninsured patients and a positive and significant or an insignificant coefficient for the privately insured patients.

As indicates in Tables 9 and 10, this study estimates all quality of care models with pooled ordinary least squares (OLS), random effect (RE), fixed effect (FE) and first-differencing (FD) specification and conducted model specification tests to identify which statistical method is preferred. The results are not entirely conclusive for both Medicaid/uninsured and privately insured quality of care models. In one case OLS is preferred; RE is preferred in other three cases; and FE is preferred in another three cases. After comparing several model specification tests from the PSIs regressions, the results

Table 9. Results for Comparisons of PSIs Model Specification Tests for Medicaid/Uninsured: Identifies Preferred Model for Each Test

		PSI models for Medicaid/Uninsured						
	Specification Tests	PSI02	PSI06	PSI07	PSI09	PSI12	PSI15	PSI composite
OLS: FE	F-test for no fixed effects	OLS	FE	FE	FE	FE	FE	FE
OLS: RE	Breusch and Pagan Lagrangian multiplier test	OLS	RE	RE	RE	RE	RE	RE
FD:FE	Serial correlation tests	FE	FE	FE	FE	FE	FE	FE
RE:FE	Hausman Test	FE	RE	FE	RE	FE	RE	FE
	Preferred Model	OLS	RE	FE	RE	FE	RE	FE

Note: OLS: Pooled Ordinal Least Square
FE: Fixed Effect Model
FD: First Differencing Model
RE: Random Effect Model

Table 10. Results for Comparisons of PSIs Model Specification Tests for Privately Insured: Identifies Preferred Model for Each Test

		PSI models for Privately Insured						
	Specification Tests	PSI02	PSI06	PSI07	PSI09	PSI12	PSI15	PSI composite
OLS: FE	F-test for no fixed effects	FE	FE	FE	FE	FE	FE	FE
OLS: RE	Breusch and Pagan Lagrangian multiplier test	OLS	RE	RE	RE	RE	RE	RE
FD:FE	Serial correlation tests	FE	FE	FE	FE	FE	FE	FE
RE:FE	Hausman Test	RE	RE	FE	RE	FE	RE	FE
	Preferred Model	OLS	RE	FE	RE	FE	RE	FE

Note: OLS: Pooled Ordinal Least Square
FE: Fixed Effect Model
FD: First Differencing Model
RE: Random Effect Model

indicates inconsistent patterns of preferred model specifications for Medicaid/uninsured and privately insured PSIs measures. Since random effect specification is superior and more efficient than pooled OLS model specification, random effect model appears relatively more frequently as the preferred model than FE method given the specification

test results. To be consistent, random effect model specification method is selected to analyze all quality of care models in this study.

Quality of care models in this study raise several econometric issues, including individual hospital heterogeneity, multiple comparisons among different quality equations, and the fact that hospital ownership was observed changing during the course of the study thus impacting the sample. First, because this study uses hospital-specific data, heterogeneity may be a problem. The presence of heteroskedasticity, while not affecting bias or consistency in coefficient estimations, influences the efficiency of standard errors. To account for unequal error variances between individual hospitals in the quality of care model, this study uses heteroskedasticity-robust standard error adjustment in the random effect (RE) model. Second, for quality of care models, there are six pairs of individual PSIs regressions with different types of patient adverse events for Medicaid/uninsured and privately insured patients. In order to know whether the effects of net Medicaid DSH estimates from different individual PSI regressions are jointly and significantly different from zero, a chow test is conducted to deal with this concern. The Chow test is an econometric test and is often used in program evaluation to examine whether coefficient estimates in multiple linear regressions have an equivalent impact on different population subgroups (Chow, 1960; Woodridge, 2006). Six individual PSIs data are pooled together and then are analyzed by using random effect models with heteroskedasticity robust standard error adjustment.[27]. After that, joint Wald tests are to

[27] Since the composite PSI already combined different individual PSIs as one measure, the joint test of chow test is test simultaneously significant for other six individual PSIs (i.e., PSI02, PSI06, PSI07, PSI09, PSI12, and PSI15) for the net Medicaid DSH variables for Medicaid/uninsured and privately insured separately.

examine the effect of net Medicaid DSH payments on both Medicaid/uninsured and privately insured separately. Finally, since several California hospitals experienced ownership changes (i.e., hospital closure or ownership conversion) during the study period, a sensitivity analysis is conducted to check if there is any difference resulting from including or excluding these hospitals in the analysis. In the result section, this study will report results from random effect models for six individual PSIs and one composite PSI measure for Medicaid/uninsured and privately insured in separate tables.

Summary

This chapter covers the research design, data sources, variable measurements, empirical specifications and analytical strategies used in this study. A research design of pre and post quasi-experimental with control and treatment groups is used to examine the research questions of interest. Unbalanced longitudinal data for California hospitals from 1996 to 2003 are utilzed to implement the reseach design. For the uncompensated care models, this study mainly uses a fixed effect specification adjusted for heteroskedasticity-robust and intra cluster corrected standard errors. For the quality of care models, this study uses random effect models with heteroskedasticity-robust standard error adjustments to take into account unobserved hospital specific factors. The findings of this study are presented in Chapter 5. In Chapter 6, the findings are discussed along with their implications, limitations, and applications for the future research.

CHAPTER 5: RESULTS

Chapter 5 discusses study findings after applying research methodologies discussed in Chapter 4. Two major sections are presented, one for the uncompensated care model and the second for the quality of care model. In each section, results for descriptive analysis, regression models and sensitivity analysis will be reported.

Uncompensated Care Model

Results of Descriptive Analysis

Table 11 provides descriptive data on uncompensated care for two hospital groups (DSH hospitals and non-DSH hospitals) both as a whole and by ownership types. DSH hospitals are defined as those hospitals that received Medicaid DSH payments. The 2003 data are adjusted for inflation using the 1996 consumer price index for medical care. Looking first at DSH and non-DSH hospitals' overall annual uncompensated care costs and also the percent of uncompensated care costs to total operating expenses, DSH hospitals provide about twice the uncompensated care as measured by costs as compared to non-DSH hospitals. For the DSH hospitals overall, annual costs increase 19.8% to $4.43 million in 2003 and the percent of expense devoted to uncompensated care also increases from 4.64% to 4.88% of total hospital operating expenses. Non-DSH hospitals overall, on the other hand, increase annual uncompensated care costs from $1.71 million in 1996 to $2.35 million in 2003, but slightly decrease the percent of total hospital expense devoted to uncompensated costs by 2003.

Table 11. Average Uncompensated Care Expenses per Hospital by Hospital DSH and Ownership Types

Hospital Category	Annual Uncompensated Care Costs (in million) [a]			% of Uncompensated Care to Total Operating Expenses		
	1996 ($)	2003 ($)	% Change	1996 (%)	2003 (%)	Difference in %
DSH Hospitals [c]						
Overall	$3.69	$4.43	19.8%	4.64%	4.88%	+0.24
Not-for-profit hospital	5.00	6.18	23.8%	4.88	5.11	+0.23
For-profit hospital	0.85	1.82	113.7%	3.34	4.61	+1.27
District hospitals	0.52	0.58	11.7%	5.59	4.18	-1.41
County hospitals	5.71	8.95	56.8%	4.96	5.49	+0.53
Non-DSH Hospitals						
Overall	$1.71	$2.35	37.0%	2.96	2.87	-0.10
Not-for-Profit hospital	2.08	2.78	33.9%	2.63	2.59	-0.03
For-Profit Hospital	0.90	1.38	53.2%	2.71	3.04	+0.33
District Hospital	1.72	1.98	14.8%	4.56	3.83	-0.73
County Hospital [b]	1.94	-		8.89	-	

Note:

[a] All dollar values presented here are adjusted for inflation to 1996 dollars by the consumer price index for medical care.

[b] Only two study county hospitals were non-DSH hospitals in 1996; And, all study county hospitals were DSH hospitals in 2003.

[c] DSH hospitals are defined as those hospitals that received Medicaid DSH payments. In the study sample, the total number of DSH hospitals in 1996 is 79 and 104 in 2003; the total number of non-DSH hospitals in 1996 is 261 and 200 in 2003.

Table 11 also reports changes in uncompensated care for study hospitals with different ownership types between 1996 and 2003. These data suggest that not-for-profit and county hospitals for the DSH and non-DSH categories generally provide higher amount of uncompensated care as measured by costs than other types of hospitals. Moreover, DSH and non-DSH district hospitals have higher percent of uncompensated care costs to total operating expenses than other hospital types in 1996, though this percent declines for these hospitals by 2003. In general, both DSH and non-DSH for-

profit hospitals have a growth in the amount of uncompensated care as measured by costs and by the percent of uncompensated care costs to total operating expenses.

Table 12 provides descriptive statistics on key variables in the analysis. These data represented means and standard deviation across multiple years from 1996 to 2003 for two hospital groups (i.e., DSH hospitals and non-DSH hospitals). The means for uncompensated care costs per year and percent of uncompensated care costs to total operating expenses are consistent with the data presented in Table 12. The amount of several variables (i.e., uncompensated care costs, net Medicaid DSH payment, Medicare DSH payments and State and local governmental financial subsidies) reflects real dollar amounts in millions that hospitals received in each year, adjusted for inflation to 1996 dollar using the consumer price index for medical care. In relation to the net Medicaid DSH payment measures, the mean and standard deviation of this variable show a wide range of values. Hospitals that receive higher amount of Medicaid DSH payments are more often large safety net and teaching hospitals.

Results of Fixed Effect Models

Table 13 reports the sets of fixed effect results for uncompensated care models. Corresponding to the econometric models discussed in Chapter 4, this study reports model (1) without ownership and net Medicaid DSH interaction variables and model (2) that includes ownership and net Medicaid DSH payment interactions. Both the analysis of the uncompensated care costs in millions and the percent of uncompensated care costs to total operating expenses are presented. The coefficient estimates for all explanatory variables from the model (2) are consistent with the coefficient estimates from the

Table 12. Descriptive Statistics for Study Variables: All hospitals and Al Study Years

	DSH Hospitals		Non-DSH Hospitals		Overall Hospitals	
	Mean	SD	Mean	SD	Mean	SD
Uncompensated Care Provision						
Uncompensated care costs per year (in millions) [a]	4.39	6.23	1.92	2.45	2.63	4.08
Percent of uncompensated care costs to total operating expense (%)	5.06	3.20	2.90	2.19	3.52	2.70
Governmental Financial Supports						
Net Medicaid DSH payment (in millions) [a]	4.97	16.49	0.00	0.00	1.43	9.12
Medicare DSH payments (in millions) [a]	3.42	3.65	1.74	2.82	1.97	12.65
State and local governmental financial subsidies (in millions) [a]	6.60	22.95	0.10	0.41	2.22	3.17
Market Characteristics (at county level)						
Ratio of Medicaid eligibles to total population	17.81	5.67	15.93	5.72	16.47	5.77
Ratio of Medicaid managed care enrollees to total population	7.42	5.24	5.87	5.10	6.32	5.19
Ratio of private HMO enrollees to total population at MSA level	42.65	18.26	41.09	20.09	41.53	19.59
Herfindahl-Hirschman Index	0.23	0.22	0.31	0.26	0.29	0.25
Presence of public hospitals in county (%)	20.60	22.80	17.82	19.91	18.62	20.82
Presence of teaching hospitals in county (%)	31.73	20.05	27.08	22.15	28.42	21.66
Median household income (in 1000s)	36.51	7.28	38.17	7.92	37.69	7.78
Unemployment rate (%)	7.11	3.68	6.60	3.30	6.75	3.42
Poverty rate (%)	1.95	5.87	2.35	6.07	2.24	6.01
Hospital Characteristics						
Full time and part time RN to staffed bed	1.20	0.58	1.38	0.63	1.33	0.62
Log of the number of hospital staffed beds	5.04	0.82	4.90	0.86	4.94	0.85
Proportion system affiliated	0.56	0.50	0.67	0.47	0.64	0.48
Proportion major teaching hospital	0.09	0.28	0.04	0.19	0.05	0.22
Proportion minor teaching hospital	0.20	0.40	0.07	0.25	0.11	0.31
Hospital Medicare share (%)	35.05	16.47	46.05	13.84	42.89	15.46
Proportion not-for-profit hospital	0.36	0.48	0.61	0.49	0.54	0.50
Proportion for-profit hospital	0.30	0.46	0.26	0.44	0.27	0.44
Proportion county hospital	0.22	0.41	0.00	0.07	0.07	0.25
Proportion district hospital	0.12	0.32	0.13	0.34	0.13	0.33
N (Study Hospital Observations, 1996-2003)	732		1815		2547	

Note:
DSH hospitals are defined as those hospitals that received Medicaid DSH payments.
[a] All dollar values presented here are adjusted for inflation to 1996 dollars by the consumer price index for medical care.

Table 13. Fixed Effect Regression Models

Variables	Uncompensated care costs (in millions)		Percent of uncompensated care costs to total operating expenses (%)	
	(1) without ownership interactions	(2) with ownership interactions	(1) without ownership interactions	(2) with ownership interactions
Net Medicaid DSH payment (in millions)	0.0294**	0.0343*	0.0120***	0.0223***
	(0.0131)	(0.0205)	(0.0034)	(0.0073)
Medicare DSH payments (in millions)	0.1718***	0.1714***	0.0542	0.0502
	(0.0299)	(0.0290)	(0.0394)	(0.0375)
State and local governmental supports (in millions)	0.0388	0.0388	-0.0053	-0.0050
	(0.0606)	(0.0605)	(0.0184)	(0.0182)
Ratio of Medicaid eligibles to total population	-0.0523**	-0.0525**	0.0211	0.0214
	(0.0235)	(0.0230)	(0.0462)	(0.0468)
Ratio of Medicaid managed care enrollees to total population	0.0021	0.0025	0.0035	0.0036
	(0.0180)	(0.0176)	(0.0271)	(0.0263)
HMO penetration at MSA level (%)	-0.0105	-0.0106	-0.0029	-0.0031
	(0.0074)	(0.0074)	(0.0111)	(0.0110)
Herfindahl-Hirschman Index	-0.4411	-0.4542	-1.3153*	-1.3293*
	(0.6642)	(0.6631)	(0.6944)	(0.6953)
Presence of public hospitals in county (%)	0.0039	0.0040	-0.0096	-0.0095
	(0.0101)	(0.0101)	(0.0092)	(0.0091)
Presence of teaching hospitals in county (%)	-0.0041	-0.0041	0.0066	0.0069
	(0.0078)	(0.0078)	(0.0098)	(0.0098)
Median household income (in 1000s)	0.1059	0.1061	0.0474	0.0485
	(0.0642)	(0.0639)	(0.0354)	(0.0354)
Unemployment rate (%)	0.1955	0.1951	-0.0551	-0.0566
	(0.1485)	(0.1498)	(0.0866)	(0.0872)
Poverty rate (%)	0.0095	0.0094	-0.0019	-0.0013
	(0.0170)	(0.0171)	(0.0208)	(0.0211)
Full time and part time RN to bed	0.2946***	0.2933***	0.1538	0.1487
	(0.1083)	(0.1085)	(0.0938)	(0.0941)
Log of the number of hospital staff beds	0.6589***	0.6647***	-0.0594	-0.0691
	(0.1778)	(0.1790)	(0.3542)	(0.3550)
System affiliated	-0.0374	-0.0391	-0.3206**	-0.3351**
	(0.0997)	(0.0984)	(0.1465)	(0.1477)
Major teaching hospital	4.2134**	4.2187**	1.1483	1.1667
	(1.7287)	(1.7166)	(0.7203)	(0.7193)
Minor teaching hospital	0.0327	0.0299	0.0276	0.0113
	(0.4372)	(0.4466)	(0.3255)	(0.3190)
Hospital Medicare share (%)	0.0044	0.0044	0.0003	0.0001
	(0.0062)	(0.0063)	(0.0062)	(0.0062)
Hospital Medicare share (%) at post BBA period	-0.0090	-0.0089	-0.0007	-0.0005
	(0.0104)	(0.0106)	(0.0075)	(0.0076)
Interaction term of for-profit hospital and net Medicaid DSH		-0.0103		0.0397
		(0.0360)		(0.0311)
Interaction term of county hospital and net Medicaid DSH		-0.0055		-0.0125
		(0.0277)		(0.0094)

Table 13 (continued)

Variables	Uncompensated care costs (in millions)		Percent of uncompensated care costs to total operating expenses (%)	
	(1) without ownership interactions	(2) with ownership interactions	(1) without ownership interactions	(2) with ownership interactions
Interaction term of district hospital and net Medicaid DSH		-0.8393*** (0.2691)		-1.0127 (0.9219)
Year 1997	0.2643 (0.3742)	0.2634 (0.3748)	-0.0357 (0.3697)	-0.0341 (0.3749)
Year 1998	0.8083 (0.7211)	0.8046 (0.7201)	0.1259 (0.5550)	0.1108 (0.5558)
Year 1999	0.8793 (0.8254)	0.8742 (0.8266)	0.0882 (0.5730)	0.0707 (0.5747)
Year 2000	1.2279 (0.8278)	1.2260 (0.8280)	0.1889 (0.5947)	0.1733 (0.5999)
Year 2001	1.5222* (0.8996)	1.5240* (0.9022)	0.1768 (0.5810)	0.1693 (0.5842)
Year 2002	1.4464* (0.8636)	1.4446* (0.8619)	0.1360 (0.5604)	0.1280 (0.5605)
Year 2003	1.5873* (0.8880)	1.5868* (0.8856)	0.3051 (0.5577)	0.3080 (0.5577)
Constant	-6.4446 (4.2092)	-6.4641 (4.2198)	2.2244 (2.4478)	2.2482 (2.4431)
Observations	2540	2540	2540	2540
R-square	0.0876	0.0879	0.0186	0.0200
Number of Hospital	376	376	376	376
Robust standard errors in parentheses				
*** p<=0.01, ** p<=0.05, * p<=0.10				

model (1). Given the study hypotheses discussed in Chapter 3 and the model specification discussed in Chapter 4, the discussion below will focus on the fixed effect models that include ownership interaction variables, model (2), in the Table 13.

The analysis of the explanatory variables associated with uncompensated care is as follows. Looking first at the net Medicaid DSH payment variable which reflects the impact of Medicaid DSH payments upon the behavior of not-for-profit hospitals, this study finds a positive and marginally significant association (p=0.10) between net

Medicaid DSH payment and uncompensated care costs and a positive and highly significant association ($p<0.01$) between net Medicaid DSH payment and the percent of uncompensated care costs to total operating expenses. This result suggests that not-for-profit hospitals may reduce their uncompensated care provision given the reductions of Medicaid DSH payment they encountered during study years after controlling for ownership and net Medicaid DSH payment interactions with not-for-profit hospital as reference group. Other things being equal, the marginal effect of the net Medicaid DSH payment indicates that an increase of one million dollars (in 1996 dollars) increases uncompensated care costs by 0.0343 million dollars, and increases the percent of uncompensated costs to total operating expenses in not-for-profit hospitals by 0.0223 percentage points in the not-for-profit hospitals. The findings for net Medicaid DSH payments support the hypothesis **H1** in this study.

In terms of other governmental financial subsidies, the positive coefficient for the Medicare DSH payments ($p<0.01$) in the analysis of uncompensated care costs suggests that hospitals provide more uncompensated care in response to an increase in Medicare DSH payments during the study period. On the other hand, the results do not show a significant relation between Medicare DSH payments and the percentage of uncompensated care costs to total operating expenses. With respect to market characteristics, the results suggest that expanding the ratio of Medicaid eligibles to total population in a market would significantly reduce hospital uncompensated care costs ($p<0.05$), but the expansion of the ratio of Medicaid eligibles to total population does not have a significant effect on the percent of uncompensated care costs to total operating

expenses. Contrary to expectations, the findings indicate that hospitals located in more competitive markets had a higher percent of operating costs devoted to uncompensated care ($p<0.1$). This result reflects the descriptive result presented in the Table 12 that DSH hospitals, which are hospitals that provided a higher amount of uncompensated care, are often located in markets with relatively lower market concentration (and thus higher hospital competition) than non-DSH hospitals.

With respect to other hospital characteristics associated with the provision of uncompensated care, the results indicate that hospitals that have more capacity (i.e., higher registered nurse to bed ratio, large bed size) would provide more uncompensated care costs ($p<0.01$) but that capacity had no effect on the percent of uncompensated care costs to total operating expenses. The result of the effect of hospital bed size on the uncompensated care provision is consistent with Bazzoli et al. (2006). Hospital system affiliation leads to lower uncompensated care costs as a percent of total operating expenses ($p<0.05$) but no significant effect on the hospital uncompensated care costs. Hospitals that became major teaching hospitals significantly increased their annual uncompensated care costs ($p<0.05$) but not the percent of uncompensated care costs to total operating expenses.

Given hypothesis 2 in this study, the coefficient estimate for the total effect of the net DSH payment for for-profit hospitals on their uncompensated care costs is 0.024 (which is equivalent to 0.0343-0.0103) with a standard error equals to 0.0312 and a p-value equals to 0.446. In addition, the coefficient estimate for the total effect of for-profit hospitals on their percent of expenses devoted on uncompensated care is 0.062 (which is

equivalent to 0.0223+0.0397) with a standard error equals to 0.026 and a p-value equals to 0.024. These results indicate that for-profit hospitals may not evidently change their uncompensated care costs when faced with declining DSH payments. Instead, they may decrease significantly in the percent of uncompensated care costs to total operating expenses in response to a reduction in Medicaid DSH payments. However, compared to not-for-profit hospitals, the overall findings for the interaction of for-profit hospitals and net Medicaid DSH payment do not support hypothesis **H2** that for-profit hospitals make smaller cuts in response to Medicaid DSH reductions. The results also indicate that compared to not-for-profit hospitals, district hospitals have smaller changes for their uncompensated care costs ($p<0.01$) in response to the reduction of net Medicaid DSH payments, but have no differential response when measured by the percent of total operating expenses devoted in uncompensated care.

Additionally, the findings for annual year dummy variables indicate that, compared to the provision of uncompensated care in 1996, hospitals significantly increase uncompensated care costs in 2001, 2002 and 2003 ($p<0.1$) but not the percent of uncompensated care costs to total operating expenses.

Sensitivity Analysis

Table 14 presents the results of several sensitivity analyses and compared the coefficient estimates of the effect of Medicaid DSH payment on hospital provision of uncompensated care with the original fixed effect model. Model (1) reports the coefficient estimates of the net Medicaid DSH payment in the original fixed effect models as reported in Table 14. Model (2) reports the coefficient estimates of net

Table 14. Sensitivity Analysis for Alternative Model Specifications in Uncompensated Care Models

	Uncompensated care costs (in millions)				Percent of uncompensated care costs to total operating expense (%)			
Model Specifications	(1) [a]	(2) [b]	(3) [c]	(4) [d]	(1) [a]	(2) [b]	(3) [c]	(4) [d]
Net Medicaid DSH payment (in millions)	0.0343*	0.0337	0.0327*		0.0223***	0.0193***	0.0130	
	(0.0131)	(0.0206)	(0.018)		(0.0073)	(0.0056)	(0.0179)	
Gross Medicaid DSH payment (in millions)				0.0355*				0.0203***
				(0.0178)				(0.0059)
Gross DSH Intergovernmental Transfer (in millions)				-0.0061				-0.0083
				(0.0210)				(0.0071)
R-square	0.0879	0.0882	0.0539	0.0928	0.0200	0.0165	0.0217	0.0199
N	2540	2335	2164	2540	2540	2335	2164	2540

Note:
Robust standard errors in parentheses
[a] Model (1) is the original fixed effect model using net Medicaid DSH as dependent variable.
[b] Model (2) is model (1) excluding hospitals that experienced ownership changes or closure during study period.
[c] Model (3) is fixed effect model adjusting autocorrelation and used net Medicaid DSH as dependent variable.
[d] Model (4) is fixed effect model using gross Medicaid DSH and gross DSH intergovernmental transfer variable.
All models were estimated using Stata software package SE 10.0 version.
*** p<=0.01, ** p<=0.05, * p<=0.1

Medicaid DSH payment from a fixed effect model like that of Model (1) but excluding hospitals that experienced ownership conversion or closure during the study years. Model (3) reports the coefficient estimates of net Medicaid DSH payment of the fixed effect model with the autocorrelation adjustment as discussed in Chapter 4. Model (4) reports the coefficient estimates of gross Medicaid DSH payment and gross DSH intergovernmental transfer, which are used to construct net Medicaid DSH payment in the fixed effect models.

Looking first at the analysis of uncompensated care costs, the coefficient estimates do not change substantially across different alternative model specifications. The coefficient estimates of net Medicaid DSH payment in Model (1) is 0.0343 ($p=0.10$), 0.0337 in Model (2), and 0.0327 ($p<0.1$) in Model (3). The coefficient estimates of gross Medicaid DSH payment is 0.0355 ($p<0.1$) and gross DSH intergovernmental transfer is -0.0061. The number of hospital year observations in Model (1) and Model (4) is 2,540. After excluding hospital observations that experienced ownership changes during study years, the sample size falls to 2,335 for Model (2). In Model (3), the number of observations from the fixed effect model with autocorrelation adjustments, as described in the Chapter 4, dropped from 2,540 to 2,164. Smaller sample sizes obviously reduce the degrees of freedom and make it more difficult to find significant results. The value of R square for the different alternative model specifications is also reported in Table 14. Likewise, as one can see the results of these sensitivity analyses for the percent of uncompensated care costs to total operating expenses are similar to the results for the uncompensated care costs.

Quality of Care Model

Results of Descriptive Analysis

Table 15 reports the total number of Medicaid/uninsured and privately insured patient discharges at risk when constructing the selected PSIs from the study hospitals during the study period from 1996 to 2003. The total number of patients at risk ranges from about 0.72 to 3.1 million. Table 15 also presents the total number of study hospital-year observations for each PSI measure included in this study.

Table 15. Study Sample of Risk-Adjusted Patient Safety Indicators and Study Hospitals

Patient Safety Indicators (PSIs)	All Study Hospitals	
	Total Number of Patient discharges at Risk, 1996-2003	Total Study Hospital-Year Observation, 1996-2003
PSI Medicaid/Uninsured		
PSI 02: Death in low mortality DRGs	2,363,792	2,294
PSI 06: Iatrogenic pneumothorax	2,480,894	2,460
PSI 07: Selected infections due to medical care	3,097,461	2,432
PSI 09: Postoperative hemorrhage or hematoma	728,878	2,207
PSI 12: Postoperative pulmonary embolism or deep vein thrombosis	732,945	2,208
PSI 15: Accidental puncture or laceration	2,575,934	2,460
PSI Privately Insured		
PSI 02: Death in low mortality DRGs	2,225,225	2,272
PSI 06: Iatrogenic pneumothorax	2,641,067	2,413
PSI 07: Selected infections due to medical care	2,923,431	2,389
PSI 09: Postoperative hemorrhage or hematoma	1,311,490	2,203
PSI 12: Postoperative pulmonary embolism or deep vein thrombosis	1,317,164	2,215
PSI 15: Accidental puncture or laceration	2,763,312	2,426

Table 16 reports descriptive data on each study PSIs for Medicaid/uninsured and privately insured for hospitals in two hospital groups (i.e., DSH hospitals and non-DSH hospitals). DSH hospitals are defined as those hospitals that received Medicaid DSH payments. The individual PSIs (i.e., PSI02, PSI06, PSI07, PSI09, PSI12, and PSI15) are presented here as percentages for Medicaid/uninsured and privately insured for the hospital, while the composite PSI (i.e., PSI Composite score) was a composite score for Medicaid/uninsured and privately insured for the hospital. Higher numbers indicate higher incidence of patient adverse events, namely worse quality outcome.

Similar to Table 12, Table 17 presents descriptive statistics on key variables in the analysis for quality of care model. These data represent means and standard deviation for

Table 16. Descriptive Statistics of Dependent Variables for Quality of Care Models

Patient Safety Indicators (PSI)	DSH Hospitals			Non-DSH Hospitals			Overall Hospitals		
	1996	2003	Difference[a]	1996	2003	Difference[a]	1996	2003	Difference[a]
PSI- Medicaid/Uninsured									
PSI 02: Death in low mortality DRGs (%)	0.010	0.018	0.009	0.012	0.017	0.005	0.012	0.018	0.006
PSI 06: Iatrogenic pneumothorax (%)	0.045	0.023	-0.022	0.049	0.038	-0.011	0.048	0.033	-0.015
PSI 07: Selected infections due to medical care (%)	0.075	0.098	0.024	0.097	0.119	0.022	0.092	0.112	0.020
PSI 09: Postoperative hemorrhage or hematoma (%)	0.077	0.208	0.130	0.046	0.177	0.131	0.053	0.187	0.135
PSI 12: Postoperative pulmonary embolism or deep vein thrombosis (%)	0.297	0.403	0.106	0.216	0.379	0.163	0.233	0.387	0.154
PSI 15: Accidental puncture or laceration (%)	0.166	0.147	-0.019	0.241	0.224	-0.016	0.223	0.198	-0.025
PSI Composite score	0.930	0.905	-2.74%	0.973	0.977	0.47%	0.963	0.953	-1.08%
PSI-Privately Insured									
PSI 02: Death in low mortality DRGs (%)	0.020	0.015	-0.005	0.028	0.018	-0.009	0.026	0.017	-0.009
PSI 06: Iatrogenic pneumothorax (%)	0.079	0.007	-0.071	0.048	0.040	-0.008	0.055	0.029	-0.026
PSI 07: Selected infections due to medical care (%)	0.117	0.064	-0.053	0.093	0.100	0.007	0.098	0.088	-0.010
PSI 09: Postoperative hemorrhage or hematoma (%)	0.046	0.219	0.173	0.062	0.215	0.153	0.059	0.216	0.157
PSI 12: Postoperative pulmonary embolism or deep vein thrombosis (%)	0.454	0.558	0.103	0.237	0.299	0.063	0.280	0.377	0.097
PSI 15: Accidental puncture or laceration (%)	0.338	0.260	-0.078	0.409	0.469	0.059	0.394	0.402	0.008
PSI Composite score	1.061	0.971	-8.49%	1.067	1.068	0.05%	1.066	1.036	-2.79%

Note:
[a] For PSI02-PSI15, difference presented here is the difference in %; for PSI composite score, difference presented here is percentage change.

Table 17. Descriptive Statistics of Study Explanatory Variables for Quality of Care Models

Explanatory Variables	DSH Hospital		Non-DSH Hospital		Overall Hospital	
	Mean	SD	Mean	SD	Mean	SD
Governmental Financial Supports						
Net Medicaid DSH payment (in millions) [a]	4.97	16.49	0.00	0.00	1.43	9.12
Medicare DSH payments (in millions) [a]	3.42	3.65	1.74	2.82	1.97	12.65
State and local governmental supports (in millions) [a]	6.60	22.95	0.10	0.41	2.22	3.17
Market Characteristics (at county level)						
Ratio of Medicaid eligibles to total population	17.81	5.67	15.93	5.72	16.47	5.77
Ratio of Medicaid managed care enrollees to total population	7.42	5.24	5.87	5.10	6.32	5.19
HMO penetration (%) at MSA level	42.65	18.26	41.09	20.09	41.53	19.59
Herfindahl-Hirschman Index	0.23	0.22	0.31	0.26	0.29	0.25
Presence of for-profit hospitals in county (%)	0.18	0.15	0.17	0.17	0.17	0.16
Median household income (in 1000s)	36.51	7.28	38.17	7.92	37.69	7.78
Unemployment rate (%)	7.11	3.68	6.60	3.30	6.75	3.42
Poverty rate (%)	1.95	5.87	2.35	6.07	2.24	6.01
Hospital Characteristics						
Full time and part time RN to bed	1.20	0.58	1.38	0.63	1.33	0.62
Log of the number of hospital staff beds	5.04	0.82	4.90	0.86	4.94	0.85
Proportion system affiliated	0.56	0.50	0.67	0.47	0.64	0.48
Proportion major teaching hospital	0.09	0.28	0.04	0.19	0.05	0.22
Proportion minor teaching hospital	0.20	0.40	0.07	0.25	0.11	0.31
Hospital Medicare share (%)	35.05	16.47	46.05	13.84	42.89	15.46
Proportion hospitals located at urban area	0.90	0.30	0.88	0.33	0.88	0.32
Proportion hospitals that provide high-tech services	0.25	0.44	0.28	0.45	0.27	0.44
Hospital all payer casemix index	0.94	0.22	1.06	0.28	1.03	0.27
Proportion not-for-profit hospital	0.36	0.48	0.61	0.49	0.54	0.50
Proportion for-profit hospital	0.30	0.46	0.26	0.44	0.27	0.44
Proportion county hospital	0.22	0.41	0.00	0.07	0.07	0.25
Proportion district hospital	0.12	0.32	0.13	0.34	0.13	0.33

Note:
DSH hospitals are defined as those hospitals that received Medicaid DSH payments.
[a] All dollar values presented here are adjusted for inflation to 1996 dollars by the consumer price index for medical care.

multiple years from 1996 to 2003 for two hospital groups (i.e., DSH hospital and non-DSH hospital). The values of several variables (i.e., uncompensated care costs, net Medicaid DSH payment, Medicare DSH payments and State and local governmental financial subsidies) reflects real dollar amounts in millions that hospitals received in each year, adjusted for inflation to 1996 dollars using the consumer price index for medical care.

Results of Random Effect Models

Tables 18 and 19 present the results of random effects models for the six PSIs and one PSI composite measure for Medicaid/uninsured and privately insured patients. To recap the theoretical hypotheses discussed in Chapter 3, this study expects that reductions in Medicaid DSH payment could result in a decrease in hospital quality of care for Medicaid/uninsured patients. If quality of care is public good, there will be a similar decrease in quality of care for privately insured patients. On the other hand, if quality of care is private good, this study expects that reductions in Medicaid DSH payment may result in an improvement or in no change in the quality of care for privately insured patients. Given the primary interests of this study and the hypotheses discussed previously, the results in Tables 18 and 19 should be reviewed simultaneously.

Overall, the results indicate a negative association between net Medicaid DSH payments and individual and composite PSIs for Medicaid/uninsured patients and a mixed effect of net Medicaid DSH payments for privately insured patients. Looking first at the estimated impact of net Medicaid DSH payments on the quality of care for Medicaid/uninsured patients, the findings while consistently negative are not particularly

Table 18. Random Effect Model Results for PSIs Measures for Medicaid/Uninsured

VARIABLES	Medicaid/ Uninsured Patients						
	PSI Composite measure	PSI 02 Death in low mortality DRGs	PSI 06 Iatrogenic pneumothorax	PSI 07 Selected infections due to medical care	PSI 09 Postoperative hemorrhage or hematoma	PSI 12 Postoperative pulmonary embolism or deep vein thrombosis	PSI 15 Accidental puncture or laceration
Net Medicaid DSH payment (in millions)	-0.0009	-0.0001	-0.0002*	-0.0005*	-0.0005	-0.0003	-0.0005*
	(0.0006)	(0.0001)	(0.0001)	(0.0003)	(0.0004)	(0.0006)	(0.0003)
Medicare DSH payments (in millions)	0.0011	-0.0000	0.0004	-0.0017	0.0034	-0.0005	-0.0007
	(0.0026)	(0.0007)	(0.0010)	(0.0022)	(0.0030)	(0.0049)	(0.0028)
State and local governmental supports (in millions)	-0.0021***	-0.0000	-0.0002	-0.0010***	-0.0006	-0.0011*	-0.0008**
	(0.0005)	(0.0001)	(0.0001)	(0.0004)	(0.0004)	(0.0006)	(0.0003)
Ratio of Medicaid eligibles to total population	-0.0008	0.0017	-0.0006	0.0029	-0.0028	-0.0017	-0.0026
	(0.0019)	(0.0011)	(0.0013)	(0.0025)	(0.0034)	(0.0056)	(0.0033)
Ratio of Medicaid managed care enrollees to total population	-0.0011	-0.0011*	-0.0004	-0.0028*	0.0007	0.0008	-0.0004
	(0.0014)	(0.0006)	(0.0009)	(0.0015)	(0.0024)	(0.0032)	(0.0023)
HMO penetration at MSA level (%)	-0.0009*	0.0003	-0.0002	0.0007	-0.0009	0.0022*	-0.0020**
	(0.0005)	(0.0002)	(0.0004)	(0.0006)	(0.0011)	(0.0012)	(0.0008)
Herfindahl-Hirschman Index	0.0741**	-0.0257*	-0.0022	0.0777*	-0.1229**	-0.0962	0.0678
	(0.0307)	(0.0147)	(0.0185)	(0.0415)	(0.0555)	(0.0869)	(0.0594)
Presence of for-profit hospitals in county (%)	-0.0001	-0.0001	-0.0001	-0.0001	-0.0014**	0.0001	0.0001
	(0.0004)	(0.0001)	(0.0003)	(0.0003)	(0.0006)	(0.0009)	(0.0006)
Median household income (in 1000s)	0.0003	0.0012	0.0001	0.0009	0.0010	-0.0032	0.0019
	(0.0014)	(0.0010)	(0.0010)	(0.0015)	(0.0022)	(0.0032)	(0.0024)
Unemployment rate (%)	-0.0007	0.0010	0.0004	-0.0015	0.0024	-0.0046	0.0022
	(0.0025)	(0.0015)	(0.0021)	(0.0020)	(0.0048)	(0.0061)	(0.0047)
Poverty rate (%)	-0.0038**	-0.0014*	-0.0004	-0.0018	-0.0046*	0.0069	-0.0061*
	(0.0018)	(0.0008)	(0.0013)	(0.0020)	(0.0024)	(0.0044)	(0.0031)
Hospital located in the urban area	0.0111	-0.0172	0.0100	-0.0039	-0.0141	-0.1064*	-0.0030
	(0.0277)	(0.0115)	(0.0237)	(0.0310)	(0.0512)	(0.0567)	(0.0493)
Full time and part time RN to hospital staffed beds	-0.0097	-0.0020	0.0010	0.0024	-0.0228*	0.0359	0.0334**
	(0.0078)	(0.0039)	(0.0050)	(0.0080)	(0.0132)	(0.0260)	(0.0146)

Table 18 (continued)

VARIABLES	Medicaid/ Uninsured Patients						
	PSI Composite measure	PSI 02 Death in low mortality DRGs	PSI 06 Iatrogenic pneumothorax	PSI 07 Selected infections due to medical care	PSI 09 Postoperative hemorrhage or hematoma	PSI 12 Postoperative pulmonary embolism or deep vein thrombosis	PSI 15 Accidental puncture or laceration
Log of the number of hospital staffed beds	0.0013	-0.0026	0.0010	0.0184*	0.0032	0.0820***	0.0265
	(0.0096)	(0.0045)	(0.0076)	(0.0104)	(0.0200)	(0.0269)	(0.0175)
System affiliated	0.0100	-0.0001	-0.0004	0.0117	0.0264	0.0081	0.0289*
	(0.0108)	(0.0061)	(0.0081)	(0.0100)	(0.0204)	(0.0368)	(0.0172)
Major teaching hospital	0.2730***	0.0089	0.0232**	0.1057***	0.0610*	0.1842***	0.0864**
	(0.0507)	(0.0083)	(0.0112)	(0.0279)	(0.0343)	(0.0561)	(0.0342)
Minor teaching hospital	0.0084	0.0074	0.0012	0.0143	-0.0148	0.0261	0.0237
	(0.0178)	(0.0071)	(0.0073)	(0.0148)	(0.0197)	(0.0335)	(0.0269)
Provide high-tech services	-0.0093	-0.0016	0.0059	-0.0195	-0.0327*	-0.0409	0.0194
	(0.0123)	(0.0063)	(0.0059)	(0.0129)	(0.0176)	(0.0316)	(0.0179)
Hospital all payer casemix index	0.0960***	0.0360***	0.0075	0.1046***	0.0340	0.1006**	0.0407
	(0.0183)	(0.0131)	(0.0102)	(0.0259)	(0.0384)	(0.0499)	(0.0290)
Hospital Medicare share (%)	-0.0005	-0.0004***	0.0003	0.0002	0.0006	-0.0006	0.0000
	(0.0005)	(0.0001)	(0.0003)	(0.0004)	(0.0011)	(0.0013)	(0.0013)
Hospital Medicare share (%) at post BBA period	0.0004	0.0004	-0.0002	-0.0001	-0.0014	-0.0009	-0.0006
	(0.0005)	(0.0004)	(0.0004)	(0.0005)	(0.0011)	(0.0016)	(0.0012)
For-profit hospital	0.0142	0.0034	0.0136	0.0124	-0.0220	0.0321	0.0177
	(0.0131)	(0.0073)	(0.0105)	(0.0144)	(0.0217)	(0.0416)	(0.0214)
County Hospital	-0.0850***	-0.0050	0.0003	0.0222	-0.0108	-0.0679	-0.0515
	(0.0295)	(0.0139)	(0.0140)	(0.0318)	(0.0382)	(0.0554)	(0.0333)
District Hospital	-0.0135	0.0060	0.0019	-0.0040	0.0229	-0.0240	-0.0088
	(0.0168)	(0.0106)	(0.0185)	(0.0143)	(0.0427)	(0.0605)	(0.0332)
Year 1997	-0.0568*	-0.0217	-0.0021	-0.0282	0.0518	0.1345*	-0.0969
	(0.0319)	(0.0145)	(0.0228)	(0.0337)	(0.0465)	(0.0719)	(0.0600)

Table 18 (continued)

VARIABLES	Medicaid/ Uninsured Patients						
	PSI Composite measure	PSI 02 Death in low mortality DRGs	PSI 06 Iatrogenic pneumothorax	PSI 07 Selected infections due to medical care	PSI 09 Postoperative hemorrhage or hematoma	PSI 12 Postoperative pulmonary embolism or deep vein thrombosis	PSI 15 Accidental puncture or laceration
Year 1998	-0.0613	-0.0135	0.0008	-0.0123	0.1160*	0.1822*	-0.0860
	(0.0395)	(0.0221)	(0.0250)	(0.0410)	(0.0675)	(0.0961)	(0.0654)
Year 1999	-0.0619	-0.0283	-0.0008	-0.0176	0.1484**	0.1842*	-0.0544
	(0.0388)	(0.0198)	(0.0249)	(0.0400)	(0.0669)	(0.0978)	(0.0652)
Year 2000	-0.0738*	-0.0286	0.0083	-0.0188	0.1288*	0.2391**	-0.0680
	(0.0391)	(0.0201)	(0.0262)	(0.0430)	(0.0701)	(0.1066)	(0.0650)
Year 2001	-0.1043***	-0.0190	-0.0207	-0.0341	0.0898	0.2328**	-0.0944
	(0.0391)	(0.0192)	(0.0252)	(0.0410)	(0.0679)	(0.1021)	(0.0653)
Year 2002	-0.0774**	-0.0211	-0.0015	0.0059	0.1283*	0.2957***	-0.0591
	(0.0391)	(0.0179)	(0.0254)	(0.0423)	(0.0743)	(0.1058)	(0.0688)
Year 2003	-0.0833**	-0.0283	-0.0088	-0.0044	0.1304*	0.2619**	-0.0980
	(0.0391)	(0.0176)	(0.0254)	(0.0388)	(0.0689)	(0.1028)	(0.0651)
Constant	0.9581***	-0.0397	0.0267	-0.2001*	0.1648	-0.2023	0.0953
	(0.0984)	(0.0510)	(0.0645)	(0.1071)	(0.1556)	(0.2358)	(0.1796)
Observations	2418	2291	2457	2429	2204	2205	2457
Number of Hospitals	363	348	367	363	338	338	367

Robust standard errors in parentheses
*** p<=0.01, ** p<=0.05, * p<=0.1
PSI indicates patient safety indicator.

Table 19. Random Effect Model Results for PSIs Measures for Privately Insured

VARIABLES	Privately Insured Patients						
	PSI Composite measure	PSI 02 Death in low mortality DRGs	PSI 06 Iatrogenic pneumothorax	PSI 07 Selected infections due to medical care	PSI 09 Postoperative hemorrhage or hematoma	PSI 12 Postoperative pulmonary embolism or deep vein thrombosis	PSI 15 Accidental puncture or laceration
Net Medicaid DSH payment (in millions)	-0.0001	-0.0007*	0.0005	0.0004	-0.0010**	-0.0042*	-0.0004
	(0.0004)	(0.0004)	(0.0003)	(0.0006)	(0.0005)	(0.0023)	(0.0005)
Medicare DSH payments (in millions)	0.0012	0.0005	-0.0004	0.0002	0.0030	0.0021	-0.0020
	(0.0035)	(0.0011)	(0.0007)	(0.0015)	(0.0027)	(0.0050)	(0.0040)
State and local governmental supports (in millions)	-0.0007	0.0003	0.0004	-0.0002	-0.0012**	-0.0022	-0.0012*
	(0.0006)	(0.0007)	(0.0003)	(0.0005)	(0.0006)	(0.0016)	(0.0007)
Ratio of Medicaid eligibles to total population	-0.0004	0.0018	-0.0007	0.0027	-0.0047	0.0076	-0.0036
	(0.0023)	(0.0013)	(0.0010)	(0.0017)	(0.0037)	(0.0048)	(0.0048)
Ratio of Medicaid managed care enrollees to total population	-0.0046***	0.0000	0.0001	-0.0023**	-0.0037	-0.0025	-0.0054**
	(0.0017)	(0.0009)	(0.0006)	(0.0011)	(0.0026)	(0.0031)	(0.0026)
HMO penetration at MSA level (%)	-0.0003	0.0001	0.0001	0.0004	0.0012	0.0016	-0.0004
	(0.0007)	(0.0004)	(0.0002)	(0.0004)	(0.0011)	(0.0010)	(0.0011)
Herfindahl-Hirschman Index	0.0127	0.0321	-0.0192	-0.0246	-0.0670	-0.1046	-0.0260
	(0.0386)	(0.0317)	(0.0191)	(0.0222)	(0.0578)	(0.0713)	(0.0820)
Presence of for-profit hospitals in county (%)	-0.0004	0.0003	-0.0002	0.0002	-0.0006	0.0005	-0.0009
	(0.0005)	(0.0004)	(0.0002)	(0.0003)	(0.0006)	(0.0008)	(0.0009)
Median household income (in 1000s)	0.0013	-0.0001	-0.0003	0.0009	-0.0003	0.0027	0.0067**
	(0.0018)	(0.0007)	(0.0005)	(0.0009)	(0.0022)	(0.0026)	(0.0029)
Unemployment rate (%)	0.0027	-0.0032**	0.0000	-0.0010	0.0082	-0.0079	0.0162**
	(0.0034)	(0.0016)	(0.0014)	(0.0019)	(0.0057)	(0.0060)	(0.0074)
Poverty level (%)	-0.0058**	-0.0006	-0.0013	-0.0042**	-0.0001	0.0068	-0.0100***
	(0.0025)	(0.0016)	(0.0013)	(0.0018)	(0.0026)	(0.0052)	(0.0037)
Hospital located in the urban area	-0.0021	0.0110	-0.0230	-0.0059	-0.0304	-0.0715	-0.0694
	(0.0362)	(0.0237)	(0.0185)	(0.0195)	(0.0585)	(0.0666)	(0.0799)
Full time and part time RN to hospital staffed beds	0.0119	-0.0086	0.0043	0.0089	-0.0051	-0.0027	0.0558**
	(0.0111)	(0.0062)	(0.0039)	(0.0067)	(0.0160)	(0.0196)	(0.0236)

Table 19 (continued)

VARIABLES	Privately Insured Patients						
	PSI Composite measure	PSI 02 Death in low mortality DRGs	PSI 06 Iatrogenic pneumothorax	PSI 07 Selected infections due to medical care	PSI 09 Postoperative hemorrhage or hematoma	PSI 12 Postoperative pulmonary embolism or deep vein thrombosis	PSI 15 Accidental puncture or laceration
Log of the number of hospital staffed beds	0.0398***	-0.0039	0.0110**	0.0004	-0.0031	0.0271	0.0614*
	(0.0131)	(0.0055)	(0.0052)	(0.0086)	(0.0242)	(0.0278)	(0.0337)
System affiliated	0.0132	0.0012	-0.0010	0.0094	0.0336	0.0465	0.0519*
	(0.0134)	(0.0101)	(0.0049)	(0.0095)	(0.0242)	(0.0329)	(0.0267)
Major teaching hospital	0.1451**	0.0155	0.0268**	0.0599***	0.0635*	0.1208	0.0082
	(0.0642)	(0.0174)	(0.0119)	(0.0231)	(0.0379)	(0.0847)	(0.0467)
Minor teaching hospital	0.0219	0.0132	-0.0026	0.0304**	-0.0062	0.0796**	-0.0018
	(0.0241)	(0.0194)	(0.0055)	(0.0122)	(0.0202)	(0.0389)	(0.0301)
Provide high-tech services	0.0155	0.0055	-0.0022	-0.0143*	0.0053	0.0070	0.0232
	(0.0145)	(0.0059)	(0.0047)	(0.0084)	(0.0191)	(0.0227)	(0.0205)
Hospital all payer casemix index	0.0914***	-0.0039	0.0277***	0.0829***	0.0164	0.1440***	0.0522
	(0.0240)	(0.0166)	(0.0066)	(0.0188)	(0.0319)	(0.0473)	(0.0424)
Hospital Medicare share (%)	-0.0005	0.0003	-0.0006	0.0006	0.0019*	-0.0001	-0.0012
	(0.0006)	(0.0004)	(0.0006)	(0.0007)	(0.0010)	(0.0016)	(0.0014)
Hospital Medicare share (%) at post BBA period	0.0004	-0.0005	0.0007	-0.0003	-0.0010	-0.0021	0.0008
	(0.0006)	(0.0005)	(0.0006)	(0.0007)	(0.0011)	(0.0018)	(0.0014)
For-profit hospital	0.0248	-0.0084	0.0020	-0.0170	-0.0076	0.0047	0.0672*
	(0.0176)	(0.0088)	(0.0055)	(0.0115)	(0.0254)	(0.0340)	(0.0344)
County Hospital	-0.1187***	0.0125	-0.0259*	-0.0172	0.0018	0.1667	-0.2643***
	(0.0336)	(0.0269)	(0.0149)	(0.0224)	(0.0511)	(0.1142)	(0.0576)
District Hospital	0.0012	-0.0031	0.0007	-0.0197*	0.0299	-0.0019	-0.0125
	(0.0214)	(0.0130)	(0.0083)	(0.0113)	(0.0424)	(0.0492)	(0.0493)
Year 1997	-0.0920**	-0.0268	-0.0359	-0.0637*	0.1586***	0.1058	-0.1738***
	(0.0420)	(0.0292)	(0.0261)	(0.0347)	(0.0420)	(0.0713)	(0.0662)

Table 19 (continued)

VARIABLES	Privately Insured Patients						
	PSI Composite measure	PSI 02 Death in low mortality DRGs	PSI 06 Iatrogenic pneumothorax	PSI 07 Selected infections due to medical care	PSI 09 Postoperative hemorrhage or hematoma	PSI 12 Postoperative pulmonary embolism or deep vein thrombosis	PSI 15 Accidental puncture or laceration
Year 1998	-0.1303***	-0.0025	-0.0692	-0.0776*	0.2046***	0.2266*	-0.2166**
	(0.0490)	(0.0233)	(0.0468)	(0.0421)	(0.0647)	(0.1208)	(0.0991)
Year 1999	-0.1186**	-0.0053	-0.0785*	-0.0619	0.1815***	0.1813	-0.1737*
	(0.0497)	(0.0227)	(0.0466)	(0.0425)	(0.0640)	(0.1199)	(0.0996)
Year 2000	-0.1180**	-0.0023	-0.0820*	-0.0579	0.2022***	0.1824	-0.1891*
	(0.0489)	(0.0237)	(0.0460)	(0.0428)	(0.0653)	(0.1189)	(0.1005)
Year 2001	-0.1270***	-0.0046	-0.0771*	-0.0837**	0.1853***	0.1913	-0.0841
	(0.0490)	(0.0237)	(0.0465)	(0.0427)	(0.0659)	(0.1192)	(0.0973)
Year 2002	-0.1363***	-0.0108	-0.0882*	-0.0569	0.2033***	0.2455**	-0.1734*
	(0.0488)	(0.0213)	(0.0460)	(0.0421)	(0.0664)	(0.1201)	(0.1015)
Year 2003	-0.1208**	-0.0039	-0.0799*	-0.0603	0.2285***	0.2908**	-0.1556
	(0.0490)	(0.0218)	(0.0456)	(0.0423)	(0.0679)	(0.1253)	(0.1046)
Constant	0.8163***	0.0265	0.0670	-0.0285	-0.0025	-0.3092	-0.0531
	(0.1176)	(0.0621)	(0.0874)	(0.0699)	(0.1648)	(0.2197)	(0.2702)
Observations	2367	2259	2410	2386	2200	2204	2414
Number of Hospitals	356	343	363	360	334	334	364

Robust standard errors in parentheses
*** p<=0.01, ** p<=0.05, * p<=0.1
PSI indicates patient safety indicator.

statistically significant. Specifically, the results indicate that net Medicaid DSH payments may marginally affect three studied PSI measures, including the percentage of patients having iatrogenic pneumothorax adverse event (PSI 06) ($p<0.1$), the percentage of patients having selected infections due to medical care (PSI 07) ($p<0.1$) and the percentage of patients having accidental puncture or laceration (PSI 15) ($p=0.1$), but the magnitudes of the effects are very small, ranging from a 0.0002 to a 0.0005 percentage point increase per one million dollar decrease in net Medicaid DSH payment. As discussed in Chapter 4, since there are many different types of patient adverse events, Chow tests is conducted to test the null hypothesis that the effects of net Medicaid DSH payments on all patient outcomes for Medicaid/uninsured patients are jointly zero. The joint tests from individual PSIs (PSI02, PSI06, PSI07, PSI09, PSI12, and PSI15) yield a chi-square value of 13.29 and a p-value equal to 0.0386. This joint test result suggests that the net Medicaid DSH payments among the individual PSIs are significantly associated with patient care, as estimated effect is uniformly of the same coefficient sign this is interpreted to mean that increased Medicaid DSH payments increased quality of care for Medicaid/uninsured patients.

With respect to the coefficient estimations of net Medicaid DSH payments for privately insured patients, the results indicate that the directions of the impacts are mixed but all those that are significant have a negative association between net Medicaid DSH payment and patient safety for privately insured. Specifically, the findings indicate net Medicaid DSH payments may marginally affect three studied PSI measures including the percentage of patient death in low mortality DRGs (PSI02) ($p<0.1$), the percentage of

patients having postoperative hemorrhage or hematoma (PSI09) ($p<0.05$), and the percentage of patients having postoperative pulmonary embolism or deep vein thrombosis (PSI12) ($p<0.1$), but the magnitude of effects are also very small, being in the range from a 0.0007 to a 0.001 percentage point increase per one million dollar decrease in net Medicaid DSH payment. Similarly, this study conducts a Chow test to test whether these coefficients as a group are jointly equal to zero. The results yield a chi-square test statistic equal to 14.30 with a p-value equal to 0.0264. The findings from this joint test indicate that net Medicaid DSH payments may have weak impacts on individual PSIs for the privately insured.

Although the results from joint tests indicate there is an association between net Medicaid DSH payments and patient adverse events for both Medicaid/uninsured and privately insured, the magnitude of the effects are very small. Moreover, because the effects are not all evident across different PSI measures, the findings do not strongly support the study hypothesis **H3a or H3b**.

In terms of PSI results for Medicaid/uninsured patients, consistent patterns of effect are also not all evident for the explanatory variables across different PSI measures. For example, higher values of PSI composite scores are associated with hospitals that: receive fewer state and local governmental financial subsidies; are located in a market with fewer populations below poverty level; are major teaching hospitals; or have a more severely ill patient population. Greater rate of in-hospital deaths for low-mortality DRGs (PSI02) is associated with hospitals that: are located in a market with lower ratio of Medicaid managed care enrollees to total population; are located in a market with fewer

populations below poverty level; or have a more severely ill patient population. Higher rate of the incidence of iatrogenic pneumothorax (PSI06) is only associated with hospitals that are major teaching hospitals. Greater rate of the incidence of selected infections due to medical care (PSI07) is associated with hospitals that: receive fewer state and local governmental financial subsidies; are located in a market with lower ratio of Medicaid managed care enrollees to total population; had more staffed beds; are major teaching hospitals; or have a more severely ill patient population. Higher rate of the incidence of postoperative hemorrhage or hematoma (PSI09) is associated with hospitals that: are located in a market with fewer populations below poverty level; or are major teaching hospitals. Greater rate of the incidence of postoperative pulmonary embolism or deep vein thrombosis (PSI12) is associated with hospitals that: receive fewer state and local governmental financial subsidies; have more staffed beds; are major teaching hospitals; or have a more severely ill patient population. Higher rate of incidence of accidental puncture or laceration (PSI15) is associated with hospitals that: receive fewer state and local governmental financial subsidies; are located in a market with fewer populations below poverty level; or are major teaching hospitals. Other explanatory variables have limited effects and also lacked consistent patterns across different PSIs measures for Medicaid/uninsured patients.

With respect to the PSI results for privately insured patients, the results suggest that higher values of PSI composite score are associated with hospitals that: are located in a market with lower ratio of Medicaid managed care enrollees to total population; are located in a market with fewer populations below poverty level; have more staffed beds;

are major teaching hospitals; or have a more severely ill patient population. In addition, compared to not-for-profit hospitals, county hospitals have lower patient adverse events as measured by PSI composite score. Higher rate of the incidence of iatrogenic pneumothorax (PSI06) is associated with hospitals that: have more staffed beds; are major teaching hospitals; or have a more severely ill patient population. In addition, compared to not-for-profit hospitals, county hospitals also have lower rate of the incidence of iatrogenic pneumothorax. Greater rate of the incidence of selected infections due to medical care (PSI07) is associated with hospitals that: are located in a market with lower ratio of Medicaid managed care enrollees to total population; are located in a market with fewer populations below poverty level; are major or minor teaching hospitals; or have a more severely ill patient population. Higher rate of the incidence of postoperative hemorrhage or hematoma (PSI09) is associated with hospitals that: receive fewer state and local governmental financial subsidies; or are major teaching hospitals. Greater rate of the incidence of postoperative pulmonary embolism or deep vein thrombosis (PSI12) is associated with hospitals that: are minor teaching hospitals; or have more severely ill patient populations. Higher rate of incidence of accidental puncture or laceration (PSI15) is associated with hospitals that: receive fewer state and local governmental financial subsidies; are located in a market with lower ratio of Medicaid managed care enrollees to total population; are located in a market with fewer population below poverty level; or have more staffed beds. Other explanatory variables have limited effects and also lacked consistent patterns across different PSIs measures for privately insured patients.

Sensitivity Analysis

As Table 20 presents, several sensitivity analyses are conducted and compared the coefficient estimations of the effect of Medicaid DSH payment on hospital patient safety indicators with the original random effect models. Model (1) reports the coefficient estimates for the net Medicaid DSH payment variable in the original random effect models as reported in Table 18 and Table 19. Model (2) reports the coefficient estimate for the net Medicaid DSH payment variable after excluding hospitals that have ever experienced ownership conversion or closure during study years. The results of this sensitivity analysis indicate that the coefficient estimates of the effect of net Medicaid DSH payment on hospital patient safety/ quality of care are robust to the presence of all hospital observations.

Summary of Key Study Findings

In this chapter, the study findings for uncompensated care model and quality of care model are presented. Given the research questions and theoretical hypotheses discussed in the Chapter 3, one could see the results primarily focused on investigating the association between net Medicaid DSH payments and hospital outcomes (i.e., hospital uncompensated care provision and patient safety/ quality indicators). With respect to the results from the uncompensated care model, the study findings support hypothesis **H1**, which suggested that not-for-profit hospitals may reduce their uncompensated care provision given the reductions of Medicaid DSH payment they encountered during study years. Other things being equal, the marginal effect of the net Medicaid DSH payment indicates that an increase of one million dollars (in 1996 dollars) increased

Table 20. Results for Sensitivity Analysis in Quality of Care Model

Dependent variable\Key Independent Variable	Medicaid/Uninsured						Privately Insured					
	Net Medicaid DSH payment (in millions)			Net Medicaid DSH payment (in millions)			Net Medicaid DSH payment (in millions)			Net Medicaid DSH payment (in millions)		
	(1)			(2)			(1)			(2)		
	N	Coefficient	SE	N	Coefficient	SE	N	Coefficient	SE	N	Coefficient	SE
PSI Composite measure	2418	-0.0009	(0.0006)	2223	-0.0010*	(0.0006)	2367	-0.0001	(0.0004)	2189	-0.0001	(0.0004)
PSI 02 Death in low mortality DRGs	2291	-0.0001	(0.0001)	2116	-0.0001	(0.0001)	2259	-0.0007*	(0.0004)	2094	-0.0005*	(0.0003)
PSI 06 Iatrogenic pneumothorax	2457	-0.0002*	(0.0001)	2258	-0.0002**	(0.0001)	2410	0.0005	(0.0003)	2228	0.0004	(0.0003)
PSI 07 Selected infections due to medical care	2429	-0.0005*	(0.0003)	2231	-0.0006*	(0.0003)	2386	0.0004	(0.0006)	2202	0.0004	(0.0006)
PSI 09 Postoperative hemorrhage or hematoma	2204	-0.0005	(0.0004)	2035	-0.0005	(0.0004)	2200	-0.001**	(0.0005)	2040	-0.0013***	(0.0005)
PSI 12 Postoperative pulmonary embolism or deep vein thrombosis	2205	-0.0003	(0.0006)	2036	-0.0001	(0.0006)	2204	-0.0042*	(0.0023)	2044	-0.004**	(0.0020)
PSI 15 Accidental puncture or laceration	2457	-0.0005*	(0.0003)	2258	-0.0006**	(0.0003)	2414	-0.0004	(0.0005)	2231	-0.0004	(0.0005)

Note: Model (1) represents the model including hospital observations that experienced ownership change or closure during study years.
Model (2) represents the models excluding hospital observations that experienced ownership change or closure during study years.
PSI indicates patient safety indicator. N represents hospital-year observations.
Robust standard errors in parentheses.
*** p<=0.01, ** p<=0.05, * p<=0.1

uncompensated care costs by 0.0343 million dollars and increased by 0.0223 percentage points the fraction of uncompensated costs to total operating expenses.

In addition, these results indicated, compared to not-for-profit hospitals, for-profit hospitals may not evidently have smaller cuts in their uncompensated care costs as well as the percent of total operating expense devoted in the uncompensated care costs when faced with declining DSH payments. The overall findings for the interaction of for-profit hospitals and net Medicaid DSH payment do not support hypothesis **H2**.

Given the anticipated hypotheses for the effect of the reduction of net Medicaid DSH payments on patient safety, although the results indicated there may be a weak association between net Medicaid DSH payments and some study measures for patient adverse events for both Medicaid/uninsured and privately insured, the magnitude of the effects are very small and in some cases mixed. Moreover, because the effects are not all evident across all PSI measures, the findings are inconclusive as regards study hypotheses **H3a and H3b**.

CHAPTER 6: DISCUSSION

In response to the growing number of the uninsured in the U.S., general approaches that state and federal governments take to address the problems are either to reduce the number of uninsured individuals by expanding public insurance coverage or to subsidize the cost of uncompensated care for health care providers (Weissman, 2005). Medicaid DSH payments are one of the major funds that support health care providers, in particular safety net hospitals, and help to offset their costs for providing care to low-income patients. The public and policy makers have often expressed concerns that safety net hospitals may reduce the medical care they provide to low-income patients when faced with Medicaid DSH budget cuts.

This study examines the impact of changes in Medicaid DSH payments resulting from the BBA health policy reform on hospital outcomes, while controlling for factors such as other governmental financial subsidies, hospital and market characteristics. Two hospital outcomes are examined: the provision of uncompensated care and quality of care for Medicaid and uninsured patients. These two dimensions are important and need to be monitored by policy makers and researchers in any health policy reform related to medical care for the uninsured population. In Chapter 5, this study presented detailed results for the uncompensated care model and quality of care model. Here the results are summarized, the key findings interpreted, and implications discussed. Study limitations and suggestions for future study are reviewed at the end of this chapter.

Summary

Uncompensated Care Model

This study applied organizational economic theory of not-for-profit hospital behavior and theoretical extensions from Newhouse (1970), Hoerger (1991), Frank and Salkever (1991) and other researchers as a framework to examine the association between the provision of uncompensated care and Medicaid DSH payments. Fixed effect models are used as the major statistical technique to assess the research questions. Data for California hospitals from 1996 to 2003 are examined. The study findings suggest that not-for-profit hospitals reduce their provision of uncompensated care in response to reductions in Medicaid DSH payments. Specifically, the marginal effect of the net Medicaid DSH payment indicates that an increase of one million dollars (in 1996 dollars) increases uncompensated care costs by $34,300 dollars, and increases by 0.0223 percentage points the percent of uncompensated costs to total operating expenses in not-for-profit hospitals.

The study results, however, do not support the hypotheses that for-profit hospitals reduce uncompensated care by a smaller degree than not-for-profit hospitals for a comparable DSH decline, as economic theory and previous study suggested (Banks et al., 1997). It may because this study only studies one state and a particular Medicaid DSH payment change. Future research is needed to examine whether public payment generosity affect for-profit hospital uncompensated care provision from theoretical perspectives.

In addition to the key findings for net Medicaid DSH payments, this study also finds several interesting results from the control variables. In terms of other governmental financial subsidies, the study results suggest that reductions in Medicare DSH payments negatively affected hospital uncompensated care provision and that the effect may be larger than that for net Medicaid DSH payments. The results indicate that a $1 million reduction in Medicare DSH payment (in 1996 dollars) is associated with a $171,400 dollar decline in hospital uncompensated care costs. The reason for the magnitude of effects different between the changes in Medicare DSH payment and Medicaid DSH payments on hospital uncompensated care may be because there are about 70% of study hospitals receiving Medicare DSH payments but only about 30% of study hospitals receiving Medicaid DSH payments. The effects will diminish statistically given the relative small number of hospitals receive the payments. The study results also indicate that one percentage point increase in the ratio of the Medicaid eligibles to total population in a county would decrease uncompensated care costs by $52,500 dollars (in 1996 dollars). Moreover, the study findings suggest that hospitals with more capacity (i.e., more nurses per staffed beds, more staffed beds) and hospitals that became major teaching hospitals have more capacity and ability to provide uncompensated care.

Quality of Care Model

This study applied organizational economic theory of not-for-profit hospital behavior and theoretical extensions from Newhouse (1970), Hoerger (1991), Spence (1975) and Dranove &White (1998) as frameworks to examine the association between hospital quality of care and Medicaid DSH payments. Random effect models are used as

the major statistical technique to assess the research questions. Data for California hospitals from 1996 to 2003 are examined. The overall study findings do not provide strong evidence to support an association between net Medicaid DSH payments and patient adverse events for both Medicaid/uninsured and privately insured. The magnitude of the effects are very small and only a few PSI measures have significant DSH effects with most of these being only marginally significant ($p<=0.1$).

In addition to the key findings of net Medicaid DSH payments, this study also finds several interesting findings from the control variables. For example, the study findings suggest a consistent inverse association between patient safety/quality and state and local governmental financial subsidies. This relation may arise because hospitals used these non-patient care revenues (i.e., state and county tax appropriation, district assessment revenue, and donations and subsidies for indigent care) to improve hospital infrastructure, for example, by investing in up-to-date equipment to improve technology efficiency or by replacing semi-private rooms to single private room to lower the chance of the spread of infection, and in turn to maintain the quality of care (Bazzoli et al., 2008). Additionally, the study results indicate that hospitals located in a market with a higher ratio of Medicaid managed care enrollees to total population generally have better patient safety/quality. This may be because California State required managed care plans and health providers to meet certain standards (Holahan, Zuckerman, Evans, & Rangarajan, 1998). California State expanded Medi-Cal managed care during these study years. Medi-Cal managed care was implemented on a county-by-county basis through a combination of voluntary and mandatory managed care plans. In order to assure quality

of care, California State established mechanisms to monitor managed care plan performance and quality of care as well as access to care for Medi-Cal beneficiaries (Bindman, Chattopadhyay, Osmond, Huen, & Bacchetti, 2005; Holahan et al., 1998). One study examined the impact of Medi-Cal managed care on the hospitalization rates due to ambulatory care sensitive conditions and found Medi-Cal managed care is associated with a large reduction in the hospitalization rate, compared to Medicaid fee-for-service (Bindman et al., 2005). Consistent with Bindman et al. (2005) study, the results from this study suggest that Medi-Cal managed care is associated with a lower incidence of hospital adverse events for both Medicaid/uninsured and privately insured patients. Moreover, the study findings suggest that hospitals with more staffed beds, major teaching hospitals, and hospitals that had a more severely ill patient population have higher incidence rates of patient adverse events.

Limitations of this Study

As with any study, this research has limitations that must be acknowledged. First, due to the lack of comparable data on key study variables across other states, this study only examined hospitals in California. The results may not be generalizable to other states. Second, this study conducts a pre-and-post design that covered the study period between 1996 and 2003 in order to capture the specific impact of Medicaid DSH payment cuts resulting from the BBA on hospital outcomes. However, other policy reforms (i.e., the Omnibus Budget Reconciliation Act of 1993, which was effective in 1995) that capped the expansion of Medicaid DSH expenditures in early 1990s may have had some residual historical effects on hospital outcomes for the study years (i.e., 1996 and 1997)

covered in this study. This historical threat may affect the internal validity of this study results. Third, the data used to construct quality measures (i.e., PSIs) were based on the administrative data, which may not capture all patients' detailed risk factors. In addition, this study uses only patient safety indicators to measure hospital quality of care. There are other types of quality measures that can be used in this kind of study, such as patient mortality, length of stay, or hospital readmissions. Despite its shortcomings, the study results do provide some important implications for health policy and practice.

Implications of the Findings

Implications for Health Policy

With respect to the current U.S. health care reform, one of the approaches that Congress and the Obama administration will use to finance health coverage involves Medicaid DSH and Medicare DSH payments.[28] The basic idea is to reallocate these funds that currently go to safety net providers for providing uncompensated care to instead finance comprehensive health care reform (Berenson et al., 2009; McKethan, Nguyen, Sasse, & Kocot, 2009). To find an optimal solution for covering more Americans over the next ten to twenty years, policy makers need to consider many factors simultaneously because when one factor changes, others might be affected subsequently.

This study provides empirical results regarding the magnitudes of the association between the changes of hospital uncompensated care provisions and other policy factors (i.e., Medicaid and Medicare DSH payments, and the ratio of Medicaid eligibles to total

[28] More detailed information on the health reform law can be found at: http://www.kff.org/healthreform/upload/housesenatebill_final.pdf. Among the reform items, the ways to finance health reform plan are listed in the last two pages. (Access Date: 01March.2010).

population). If Medicaid covers more low-income uninsured after universal health reform, hospitals may no longer need to provide free care and thus the hospital provision of uncompensated care will decline. Hospitals, in turn, receive guaranteed payment revenue from payers like Medicaid for caring for low-income patients. In this regard, it would make sense for proposed health reform policy to redirect the Medicaid and Medicare DSH payments that originally fund hospitals to provide such care to low-income patients and to cover the universal health insurance coverage.

However, a concern may arise during the transition to health reform as Hsieh, Clement, & Bazzoli (2010) discussed in their paper, "… If there is a regulatory mandate requiring individuals to obtain health insurance, it will not immediately solve the issue of the uninsured and hospital uncompensated care." Traditionally, safety net hospitals play important roles in providing high-cost and potentially unprofitable services and care for a disproportionate share of the low-income population. Therefore, they mostly rely on the Medicaid and Medicare DSH to offset the unreimbursed costs of these services. If safety net funds that originally are used to support safety net providers decrease immediately, safety net providers may be adversely affected because they will still need to take care of low-income patients who are not insured and do not have sufficient financial support for health care during the transition period to universal coverage. If that is the case, policy makers need to carefully address the size of budget cutbacks to safety net funds because these cuts may harm the financial condition of safety net providers and their continuing ability to treat low-income, uninsured individuals during the transition.

In addition, reductions in safety net funding may affect not only the provision of hospital uncompensated care but also other hospital outcomes (i.e., quality of care). Although this study does not find substantial evidence suggesting that reductions in Medicaid DSH payment after the BBA had a negative impact on hospital quality of care for either Medicaid/uninsured or privately insured patients, future research is necessary to continuously monitor hospital quality of care when healthcare reform is implemented. Policy makers may need to collect better patient safety and quality indicators in order to have a better sense of the effect of hospital finances on the quality of care provided to patients.

Another issue may also arise in relation to community benefit requirements of not-for-profit hospitals after comprehensive healthcare reform is implemented(Bazzoli, Clement, & Hsieh, 2010). Currently, the revised IRS 990 tax-exempt form requires hospitals to report the dollar amount of community benefit provided (namely, charity care, uncompensated care and Medicaid shortfalls). After comprehensive healthcare reform, hospitals may no longer have much charity care or uncompensated care, but may provide more care to Medicaid patients, policy makers may need to rethink what activities constitute community benefits in relation to tax exempt status of not-for-profit hospitals once health reform is implemented.

Implications for Practice

A major uncertainty confronting hospitals currently is the types of changes that will result from upcoming comprehensive healthcare reform. If safety net funds from Medicaid and Medicare DSH are reallocated to fund comprehensive health coverage,

organizations originally receiving state and federal subsidies for uncompensated care may no longer receive this assistance. Hospital managers and administrators, in particular those associated with safety net providers, need to understand their environment and estimate the possible reductions in safety net funding they may experience. For example, hospital managers need to continue to collect and analyze information on the amount of uncompensated care they provide, how many state and federal subsidies they receive for supporting such care and what the historical Medicaid payment rate for Medicaid patients has been. Using such data, hospital managers may anticipate possible scenarios and conduct sensitivity analyses regarding the simultaneous impacts of reduced Medicaid and Medicare DSH as well as expanded Medicaid coverage for the uninsured on hospital financial performance. It will be helpful for hospitals to adjust and reallocate available resources when they have a better idea of potential future scenarios.

In addition, although the study results do not strongly support that reductions in Medicaid DSH payment after the BBA had a negative impact on hospital quality of care for either Medicaid/uninsured or privately insured patients, hospital managers still need to continuously monitor hospital quality of care.

Suggestions for Future Study

As discussed previously, this study examines only California hospitals to assess the impact of Medicaid DSH payment changes resulting from the BBA policy changes on the provision of hospital uncompensated care and quality of care. If Medicare and Medicaid DSH payment will be reallocated to fund comprehensive healthcare reform, future studies are needed, including:

(1) To examine what effects of the reduction in safety net financial subsidies will have on safety net hospitals' financial conditions in the short-run and in the long-run after comprehensive health reform is implemented;

(2) To examine what effects of the reductions in safety net financial subsidies will have on safety net hospitals' quality of care in the short-run and in the long-run after comprehensive health reform is implemented;

(3) Given the results of qualify of care models, the patient safety indicators may not be sensitive to capture the quality of care for low-income population. Future research are needed to examine quality indicators that are more sensitive to care received by Medicaid and uninsured patients, such as births or birth complication.

Conclusions

Medicaid Disproportionate Share Hospital (DSH) payment is one of the major funding sources that hospitals used to offset part of their uncompensated care costs since early 1990s. This payment scheme has been revised in many prior health reforms such as the Medicaid Voluntary Contribution and Provider-Specific Tax Amendments of 1991, the Omnibus Budget Reconciliation Act of 1993, and the Balanced Budget Act of 1997. Medicaid DSH payments may be eliminated in the future if funding is redirected towards support of health care reform provisions. In other words, if there is universal coverage in the U.S., the main purpose of these payments may no longer be necessary. Nevertheless, during the transition from the old to new system, it is necessary to study the effects of the transition and so that the best health policy decisions can be made.

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VITA

Hui-Min (Esther) Hsieh was born in Kaohsiung City, Taiwan on February 2nd, 1977. She received her Bachelor and Master degree in Business Administration at National Chung Cheng University, Chiayi County, Taiwan in 1999 and 2001, respectively. Between 2001 and 2005, she was a hospital administrator with the Center of Health Performance Evaluation and Research at Kaohsiung Medical University, Kaohsiung City, Taiwan. She served as an adjunct instructor with Department of Business Administration at Southern Taiwan University, Tainan City from 2002 to 2005. Having several year of experience both in academic and hospital administration, in fall 2005, she decided to pursue her research interests and thus enrolled in the Department of Health Administration's PhD program at Virginia Commonwealth University. While a doctoral student, she worked with Dr. Gloria J. Bazzoli for three years on a NIH grant supported project examining changing safety net resources in communities and its impact on minority access to health care. Five years of doctoral trainings in the U.S. provided her solid theoretical and methodological foundations to examine relevant, real world questions facing the U.S. health care system. She completed all Ph.D. requirements and graduated in May 2010. Her research interests focused on health program evaluation, health economics, health finance, research method and applied statistical methodology.