Hospital Service Changes in California: Trends, Community Impacts and Implications for Policy

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FROM THE DIRECTOR

I am pleased to issue *Hospital Service Changes in California: Trends, Community Impacts and Implications for Policy*, funded by the California HealthCare Foundation. The changing landscape and nature of hospitals in California is of central concern to the delivery of health care services to all our citizens. Our hospitals function in a dynamic environment and must constantly change to meet the evolving disease patterns, population growth and diversity, new medical technology, and shifts in the health care market place. This study is a systematic look at the changes in services offered by California hospitals from 1995 to the 2002.

The study utilizes data from the Office of Statewide Health Planning and Development, which is the most comprehensive and reliable database on California hospitals. It shows that over the study period there were several significant shifts in service patterns. For example, over half the hospitals either closed or opened at least one facility between 1995 and 2002, and at least a third added one or more services. The most frequently closed service [28 hospitals] was obstetrics, labor and delivery. The most frequently opened service was in-patient rehabilitation. Hospitals that closed four or more services were typically located in small rural areas and were already experiencing financial difficulties.

This report documents these changes and provides a systematic exploration of the possible explanations for what has happened. We hope it will improve your understanding of the hospital system in California.

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EXECUTIVE SUMMARY

Hospitals in California face a number of serious challenges in the current health care marketplace. Aside from the financial issues facing hospitals across the country, such as increasing restrictions on reimbursement rates from both public and private payers, California hospitals must comply with state government mandates on such things as nurse staffing ratios and seismic upgrades to facilities. A substantial number of hospitals have closed their doors in recent years: a recent study by the Nicholas C. Petris Center on Health Care Markets and Consumer Welfare found that 40 general acute care (GAC) hospitals closed in the state during the period of 1995 through 2003. The announcement in January 2004 by Tenet Healthcare Corporation, a major hospital owner in the Southern California market, that it will divest itself of 19 hospitals in the region suggests that more closures are imminent.

While hospital closures have generated a great deal of media attention and community concern, hospitals have other possible responses to the difficult financial environment. This report focuses on one such response. Are hospitals changing their inpatient service offerings in order to improve their financial health? Financially troubled hospitals may face strong incentives to eliminate services that are perceived as money-losing. Conversely, hospitals may add new services, in service areas where profitability is expected to be greater. Hospitals might seek to offer new services that make use of the latest medical technologies, on the assumption that such services would be more profitable.

To date, no systematic studies have been done on the incidence of inpatient service changes in California hospitals. This report is intended to fill that gap. Our objectives for this report are to:

1) Create valid measures of changes in the inpatient service offerings in California hospitals;

2) Thoroughly describe, using these measures, the extent of service changes during the period between 1995 and 2002;

3) Identify types of services that hospitals eliminated most frequently, and assess the impact of these service closures on local communities;

4) Identify types of services that hospitals added most frequently, and discuss possible reasons why hospitals added these to their service offerings;

5) Assess the financial condition of hospitals making extensive changes in service offerings.

6) Make recommendations to health policymakers, hospital executives, and health services researchers concerning the broad issue of hospital service changes.

We use a variety of data sources and methodological approaches to fulfill these objectives. Our primary sources of quantitative data will come from the California Office of Statewide Health Planning and Development (OSHPD). We use OSHPD's patient discharge dataset, which contains data on every inpatient hospitalization in the state, to measure changes in hospital service offerings. We use the information each patient's diagnosis-related group (DRG) and apply a unique categorization scheme to create 48 hospital service categories (HSCs). We then use changes in the number of inpatient discharges within these categories between 1995 and 2002 as our measure of service change.

We also use the OSHPD patient discharge data to assess the impact of obstetrics service closures in the hospital service markets of 26 hospitals that closed this service. Using ZIP Code data from patient discharge records involving newborns, we measured the distances traveled by expectant mothers to receive obstetrics care before and after the closures. We also analyze birth outcomes (delivery complications and use of cesarean section) to see whether travel distances have any medical impact.

Another quantitative data source is OSHPD's Hospital Annual Disclosure Report, which hospitals must submit after each fiscal year. These reports include extensive financial data, and we will use this to assess the financial health of hospitals that are changing their service offerings. We focus in particular on hospitals that made large numbers of service changes over

the study period, and on hospitals that closed obstetrics units and those that opened inpatient rehabilitation services (the two most frequently closed and opened services, respectively).

Finally, we present qualitative data, in the form of hospital case studies. We conducted site visits at four hospitals that eliminated obstetrics (labor and delivery) services, meeting with hospital executives and key medical personnel, and discussing with them the reasons for, and impacts of, their decision to stop offering obstetrics services. We also met with other health care providers and administrators in each hospital's surrounding community, to find out how the service closure at the hospital affected access to care for local residents.

Our major findings indicate that many California hospitals made changes in their service offerings during the study period (1995-2002), though very few hospitals made extensive changes. All together, just over half of the hospitals in our study population (189 of 368) either closed or opened at least one service. About one-fourth of the hospitals in our study population closed one or more services, but most of these hospitals closed only one or two services. Only a very small group of hospitals closed four or more services, and in some of these cases, the high number of service closures was connected to either administrative restructuring within a hospital system, a hospital's merger with another institution, or (in one instance) to serious financial difficulties leading to a hospital's closure during 2002, the final year of the study period. While the number of service closures overall is relatively low, we do find that the most prevalent types of service being closed relate to labor and delivery services (normal newborn births and neonatology). This potentially troubling development is a major focus of this report. In addition, we find that the small group of hospitals closing four or more services (and not involved in mergers or administrative changes within systems) is overwhelmingly small, rural, and financially troubled. The hospitals in the small group of "high closers" experienced a marked deterioration of their financial positions over the course of the study period.

As with service closures, we find that California's short-term GAC hospitals did not open services with great frequency, but made some important changes nonetheless. In total, hospitals added about as many new inpatient services as they closed. About one-third of the hospitals in our study population added one or more services, but most of these opened only one or two new

services. A small number of hospitals opened a substantial number of services (here defined as three or more). Again, some of these apparent service openings were likely the result of mergers or system reorganizations that affected hospital data reporting. But the small group of hospitals making three or more of what we will call "legitimate" service additions was predominantly small and rural, as was the group that closed four or more services. However, this small group of "high openers" saw improvements in their financial health over the study period, in contrast to the high closers. These findings are intriguing, and we will discuss their implications for hospitals' financial strategies. By far, the service hospitals added most frequently was rehabilitation, suggesting that many hospitals have responded to demographic shifts – specifically, the increasing number of elderly in California (and nationwide) – by offering rehabilitative services. Interestingly, we find that a number of hospitals also began offering labor and delivery services, though this was a much smaller group than those hospitals closing the service.

The following table summarizes some of the key findings discussed in the report.

Finding	Number of Hospitals	Percentage (of 368 Hospitals)
Hospitals Making Any Service Change	189	51.4%
Hospitals Closing One or More Services	88	23.9%
Hospitals Opening One or More Services	123	33.4%
Hospitals Closing Obstetrics (Labor & Delivery)	28	7.6%
Hospitals Opening Inpatient Rehabilitation	57	15.5%

Source: Petris Center analysis of OSHPD patient discharge data.

Finally, our analysis of the impact of obstetrics service closures revealed little negative impact, so far, on health care consumers. Hospital executives and physician leaders at three of our four case study hospitals felt that their closures of labor and delivery units were not burdensome to their communities, as many expectant mothers were already bypassing the case study hospitals for larger, more urban hospitals. (Respondents at one case study hospital did express concerns about the effects of increased travel distance on low-income patients.) Our analysis of patient data also supports the view that obstetrics closures are not having negative effects on consumers. Using patient ZIP Code data to analyze travel distances in the hospital markets of the 26 hospitals that closed their obstetrics units, we find that the average distance traveled for

obstetrics care increased only very slightly – just over two-tenths of a mile – between 1995 and 2002. We also find that, over the study period, more than three-fourths of patients in the state as a whole bypassed their nearest local hospital for childbirth, picking more distant (but presumably larger) facilities instead. Since so many women were already bypassing their nearest local hospitals, any possible effects of labor and delivery unit closures were largely muted. Indeed, our analysis of travel distances and birth outcomes found that higher travel distances were not associated with an increased likelihood of either a cesarean delivery, or a delivery with complications. While these findings are reassuring in that they do not suggest that California has an immediate problem with access to obstetrics care as a result of service closures, we strongly believe that policymakers and researchers should continue to monitor this situation.

INTRODUCTION

Hospitals face serious financial challenges in today's health care market. Both private and public sector insurers have aggressively restricted their provider reimbursement rates in recent years. Financial problems are particularly acute among public hospitals, which constitute the health "safety net" for the large and growing number of Americans without health insurance. More generally, the country's aging population, and the increased prevalence of chronic diseases, combined with the growing sense of alarm among policymakers and the general public over the rising share of national income devoted to health care, suggest that the hospital industry's operating margins will continue to be squeezed in the coming years.

California hospitals face additional difficulties. The state's hospital market is one of the most competitive in the nation, with the highest managed-care penetration of any state (National Center for Health Statistics 2003, p. 366). Hospitals' operating costs, especially for wages, are higher in California than in other parts of the country. At the same time, California's recently enacted nurse-to-patient staffing ratio requirements (which took effect on January 1, 2004) will further raise these costs. Finally, California hospitals must comply, by 2008, with state regulations mandating expensive seismic retrofitting of hospital buildings. As a result of these pressures, operating margins at California hospitals have suffered in recent years; more than half reported operating losses in 1999, according to an earlier study by the California HealthCare Foundation (California HealthCare Foundation 2001).

A number of hospitals in California have closed their doors in recent years in response to financial distress. A recent study by the Nicholas C. Petris Center on Health Care Markets and Consumer Welfare found that 40 general acute care (GAC) hospitals closed in the state during the period of 1995 through 2003 (Maiuro 2004). The announcement in January 2004 by Tenet Healthcare Corporation, a major hospital owner in the Southern California market, that it will divest itself of 19 hospitals in the region suggests that more closures are imminent. Among the factors cited by Tenet executives as driving their decision were the costs of seismic retrofitting. In Northern California, the Columbia/HCA Healthcare Corporation closed the San Jose Medical

Center in December 2004, creating concerns about adequate hospital capacity for residents of the city.

Hospital closures generate a great deal of media attention, and understandable public concern, in the affected communities. However, an exclusive focus on hospital closures risks missing another possible response to financial problems. Are hospitals changing their inpatient service offerings in order to improve their financial health? Certain types of services, such as emergency services, are widely viewed as unprofitable, because many users of such services may lack health insurance (Burt and Arispe 2004). Other services, such as labor and delivery (obstetrics), may be unprofitable at low volumes, leading smaller hospitals to close these units. Financially troubled hospitals may face strong incentives to eliminate such services. These service closures may spark intense concern among the affected communities; in particular, residents may fear that service closures will create a downward spiral of fewer patients, leading a hospital to close its doors entirely (Garofoli 2001).

Conversely, some hospitals may actually be adding new services, presumably in areas where profitability is expected to be greater. Hospitals might seek to offer new services that make use of the latest medical technologies, on the assumption that such services would be more profitable. They may also add services in response to reimbursement policies of large public payers, such as the federal Medicare program. In some cases, the very services that some hospitals are closing due to financial concerns may be opened by others, in circumstances more likely to generate profits. For example, obstetrics (labor and delivery) services may close in some rural hospitals, where delivery volumes may be small and a high proportion of patients may lack health insurance, while at the same time urban hospitals might open new "birthing centers," offering such amenities as large, hotel-quality rooms to a customer base willing, and able, to pay a premium for such services.

The changing service mix of California hospitals is an important, but so far largely neglected, topic. The policy relevance of this topic is obvious: as hospitals struggle to survive in the difficult economic climate they face today, they face strong incentives to eliminate certain critical, but unprofitable, services. If this is in fact occurring, the potential impact on access to

health care could be serious. Consumers in need of health care would have to bypass their closest local hospital if that hospital no longer offers a needed service. In rural areas, service eliminations might force consumers to travel long distances to receive care they previously could have obtained closer to home. In urban areas with large numbers of hospitals, travel distances might not be as great, but the amount of time required for travel by those dependent on public transportation remains a serious issue. Moreover, while an urban area may have a variety of hospital facilities, not all of them serve patients on public insurance (Medicare and Medi-Cal), or indigent patients. In both rural and urban areas, the issue of vulnerable populations looms large. California's major cities have large numbers of poor and uninsured; the state's rural, agricultural regions have substantial populations that, in addition to being poor and uninsured, are undocumented immigrants, and thus particularly vulnerable.

To date, no systematic studies have been done on the incidence of inpatient service changes in California hospitals. This report is the culmination of a two-year research project, conducted by the Nicholas C. Petris Center on Health Care Markets and Consumer Welfare at the University of California-Berkeley, to provide an initial evaluation of this interesting and important phenomenon. Our goals in this report are to:

1) Create valid measures of changes in the inpatient service offerings in California hospitals;

2) Thoroughly describe, using these measures, the extent of service changes during the period between 1995 and 2002;

3) Identify types of services that hospitals eliminated most frequently, and assess the impact of these service closures on local communities;

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We use a variety of data sources and methodological approaches to fulfill these objectives. Our primary sources of quantitative data will come from the California Office of Statewide Health Planning and Development (OSHPD). We use OSHPD's patient discharge dataset, which contains data on every inpatient hospitalization in the state, to measure changes in hospital service offerings. This dataset allows us to assess a hospital's service mix by looking at the services actually provided in that hospital; this approach is much more accurate and reliable than other potential methods, as we discuss in detail in Chapter 2. A second source of quantitative data comes from OSHPD's Hospital Annual Disclosure Reports, which hospitals must submit to OSHPD after each fiscal year. These reports include extensive financial data, and we will use this to assess the financial health of hospitals that are changing their service offerings.

We also present qualitative data, in the form of hospital case studies. Based on our analysis of the OSHPD discharge data, we selected four hospitals that eliminated a specific service, one that is of great concern to people in local communities: obstetrics (labor and delivery) services. We conducted site visits at each hospital, meeting with hospital executives and key medical personnel, and discussing with them the reasons for, and impacts of, their decision to stop offering obstetrics services. We also met with other health care providers and administrators in each hospital's surrounding community, to find out how the service closure at the hospital affected access to care for local residents. The site visit interviews provided many insights into the decisionmaking processes of health care leaders faced with difficult choices.

We also performed an extensive quantitative analysis of the impact of labor and delivery unit closures among hospitals in our study population. During the study period, 26 hospitals closed their obstetrics units, and we measured the impact of these service closures on access to care among health care consumers in these markets. To do this, we analyzed the hospital bypass behavior of health care consumers following service closures. Using ZIP Code data from OSHPD patient discharge records involving newborns, we measured the distances traveled by expectant mothers to receive obstetrics care before and after the closures. This analysis is

particularly valuable, because it shows the real impact, in terms of travel distances to hospitals where services remain available, of obstetrics service closures. We also used data on demographics and source of payment to examine the impact on population subgroups that may be particularly vulnerable to reduced access to care as a result of the closures. Finally, we analyze birth outcomes (delivery complications and use of cesarean section) to see whether travel distances have any medical impact.

In this study, we confine our focus to short-term, general acute care (GAC) hospitals. We do this for two major reasons: first, short-term GAC hospitals constitute the vast majority of California hospitals, and second, because short-term GAC hospitals are expected by the general public to provide as wide a variety of services as possible. While we exclude other types of hospitals, such as specialty hospitals, from our data analysis, we will in Chapter 7 discuss the possibility that new specialty hospitals could siphon away valuable business from GAC hospitals, thus further undermining their already difficult financial positions.

Our major findings indicate that many California hospitals have made changes in their service offerings during the study period (1995-2002), though very few hospitals have made extensive changes. All together, just over half of the hospitals in our study population (189 of 368) either closed or opened at least one service. About one-fourth of the hospitals in our study population closed one or more services, but most of these hospitals closed only one or two services. Only a very small group of hospitals closed four or more services, and in some of these cases, the high number of service closures was connected to either administrative restructuring within a hospital system, a hospital's merger with another institution, or (in one instance) to serious financial difficulties leading to a hospital's closure during 2002, the final year of the study period. While the number of service closures overall is relatively low, we do find that the most prevalent types of service being closed relate to labor and delivery services (normal newborn births and neonatology). This potentially troubling development is a major focus of this report. In addition, we find that the small group of hospitals closing four or more services (and not involved in mergers or administrative changes within systems) is overwhelmingly small, rural, and financially troubled. The hospitals in the small group of "high closers" experienced a marked deterioration of their financial positions over the course of the study period.

As with service closures, we find that California's short-term GAC hospitals did not open services with great frequency, but made some important changes nonetheless. In total, hospitals added about as many new inpatient services as they closed. About one-third of the hospitals in our study population added one or more services, but most of these opened only one or two new services. A small number of hospitals opened a substantial number of services (here defined as three or more). Again, some of these apparent service openings were likely the result of mergers or system reorganizations that affected hospital data reporting. But the small group of hospitals making what we will call "legitimate" service additions was predominantly small and rural, as was the group that closed four or more services. However, this small group of "high openers" saw improvements in their financial health over the study period, in contrast to the high closers. These findings are intriguing, and we will discuss their implications for hospitals' financial strategies. By far, the service hospitals added most frequently was rehabilitation, suggesting that many hospitals have responded to demographic shifts – specifically, the increasing number of elderly in California (and nationwide) – by offering rehabilitative services. Interestingly, we find that a number of hospitals also began offering labor and delivery services, though this was a much smaller group than those hospitals closing the service.

Finally, our analysis of the impact of obstetrics service closures revealed little negative impact, so far, on health care consumers. Hospital executives and physician leaders at three of our four case study hospitals felt that their closures of labor and delivery units were not burdensome to their communities, as many expectant mothers were already bypassing the case study hospitals for larger, more urban hospitals. (Respondents at one case study hospital did express concerns about the effects of increased travel distance on low-income patients.) Our analysis of patient data in Chapter 6 supports the view that obstetrics closures are not having negative effects on consumers.

Using patient ZIP Code data to analyze travel distances in the hospital markets of the 26 hospitals that closed their obstetrics units, we find that the average distance traveled for obstetrics care increased only very slightly – just over two-tenths of a mile – between 1995 and 2002. We also find that, over the study period, more than three-fourths of patients in the state as a whole bypassed their nearest local hospital for childbirth, picking more distant (but presumably

larger) facilities instead. Since so many women were already bypassing their nearest local hospitals, any possible effects of labor and delivery unit closures were largely muted. Indeed, our analysis of travel distances and birth outcomes found that higher travel distances were not associated with an increased likelihood of either a cesarean delivery, or a delivery with complications. While these findings are reassuring in that they do not suggest that California has an immediate problem with access to obstetrics care as a result of service closures, we strongly believe that policymakers and researchers should continue to monitor this situation.

The main body of this report will be structured as follows. Chapter 1 discusses the financial pressures facing hospitals in today's health care environment, and how hospitals may respond to these pressures. This chapter reviews the small body of research to date that has dealt with hospital service closures. Chapter 2 lays out the research methodology for the present study, including a discussion of different ways of measuring service changes. We explain the advantages of using patient discharge records to construct this measure, and present a unique system of hospital service classification, borrowed from Zwanziger, Melnick, and Eyre 1994 and then updated, that allows us to condense over five hundred different Diagnosis Related Groups into a much simpler coding scheme of only 48 service categories. Chapter 3 presents the core findings of the study, giving detailed data on service closures and additions, at both the service level and the hospital level. Chapter 4 looks at the financial dimension of service changes: we will present basic data on the financial performance of the hospitals in our study population, and make comparisons between those that changed their service offerings in the study period and those that did not. Chapters 5 and 6 focus specifically on obstetrics service closures. We present the results of our case study site visit interviews, all of which involved hospitals that stopped offering labor and delivery services, in Chapter 5. Then in Chapter 6, we analyze the hospital bypass behavior of consumers in geographic areas affected by labor and delivery closures, to determine whether these closures forced expectant mothers to travel greater distances to receive care, or whether many women were already bypassing their nearest hospital in favor of larger, but more distant, hospitals. Chapter 7 concludes the report with policy implications and suggested directions for future research on the issue of hospital service changes, and their impacts on hospitals, communities, and health care consumers.

CHAPTER 1: HOSPITAL RESPONSES TO FINANCIAL PRESSURES IN THE NEW HEALTHCARE MARKETPLACE

Hospitals are dealing with serious financial challenges in the current health care industry environment. Public sector payers, such as the Medicare and Medi-Cal programs, have for some years been tightly restricting their reimbursement levels for hospital services. Among private payers, managed care organizations are similarly seeking to keep down costs, through aggressive utilization management (prior authorization requirements, restrictions on covered procedures and prescription medications), along with tighter limits on reimbursement rates. These cost-containment strategies often dovetail with changes in medical practice: new technologies increasingly allow doctors to shift treatment for some conditions to an outpatient basis, which is much less expensive.

These dramatic changes in both the practice of medicine and the structure of the health care marketplace are contributing to the decline of the traditional hospital, with its primary focus on inpatient services. One recent study of hospital closures cites a 12% decline in short-term hospital bed capacity between 1988 and 1998, with about 500 hospitals closing their doors during roughly the same period (Lindrooth, Lo Sasso, and Bazzolli 2003). Not surprisingly, hospitals that close tend to be smaller and less efficient, and to have been in severe financial distress for an extended period prior to closing (Ibid.; Scheffler et al. 2001).

In this difficult environment, hospitals that remain open must constantly seek ways to remain financially viable, as must any business enterprise. Duffy and Friedman (1993) suggest several (often interrelated) strategies that hospitals facing chronic financial losses might pursue to remedy their situations. First, hospitals could attempt to change their patient case mix, by reducing their admissions of patients likely to be unprofitable (the uninsured, or the most seriously ill). Second, hospitals could reduce their investments in new plant and equipment (particularly high-technology equipment). Third, hospitals could alter their service mix, cutting unprofitable services and adding profitable ones.

This study examines the last of these strategies – changing the mix of service offerings as a way to maintain financial viability. Duffy and Friedman cite specific service areas that financially troubled hospitals may want to add or drop. Unsurprisingly, they suggest that hospitals may want to close "two essential but traditionally money-losing services: obstetrics and emergency room care" (1993, p. 155). They also suggest that hospitals might add several "nontraditional" services viewed by the hospital industry as more profitable, including psychiatric acute care, drug and alcohol dependency, and rehabilitation. Rather than test Duffy and Friedman's specific hypotheses about service types, though, we instead look more broadly at the service change phenomenon among California hospitals. We will in effect generate a census of changes in hospital service offerings. In the course of doing so, we will find that some of the services Duffy and Friedman mention have in fact been among the most frequently closed or opened services among the hospitals covered in our study.

From the perspective of health services research, this phenomenon has not been widely studied. The few examples of research in this area have looked at samples of financially distressed hospitals across the United States (Ibid.; McCue 1997). In this study, we both narrow and expand the scope of prior work. We focus exclusively on short-term, general acute care (GAC) hospitals in California that were open during our study period (1995 through 2002). This research design allows us to accomplish several critical objectives: to measure the actual incidence of hospital service changes, over time, within a full population, rather than a sample, of hospitals, in the state of California. This design enables us to look at the behavior of all hospitals, the financially stable as well as those in financial distress.

While this study will fill a gap in existing research, our primary interest is in speaking to important public policy issues. The most compelling reason for studying changes in hospital service offerings is the potential impact of such changes on access to health care. In many instances in which hospitals choose to cut certain services, there are very sound economic justifications for doing so. There may be excess capacity for a particular service (or for inpatient hospital beds generally) in a market area, and the reduction of this excess capacity could improve profitability for the remaining providers, without necessarily reducing access to care. Moreover, there may be clinical benefits to reducing excess hospital capacity: a substantial literature has

found a positive relationship between the volume of patients served at specific health facilities and the health outcomes those patients experience. This volume-outcome relationship has been found in a wide variety of services and procedures (see Halm, Lee, and Chassin 2002 for a comprehensive review of volume-outcome studies). Reduction of excess capacity would likely result in higher service volumes at the remaining facilities in a particular market, which might then lead to improved outcomes for patients.

When service closures reduce excess capacity, they should have very little impact on access to care, and may even improve the overall quality of care. However, service closures in certain communities, such as sparsely populated rural areas, or inner-city areas with high percentages of uninsured persons, have the potential to do more harm than good. For example, a study of hospital closures in Los Angeles County finds that, while the overall impact of closures on access to care is limited, elderly and low-income residents reported difficulties in gaining access to care as a result of these closures (Buchmueller, Jacobson, and Wold 2004). A study of rural hospital closures surveyed rural health professionals in communities affected by closures, and found that respondents perceived increased barriers to health services, particularly for elderly, disabled, and low-income residents (Reif, DesHarnais, and Bernard 1999). In medically underserved areas, economic concerns may have to be superseded by the broader public interest in maintaining essential health services for the entire population.

While the existing research has focused on hospital, rather than service, closure, the two issues are closely related. Analyses of hospital closures show that smaller hospitals, and those offering fewer services, are most likely to close (Scheffler et al. 2001; Lindrooth, Lo Sasso, and Bazzolli 2003). Contraction of service offerings could therefore be a prelude to later hospital closure. A study of small hospitals (defined as having fewer than 100 beds) found that financially successful hospitals offered a greater number of services than did financially troubled facilities (McCue 1997). It is possible that small, struggling hospitals might stop offering certain unprofitable services, in the hope that doing so would improve their finances, only to find that reducing services actually makes the situation worse, over the longer term, creating a downward spiral of decreasing patient demand and lower revenues. As noted above, while the closure of smaller and less efficient hospitals in urban areas might have only limited effects on access to care, and have

a beneficial effect on health care quality, closures in rural areas could have significant negative impacts on both.

When hospitals add services, this also obviously affects access to care. New service offerings can certainly improve access to care in local communities. But it is also quite likely that hospitals adding services will base their decisions on the need to increase their revenues. Given this reality, service additions may not always represent a real increase in access to necessary health services, particularly for communities and demographic groups that have historically had insufficient access.

More broadly, the health care industry has become increasingly entrepreneurial, in response to the difficult financial environment. As insurers (public and private) have clearly signaled their intent to achieve cost control by limiting reimbursements, physicians have just as strongly sought to counter these trends. A recent study of individual physicians' practices found them aggressively undertaking a number of strategies to increase revenues (Pham et al. 2004). These strategies include increasing investment in profitable ancillary services (such as new diagnostic imaging and laboratory technologies), forming investment partnerships with other physicians to open new specialty facilities, and reducing involvement with uninsured and low-income patients, and with patients needing services perceived to have a high malpractice litigation risk, such as obstetrics.

None of these strategies bodes well for the traditional general acute care hospital. New, physician-owned specialty facilities and diagnostic imaging centers could potentially drain the most lucrative patients and procedures from general hospitals, leaving only the least profitable services, and perhaps the least insured and most ill patients. These trends are still in their infancy, but GAC hospitals will clearly have to find ways to respond. The present study looks at one aspect of what we might call hospital (rather than physician) entrepreneurialism – the strategy of changing a hospital's service mix to improve its financial position. Our findings will help to inform policymaking in California, but should also be of broader interest, since trends in the California health care market often spread quickly to the rest of the country. Lessons learned from this analysis should also be valuable to hospital executives in California and elsewhere.

CHAPTER 2: STUDY METHODOLOGY

As noted in the previous chapter, very little systematic work has been done on changes in hospital service offerings. In order to conduct this study, then, we had to devise a means of accurately measuring the phenomenon, using the data available. California's hospital regulatory agency, OSHPD, collects and disseminates two data sources that are strong candidates to serve this purpose: its Hospital Annual Disclosure Report data, and its patient discharge data reports.

Evaluating Potential Data Sources for Service Analysis

In this section, we will briefly describe these two data sources. We will then explain why we chose one – the patient discharge data – over the other (the Annual Disclosure Report data), and how we constructed our database of hospital service changes.

OSHPD Hospital Annual Disclosure Report

Hospitals in California are required to submit a full report on their operations and finances to OSHPD after each hospital fiscal year. As a part of this report, hospitals are expected to fill out a services inventory checklist. This checklist contains around 200 different types of services, including both inpatient and outpatient services. For each service, the hospital is expected to indicate whether or not the service was offered during the report period. Potentially, we could measure hospital service closures by comparing hospitals' responses on the service checklist for the beginning and ending years of our study period, 1995 and 2002. If a hospital indicated that a particular service was offered in 1995, but in 2002 indicated that the service was not offered, this could be considered a service closure. (We could also look at the checklist data from the intervening years, should we wish to pinpoint the year in which a hospital stopped offering a particular service.)

OSHPD Patient Discharge Data

California hospitals are also required to submit a detailed record on each person discharged from an episode of inpatient hospitalization. OSHPD checks these records for errors, and then compiles them into a database containing records for all inpatient discharges in the state in each calendar year. The resulting database contains a wealth of data on the patient's hospitalization, such as their primary and secondary diagnoses, length of stay in the hospital, procedures performed, and basic demographic information on the patient. For the purposes of this study, we are most interested in the patient's primary diagnosis. This information is reported as a Diagnosis-Related Group (DRG) code corresponding to the diagnosis.[1] The DRG system is designed "to group together patients who are similar clinically and who have a similar pattern of resource use" (Muldoon 1999), and has become the dominant method of classifying inpatient hospital cases in the U.S. health care system.

Selection of Data Source for Service Availability Measure

At first glance, the services inventory checklist from the Hospital Annual Disclosure Report would appear the best option for measuring changes in service offerings. The checklist has the strong advantage of relating directly to hospital service offerings, which should make the analysis simple and straightforward. Unfortunately, we found serious data quality problems with this data when we evaluated it for possible use in this study.

An early indication that the service availability reports had data quality problems was that some hospitals reported certain services as being available, then unavailable, and then available again, in successive years. Moreover, we observed these fluctuating availability reports in services requiring high overhead, such as coronary intensive care. We felt it was extremely implausible that the availability of such services would vary from year to year in this manner. As a test of the validity of the services inventory checklist, we compared hospital responses on the checklist

[1] The reporting hospitals do not themselves assign DRGs to the patient discharge records. Instead, for each patient they report diagnostic and procedure codes from the International Classification of Diseases, 9th Revision, Clinical Modification (ICD-9-CM) system. OSHPD personnel then use DRG "Grouper" software, issued by the federal Centers for Medicare and Medicaid Services (CMS), to assign a DRG to each patient discharge record. The DRG is then included as a data element in the patient discharge database that OSHPD makes available to the public.

with responses to another part of the Annual Disclosure Report forms, in which hospitals reported bed capacity and patient censuses for specific services. In doing so, we discovered that, for many hospitals, responses to the services inventory checklist were inconsistent with responses to other parts of the Annual Disclosure Report.

These inconsistencies created the mistaken impression that some hospitals had changed their service offerings, when they had not in fact done so. We believe this problem stems in part from the complexity of the response-coding scheme used in the services inventory checklist. During the years of our study period, there were nine distinct codes (i.e. responses to the question of whether a particular service is offered or not) on the form. Hospitals were expected to make complex distinctions between services offered in a "separately organized, staffed and equipped unit of the hospital" and services offered both on- and off-site through contractual arrangements with other health care facilities. The form also asked hospitals to specifically identify services offered on-site, but billed through a different entity.[2]

We strongly suspect that many of the hospital administrative personnel who were tasked with filling out this checklist were confused by the large number of possible responses, and as a result, unintentionally made inaccurate and inconsistent reports. OSHPD has since simplified this form, reducing the number of codes from nine to four, and eliminating the distinctions based on contractual (provision) and billing arrangements. But this change has only become effective for reporting during state fiscal year 2004; the data for our study period used the more complex coding scheme, and this clearly affected the results.

The patient discharge records, by contrast, are more complicated on the surface, but ultimately allow for simpler and far more accurate measurement of service changes. There are currently over 500 different Diagnosis-Related Groups (DRGs); annual revisions change the number of codes available, generally by adding new ones. While this coding system is admittedly complex, we have strong reasons to feel more confident of the data quality. The diagnostic and procedure codes that determine a patient's DRG are, obviously, integral parts of each patient's medical

[2] The OSHPD Hospital Annual Disclosure Report forms may be viewed on the Internet at http://www.oshpd.ca.gov/hid/HID/hospital/finance/annual/index.htm. The services inventory checklist is Page 2.

record; the services inventory checklist, by contrast, is a (rather confusing) form filled out by administrative personnel, and bears no relation to patient data. More importantly, the diagnostic and procedure codes, and the resulting DRG codes, are central to the hospital billing process. We therefore assume that hospitals have very powerful financial incentives to report this data as accurately as possible, in order to secure payments promptly.

In terms of data quality, then, the patient discharge data is vastly superior to the services inventory checklist. But is it a viable measure of hospital services? Clearly, considering each DRG as a "service" is not a good option, both because of the sheer number of categories, and the fact that many of them represent rarely performed procedures. Fortunately, Zwanziger, Melnick, and Eyre (1994) have developed a system for collapsing the DRG codes into 48 hospital service categories. While this system was developed to study hospital antitrust issues, it will serve our purposes equally well. The authors constructed their service categories so that each one "will consist of all services that would generally be provided by the same (physician) specialty" (Ibid., p. 438). By reflecting actual patterns of clinical practice, this "approach…mirrors the one that HMOs and PPOs use in assessing the services that different hospitals are capable of providing" (Ibid.). The result is an easily comprehensible system that will vastly simplify any analysis using DRGs.

We therefore use the DRG data from the patient discharge records to measure the availability of hospital services. Our method is quite simple. For the beginning and ending years of our study period – 1995 and 2002 – we take the DRG from each of the patient discharge records, and recode these into Zwanziger, Melnick, and Eyre's 48 hospital service categories (HSCs).[3] We compare the number of inpatient discharges in each HSC in 1995 and 2002, for each hospital in our study population, which is made up of short-term, general acute care (GAC) hospitals that were open in both years. (Selection of the study population will be discussed below.) If the number of discharges in a particular service category either decreased or increased sharply between 1995 and 2002, then we consider this evidence of a service closure or a service opening,

[3] We obtained an updated version of the original 1994 coding scheme, incorporating changes in the DRG system through the year 2002, from the authors. See Appendix B for a chart showing the DRGs that comprise each HSC.

respectively. (We will give the precise criteria for each at the beginning of the next chapter, which presents our core findings.)

We are confident that this method provides a much more reliable measure of service changes than the services inventory checklist. The patient discharge data represent an objective measure of actual service utilization, while the checklist provides only a subjective assessment of service availability. One disadvantage of our method should be noted, however. Because the patient discharge data only covers inpatient hospitalizations, we cannot determine the availability of outpatient services. Future work in this area should examine ways to extend this analysis to outpatient services.

Selection of Hospital Study Population

OSHPD classifies hospitals in California into eight distinct categories, based on two characteristics: the type of care provided, and whether the hospital is intended for short- or long-term hospitalizations. The different types of care are general (acute care), children's, psychiatric and specialty, with either short-term or long-term varieties of each. In this study, we confine our analysis to short-term, general acute care (GAC) hospitals. The primary reason for doing so is simply that these hospitals are the type of health care facilities that are generally expected to provide the widest variety of inpatient hospital services. In other words, short-term GAC hospitals are what we have in mind when we speak of "going to the hospital." Moreover, short-term GAC hospitals constitute the vast majority - over 80% - of hospitals in operation in California, and account for an even higher proportion of inpatient hospitalizations - over 90% of all discharges from California hospitals in both 1995 and 2002. Finally, because non-GAC hospitals tend to (by definition) have narrower service offerings to begin with, we believe that excluding them from the study allows us to focus solely on the type of hospitals that are most likely to experience service mix volatility.

Within the population of short-term GAC hospitals, we further restricted the analysis to facilities that were open during at least part of both 1995 and 2002, the beginning and end points of our study period. This follows logically from our desire to measure service changes outside the

context of hospital closures. As noted in the introduction, 40 GAC hospitals closed their doors permanently during our study period, and more are likely to do so in the near future. Clearly, hospital closures are a serious problem, and the effects of such closures on access to health care in communities must be assessed. But since we are interested here in service changes as a strategy hospitals may use to *avoid* closure, we will exclude those hospitals that did actually close during the study period.

The hospital study population, selected by the criteria listed above, consists of 368 hospitals. (Please see Appendix A for the complete list of hospitals.) The first challenge in defining this group was making sure that only short-term GAC hospitals were included. For the most part, we used the hospital-type designation in each hospital's OSHPD Annual Disclosure Report to determine eligibility for inclusion. While this data is reported by administrative personnel at each hospital, and as such is subject to inaccuracies (as discussed previously), this is the only available source of information on hospital type. In a few cases, we did find clearly erroneous hospital type designations in either the 1995 or the 2002 Annual Disclosure Reports, and corrected these mistakes.[4]

Not all hospitals that appear in the patient discharge data are represented in the Annual Disclosure Report data, however. Some hospitals consolidate their Annual Disclosure reporting with nearby facilities that are under the same ownership and are operating under the same Department of Health Services (DHS) license; in OSHPD's terminology, these are "parent-satellite" relationships. In many cases, satellite hospitals do report their inpatient discharge data separately from the parent facility, but since they do not file a separate Annual Disclosure Report, such facilities do not have a type of care designation. In these instances, we determined whether or not satellite hospitals fell into the short-term GAC group by checking hospital websites for information, looking at prior years of the Disclosure Report data (some satellite hospitals began consolidated reporting with a parent facility only recently, meaning that they had a separate identity in the data prior to that), or by examining a hospital's discharge patterns (to see if it provides services in a wide range of HSCs).

[4] For example, one GAC hospital was mistakenly labeled as a psychiatric hospital in the 2002 data. Annual Disclosure Report data from previous years correctly listed it as a GAC hospital, and a check of the hospital's website confirmed that the hospital had not been converted to a psychiatric-only facility.

One final adjustment was necessary to ensure the accuracy of the list of hospitals. During the study period, a few hospitals opened new facilities, and moved their operations to these new buildings, closing their old ones. OSHPD assigns a new identification number (used for the agency's data collection) to new facilities, and in some instances the actual name of a hospital was changed. For example, Siskiyou General Hospital, in Yreka, moved its operations to a new facility in 1997, and also changed its name to Fairchild Medical Center. We felt that the best decision rule for instances such as this was to treat the two facilities as one hospital; the data point for 1995 would be represented by the old facility, and for 2002, by the new one.

In most of these instances, the new facility is in very close proximity to the old location, but not always. As another example, the San Bernardino County Medical Center moved to a new facility, about ten miles away from its old location, in 1999 (and changed its name to Arrowhead Regional Medical Center). One could argue that, because of the distance between the two facilities, they ought to considered as separate entities, in which case neither would be part of the study population (because they were not open in both 1995 and 2002). However, Arrowhead Regional Medical Center remains the major public hospital for residents of San Bernardino County, which is quite large; moreover, the population served remains the same – those county residents who rely on public hospitals for medical care. We therefore decided that it was appropriate to consider the old and new facilities as a single entity, despite the distance between them.

Other Data Sources and Methodologies

While the OSHPD patient discharge data forms the core of our analysis of hospital service offerings, other types of data and modes of analysis also play important roles in this study. Although the OSHPD Hospital Annual Disclosure Report data did not prove adequate for measuring hospital service changes, we will obviously use it for our analysis of the financial condition of hospitals that substantially changed their service offerings (presented in Chapter 4). The financial data in the Disclosure Reports are subject to human error, as with the hospital service inventory checklists; but we would expect the error rate, and the substantive impact of any errors, to be much lower for reports of critical financial data as compared with the service

inventory. Hospitals have obvious incentives to record and report their financial accounts as accurately as possible.

The case study site visits provide a completely different kind of information than the OSHPD data. These semi-structured interviews with key informants give us rare insights into the thinking of hospital administrators, physicians, and other health care decisionmakers. Such insights cannot possibly be gleaned from the quantitative OSHPD data. This detailed, qualitative data source provides a useful balance to the exclusively quantitative OSHPD discharge and financial data, and gives our discussion of the impact of specific service closures (in Chapter 5) a richness it could not otherwise have attained. Finally, our analysis of the impact on consumers of obstetrics service closures, in Chapter 6, also uses the OSPHD patient discharge data, in conjunction with data on distances between ZIP Code centroids (geometric centers) for patients and hospitals. This analysis allows us to measure the distances patients traveled to receive obstetrics care. A number of regression analyses are performed in this chapter; we will discuss in detail the methodology of these analyses in the text of the chapter.

CHAPTER 3: SERVICE CHANGES AMONG CALIFORNIA HOSPITALS, 1995-2002

In this chapter, we present the major findings of the study. We will give a detailed accounting of the incidence of service closures, and service additions, in California short-term, general acute care (GAC) hospitals, during the study period of 1995 through 2002. We will present results for the 368 hospitals in our study population, and for the inpatient hospital service categories (HSCs). For the analysis of the hospital study population, we will rank the individual hospitals by the number of services they closed or added during the study period. We will also break down the hospital findings by hospital characteristics, such as geographic region, hospital size, type of ownership and for-profit/non-profit status, and urban/rural status. For the analysis of HSCs, we will rank services by the number of hospitals closing, or adding, each category. We will then discuss potential reasons for these changes in specific services. In some instances, service changes may result from changes in clinical practice – for example, some services may be changing from a predominantly inpatient to an outpatient basis. In other cases, service changes are more likely related to profitability issues.

Our general findings indicate that slightly more than half of the hospitals in the study population made at least one service change during the study period. However, most of these hospitals made only one service change. Nearly one-fourth of the hospitals closed at least one of the 48 service categories used in our analysis, but most closed only one; about one-third of the hospitals opened one or more new services, but, again, most added only one. Only a very small number of hospitals made extensive changes in their service offerings. Interestingly, most of the hospitals that made changes either closed or opened services; few hospitals did both. Looking at the hospital service categories themselves, we find that roughly half of the services were neither closed nor opened by any hospitals, or by only one, during the study period. Several services, however, were involved in a large number of service changes.

While the overall findings do not suggest dramatic changes in hospital service offerings in the 1995-2002 period, a closer look at the details of the data do point out a number of interesting, and potentially troubling, patterns. A significant portion of the hospitals that most dramatically

changed their service mix, according to our data, did so as a result of mergers with nearby facilities or because of reorganizations among already affiliated hospitals. This has the effect of further reducing the incidence of "legitimate" service change.[5] However, the hospitals that made legitimate service changes (not resulting from a merger or reorganization within a hospital system) shared certain characteristics of great interest. Hospitals that closed substantial numbers of services tended to be smaller, and to have a rural location, compared with the broader population of hospitals in the study. Interestingly, the small group of hospitals that added several services (not as a result of consolidations or system reorganizations) was also predominantly small and rural.

Our findings concerning the types of services most often closed or added are also important. Services closed most frequently include obstetrics (normal newborn delivery and neonatology), an essential group of services, but one that some hospital executives perceive as unprofitable. Other often-closed services represent changes in medical practice: some services, such as chemotherapy, are increasingly provided on an outpatient, rather than inpatient, basis. Our analysis of service additions revealed interesting findings as well. By far the most commonly added service was inpatient rehabilitation services, an area that is growing quickly due to demographic trends (the aging population) and to the specific details of Medicare reimbursement policies for this service. Also, we find that some of the service categories most often closed, including normal newborn delivery and neonatology, were also added by a number of facilities (though by far fewer than closed these services). This suggests that obstetrics services can be profitable for hospitals, under the right circumstances: access to a larger and more affluent patient base, for example, could create a more favorable environment for new labor and delivery units.

In this chapter, we will report aggregate results on service changes without regard to whether the changes are "legitimate." Instead, we will present the total numbers of changes, for hospitals and for service categories, as they emerged from our analysis of the discharge data. We have chosen

[5] We consider service changes as "legitimate," rather than as an artifact of the data and methodology (which we will call "phantom" changes), when the hospitals in question were not involved in mergers and/or data reporting consolidations with other facilities during the study period. We also consider whether the constituent parts of merged or consolidated hospitals offered a particular service prior to the merger or reporting consolidation, and whether nearby facilities in a hospital system appear to have moved or consolidated the site of a particular service.

to do this because of the difficulty involved in assessing the individual situations of all of the hospitals that made service changes: in total, 189 hospitals closed and/or opened at least one service. We do, however, take into account the legitimacy of service changes when discussing subgroups of hospitals, such as hospitals that made substantial numbers of service changes. It is therefore important to note that the total figures we report overstate, to some extent, the incidence of legitimate service changes.

Service Closures by Hospitals

This section will present data on the incidence of service closures for our hospital study population, during the years 1995 through 2002. As discussed previously, the study population includes 368 short-term, GAC hospitals that were open (i.e. reported some number of inpatient discharges) during at least part of the beginning and ending years of the study period, 1995 and 2002. This group of hospitals accounts for over 90% of all inpatient hospitalizations in California in both of those years.[6]

Overall, California hospitals did not reduce their service offerings substantially during the study period. However, a small number of hospitals did close four or more services. After presenting the general data on service closure, we will look more closely at this small group of hospitals (high closers).

Measuring Service Closure

In determining whether or not a hospital has closed a particular service, we need to establish what constitutes "closure." As discussed in Chapter 2, we compare the total number of discharges in each hospital, for each of the 48 HSCs, in 1995 and 2002. Obviously, a service closure designation would require a sharp decrease in the number of discharges in 2002, as compared with 1995. The problem is in determining the magnitude of decrease required to count as a closure. A decrease of 100%, i.e. from some non-zero number in 1995 to zero in 2002, is

[6] In 1995, the study group of hospitals accounted for 3,269,080 out of 3,629,322 total discharges from all California inpatient health facilities (90.07%). In 2002, they accounted for 3,636,395 out of 3,916,363 (92.85%).

clearly an unrealistic threshold. Hospitals, particularly those with emergency capability, are expected to treat any person who arrives with a medical condition requiring immediate attention. Thus hospitals may, in the course of a year, end up providing a specific service that they do not routinely offer to a small number of patients. As an example, and one that will be relevant to our findings, hospitals that have formally closed their labor and delivery units may still deliver a small number of newborns each year, because of patients in labor and needing immediate assistance who come unexpectedly through the hospital's doors. More broadly, hospitals might end up performing certain procedures that they normally would not as a result of medical emergencies on the part of patients already admitted for other reasons.

Because hospitals may still serve small numbers of patients in service categories that they have formally closed, some threshold lower than a 100% decrease in discharges must be selected. For the same reason, we need to establish a minimum level of discharges in 1995 from which a decline in 2002 can be measured, so as to avoid designating a hospital as having offered a specific service category in 1995, when in fact they did not routinely do so. In our view, the most intuitively reasonable thresholds for determining whether a hospital has closed a service are, first, that the number of discharges should have decreased by more than 95% between 1995 and 2002, and that this decrease should come from a minimum baseline of more than 10 (i.e., 11) discharges in 1995. As a test of the sensitivity of the percentage decrease criterion, we also ran the basic data analysis using 85% and 99% as alternative thresholds (with the baseline discharge requirement remaining the same). While we will present summary data for the 85% and 99% thresholds, the discussion of specific hospitals and services will focus only on the 95% threshold analysis.

Primary Findings

The overall incidence of service closure by hospitals was modest. Using the definition of service closure as a greater than 95% reduction in discharges between 1995 and 2002 (with more than 10 discharges as a 1995 baseline), 88 of the 368 hospitals in the study population, or 23.9%, closed at least one hospital service category (HSC). Of these 88 hospitals closing any services, 53 closed only one service, while 25 hospitals cut two or three services. A total of 10 hospitals

closed four or more services; of this small group, six hospitals cut six or more HSCs. The maximum number of HSCs closed by any one hospital was 17. In total, the 368 hospitals closed 189 services.

Before looking more closely at the findings based on the 95% decrease criterion, we briefly present the summary results for our two sensitivity comparison criteria. Using a greater than 85% reduction in discharges as the threshold for service closure, 136 of the 368 study hospitals (37%) closed one or more HSCs. Of these 136 hospitals, 78 cut only one service, and 39 cut two or three services. Nineteen hospitals closed four or more services, with eight hospitals closing six or more. The maximum number of services closed by any single hospital was 30. Using a greater than 99% reduction in discharges as the criterion, only 68 of the 368 hospitals (18.5%) cut any HSCs. Of these, 39 hospitals cut only one service, and 23 cut two or three services. One hospital closed four services, and five hospitals closed six or more services, with a maximum of nine services cut by a single hospital. This sensitivity analysis suggests that our results are not overly sensitive to the definition of service closure.

Returning to the 95% results, we now look more closely at the characteristics of hospitals that closed services. Specifically, we will examine the following: hospital location (urban/rural, Northern/Southern California), hospital size (measured in beds), and type of ownership. After presenting a summary of these characteristics for all of the 368 hospitals in the study population, we will make a number of comparisons between the group of hospitals that closed no services, the group that closed one or more, and the small group of hospitals that closed four or more services (high closers).

The 368 hospitals in the study population obviously represent the full spectrum of characteristics. In terms of geographic location, a slight majority of these hospitals are located in Southern California (208, compared with 160 in Northern California).[7] Determining whether a hospital is in an urban or rural location is less straightforward. Typically, urban/rural designations that guide federal government health policies have been based on the county in which a hospital is

[7] We have defined Southern California as comprising the following counties: Imperial, Kern, Los Angeles, Orange, Riverside, San Bernardino, San Diego, San Luis Obispo, Santa Barbara, and Ventura.

located. This system, by ignoring the significant variations within counties, results in many hospitals that by most measures would be considered rural being designated as urban. In California, which has a number of counties that are very large geographically, this problem is particularly acute (California State Rural Health Association 2003). OSHPD, however, provides a list of hospitals that it designates as "small and rural," regardless of county; we will use the OSHPD designation to distinguish between urban and rural hospitals. In our study population, 73 of the 368 hospitals (19.8%) have received the small and rural designation.

Hospital size and ownership data are available from the OSHPD Hospital Annual Disclosure Reports. For convenience, we will use figures only from the 2002 hospital reports.[8] The most generally accepted measure for hospital size is the number of staffed beds, as this represents a hospital's effective capacity to treat inpatients. The average number of staffed beds among the hospitals in our study population (in 2002) was 187.6, while the median number of beds was 153. Of the full group of 368, 117 (31.8%) have fewer than 100 beds, while 23 (6.25%) have 500 or more. Looking at type of ownership, we find that the vast majority of hospitals are either non-profit, or in some way rely on public funds: 209 of the 368 hospitals are non-profit, while an additional 45 are district hospitals (meaning that they receive support from local property taxes), and 20 are owned by a city or county. In total, 274 hospitals (74.5%) are either non-profit or "public" in some sense. The remaining 94 hospitals (25.5%) are for-profit.

Comparison of Hospitals Closing Any Services to Non-Closers

Next we will look at the characteristics of the 88 hospitals that closed one or more services ("closers"), and compare this group with the 280 hospitals that closed no services ("non-closers"). The closers tended to be smaller in bed size, with an average of 153.1 beds and a median of 111, compared with 198.4 and 170, respectively, for the non-closers. A greater proportion of the closers group had fewer than 100 beds - 38 of 88, or 43.2% - than did the non-closers (79 of 280, or 28.2%). A slightly higher proportion of the closers received OSHPD's small and rural designation - 19 of 88, or 21.6%, compared to 54 of 280, or 19.3%. In terms of

[8] Six hospitals in the study population did not have Annual Disclosure Reports in 2002, because they had previously consolidated their reporting with a parent facility. For these hospitals, we have taken the data from reports filed in earlier years, before they began consolidated reporting.

geographic location, 41 of the closers were in Northern California, while 47 were in the southern part of the state. For non-closers, the numbers were 119 and 161, respectively.

Returning to type of ownership, the group of 88 closers included 13 district hospitals, 28 for-profits, and 47 non-profits (14.8%, 31.8%, and 53.4%). The group of 280 non-closers was made up of 20 city- or county-owned hospitals, 32 district hospitals, 66 for-profits, and 162 non-profits (7.1%, 11.4%, 23.6%, and 57.9%). It is interesting to note that none of the city- or county-owned hospitals closed any services, by our measures, given the fiscal pressures under which such hospitals operate.

Characteristics of High-Closers

As noted above, only 10 hospitals in our study population of 368 closed four or more services (2.7%). Table 3.1 lists the 10 hospitals closing four or more services.
In fact, several of these hospitals are exceptional cases, for reasons we will discuss below, and as such should not really be considered "high-closers."

Table 3.1: Hospitals Closing Four or More Services Between 1995 and 2002

Name of Hospital	County	Number of HSCs Closed
St. Luke Medical Center	Los Angeles	17
Community Hospital of Long Beach	Los Angeles	11
Sharp Cabrillo Hospital	San Diego	11
The General Hospital (Eureka)	Humboldt	9
Tri-City Regional Medical Center	Los Angeles	8
Sanger General Hospital	Fresno	6
Chowchilla District Memorial Hospital	Madera	5
Coalinga Regional Medical Center	Fresno	4
Sharp Memorial Hospital	San Diego	4
Healdsburg General Hospital	Sonoma	4

Source: Petris Center analysis of OSHPD patient discharge data.

The hospital with the most closed services, St. Luke Medical Center, actually closed its doors in February 2002, following an announcement in January of that year that the hospital would close. Because of the small number of inpatients treated at the facility during the early weeks of 2002, St. Luke appears to close a large number of services. In fact, it more properly should be

considered a case of facility, rather than service, closure, but because it has inpatient discharges from 2002, it is included in our analysis. The General Hospital (Eureka) was purchased in late 2001, and became part of the St. Joseph Health System. However, data reporting was not fully consolidated until the early part of 2002, meaning that the General Hospital facility reported a small number of discharges in 2002, making it eligible for inclusion in the study population. Two other facilities, Sharp Cabrillo Hospital and Sharp Memorial Hospital, are part of the Sharp HealthCare system, which has a number of hospitals in the San Diego area. The apparent service closures in these two facilities were actually the result of a reorganization within the Sharp system: Sharp Cabrillo Hospital changed its primary focus to rehabilitation and skilled nursing care, while three of the four services "closed" by Sharp Memorial were obstetrics and gynecological services that were transferred to the Sharp Mary Birch Hospital for Women, which adjoins the Memorial facility.

Leaving aside these four exceptional cases, the six remaining hospitals are predominantly small and rural: five of the six have fewer than 100 beds, while four of the six are designated as small and rural by OSHPD. The six "legitimate" high-closers have an average of 60.3 beds. Three of the hospitals are district facilities, with two non-profits and one for-profit. Four are in the northern part of the state, with the remaining two in the southern part.

Key Points Regarding Service Closures

Overall, service closures clearly have not been widespread among California hospitals during the 1995-2002 period, with slightly less than one fourth of the hospitals in our study population closing any services. However, a closer analysis of the hospitals that did close services reveals a number of important issues. First, hospitals that did close services tended to be smaller (in terms of number of staffed beds) than those that did not close any services. The very small group of hospitals that had four or more "legitimate" service closures was overwhelmingly small and rural. Another important, and related, point is that some apparent instances of very high numbers of service closures are in fact artifacts of the data reporting and analytic methods. Future research in this area must take account of the specificity and complexity of California hospitals, which comprise a highly variable ecosystem of mergers and reorganizations within hospital

systems. Finally, it is intriguing that none of the city- or county-owned hospitals closed any services at all. While it is likely that the public hospital sector will see service closures in coming years, as a result of the fiscal crisis of state and local government in the state, it appears that public hospitals were able to maintain their mission of providing the widest possible variety of medical services during our study period.

Service Openings by Hospitals

This section will present our findings concerning service openings by hospitals during the 1995-2002 study period. In its structure, this section will largely parallel the previous section on service closures. Overall, we find that a somewhat larger number of hospitals added at least one service, but that fewer hospitals added multiple services; as a result, California hospitals added roughly the same number of services as they closed during the study period.

Measuring Service Opening

As with service closures, we had to determine the best criteria for determining what constitutes "service opening." Again, the key points were determining a threshold for percentage change, and a baseline level of discharges in 1995. However, because of the fact that in this instance we are measuring increases in discharges, our criteria will of necessity be different than those for service closures. In particular, there is the problem that a percentage increase cannot mathematically be measured if the baseline number is zero (because the calculation would involve undefined operations with zero). To remedy this problem, we simply changed any value (number of discharges) equal to zero in 1995 to one. We again set the required baseline level of 1995 discharges at 10, although in this case, a hospital must have *fewer* than 10 discharges, rather than more, to be included in the analysis.

We chose a greater than 1000% increase (from a baseline of nine or fewer discharges in 1995) as the threshold required for a service to count as "opened" by a hospital. (An exactly 1000% increase in any number equals the original number multiplied by 11). Again, we performed a simple sensitivity analysis using two thresholds, 500% and 1500%, as a test of the

appropriateness of the 1000% criterion. As with service closures, we will present only summary data for the sensitivity comparison thresholds, reserving detailed discussion for the results of the 1000% analysis.

Primary Findings

Just as we found with respect to service closures, the incidence of service openings by California hospitals was relatively modest during the 1995-2002 period. However, a substantial minority of hospitals did add at least one new service. Defining a service opening as a greater than 1000% increase in discharges in 2002, from a 1995 level of fewer than 10, we found that 123 hospitals (33.4% of the hospital study population) added one or more hospital service categories (HSCs). Of this group of 123 hospitals, the vast majority - 96 hospitals - added only one HSC. Most of the remainder, 23 hospitals, added two or three services. Only four hospitals added four or more services, with two of these adding four, one adding five, and one hospital adding 21 services. In total, the 368 hospitals in the study added 185 services.

We will again briefly present summary results of our sensitivity analysis before moving on to a more detailed discussion of the results of the analysis using 1000% as the percentage increase criterion. Using a greater than 500% increase in discharges as the threshold for service opening, 177 hospitals (48.1% of the study group of 368) added at least one new service. Of these 177, 101 hospitals added only one service, while 62 hospitals added two or three services. A total of 14 hospitals added four or more services, with 11 of these adding four or five. One hospital added six services, and two hospitals added very large number of services, 11 and 23 respectively. Using the stricter criterion of a greater than 1500% increase, 102 hospitals (27.7%) added one or more services. Of these, 83 hospitals added only one service, while 16 hospitals added two or three. One hospital added four services, one added five, and one added 19. As with the service closure analysis, the comparison of different criteria suggests that our results are not highly sensitive to the definition of service addition.

Returning to the results of the 1000% increase analysis, we will again examine the characteristics of those hospitals that added services during the study period, comparing these to the larger

group that opened no new services ("non-openers"). We will also look more closely at the very small group of hospitals that added three or more services.

Comparison of Hospitals Opening Any Services to Non-Openers

The 123 hospitals that added any new services were quite similar to the group of 245 non-openers. In terms of size, as measured by the number of staffed beds, the openers had an average of 185.1 and a median of 150; the non-openers were almost the same, with an average of 188.9 and a median of 155 beds. Roughly the same proportion of hospitals in both groups had fewer than 100 beds - 29.3% of the openers (36 of 123) and 33.1% of the non-openers (81 of 245). The proportions receiving OSHPD's small and rural designation were also similar: 17.9% (22 of 123) of the openers and 20.8% (51 of 245) of the non-openers. Looking at geographic location, we found that 73 of the openers were in Southern California, while the remaining 50 were in the northern part of the state. For the non-openers, 135 were in the southern region, and 110 were in Northern California.

With respect to type of ownership, the two groups are also broadly similar. The group of 123 openers included five city/county hospitals, 11 district hospitals, 37 for-profits, and 70 non-profits (4.1%, 8.9%, 30.1%, and 56.9%). The 245 hospitals that added no services included 15 city/county and 34 district hospitals, along with 57 for-profits and 139 non-profits (6.1%, 13.9%, 23.3%, and 56.7%). The two groups, openers and non-openers, are similar to each other and to the study population as a whole in terms of ownership type.

Characteristics of High-Openers

Very few hospitals opened substantial numbers of services. In the analysis of service closures above, we defined "high-closers" as hospitals closing four or more. Because of the wider, but flatter, distribution of service openings, we will define "high-openers" as those adding three or more services. Even so, only 13 hospitals met this criterion (see Table 3.2). As we found with service closures, a number of the "high-openers" also reflect exceptional circumstances, such as mergers and consolidations within hospital systems.

Table 3.2: Hospitals Opening Three or More Services Between 1995 and 2002

Name of Hospital	County	Number of HSCs Opened
Orange County Community Hospital (Buena Park)	Orange	21
Kingsburg Medical Hospital	Fresno	5
St. Joseph Hospital (Eureka)	Humboldt	4
Los Angeles Metropolitan Medical Center	Los Angeles	4
Community Medical Center (Clovis)	Fresno	3
Sutter Lakeside Hospital	Lake	3
Community & Mission Hospitals (Huntington Park)	Los Angeles	3
Lincoln Hospital Medical Center	Los Angeles	3
Coast Plaza Doctors Hospital	Los Angeles	3
Mammoth Hospital	Mono	3
Sutter General Hospital	Sacramento	3
Colorado River Medical Center	San Bernardino	3
Mills-Peninsula Medical Center	San Mateo	3

Source: Petris Center analysis of OSHPD patient discharge data.

Orange County Community Hospital (Buena Park), which by a wide margin opened the most services of any California hospital (21), underwent two consolidations during the study period. First, a satellite facility, Orange County Community Hospital (Orange), began to consolidate its discharge reporting with the Buena Park facility. Second, the Orange County Community Hospital purchased Bellwood General Hospital, and again consolidated this facility's discharge reporting with its own. In this case, the large number of "new" services is almost certainly an artifact of this reporting consolidation. Of the remaining hospitals that, according to the data, added three or more services, several others were also involved in mergers and/or reporting consolidations with satellite facilities during the study period: St. Joseph Hospital (Eureka), Los Angeles Metropolitan Medical Center, and Mills-Peninsula Medical Center all fall into this category. Finally, one of the three services opened by Sutter General Hospital was also closed by a nearby sister facility, Sutter Memorial Hospital, suggesting that the site of the service was transferred.

Leaving out the five hospitals referenced above, the remaining eight are predominantly small and rural. The average staffed bed size for these eight hospitals is only 73, while the other five have an average of 296.8 beds. Of the eight "legitimate" high-openers, four have received the OSHPD small and rural designation, while none of the other five have. Two of the eight high-

openers are district hospitals, and two are non-profits; the remaining four are for-profits. Half of the eight hospitals are in the northern and half in the southern part of the state.

Key Points Regarding Service Openings

Just as with service closures, service openings by California hospitals were not widespread during our 1995-2002 study period. However, there are still several points of interest. While fewer hospitals added large numbers of services (compared with service closures), more hospitals opened at least one new service. Overall, the group of hospitals that opened any services was fairly similar to the group of non-openers; by contrast, service closers tended to have fewer staffed beds than non-closers. Interestingly, the eight hospitals that we consider "legitimate" high-openers tend to be very small, and in rural locations. This suggests that some small and rural hospitals are responding to potential financial vulnerability by expanding, rather than contracting, their service offerings.

Another interesting finding will conclude this discussion of service changes by hospitals. We found that those hospitals making service changes either closed or opened services, but for the most part did not do both. Only 22 hospitals both closed and opened a hospital service category. Of the 88 hospitals that closed one or more services, 66 (75%) did not add any new services; of the 123 hospitals opening any services, 101 (82.1%) did not close any. Thus it appears that, among hospitals changing their service offerings, these decisions are mostly unidirectional: hospitals are either expanding or contracting their menu of available services, rather than making more wholesale changes that might involve both closing and opening multiple services.

Types of Services Most Frequently Closed or Added

Next we will examine hospital service changes from the other major perspective, that of the service categories themselves, rather than that of the hospitals. While the previous analysis of the raw numbers of services closed or opened by hospitals showed fairly little variation, with only very small groups making multiple service changes, when we look at the services themselves, much clearer patterns emerge. From the hospital service category (HSC)

perspective, both closures and additions are heavily concentrated in a small number of services. Five HSCs account for over half of all service closures, while just one HSC makes up nearly one-third of all service additions. Interestingly, a few services were closed by some hospitals, but opened by others. After presenting summary findings on the services most frequently closed or added, we will briefly discuss some possible explanations for these changes.

Service Closures by Hospital Service Category

In the discussion that follows, we will use the results from the analysis using a greater than 95% reduction in discharges as the threshold for inclusion. Results for the two sensitivity comparisons (85% and 99%) are presented in Appendix C, along with the full results of the 95% analysis. Using the 95% criterion, we find that the two most frequently closed services were normal newborn delivery and neonatology. Between 1995 and 2002, 28 hospitals stopped offering normal newborn delivery on a routine basis (though some continued deliver a few babies each year on an emergency basis).[9] Meanwhile, 24 hospitals also closed neonatal units. All of these hospitals were also in the group of 28 that closed their normal newborn units; the remaining 4 hospitals from the larger group did not have sufficient numbers of neonatal deliveries in 1995 to be considered to offer neonatology services according to our analysis, though each did have some neonatal deliveries (fewer than 10).[10]

Three other services were closed by more than 10 hospitals: chemotherapy, rehabilitation, and obstetrics/gynecological surgery, which were closed by 18, 14, and 12 hospitals respectively. Ten services were cut by four to eight hospitals, while an additional 10 were closed by two or three hospitals. Twelve services were closed by only one hospital, while 11 were not closed by any hospitals. Table 3.3 lists the services closed by four or more hospitals.[11]

[9] Two of these hospitals did not actually close their obstetrics units; instead, they transferred obstetrics to administratively separate entities within the same physical location. These hospitals will be excluded from the consumer impact analysis in Chapter 6.

[10] After delivery, a newborn becomes an inpatient hospitalization with his or her own record, separate from that of the mother. Upon discharge from the hospital, the baby's OSHPD discharge record will reflect a DRG that, according to our classification scheme, will go into either HSC 48 or 9, depending on whether the baby's delivery was normal, or required neonatal intervention.

[11] The 48 HSCs are broken down into four categories: Medical, Surgical, Specialty, and Specialized Services. The tables in this chapter will show both the category and the name for each HSC.

Table 3.3: Services Closed by Four or More Hospitals

HSC Number	HSC Type	HSC Name	# Hospitals Closing HSC
48	Medical	Normal Newborn	28
9	Medical	Neonatology	24
14	Spec. Services	Chemotherapy	18
12	Medical	Rehabilitation	14
36	Surgical	OB/Gyn Surgery	12
11	Medical	Psychiatry	8
40	Surgical	Orthotics	8
18	Spec. Services	Radiology	7
45	Surgical	Vascular Surgery	7
32	Surgical	General Surgery	6
13	Medical	Substance Abuse	5
16	Spec. Services	Invasive Cardiology	5
29	Surgical	Cardiology	4
35	Surgical	Neurological Surgery (w/Craniotomy)	4
42	Surgical	Thoracic Surgery	4

Source: Petris Center analysis of OSHPD patient discharge data.

Service Openings by Hospital Service Category

In the following discussion of the most frequently opened services, we will refer only to the results from the analysis using a greater than 1000% increase in discharges as the minimum requirement. We will present the two sensitivity comparisons, 500% and 1500%, in Appendix D, along with the complete results of the 1000% analysis. Using the greater than 1000% increase criterion, we find that by far the most widely added service was rehabilitation. A total of 57 hospitals added this service, accounting for 30.8% of all service additions among California hospitals during the study period, and 46.3% of all hospitals that opened one or more services. The second most frequently added service was renal dialysis,[12] which 12 hospitals added.

All of the other HSCs were added by fewer than 10 hospitals. Two services, neonatology and cardiology (surgery), were added by nine hospitals, while eight hospitals added normal newborn delivery. Another service that (as with normal newborn and neonatology) was cut by a large number of hospitals, chemotherapy, was also added by seven hospitals. In all, 11 HSCs were cut

[12] This refers to dialysis done on an inpatient basis for persons with renal failure.

by four to nine hospitals, while 15 were cut by two or three hospitals. Twelve services were cut by only one hospital, and eight were not closed by any. Table 3.4 lists all services that were opened by four or more hospitals.

Table 3.4: Services Opened by Four or More Hospitals

HSC Number	HSC Type	HSC Name	# Hospitals Opening HSC
12	Medical	Rehabilitation	57
19	Spec. Services	Renal Failure (Dialysis)	12
9	Medical	Neonatology	9
29	Surgical	Cardiology	9
48	Medical	Normal Newborn	8
14	Spec. Services	Chemotherapy	7
11	Medical	Psychiatry	6
13	Medical	Substance Abuse	6
24	Specialty	Gastroenterology	5
28	Surgery	Burns	5
40	Surgery	Orthotics	5
20	Spec. Services	Renal Failure	4
27	Specialty	Pulmonology	4

Source: Petris Center analysis of OSHPD patient discharge data.

Discussion of Services Most Frequently Closed or Opened

When interpreting these findings, we must keep in mind that changes in medical practice may play a large role, particularly in the case of service closures. Since we are analyzing data on inpatient hospitalizations, changes in medical practice, and the development of new technologies, might make certain procedures that previously required hospitalization easier to perform on an outpatient basis. Indeed, the reduction of inpatient hospitalization in favor of outpatient procedures has been a long-term trend in the health care system, one that is beneficial both from the patient perspective and from the standpoint of cost containment.

The most obvious method of testing whether or not such changes are taking place in the service categories studied here is to simply compare the number of discharges in all California hospitals over time in these services. If services that are frequently closed (or opened) are declining (or

increasing) in terms of discharges, then changing medical practices are clearly playing a role. If there is no association between changes in hospital service offerings in a particular area of medicine and the number of discharges in that area, then other factors, such as hospital financial decisions, are the likely cause. Table 3.5 presents data on whether selected HSCs are growing or declining in overall numbers.

Table 3.5: Selected Hospital Service Categories, 1995 and 2002 Discharges

Service	1995 Discharges	2002 Discharges	% Change	Net Service Closures/Openings
Radiology	1,571	880	-44.0%	-6
Chemotherapy	20,115	14,015	-30.3%	-11
Neonatology	164,334	135,404	-17.6%	-15
Ob/Gyn Surgery	688,712	665,830	-3.3%	-9
Substance Abuse	40,343	40,365	0.05%	+1
Normal Newborn	396,861	404,085	1.8%	-20
Psychiatry	179,717	199,494	11.0%	-2
Cardiac Surgery	37,197	41,678	12.0%	+5
Rehabilitation	28,427	52,292	84.0%	+43
Renal Failure (Dialysis)	103	673	553.4%	+12

Source: Petris Center analysis of OSHPD patient discharge data.

Radiology and chemotherapy are clearly continuing to shift to an outpatient basis; based on the small number of discharges in both 1995 and 2002, radiology had apparently done so already. It is interesting that while inpatient chemotherapy continues to decline, reflected in the fact that 18 hospitals closed the service, seven hospitals added it. This is likely the result of consolidation and reorganization within the hospital system generally. As demand for this service falls, we would expect that hospitals with smaller treatment volumes would move to eliminate it, leading to its concentration in a smaller, and somewhat different, group of hospitals.

In terms of growing services, the most interesting example is inpatient rehabilitation. This service's expansion during our study period is quite dramatic, both in terms of the percentage increase and the actual numbers of inpatient hospitalizations for rehabilitation. One factor clearly driving this growth is the aging of California's (as with the country's) population, since the bulk of patients in this category are elderly persons needing rehabilitative therapy following strokes, injuries from falls, and the like. But Medicare reimbursement policies play a critical role

as well. Until recently, inpatient rehabilitation services were exempted from Medicare's Prospective Payment System (PPS), which in 1983 replaced the previous cost-based payment system for most services. Both freestanding specialty rehabilitation hospitals and rehabilitation units within general acute care hospitals were able to continue receiving the more generous cost-based reimbursements, which made rehabilitation a profitable service area. Unsurprisingly, the PPS exemption encouraged rapid growth in the provision of inpatient rehabilitation services: the number of facilities or hospital units grew rapidly, as did Medicare expenditure on rehabilitation (Thompson and McCue 2004).

Responding to these trends, the Balanced Budget Act (BBA) of 1997 directed the Medicare system to implement a PPS for inpatient rehabilitation facilities services. The PPS, which took effect beginning in 2002, is widely expected to result in lower reimbursements to hospitals, as it has done for hospital services generally. Presumably, this change will lessen interest among general hospitals in adding rehabilitation units, as their potential profitability is thus constrained. The implementation of the PPS may also create incentives for existing providers to avoid patients with more serious needs, and to discharge more quickly those patients they do accept (Stineman 2002). Interestingly, most of the 57 hospitals in our study population that added inpatient rehabilitation services did so between 1997 and 2002, despite the federal government's signaling of its intent to subject rehabilitation to the PPS reimbursement rules (though these were not implemented until 2002). Presumably, this reflects both the time needed for hospitals to plan for the addition of new services – i.e., many of the hospitals adding rehabilitation units after 1997 may have decided to do so prior to the BBA's passage – and uncertainty over when, and in what form, the new reimbursement rules would actually be put in place.

In percentage terms, the fastest growing service category by far is renal failure (dialysis), which grew by 553.4% during the study period. However, the actual numbers of discharges in this category remain quite small. It is possible that the increase is an early indicator of the growing prevalence of diabetes (the major cause of renal failure) in the population.

From a health policy perspective, the large number of closures of labor and delivery services is perhaps the most immediate area of concern. The labor and delivery HSCs, normal newborn and

neonatology, together account for 27.5% of all service closures in our study population. Excluding the third and fourth most frequently closed services, chemotherapy and rehabilitation, for the reasons discussed above, we see that the top three most-closed services relate to obstetrics and gynecology.[13] Normal newborn delivery services were eliminated more than three times as often as the next most frequently closed, non-OB/Gyn service (psychiatry, closed by eight hospitals). While the number of neonatal births did drop by 17.6% over the 1995-2002 period, the reasons for this decline are unclear; consequently, it is impossible to say whether there is some genuine change in the health status of the underlying population (expectant mothers) that would signal a reduced need for neonatology services in the future. Moreover, since the number of normal newborn births increased slightly (by 1.8%) over the period, the fact that a net 20 hospitals closed their labor and delivery units (28 closers less eight openers) cannot be explained by a decline in demand. The key question concerning closures of labor and delivery services is whether these have adverse affects on the communities involved, and on health care consumers in these communities. We address this topic in detail in Chapters 5 and 6.

Concluding Comments on Hospital Service Changes

Overall, a substantial proportion of California's short-term, GAC hospitals changed their service offerings during the study period. Roughly one-fourth of all hospitals closed one or more of the 48 hospital service categories (HSCs), while one-third opened one or more new services. Since there was little overlap between the group of hospitals closing services and those opening services, the group making some kind of change during the study period comprises just over half of the study population. Hospitals closed and opened about the same total number of services, although the distribution of service openings among hospitals was somewhat broader: more hospitals opened at least one service (compared to those closing one or more), but fewer hospitals opened multiple services.

It is important to note the role of hospital mergers, consolidations, and administrative changes within hospital systems in generating what we call "phantom" service changes, in which

[13] HSC 36, OB/Gyn surgery, includes mothers' hospital discharges following delivery of a newborn. The category also includes non-birth related procedures, such as hysterectomies. Some hospitals obviously maintained the latter type of services even as they eliminated labor and delivery.

although the data show a closure or an opening, closer inspection of the facilities involved strongly suggests that these service changes are more apparent than real. This obviously has the effect of reducing further the incidence of "legitimate" service changes. We have not attempted to verify the legitimacy of all individual service changes, but we have identified those hospitals among the high-closers and high-openers whose service changes are, we believe, most likely the result of mergers and data reporting consolidations with other facilities.

Since the broader phenomenon is not widespread, issues surrounding the specific types of services that California hospitals closed or added most often have the greatest relevance to health policy. In particular, we find the relatively high number of OB/Gyn-related service closures to be a critical topic, meriting a closer analysis. This will be the subject of Chapters 5 and 6 below. First, however, we will turn in the next chapter to the question of whether there is any association between hospital service changes and hospital financial conditions.

CHAPTER 4: SERVICE CHANGES AND HOSPITAL FINANCIAL PERFORMANCE

In order to remain competitive, hospitals must offer a mix of services that will maximize their potential for profitability.[14] Of course, hospitals have a universally acknowledged role in serving the public's needs, and in recognition of this role, hospitals provide many essential, but unprofitable, services to their communities. They also provide care in many cases to persons who lack insurance or the ability to self-pay. Nonetheless, hospitals, whether they are for-profit, non-profit, or publicly-owned, are business enterprises, and as such must strive for financial viability. One of the major assumptions underlying this study is that hospitals' financial concerns may lead them to change their service offerings. Hospitals, we expect, will naturally want to eliminate unprofitable services, and add profitable ones. Again, it is absolutely critical to note that profitability is not the *only* concern hospitals have, but it is necessarily a major goal.

In this chapter, we examine some key measures of financial health for the hospitals in our study population, and make some comparisons between those hospitals that closed or opened substantial numbers of services, and the (much larger) group that did not. We will also look at hospitals that closed their labor and delivery services and those that opened inpatient rehabilitation services (the most frequently closed and opened services, respectively). The goal of this chapter is to determine what happened to the financial performance of hospitals that made these changes, as compared to the rest. We are not making any claim of causality here: attributing changes in hospital finances to specific service changes is beyond the scope of the present study. Future research should do the highly detailed financial analysis necessary to test such claims. Any number of factors aside from service mix can affect hospital financial outcomes: competition within specific markets, changing reimbursement rates from both private and public payers, the health and insurance status of populations served by specific facilities. In California, state government policies, such as mandated nurse staffing ratios and seismic upgrades to facilities, affect hospitals in ways unique to the state. Rather than account for these various factors, our aim instead is to present an initial survey of what happened financially to the

[14] We use the term "profitability" in the generic sense of taking in more money in payment for services than is spent providing these services, or at least avoiding financial losses. Many hospitals, of course, are non-profit, and for these, "profitability" should be understood as fulfilling the mission of providing care without making losses, or at least not making losses at an unacceptably high level.

hospitals in our study group, and whether differences among hospitals in these financial indicators are associated with service changes.

One of our most important findings is that the very small group of hospitals that closed four or more services experienced a dramatic deterioration in financial performance over the study period. By contrast, the financial picture for the small group of hospitals that added three or more new services improved during the same period. The two specific service changes we examine (closure of obstetrics and addition of inpatient rehabilitation) do not appear to be associated with sharp differences in financial performance.

Basic Measures of California Hospital Finances, 1995-2002

This section presents summary data on three basic indicators of hospital financial health for the hospitals in the study population: operating margin, total margin, and net patient revenue per staffed bed. The first two measures, operating and total margins, provide a broad picture of hospital profitability, while the revenue per bed measure illustrates a hospital's success in generating revenue while controlling for size. Data for this analysis comes from the Annual Disclosure Reports that hospitals are required to submit to OSHPD.

Financial data is not available for all of the 368 hospitals in the study population. OSHPD exempts hospitals in the Kaiser Permanente system from financial reporting for each separate facility; instead, Kaiser reports aggregated financial data for its Northern and Southern California regions. (Kaiser hospitals do report discharges by facility, and are therefore included in the service change analysis.) As a result, the 24 Kaiser facilities in the study population are excluded from this analysis. Fortunately, no Kaiser hospitals are in either the high-closer or high-opener groups, so their exclusion will only affect the data for the full population and for the very large groups of hospitals that did not make extensive service changes. Separate financial reports are also missing for one hospital in 1995 and for six hospitals in 2002, because of consolidations in financial, but not discharge, reporting (parent/satellite relationships). Five of these six hospitals became satellites during the study period, meaning that they had separate financial reports for 1995, but not for 2002. One of these hospitals (The General Hospital of

Eureka) was in our group of high-closers, but as noted in Chapter 3, is an instance of "phantom" service closure, as the hospital was bought by a neighboring facility in late 2001, but continued to report discharges separately until early 2002. Finally, one hospital submitted a financial report in 1995 that listed no patient care revenues; this observation is dropped as a presumptive error. In total, 342 of the 368 hospitals in our study population had usable financial reports in 1995, and 338 had them in 2002.

Another caveat about the financial data is that the report periods do not correspond precisely with those of the discharge data. OSHPD consolidates the inpatient discharge records into calendar year units, but the Annual Disclosure Reports generally cover the individual hospitals' fiscal years. Therefore, financial data that we will refer to, for simplicity, as being from 1995 or 2002 may actually report data from some portion of 1994 and 2001, depending on the fiscal reporting periods adopted by specific hospitals. In addition, several hospitals submitted multiple, separate reports covering periods of less than one year that, when combined, did cover one full year. For these hospitals, we simply added together the relevant figures in each report. Finally, a few hospitals failed to provide a full year's worth of data for the 1994-1995 and 2001-2002 fiscal periods; we have made no attempt to correct for this missing data, and simply use the data that is available.

One final caveat concerning our analysis centers on Disproportionate Share Hospital (DSH) payments. These are payments made under a joint federal-state program to compensate hospitals that serve a disproportionate share (as determined by a formula) of Medicaid (Medi-Cal) and uninsured patients. Under the rules of California's DSH program, public entities (counties, health care districts, and the University of California system) contribute monies to the state, in the form of intergovernmental transfers, which the state then uses to obtain federal matching funds. DSH payments, which consist of both the federal matching funds and the original intergovernmental transfers, are then made available to all qualifying hospitals, both public and private. These payments reflect the amounts of the transfers supplied by the public entities. When analyzing the finances of county, district, and University of California (UC) hospitals, one must choose whether or not to consider these transferred DSH funds as part of the hospitals' revenues, on the income statement, or whether instead to treat the DSH transfers as deductions

from revenue. We have decided to treat these funds as part of the income statements for the hospitals that received them, rather than as deductions from revenue. This decision has a great impact on the financial indicators we calculate. Treating DSH transfers as revenues causes all of the values we calculate here – operating margins, total margins, and net patient revenues per bed – to be much higher (in a positive direction) than they would otherwise. Had we chosen instead to treat the DSH transfers as deductions from revenue, the financial indicators for these hospitals would be dramatically worse, and would tend to drag down the averages of all the hospitals in our study population, and of the various subgroups we examine here.[15] But because we are interested in comparing financial performance over time, and not in comparing the performance of different types of hospitals, the treatment of DSH funds as part of the income statements does not affect the analysis.

Hospital Operating Margins

Operating margin is a widely used financial indicator. Essentially, a margin is the ratio of profit to revenue, i.e. profit expressed as a percentage of revenue. In calculating an operating margin, revenues not coming from normal business operations are excluded. This has particular relevance in the hospital industry, because non-profit and public hospitals often have very large sources of non-operating revenue. For example, non-profit hospitals receive charitable donations and investment income from endowments, and public hospitals receive tax funds from cities, counties, and (in California) health care districts formed specifically to assist community hospitals.[16] Because the calculation of operating margin includes only those revenues and costs directly related to patient care, non-profit and public hospitals tend to have lower margins than for-profits.

[15] The authors would like to thank Kenrick J. Kwong of OSHPD for pointing out, and clarifying, the distinction between these two different treatments of DSH transfer funds.
[16] For-profit hospitals can also have non-operating income, which generally takes the form of returns on investments.

We calculated operating margins for 1995 and 2002, for those hospitals in our study population that had separate financial reports, using the following formula:

Operating Margin = Net from Operations/(Net Patient Revenue + Other Operating Revenue)

Where Net from Operations = Total Operating Revenue – Operating Expenses.

To evaluate groups of hospitals (such as the study population as a whole, or the high-closers, and so forth), we calculated both simple average margins, and aggregated group margins. The simple average margin of a group of hospitals is the arithmetic mean of the individual operating margins of those hospitals. (We will also present median values for some measures.) An aggregate group margin, in contrast, contains all of the individual pieces of financial data for all hospitals in the group: that is, for a group of hospitals, the aggregate group margin would equal the sum of all the individual hospitals' reported values for net from operations, divided by the sum of all values for net patient revenue and all values for other operating revenue. Both simple average and aggregate group margins are useful measures. The simple average looks at a group of hospitals, giving each equal weight, while the aggregate group margin is essentially a weighted margin, in which larger hospitals (which would tend to have numerically larger values for revenues and expenses) have proportionately larger impact on the group margin (Dalton and Slifkin 2003).

Overall, the simple average operating margin for hospitals in our study population that reported financial data declined somewhat, going from +1% in 1995 to –1.4% in 2002. The median value of the individual hospital operating margins was +2.0% in 1995 and +1.2% in 2002. Aggregating all of the financial data, we found that the operating margin for the group as a whole was considerably better, and remarkably stable, at +5.1% in both years. The difference between simple average and aggregated group margins occurs because large hospitals, which account for a greater proportion of the revenues and expenses in the aggregated calculation, tend to perform better financially than smaller hospitals.[17]

[17] For example, in the 2002 data, the 121 hospitals with 200 or more beds account for 84.1% of all net patient revenue within the group of 338 study hospitals with financial data in that year, and have an aggregate group average operating margin of +6.8%. Meanwhile, the 217 hospitals with fewer than 200 beds account for only 15.9% of the full group's net patient revenue, and have an aggregate margin of +0.65%.

Total Margins

While operating margins deal only with revenues and costs coming from patient care, total margins include non-operating revenues, such as charitable donations and tax funds. Operating margins are useful because they focus solely on patient care activities. Total margins, in turn, give a fuller sense of a hospital's overall financial status. This is especially important in evaluating the financial performance of non-profit and public hospitals.

We calculated total margins for 1995 and 2002, using the following formula:

Total Margin = Net Income/(Net Patient Revenue + Other Operating Revenue)

Where Net Income = Net from Operations + Non-Operating Revenue, less Non-Operating Expenses, Income Taxes, and Extraordinary Items.

As with operating margin, we present both simple average margins and aggregated group margins. The simple average total margin for the hospitals with financial data in the study population decreased from +3.4% in 1995 to +2.2% in 2002, while the median value of the individual hospital margins increased from +2.9% to +3.2%. The aggregated average total margin for the entire group was, again, much higher than the simple average, and had roughly the same value in both years. In 1995, the aggregated group margin was +8.8%, while it was +8.6% in 2002.

Net Patient Revenue Per Bed

Another key measure of hospital financial performance is net patient revenue per staffed bed. This measure reflects a hospital's ability to use its resources to generate revenues. It also indirectly measures hospital capacity utilization: hospitals with large numbers of vacant beds will, other things being equal, have lower revenue per bed. We calculated net patient revenue per bed by simply dividing net patient revenue by the number of staffed beds; both are data elements in the OSHPD financial reports.

For the study population as a whole, net patient revenues per bed increased substantially between 1995 and 2002, by all measures. The simple average of all of the individual revenue figures was

$380,457 per bed in 1995, rising to $543,910 in 2002. The median value of the individual figures grew from $342,082 to $483,328 over the period. Aggregating the data for the group, the average net patient revenue per bed was $410,810 in 1995, growing to $604,878 in 2002. By all of the above measures (simple average, median, and aggregated group average), net patient revenues per bed increased by between 41.3% and 47.2% over the period. Clearly, hospital revenues are increasing rapidly, in line with the generally high rate of inflation in the health care sector. These increased revenues, however, are not translating into higher profitability for hospitals as a group.

Financial Performance of High-Closers and High-Openers

Next, we compare the financial performance of hospitals that closed or opened a substantial number of services to those that did not. As in Chapter 3, we define "high-closers" as hospitals that closed four or more services, and "high-openers" as those adding three or more. We will also follow Chapter 3 in distinguishing between hospitals making "legitimate" service changes (i.e. not the result of administrative consolidations and/or mergers with other facilities) and those with "phantom" service changes. As a result, the group of high-closers includes six hospitals, and the group of high-openers has eight members. Table 4.1 lists the hospitals in the two groups.

Table 4.1: High-Closer and High-Opener Hospitals (1995-2002)

High-Closers (Four or More HSCs)	High-Openers (Three or More HSCs)
Chowchilla District Memorial Hospital	Coast Plaza Doctors Hospital
Coalinga Regional Medical Center	Colorado River Medical Center
Community Hospital of Long Beach	Community & Mission Hospitals (Hunt. Park)
Healdsburg General Hospital	Community Medical Center (Clovis)
Sanger General Hospital	Kingsburg Medical Hospital
Tri-City Regional Medical Center	Lincoln Hospital Medical Center
	Mammoth Hospital
	Sutter Lakeside Hospital

Source: Petris Center analysis of OSHPD patient discharge data.

By all measures, the six high-closers saw their financial performance deteriorate sharply between 1995 and 2002. In terms of operating margins, the simple average margin fell from –3.6% to –42.7%, while the aggregate operating margin for the group decreased from –3.0% to –7.3%. By

contrast, the operating margins for all other hospitals (with financial reports) besides these six were fairly stable: simple average margins decreased somewhat, from +1.1% in 1995 to –0.7% in 2002, but the aggregate group average margin increased slightly from +5.1% to +5.2%. Total margins for the high-closers showed a similar pattern, with the simple average margin falling dramatically (from –1.2% to –34.8%) and the aggregate group margin decreasing as well, from –0.8% to –2.5%. For all other hospitals, the simple average declined from +3.5% to +2.9%, while the aggregate group average fell very slightly, from +8.9% to +8.6%. Finally, looking at net patient revenues per staffed bed, we found that the six high-closers experienced sharp declines in both simple and aggregated group averages. The simple average fell from $277,090 to $177,552 per bed, while the group average dropped from $330,832 to $203,592 per bed. The remaining hospitals stood in sharp contrast to the high-closers, with the simple average increasing from $382,303 to $550,531 per bed, and the group average from $411,408 to $607,249 per bed.

The eight high-openers experienced a distinct improvement in their finances over the study period, according to two of the three basic indicators analyzed here. Looking at operating margins, the high-openers improved their simple average margins from –7.5% in 1995 to +1.7% in 2002; the aggregated group margin increased from +1.1% to +5.1% over the same period. The other hospitals in the study population had little change: the simple average operating margin fell from +1.2% to –1.5%, while the aggregate group average stood at +5.1% in both years. There is much less variation, however, in the total margins of the two groups (the high-openers and the remaining study hospitals). For the high-openers, the simple average margin fell from +2.2% in 1995 to –0.1% in 2002; the aggregate group average also fell slightly, from +6.2% to +5.4%. The remaining hospitals followed the same pattern, with the simple average falling from +3.5% to +2.2%, and the group aggregate average decreasing very slightly, from +8.8% to +8.6%. Returning to net patient revenues per staffed bed, the pattern of greater improvement for the high-openers than for the other hospitals reappears. Revenues per bed more than doubled for the high-openers, according to both the simple average (from $242,921 to $540,029) and the aggregate group figure (from $226,732 to $474,477). The remaining study hospitals also improved their per bed revenues, but less dramatically: the simple average figure increased from $383,751 to $544,004, or 42%, while the aggregated group average grew from $412,536 to $606,126 (47%).

In summary, the six hospitals that closed four or more services started from a somewhat weaker baseline financial position than the rest of the study population hospitals, and then deteriorated markedly between 1995 and 2002, compared to the generally stable performance of the remaining hospitals. The eight hospitals that opened three or more services also started from a weaker financial position in 1995, but by contrast improved their finances, compared with the remaining hospitals (according to two of the three financial indicators reviewed here). In the next section, we will examine the finances of hospitals making the two most common specific service changes.

Specific Service Changes and Hospital Financial Performance

We now examine the financial performance of hospitals that made the two most common service changes – adding inpatient rehabilitation services (57 hospitals) and closing labor and delivery (28 hospitals). For the sake of brevity, we will only present data on operating margins and net patient revenues per bed. In constructing the populations of rehabilitation openers and obstetrics closers for this analysis, we depart from the previous practice of filtering out "phantom" service changes (those that are the result of mergers, system consolidations, data reporting consolidations). We do so because our primary interest here is in the financial health of hospitals as distinct administrative entities, rather than in the number of net service closures or openings. For example, if a hospital system with two facilities in one town were to consolidate labor and delivery services in only one site, there is a strong argument for not considering this a net reduction of service availability (provided the two facilities are in reasonably close proximity). But from a financial perspective, the service consolidation will have a specific impact on both facilities, assuming that they have separate financial reporting. Therefore, we have excluded from this analysis only those hospitals that do not have separate financial reports for both 1995 and 2002.

Closure of Labor and Delivery

As noted in Chapter 3, 28 hospitals closed their normal newborn obstetrics units during the study period. In addition, 24 of these hospitals closed their neonatal units. We will confine our

analysis to 24 of the 28 hospitals closing labor and delivery: three of them did not have separate financial reports in 2002, and one – St. Luke Medical Center – closed in February 2002.

The financial picture for these hospitals is mixed in comparison with the remaining members of the study population. Simple average operating margins for the closer group fell fairly sharply, from –0.7% in 1995 to –11.2% in 2002, but the aggregated group average margin increased substantially, from +0.8% to +4.6%. The simple average operating margin for all other hospitals fell slightly from +1.1% to –0.7%, while the group average was stable, decreasing from +5.4% to +5.2%. In terms of net patient revenues per bed, hospitals closing labor and delivery services saw their simple average revenues rise at a slower pace than did the remaining hospitals, from $410,772 per bed in 1995 to $548,498 (a 34% increase) in 2002, compared with an increase from $378,169 to $543,559 (44%) for all other hospitals. Obstetrics closers did, however, experience a sharper increase in the aggregated group average for the revenue per bed indicator, with closers going from $429,443 to $774,442 (80%), and the remaining hospitals increasing from $409,655 to $596,668 (46%) per staffed bed. Unfortunately, there is no clear pattern of association between obstetrics closure and financial performance.

Opening of Inpatient Rehabilitation

Financial data for both years is available for all 57 hospitals that added inpatient rehabilitation services. By some measures, these hospitals improved their financial performance relative to the other hospitals in the study population, but the differences between the two groups were not substantial. Looking at operating margins, the simple average for the group of rehabilitation openers fell slightly, from +2.4% in 1995 to +1.8% in 2002, but the aggregated average margin for the group increased strongly, from +2.3% to +6.5%. The remaining hospitals experienced decreases in operating margin, by both measures: the simple average for this group fell from +0.7% to –2.1%, and the aggregate group average from +5.5% to +4.9. In terms of net patient revenues per bed, the simple average for the opener group grew from $360,036 to $548,441, or 52%, while the group average increased from $368,186 to $601,546 (63%). Revenues per bed grew at a somewhat slower pace in the remaining hospitals, with the simple average increasing from $380,457 to $548,529 (44%), and the aggregated group average rising from $416,443 to

$615,261 (48%). While the hospitals that opened rehabilitation units did experience somewhat faster growth in revenues per bed, there was no clear association with operating margins.

Concluding Comments on Service Changes and Hospital Financial Performance

Overall, the hospitals in our study population that reported financial data saw little change in their performance in 2002 as compared with 1995. Operating and total margins were quite stable, particularly when the individual financial figures are aggregated to produce a group average. Net patient revenues per bed did rise substantially across the hospital population, but this increase is not associated with improved financial performance. It undoubtedly reflects instead the high rate of cost increase in the health care sector.

The hospital subgroups of interest here did have more variation. Those that closed four or more services had considerably lower values for these financial indicators in 1995, compared with the rest of the study population, and they experienced a sharp decline in these indicators over the study period, while the others were financially stable. This finding strongly suggests that closure of a large number of services is an indicator of serious financial distress, and a possible precursor to hospital closure. Those hospitals that opened three or more services also had lower baseline values on the financial indicators than did the remainder of the study population, but in contrast to the high-closers, saw substantial improvement (both absolute and relative) in their operating margins and net revenues per bed. Looking at the two most common service changes (closure of labor and delivery and addition of rehabilitation), there is some evidence that opening an inpatient rehabilitation unit is associated with higher revenues per bed, but otherwise there are no clear patterns of association between either specific service change and broader hospital financial performance.

The summary of basic financial indicators presented in this chapter is not intended to suggest, or demonstrate, a causal link between service changes and financial performance. We can only point to associations between the two, and suggest that future research study this issue in much greater depth, to see whether a definitive connection exists. Hospitals may close services because they no longer have the financial resources to offer them; those doing well financially

are much more likely to expand and offer new services. Once made, these service changes would then have their own independent effects on hospital finances. Ultimately, the relationship between service mix and financial health takes the form of a feedback loop, and the summary analysis presented here cannot specify this relationship definitively. However, the evidence of an association between high service closures and financial distress, and between high service openings and improved financial performance, is intriguing and suggests a direction for future study.

CHAPTER 5: CASE STUDIES OF FOUR HOSPITALS CLOSING LABOR AND DELIVERY (OBSTETRICS) SERVICES AND THEIR SURROUNDING COMMUNITIES

Since the phenomenon of hospital service changes has not been studied extensively, it is no surprise that even less attention has been paid to the effects of service closures on the communities in which hospitals are located. When a hospital closes a service, how are residents of the community affected? Does access to care worsen? Does the quality of care change? Prior research has not addressed the financial impacts on hospitals closing these services either. Does the closure of labor and delivery units actually improve the financial viability of troubled hospitals?

The next two chapters will address in depth the impact of obstetrics unit closures on hospitals, communities, and health care consumers. In this chapter, we present the findings of our intensive case studies of four hospitals (and their surrounding communities) that closed their labor and delivery services between 1999 and 2002. In Chapter 6, we will analyze patient data to assess the effects of labor and delivery closures on health care consumers, looking at both travel distances and birth outcomes.

Rationale for Obstetrics Services as Focus of Case Studies

We selected obstetrics services for further analysis for a variety of reasons. First, as discussed in Chapter 3, 28 hospitals closed their normal newborn labor and delivery units between 1995 and 2002, making labor and delivery department closures the most commonly closed service over that time period. Of these hospitals, 24 also closed neonatology units (the remaining four hospitals only had units for normal newborn deliveries). Second, labor and delivery services account for a substantial proportion of all inpatient discharges in California. In 1995, normal newborn and neonatal deliveries together represented 15.5% of all discharges (10.9% and 4.5%, respectively) while in 2002, they accounted for 13.8% (10.3% and 3.5%, respectively).[18] Third,

[18] The separate normal newborn and neonatal figures for 1995 do not add up to the combined figure due to rounding. These percentages are based on the full OSHPD discharge set, including hospitals not part of our study population,

labor and delivery services have typically been available in most community (short term, general acute care) hospitals: in our study population, 268 of 368 hospitals, or 72.8%, offered normal newborn delivery in both 1995 and 2002. Fourth, many patients have their first contact with a hospital through labor and delivery, and thus this service can provide an opportunity to develop loyalty among community residents. Finally, travel for labor and delivery can be burdensome to patients, particularly low-income patients who may not have a car. If small, rural hospitals in relatively isolated locations stop offering labor and delivery, a subset of the population may suffer negative effects, both in terms of the time and cost of travel, and potentially in terms of health outcomes.

Previous research has addressed the impact of hospital closure on access to care, but not the impact of specific service closures (Buchmueller et al. 2004, Reif et al. 1999). Other research has looked at factors associated with whether or not small, rural hospitals provide obstetrical care, focusing on demographic and geographic characteristics of the communities in which these hospitals are located (Lambrew and Ricketts 1993). Finally, some research has analyzed health care consumers' decisions to bypass local, but rural, hospitals in favor of more distant, but more urban, hospitals (Radcliff, Brasure, Moscovice, and Stensland 2003). The only previous analysis we have found that addresses the consequences of a specific service closure is by Bronstein and Morrisey (1990), which in fact looks at closures of obstetrics units in rural hospitals. Looking at data from Alabama covering the years 1983 through 1988, the authors find that closures added to the distance traveled to receive care, but only modestly. They argue that residents of the affected communities were already bypassing their local hospitals prior to the labor and delivery service closures. These findings, while of great interest, are quite dated at present, and obviously do not speak to California's situation. In the work that follows, we will closely examine the effects of labor and delivery closures in California.

such as specialty children's hospitals. The 368 hospitals in the study population account for roughly 96% of normal newborn births, and 93% of neonatal births, in both 1995 and 2002.

Characteristics of Case Study Hospitals

The 28 hospitals that closed their obstetrics units were generally small, with an average of 131.1 staffed beds. Eight of them (29%) have received OSHPD's small and rural designation, as compared to 15% of all California hospitals. However, six of the 28 hospitals that our discharge data analysis shows as closing obstetrics units are apparent cases of reorganizations within hospital systems. If we remove these six hospitals, the average size of the remaining 22 drops to 106.1 staffed beds. Clearly, closures of labor and delivery units were concentrated among smaller hospitals, which would likely have low birth volumes.

We selected four of the hospitals that closed normal newborn delivery units for intensive study. The case study hospitals were chosen to represent a range of geography, ownership, size, and market competition. The first hospital (Hospital A) is in a rural community with a population of approximately 11,000. The nearest competitor is 50 miles away. The second hospital (Hospital B) is in a community of 35,000, with a major city 20 miles distant. The third hospital (Hospital C) is in a city of 73,000 located within a large consolidated metropolitan area. The fourth hospital (Hospital D) is in a market area of 140,000, also in a large metropolitan area. Hospitals A, B, and C are district hospitals, although B and C were not-for-profit hospitals at the time the labor and delivery departments were closed. Hospital D is a for-profit hospital.

Findings from Case Study Site Visits

For all four case studies, we visited the hospital and interviewed one or more members of the executive team who were at the hospital when the obstetrics unit closed. We also interviewed other local physicians (Hospitals A, B, and C) and executives of hospitals that compete with the case study hospital (Hospital D). The interview guide used for these meetings is included in Appendix E.

In each of the four site visits, the stated reason for closure of the labor and delivery unit was that the hospitals did not have enough deliveries to avoid losing money on that service. The point at which each hospital's administrators judged that the obstetrics unit would have broken even

financially varied. For example, Hospital B needed 20 to 25 deliveries per month (240-300 per year) to break even, while Hospitals C and D had volumes equal to that but were losing money. Hospitals A and B had very low numbers of deliveries when they closed their obstetrics service: Hospital A had 112 the year before closure, and Hospital B had 144 deliveries.

While the volume of deliveries varied across these hospitals, they all shared the experience that their birth volumes had declined significantly in recent years. All four hospitals reported that at their peak they had delivery volumes at least double that experienced the year before closing the service. The dropping numbers of births were associated with declining competitiveness of the hospital in general. The hospital executives provided various reasons for their declining shares of their markets. Executives at three of the hospitals noted that health maintenance organizations drew patients away from their hospital because the HMOs had a growing presence in the market but did not have a contract with their hospital.

Leaders at all four hospitals observed that their labor and delivery service provided personalized care for low-risk births but could not accommodate high-risk births. One former director of the labor and delivery unit bemoaned her perception that pregnant women increasingly favor hospitals that offer tertiary perinatal services, regardless of the risk faced for that pregnancy. Her hospital offered one-on-one labor support, an on-staff lactation consultant, and a labor tub, and even established a contract with a nearby tertiary medical center for emergency perinatal support. Another hospital executive noted that his hospital did not offer 24-hour anesthesia, so laboring women could not receive epidural anesthesia at his hospital. The lack of this procedure limited the number of women who would consider his hospital for delivery.

Three of the hospitals had made a concerted effort to increase their volumes of deliveries in the years before closing their obstetrics service. Hospital A, a rural hospital, had recruited an obstetrician, an anesthesiologist, and a general surgeon to the community by offering salary guarantees. These physicians could provide appropriate back-up care to local family practice physicians who could perform low-risk deliveries but not cesarean deliveries. Prior to guaranteeing 24-hour surgical capability, family practice physicians had little choice but to perform their deliveries at hospitals 50 miles away. The enhancement of services at this hospital

increased the number of deliveries performed per year, but not enough to compensate for the cost of providing the salary guarantee and 24-hour nursing coverage. Volumes may not have increased as much as anticipated at this hospital, because there was a battle between a prominent local family practitioner and the previous hospital administration. The physician did not feel comfortable delivering babies at the hospital because it did not provide adequate surgical services in case a cesarean section was needed. Even though that physician began to perform some deliveries at the hospital after the obstetrician began practice there, there was reportedly a sense in the community that the quality of care at the hospital was inadequate and thus many patients and physicians continued to go elsewhere.

Hospitals C and D also tried to increase delivery volumes. Hospital C persuaded an obstetrician who lived nearby but practiced in another community to move her practice to that hospital, in an effort to rebuild the obstetrics service. Hospital D tried to offer a midwifery practice to attract low-risk women, but according to the director of a competing hospital, did not pursue this strategy aggressively enough to make it successful.

Two of the hospitals closed other departments at the same time labor and delivery was eliminated. Hospital A closed its operating room shortly after the obstetrics department closed, because this hospital's surgeon and anesthesiologist left the community when their salary guarantees were eliminated. The hospital tried to continue offering surgeries with a nurse anesthetist's support, but state regulators required that an anesthesiologist have oversight and thus the service was closed. Hospital B reduced the size of its medical-surgical unit, closed its special care unit (intensive care), and stopped scheduling surgeries for one of its two operating rooms.

Many other services were untouched when the obstetrics units were closed. All four hospitals have kept their emergency rooms open and view this as an essential service. Hospitals B, C, and D have maintained their operating rooms, and offer gynecologic surgery, orthopedic surgery, and other procedures. Hospital B opened a telemetry unit, a subacute care unit, and plans to start scheduling some hours for its second operating room. Hospital C has maintained a subacute unit

as well. Hospital D offers a wide range of services, including a geriatric psychiatric inpatient unit and acute care rehabilitation. All four hospitals offer laboratory and radiology services.

The effects of the obstetrics unit closure on the hospitals varied. Hospitals A, B, and C all saw a substantial decline in acute care inpatient volumes in the years immediately following their closures of labor and delivery units. Administrators at Hospital A believed that the closures of other services at the same time as labor and delivery likely contributed to their declining volume. Only Hospital D experienced a growing patient volume, with an over 30% increase in discharges between 2000 and 2002. All four hospitals saw reductions in staffing after their service closures. Hospital A had relied heavily on agency nurses to staff its obstetrics unit, and thus reduced this expense. Hospitals C and D offered opportunities for the obstetrics staff to apply for other positions in their hospitals, but many of the staff found positions in labor and delivery departments at other hospitals. Hospital B, which reduced the size of its medical-surgical unit and closed its special care unit, experienced an exodus of employees from its medical-surgical department. The hospital executive expressed surprise about this, and noted that hospital payroll dropped from $9.4 million to $6.9 million.

Each hospital faced differing community responses to the announcement of the obstetrics closures. All of the hospitals provided their communities with one or two months notice that their obstetrics departments would be closing. Hospital B had a relatively supportive community response, because residents understood that the obstetrics unit closure was necessary to improve the hospital's financial position and prepare it for a vote to become a district hospital. Hospital A's leadership reported that there was virtually no response from the community; in fact, the community was more upset about the departure of the obstetrician who practiced in town but left after the labor and delivery department closed. Some community residents expressed sadness about the closure of the obstetrics department at Hospital D, because that hospital provided personalized care and a supportive environment for low-risk births. The greatest outcry was observed at Hospital C, particularly from families in which multiple generations of babies had been born at the hospital.

Local physicians were significantly affected by the labor and delivery closures. As noted above, Hospital A had provided a salary guarantee to an obstetrician to practice in the community, and that physician left when the hospital closed its obstetrics department and ended the salary guarantee. Hospital C's leaders reported that some obstetricians moved their practices to the nearest large city, as did other doctors. Some obstetrician-gynecologists continue to perform gynecologic surgeries at Hospital B, but they are forced to split their surgical practices between Hospital B and other facilities because Hospital B schedules only one operating room. As a result, local physicians are drawn more to practice in the nearby large city, forcing community residents to travel for care. Obstetricians with offices near Hospitals C and D stayed in their locations and continue to do some gynecologic surgeries at those hospitals. One physician who practiced at Hospital C reported that her volume of maternity patients declined in the short term, but has returned to pre-closure levels.

All hospital leaders noted that the physicians who had previously performed deliveries at their facilities had admitting privileges at other hospitals, and thus they were able to continue their medical practices. However, these physicians faced greater inconvenience in their practices because they had to travel greater distances to care for maternity patients. One physician noted that she had been able to easily monitor the progress of a laboring patient because her office was at the hospital; now, she must cancel outpatient appointments in order to travel to a hospital 20 minutes away to check a patient. Another physician said that the closure of the obstetrics department next door to his office had little effect on his practice, but also noted that he hoped a patient whose labor was being induced 50 miles away would commence soon so that he could perform the delivery on a regular workday. Distant deliveries can have a significant effect on the ability of physicians to conduct their office practice and maintain their leisure time.

Patients also face problems resulting from the need to travel for maternity care. However, the hospital leaders interviewed for this study had different perceptions of whether their obstetrics department closures had affected access to care in their communities. Residents of the community in which Hospital A is located have difficulty traveling 50 miles to the nearest maternity unit, and some go to the emergency room at Hospital A. The leadership of this hospital believes low-income patients face greater travel problems, and they note that it is

difficult to transfer a patient to another hospital because hospitals in the county are overcrowded. Physicians and executives associated with Hospitals B and C believe there are few problems with access to care, and that larger effects come from health plans directing patients to particular hospitals. They do not believe low-income patients are disproportionately affected by this tendency. The leaders of Hospital D noted that other community hospitals easily absorbed the patients who had previously delivered at Hospital D, but it took a few months before people (known as "coyotes") who transported undocumented immigrants from Mexico learned that Hospital D no longer offered maternity services. "Coyotes" previously had transported women to Hospital D to deliver babies, who would then become U.S. citizens, by virtue of having been born on U.S. soil. All four hospitals reported that they have one or two deliveries per quarter in their emergency rooms, and two hospitals said that the labor and delivery nurses who stayed at the hospital helped train the emergency room staff for these unplanned deliveries.

While our key informants reported that the closures of labor and delivery units helped stem financial losses, all four hospitals remain in precarious financial positions. The three district facilities, Hospitals A, B, and C, reported that they lose money each year, but for hospitals B and C the revenues from the hospital district parcel taxes cover their losses. Hospital A does not receive any operating revenue from its district, because the district tax revenues are channeled toward payment of construction bonds from 1992. Hospital A filed for bankruptcy in 2003. Hospital B held a special election to increase its district parcel tax in 2004, and won the election. Executives at Hospital D, the for-profit facility, reported that the hospital earned a profit in 2002, but faced a small loss in 2003-2004 due to two particularly expensive patients whose insurance did not fully reimburse their costs.

Hospital leaders and local physicians expressed concerns about the long-term effects of the obstetrics unit closures on the viability of their hospitals. The hospital executives all recognized that maternity services provide a point of entry for patients, and that patients may be loyal to hospitals at which they had good maternity experiences. This was particularly true of Hospital C, which has a very long history in its community; multiple generations of some local families had been born in the hospital. However, executives and physician leaders at all four hospitals felt they were forced to close their obstetrics departments due to unsustainable financial losses,

and that this decision was justified because it helped them keep their hospitals open. The executive of Hospital B emphasized that it was paramount to his community that he keep the emergency room open, and noted that the closure of the special care unit may have had a greater negative effect on the community than the maternity closure. While all the hospital leaders were cautiously optimistic about their hospitals' futures, physicians in two of the communities expressed pessimism about the long-term prospects for the hospitals.

Concluding Comments on Case Study Site Visits

Our key informants at all four case study hospitals told us that they felt they had no choice but to close their labor and delivery units, because of the serious and sustained financial losses these units were making. While our respondents felt proud of the high quality and personal service their obstetrics units had provided, delivery volumes simply were not sufficient to cover their costs. Three of the four hospitals reported declines in inpatient volumes, and all four in staffing levels, following the obstetrics service closure. While most respondents did not feel that the labor and delivery closures had negative impacts on access to care in their communities, and all of the hospital executives we spoke to felt that the closure helped relieve, though not eliminate, financial pressures, many respondents (from both the hospitals themselves and from the communities) expressed fears that the closures could lead to a smaller and less loyal patient base in the longer term.

CHAPTER 6: IMPACTS OF OBSTETRICS SERVICE CLOSURES ON HEALTH CARE CONSUMERS

In this chapter, we significantly extend the analysis of obstetrics service closures begun in the previous chapter. Using data on patient ZIP Codes, we estimate the impact of these service closures on distances expectant mothers must travel to receive care following these closures. We also use data on patient demographic characteristics and source of payment to investigate the effects on specific subgroups whose access to care may be particularly vulnerable to disruption because of service closures. Finally, we analyze data on birth outcomes to determine whether obstetrics closures have negative clinical impacts.

Summary Data on Hospitals Closing Labor and Delivery

For this analysis, we used the OSHPD patient discharge data (PDD) from 1995 through 2002. Twenty-six hospitals in California were identified as having closed their labor and delivery departments during this time period. (According to the data analysis, 28 hospitals actually did so, but two hospitals – Stanford University Hospital and Sharp Memorial Hospital – are excluded from this analysis because their "closure" was actually an administrative change only. In both of these cases, obstetrics services were transferred to an administratively separate entity on the same hospital campus: Stanford's moved to the Lucille Packard Children's Hospital, and Sharp Memorial's to the Sharp Mary Birch Hospital for Women.)

Using the OSHPD PDD, we identified the ZIP Codes from which at least 2% of the hospital's discharges of labor and delivery patients came in 1995, up to a total of 85% of each hospital's labor and delivery patients. Labor and delivery patients were those with diagnosis-related group (DRG) codes of 370 through 375. The resulting ZIP Codes are defined as the relevant market for each hospital, and all patients in other ZIP Codes are excluded from the analysis. A total of 196 ZIP Codes were identified as being parts of the 26 hospital markets, and accounted for 699,787 discharges (in all DRGs) in 1995. This is 19% of the total number of inpatient discharges in

California in that year. Twenty-one of the 196 ZIP Codes were in two hospital obstetrics markets, and two ZIP Codes were in three markets.

The patients in these ZIP Codes visited hospitals for a variety of diagnoses. Labor and delivery is one of the more common reasons for hospital admission, and accounts for 16% of the discharges in these ZIP Codes in 1995 (112,915 patients). Tables 6.1 and 6.2 present characteristics of the patients in the 26 markets, for all hospital discharges and for labor and delivery only. As seen in Table 6.1, the overall share of patients in the market going to the hospital that closed its labor and delivery department dropped after closure, from over 13 percent to only 9 percent. Table 6.2 shows that the share of patients in these markets going to the hospital for labor and delivery was 11.6 percent; the drop in overall discharges was larger than the number of labor and delivery patients who had been served. These figures suggest that when a hospital closes its labor and delivery department, its overall market position may be diminished. The average distance traveled by all patients in these markets increased from 8.14 to 8.52 miles between 1995 and 2002, and this difference is statistically significant. There was also a statistically significant, but very small, increase in distance traveled by obstetrics patients in these markets, from 6.57 to 6.79 miles.

Table 6.1: Characteristics of Patients in the 26 Markets, for All Hospital Discharges, 1995 and 2002

	1995		2002	
	Mean	Standard Deviation	Mean	Standard Deviation
Share going to L&D closer	13.2%		8.9%	
Average distance traveled (miles)	8.14	21.57	8.52	22.36
Scheduled admission (%)	19.6%		17.8%	
Hispanic (%)	26.6%		29.5%	
White (%)	47.4%		43.3%	
Black (%)	13.4%		12.4%	
Medicare insurance (%)	26.3%		29.9%	
Medi-Cal insurance (%)	28.8%		26.2%	
HMO insurance (%)	23.0%		24.5%	
PPO insurance (%)	9.1%		10.3%	
Average length of hospital stay	4.17	7.35	4.26	7.48
Number of patients	699,787		678,429	

Source: Petris Center analysis of OSHPD patient discharge data.

Table 6.2: Characteristics of Patients in the 26 markets, for Labor and Delivery Discharges, 1995 and 2002

	1995		2002	
	Mean	Standard Deviation	Mean	Standard Deviation
Share going to L&D closer	11.6%		0.01%	
Average distance traveled (miles)	6.57	10.38	6.79	10.47
Scheduled admission (%)	26.6%		23.4%	
Hispanic (%)	43.1%		47.8%	
White (%)	31.0%		26.5%	
Black (%)	10.0%		7.9%	
Medicare insurance (%)	0.3%		0.2%	
Medi-Cal insurance (%)	47.8%		46.4%	
HMO insurance (%)	31.4%		35.4%	
PPO insurance (%)	11.3%		12.5%	
Average length of hospital stay	1.83	1.72	2.55	2.15
Number of patients	112,915		99,256	

Source: Petris Center analysis of OSHPD patient discharge data.

There are some general population trends between 1995 and 2002 that could be related to the labor and delivery closures. In 2002, fewer patients, both in general and for labor and delivery, had scheduled admissions. The racial and ethnic mix of patients changed over this time period, with more Hispanic and fewer Black patients. Medi-Cal insurance coverage declined slightly, both for all patients and for those giving birth. The share of patients covered by managed care plans rose between 1995 and 2002 in the 26 markets. Finally, there was an overall decline in the number of hospital discharges and in the number of labor and delivery discharges in the 26 markets during these years.

Tables 6.3 and 6.4 present information about the patients who received care at the 26 hospitals that closed labor and delivery services between 1995 and 2002. All patients are examined in Table 6.3, and Table 6.4 contains data for labor and delivery patients in 1995. Thirteen patients were discharged for births in 2002, because most hospitals have a few patients precipitously deliver in the emergency room each year. As seen in Table 6.3, the hospitals that closed labor and delivery experienced a very sharp decline in the total number of patients for whom they cared – from 92,683 in 1995 to 59,897 in 2002. This drop was only partially attributable to the

loss of 13,120 births that had occurred in 1995. The case studies found that many hospitals close other departments at the same time they close labor and delivery; this phenomenon might account for the overall drop in discharges. It also is possible that closure of labor and delivery damages the overall competitiveness of a hospital, and leads to loss of patients in all categories.

Table 6.3: Characteristics of Patients in the Hospitals That Closed Labor and Delivery, for All Hospital Discharges, 1995 and 2002

	1995		2002	
	Mean	Standard Deviation	Mean	Standard Deviation
Average distance traveled (miles)	4.71	4.91	4.77	4.60
Scheduled admission (%)	20.0%		14.2%	
Hispanic (%)	20.3%		13.3%	
White (%)	56.8%		62.3%	
Black (%)	11.7%		12.0%	
Medicare insurance (%)	36.1%		58.2%	
Medi-Cal insurance (%)	22.9%		10.0%	
HMO insurance (%)	24.3%		16.7%	
PPO insurance (%)	5.4%		7.8%	
Average length of hospital stay	3.88	5.47	4.72	6.18
Number of patients	92,683		59,897	

Source: Petris Center analysis of OSHPD patient discharge data.

The hospitals that closed labor and delivery experienced a drop in the share of patients with scheduled admissions, from 20 to 14 percent. A relatively high share of obstetrics patients in these hospitals (33.6%) had scheduled admissions for birth, likely accounting for most of the drop in scheduled admissions. After closure of labor and delivery, the overall patient population changed significantly. Hospitals that closed obstetrics saw fewer Hispanic patients after closure, and also had a higher share of Medicare and PPO patients. The shares of Medi-Cal and HMO insurance dropped for these hospitals between 1995 and 2002. The average length of stay rose, from 3.9 days to 4.7 days, which is expected since obstetrics lengths of stay tend to be quite short.

Table 6.4: Characteristics of Patients in the Hospitals That Closed Labor and Delivery, for Labor and Delivery Discharges, 1995

	1995	
	Mean	Standard Deviation
Average distance traveled (miles)	5.36	5.77
Scheduled admission (%)	33.6%	
Hispanic (%)	40.2%	
White (%)	33.2%	
Black (%)	10.4%	
Medicare insurance (%)	0.2%	
Medi-Cal insurance (%)	47.7%	
HMO insurance (%)	33.7%	
PPO insurance (%)	6.6%	
Average length of hospital stay	1.67	1.12
Number of patients	13,120	

Source: Petris Center analysis of OSHPD patient discharge data.

A comparison of Tables 6.2 and 6.4 reveals differences in patient characteristics between the hospitals that closed their obstetrics departments and those that did not. Patients in these markets who chose to receive care at the hospital that closed labor and delivery (prior to the closure) had shorter travel distances than those who delivered at other hospitals. The share of labor and delivery patients with scheduled admissions in 1995 was higher at the hospitals that closed labor and delivery. The hospitals that closed the service had a lower share of Hispanic patients, and higher shares of White and Black patients, in 1995. More patients in the service-closing hospitals were insured by HMOs. Finally, the average length of hospital stay was somewhat lower in the hospitals that subsequently closed labor and delivery.

Creating the Dataset for Regression Analysis

Hospital Data

The first step in creating a dataset for regression analysis involved obtaining data on the hospitals in the markets in which a labor and delivery unit closure took place. The OSHPD Annual Disclosure Reports were used for 1995-96 (OSHPD Data Year 21) through 2002-03 (OSHPD Data Year 28). These data are reported for fiscal years ending between June 30 and June 29.

Thus, for Data Year 21, hospitals reported for their fiscal year that ends sometime between June 30, 1995, and June 29, 1996. As a result, Data Year 21 contains data for at least half of 1995. We associated all patients giving birth in 1995 with the hospital reports from Data Year 21, even though doing so does not perfectly match the calendar year to the hospital's reporting year.

Some hospitals submit more than one report in a reporting year; for example, a hospital might submit two reports in Data Year 21, each of which provides information for a portion of the year. This most often occurs when a hospital changes ownership. The previous owner will submit a final report and, if the new owner's fiscal year also ends in the same reporting year, the new owner will submit a report. OSHPD reports the exact start and end dates for each report. When there are multiple reports in a single reporting year, one report is usually longer than the other; in fact, one report often covers 365 days, and the other covers only part of a year. To address duplicate reports, we added variables, or computed weighted averages. We then adjusted all observations so the reported numbers of discharges, births, and other volume-related variables are scaled for a year of 365 days.

Hospital-level variables we use in this analysis include:

- Type of ownership, whether for-profit, not-for-profit, or government
- Number of discharges, and number of obstetrics discharges
- Number of deliveries
- A service mix index that is weighted by technology availability
- An indicator for whether the hospital has a neonatal intensive care unit
- An indicator for whether the hospital has labor and delivery services

Distance Data

There are 196 ZIP Codes comprising the markets in this study. We linked these ZIP Codes to a file of the latitude and longitude of the centroid (or geometric center) of each ZIP Code. We then calculated from each ZIP Code the straight-line distances to the nearest hospital, the next-nearest hospital, the nearest hospital with a neonatal intensive care unit, the hospital selected by the patient, and the hospital that closed obstetrics.. Straight-line distances may not reflect the

actual travel time to each hospital; however, we could not easily obtain actual average travel times from place to place. Moreover, since patient locations are based on ZIP Code centroids, and thus are approximate, any estimate of travel time from that centroid would likely introduce additional measurement error to the data. The characteristics of each of the hospitals were merged to the patient discharge data, by the ZIP Code of the patient's residence. Thus, the data set used for analysis has patient characteristics and characteristics of the hospitals described above.

Data Analysis

Models of Patient Choice of Hospital

A patient's choice of hospital for labor and delivery is determined by a variety of factors. The choice of hospital for birth is often determined by one's choice of obstetrician. A locally-based obstetrician might prefer the nearest hospital, but this relationship is not certain. Patients are likely to select obstetricians with knowledge of the hospitals preferred for birth. A rural patient who prefers to deliver at a distant hospital will likely select an obstetrician near that hospital, and travel for both prenatal care and delivery. Rural patients also might find local providers who prefer to travel for birth. In either case, the choice of hospital for delivery is not selected solely by the physician.

A variety of studies report that travel time is a key factor determining hospital choice, particularly for obstetrics care (Cohen and Lee 1985; McGuirk and Porell 1984). Many studies of hospital choice have focused on rural hospital markets, examining patient decisions to seek care at an urban hospital rather than the nearby rural facility (Bronstein and Morrisey 1991; Radcliff et al. 2003). These studies have found that women with greater economic resources are more likely to bypass the nearest rural hospital in order to use hospitals with high birth volumes and high-risk infant services (Bronstein and Morrisey 1991).

The perceived quality of hospitals also might affect patient choice (Lane and Lindquist 1988). However, perceived quality is not necessarily the same as actual quality. Patients often view the

availability of specialized high-technology services as a sign of high quality (Spetz and Maiuro 2004). Hospitals might develop neonatal intensive care units in order to attract patients who think that the availability of sophisticated neonatology is associated with quality (Baker and Phibbs 2002). The volume of patients treated at a hospital also can symbolize quality in the eyes of patients. Indeed, a number of studies demonstrate that there is a positive association between the volume of a procedure performed at a hospital and a variety of patient outcomes (Halm, Lee, and Chassin 2002).

Our analysis advances the literature in three important respects. First, we include both rural and urban patients in the analysis; thus we focus on hospital choice for all patients, not just rural patients. Second, we have variation in the distance to the nearest hospital over time, because we focus on markets in which a hospital closed its labor and delivery service. This should improve our ability to measure the importance of factors that affect choice of hospital. Third, we examine both choice of hospital and outcomes associated with this choice.

The Decision to Bypass the Nearest Hospital

The first question we address is: what factors affect a patient's decision to bypass the nearest hospital for obstetrics care? To answer this question, we estimate a linear probability model in which the dependent variable equals 1 if the patient bypasses the nearest facility, and equals 0 otherwise.

The explanatory variables in the model are:

- The straight-line distance to the nearest hospital, the next-nearest hospital, and the nearest hospital with a neonatal intensive care unit
- The numbers of deliveries at the nearest hospital, the next-nearest hospital, and the nearest hospital with a neonatal intensive care unit (delivery volumes at nearby hospitals are signals of quality, HMO contracts, and provider preferences)

- A summary measure of service mix, weighted for technology availability, which is called a Saidin Index (Spetz and Maiuro 2004), for the nearest hospital, the next-nearest hospital, and the nearest hospital with a neonatal intensive care unit
- Ownership of the nearest hospital, the next-nearest hospital, and the nearest hospital with a neonatal intensive care unit, measured as dummy variables for for-profit ownership and government ownership (not-for-profit ownership is the excluded category)
- Patient age, measured in 6 categories (20-24, 25-29, 30-34, 35-39, 40-49, and all other ages or unknown age)
- Expected source of payment for the patient's care, measured with dummy variables for Medi-Cal, indigent programs, other government programs, self-pay, HMO, and PPO
- The race/ethnicity of the patient, measured with dummy variables for Hispanic, Black, Native American, Asian, and Other Race (White is the excluded category)
- Whether the patient resides in an urban county, measured with a dummy variable

Some regression equations were estimated specifically for patients who had a cesarean delivery (DRGs 370 and 371). Separate equations also were estimated for patients with complicating diagnoses (DRGs 370 and 372).

Dummy variables are included in the equations for each year, to control for overall changes across time. Finally, because multiple patients are observed in each market, there might be heteroskedasticity in the errors of the regression. To address this possibility, all standard errors are estimated using the Huber-White method, clustering for the market in which the patient is located (implemented using Stata Version 8SE). These markets are defined according to the hospitals that closed obstetrics services.

Overall, 77.9% of patients bypassed the nearest hospital for obstetrics care, as shown in Table 6.5. A higher share of urban patients bypassed the nearest facility – 78.6% as compared to only 52% of rural patients. The overall rate of hospital bypass varied slightly over time; it ranged from 74.9% to 79.6%, peaking in 1997 for urban patients and 1998 for rural patients. The lowest rate of bypass was observed in 2002.

Table 6.5: Percentages of Patients Bypassing the Nearest Hospital

	All patients	Urban patients	Rural patients
All patients	77.9%	78.6%	52.0%
C-section deliveries	77.9%	78.7%	51.9%
Vaginal deliveries	77.9%	78.5%	52.0%
Uncomplicated deliveries	77.4%	78.1%	51.4%
Complicated deliveries	81.1%	87.8%	55.8%
Nearest hospital closed	85.7%	86.9%	61.0%
Nearest hospital did not close	76.4%	77.0%	48.4%
Medi-Cal insurance	72.6%	73.3%	51.1%
Private insurance	82.8%	83.4%	52.9%
HMO insurance	84.0%	84.2%	54.2%
PPO insurance	81.2%	81.7%	61.2%
White	77.2%	78.6%	49.7%
Hispanic	75.9%	76.4%	54.2%
Black	81.4%	81.8%	45.1%
Asian	82.5%	82.7%	41.4%
Native American	72.2%	73.6%	68.2%
Age 14 and under	73.5%	74.1%	58.2%
Age 15-19	73.2%	74.1%	51.9%
Age 20-24	75.4%	76.2%	50.7%
Age 25-29	78.4%	79.1%	52.0%
Age 30-34	80.2%	80.7%	54.0%
Age 35-39	80.7%	81.2%	51.5%
Age 40-49	80.9%	81.3%	56.6%
Age 50 and older or unknown	75.7%	76.4%	
1995	78.3%	79.0%	54.2%
1996	78.0%	78.4%	57.3%
1997	79.6%	80.1%	62.8%
1998	79.0%	79.4%	64.9%
1999	79.0%	79.6%	57.7%
2000	77.4%	78.3%	44.0%
2001	76.9%	78.0%	37.4%
2002	74.5%	75.5%	37.6%
Number of observations	836,819	815,309	21,510

Source: Petris Center analysis of OSHPD patient discharge data.

There was no variation in the rate of bypass for patients who had cesarean deliveries as compared to those with vaginal deliveries. However, patients with complicated deliveries were more likely to bypass the nearest hospital, regardless of whether they lived in rural or urban counties.

Patients were more likely to bypass the nearest hospital when that hospital eventually closed its obstetrics service. This suggests that hospitals that eventually closed their labor and delivery units faced greater bypass rates than hospitals that kept their obstetrics service open. Hospitals facing significant bypass of obstetrics patients might be more likely to decide that they cannot continue to compete in this product market.

Patient characteristics were associated with bypass rates. Patients insured by Medi-Cal were less likely to bypass the nearest hospital than are those with private insurance. Both urban and rural patients insured by health maintenance organizations (HMOs) bypassed the nearest hospital for labor and delivery more often than average. Patients in urban markets who were insured by preferred provider organizations (PPOs) were less likely to bypass the nearest hospital, suggesting that HMOs might be more willing to channel urban patients to more distant hospitals than other types of insurers. In contrast, rural patients insured by PPOs bypassed the nearest hospital at a higher rate than did HMO patients, perhaps because those insured by PPOs have a broader choice of hospitals and prefer to travel for obstetrics care.

The ethnicity of patients was associated with the share that bypasses the nearest hospital. Among urban patients, those who are Asian and Black were more likely to bypass the nearest hospital than are other patients. Among rural patients, Hispanics and Native Americans were more likely to bypass the nearest facility for obstetrics care. There may be some connection between the ethnicity of a patient, insurance coverage, and the likelihood of bypassing the nearest hospital. For example, a higher share of Asian patients were insured by HMOs, and HMO patients were more likely to bypass the nearest hospital. However, the ethnic variation in bypass rates was not solely the result of the insurance coverage. Black patients in the markets analyzed were more likely to be insured by Medi-Cal, but Medi-Cal patients were less likely to bypass the nearest hospital.

Finally, as found in other studies, patient age was positively associated with the likelihood of bypassing the nearest hospital for obstetrics care. Urban patients had consistently higher bypass rates with age, while there was more variation among rural patients. The greater variation

among rural patients might in part arise due to the relatively small numbers of persons in some age groups.

Tables 6.6, 6.7, and 6.8 present the coefficients and standard errors of linear probability models of the probability of bypassing the nearest hospital. Because of their large size, these tables are printed in Appendix F. Table 6.6 provides the equations for all patients, and separate coefficients for equations estimated for urban patients only, and for rural patients only. Statistically significant coefficients (α=0.05) are in bold type.

The distance a patient must travel to different hospitals affects the probability of bypassing the nearest one. The likelihood of bypassing the nearest hospital increased with the distance to that hospital, in both the equation estimated for all patients and that for rural patients. This suggests that the further a patient must travel for obstetrics care, the less attractive the nearest hospital is. This may be because once a laboring patient is already traveling a substantial distance to receive care, additional travel time is seen as less burdensome. For the full population and for urban patients, the likelihood of bypassing the nearest hospital decreased as the distance to the next-nearest hospital increased. This is consistent with theory. The distance to the nearest hospital with a neonatal intensive care unit (NICU) did not affect the probability of bypass.

The volume of deliveries at nearby hospitals affected the probability of hospital bypass, presumably because patients tend to favor hospitals with higher delivery volumes. Causality cannot be determined in this relationship, however, because higher delivery volumes are a result of patient choice, while patient preferences are themselves affected by the high delivery volumes (in statistical terms, there is endogeneity). The probability of bypassing the nearest hospital decreased as the volume of deliveries at that hospital rose, while the probability of bypassing the nearest hospital rose as the volume of deliveries at the next-nearest hospital increased. Although the level of technology at nearby hospitals was expected to affect bypass patterns, the coefficients for the Saidin index are in general statistically insignificant. For urban patients, the probability of bypassing the nearest hospital increased with the technology level of the next-nearest hospital; however, the technology level of the nearest hospital did not have an effect on

the probability of bypass. The probability of bypass decreased as the technology index at the nearest NICU rose, which is unexpected.

The ownership of hospitals had a small influence on bypass patterns in the urban and rural groups. The probability of an urban patient bypassing the nearest hospital rose if that nearest hospital operates for profit, suggesting that urban patients prefer not-for-profit and government hospitals. The probability of bypassing the nearest hospital also rose if the nearest hospital with a NICU is owned by a government entity; this result holds for both rural and urban patients.

As has been found in prior research, the probability of bypassing the nearest hospital rose with the mother's age. This pattern was stronger for urban patients than for rural patients. Insurance coverage had some influence on bypass behavior. Among rural patients, those with Medi-Cal insurance or whose delivery was expected to be covered by a program for indigent patients were less likely to bypass the nearest hospital. Among urban patients, those insured by HMOs and PPOs were more likely to bypass the nearest hospital, perhaps because managed care insurance plans direct them to other facilities.

There were some differences in bypass patterns across ethnic and racial groups. Black and "other race" urban patients were more likely to bypass the nearest hospital, all other things held equal. Rural Hispanic patients were less likely to bypass the nearest hospital, while Native American and "other race" rural patients were more likely to bypass. It is possible that the coefficient for Native American patients results from their travel to Indian Health Services facilities for delivery.

Among urban patients there has been little change in bypass behavior over time, except that bypass rates dropped in 2002 as compared to prior years. Bypass rates were higher for rural patients prior to 1998 than after 1998. The constant terms of the equations indicate that rural patients were generally less likely to bypass the nearest hospital than urban patients, all other factors held equal. This is consistent with the summary statistics presented in Table 6.5.

Table 6.7 (in Appendix F) presents the bypass equation estimated for patients who had cesarean delivery and for those who had vaginal deliveries. The factors affecting patient bypass of the nearest hospital were similar for these two groups of patients. The distances to the nearest and next-nearest hospital had a stronger effect on the decision of patients who had vaginal deliveries than on those who had cesarean deliveries, perhaps because patients having cesarean deliveries are, on average, in greater need of particular hospital services and thus have less discretion in their choice of hospital. The volumes of deliveries at the nearest and next-nearest hospitals had the expected influence.

As expected, the probability of bypassing the nearest hospital rose with the patient's age, but this effect was stronger for patients who had cesarean section deliveries than those who had vaginal deliveries. This may be because older women who anticipate they will have a cesarean delivery are more selective in their choice of hospital because they have greater risks.

As reported above, patients who were insured by HMOs and PPOs were more likely to bypass the nearest hospital, although HMO patients who had cesarean deliveries were somewhat less likely to bypass the nearest hospital than were those who had vaginal deliveries. Black patients were more likely to bypass the nearest hospital, as were Asian patients who had cesarean deliveries.

Table 6.8 (in Appendix F) presents the bypass equations for patients who had complicated deliveries, and for those with no complications. Patients who had complicated deliveries exhibited some differences as compared to those with normal deliveries. Most importantly, the distances to the nearest and next-nearest hospitals did not have a statistically significant effect on the decision to bypass the nearest hospital. This may be because patients who anticipate delivery complications do not select hospitals based on distance. The volumes of deliveries at nearby hospitals had the anticipated effect on bypass choice, as do the age of the patient, HMO and PPO insurance, and ethnicity.

As a whole, the equations estimating the probability of a patient bypassing the nearest hospital produce coefficients that are consistent with expectations. Maternal age, volumes of deliveries at

each hospital, and travel distances all had significant effects on the decision to bypass. Insurance coverage also had an effect, with HMO and PPO-insured patients more likely to bypass the nearest facility. Patients with uncomplicated and vaginal deliveries appeared more sensitive to the distances between hospitals, while distance did not influence the hospital choice of patients with complicated deliveries.

Distance Traveled by Obstetrics Patients

As discussed above, a very large share of obstetrics patients bypass the nearest hospital to received care. However, the significance of this decision, in terms of distance and costs, is not indicated by the analysis of whether a patient bypasses the nearest facility. In order to understand the costs of the choice of hospital, we examined the distances traveled by patients in the 26 markets we analyzed. This analysis follows considerable research dealing with travel distance for health services. Much of this literature focuses on rural patients, for whom travel distances can be quite long. Numerous studies indicate that travel distances are related to severity of illness, and that elderly patients are less likely to travel outside their county of residence (Hogan 1988; McGuirk and Porell 1984; Folland 1983).

As with the equations that examine the patient bypass decision, we anticipate that the distance traveled by obstetrics patients will depend on the distances to nearby hospitals, the services offered at those hospitals, the patient's insurance carrier, and the patient's age and ethnicity. We also include the distance to the hospital in the market that closed its labor and delivery unit.

Table 6.9 summarizes the distances traveled by obstetrics patients. Patients traveled an average of 6.7 miles for obstetrics care. Urban patients had shorter travel distances, averaging 6.5 miles, while rural patients averaged 14.3 miles. Travel distances were higher for patients with cesarean deliveries and complicated deliveries, for both urban and rural patients. Patients whose nearest hospital closed obstetrics had longer average travel distances than those whose nearest hospital retained the service, regardless of rural or urban location.

Insurance coverage was associated with average travel distances. Patients who were insured by Medi-Cal traveled the shortest distance on average (5.8 miles), while those insured by PPOs

traveled the farthest (7.7 miles). These overall patterns are primarily the result of urban insurance-distance relationships. Among rural patients, those with HMO insurance traveled the farthest, averaging 15.4 miles. Rural patients with Medi-Cal insurance and those with private insurance averaged 14.2 miles.

Table 6.9: Average Travel Distances for Obstetrics Patients

	All patients	Urban patients	Rural patients
All patients	6.72 (10.99)	6.52 (10.29)	14.27 (25.00)
C-section deliveries	6.97 (11.68)	6.72 (10.76)	15.18 (27.12)
Vaginal deliveries	6.65 (10.79)	6.46 (10.15)	13.96 (24.22)
Uncomplicated deliveries	6.63 (10.83)	6.43 (10.18)	13.89 (23.95)
Complicated deliveries	7.34 (12.06)	7.08 (10.96)	16.81 (30.98)
Nearest hospital closed L&D	7.28 (13.06)	6.88 (11.54)	15.38 (29.47)
Nearest hospital did not close L&D	6.61 (10.58)	6.45 (10.04)	13.84 (22.98)
Medi-Cal insurance	5.84 (10.21)	5.54 (9.20)	14.23 (24.18)
Private insurance	7.43 (11.17)	7.31 (10.68)	14.17 (26.03)
HMO insurance	7.21 (9.67)	7.14 (9.28)	15.40 (29.92)
PPO insurance	7.66 (13.10)	7.49 (12.47)	14.89 (28.59)
White	8.00 (13.53)	7.75 (12.51)	12.96 (26.14)
Hispanic	6.01 (9.15)	5.82 (8.71)	15.05 (19.19)
Black	6.19 (9.83)	6.14 (9.41)	11.94 (30.95)
Asian	6.38 (9.88)	6.36 (9.73)	10.40 (28.23)
Native American	14.17 (26.64)	8.62 (14.55)	29.51 (42.01)
Age 14 and under	6.57 (15.33)	6.27 (15.35)	14.27 (12.91)
Age 15-19	6.41 (11.52)	6.10 (10.80)	14.09 (21.55)
Age 20-24	6.58 (11.82)	6.29 (10.76)	14.65 (27.37)
Age 25-29	6.72 (10.43)	6.54 (9.72)	13.86 (24.82)
Age 30-34	6.88 (10.69)	6.75 (10.34)	13.76 (21.43)
Age 35-39	6.91 (10.50)	6.77 (9.92)	14.90 (26.91)
Age 40-49	6.87 (11.19)	6.69 (10.22)	17.33 (35.19)
Age 50 and older or unknown	7.08 (8.14)	7.13 (8.16)	
1995	6.69 (12.25)	6.52 (11.71)	13.13 (24.59)
1996	6.67 (11.12)	6.46 (10.32)	14.47 (26.82)
1997	6.75 (10.83)	6.56 (10.14)	14.20 (25.25)
1998	6.76 (10.70)	6.55 (10.09)	14.50 (23.17)
1999	6.67 (11.18)	6.48 (10.55)	13.66 (23.81)
2000	6.70 (10.79)	6.49 (9.98)	14.74 (26.41)
2001	6.73 (10.71)	6.52 (9.96)	14.40 (24.77)
2002	6.78 (10.05)	6.54 (9.17)	15.16 (24.90)
Number of observations	828,458	806,949	21,509

Source: Petris Center analysis of OSHPD patient discharge data.

There appeared to be an association between the race and ethnicity of patients and their average travel distance. Urban Hispanic patients had the lowest average travel distance, at 5.8 miles. Urban White patients traveled an average of 7.8 miles. However, rural Hispanic patients had longer travel distances than rural White patients (15.1 miles versus 13.0 miles). For both the urban and rural patient categories, Native American patients had the largest average travel distance: 8.6 miles for urban mothers and 29.5 miles for rural mothers. These long distances are consistent with the higher bypass rates observed among this group.

Travel distances increased with patient age for urban patients through 39 years. Among rural patients, there was no clear association between patient age and travel distance.

There was a slight increase in average travel distances over time, particularly for rural patients. In 1995, rural patients traveled an average of 13.1 miles for obstetrics care; this rose to 15.2 miles by 2002. Urban travel distances were relatively stable over this period.

Tables 6.10, 6.11, and 6.12 present the coefficients of the linear regression equations of the distance traveled by obstetrics patients. Again, because of the size of these tables, we will print them in Appendix F. These regression equations allow us to observe the effects of hospital and demographic characteristics, holding other factors constant. As seen in Table 6.10, the distances between the patient's ZIP Code centroid and the nearest and next-nearest hospitals had positive, statistically significant effects on the ultimate distance traveled by the patient. However, the distance to the nearest hospital with a NICU did not significantly affect distance traveled. Patient travel distances declined with the volume of deliveries at the nearest hospital; that is, if the nearest hospital had a higher volume of deliveries, patients traveled shorter distances on average, presumably because they were more likely to select the nearest one. Again, we cannot determine causality in this relationship, because delivery volumes and patient preferences influence each other. Surprisingly, the technology indices of nearby hospitals did not have statistically significant effects on travel distance. Hospital ownership also did not generally affect travel distance.

Patients' demographic characteristics affected the distances they traveled for obstetrics care. In general, older patients traveled longer distances, with mothers aged 35 to 39 traveling 0.32 miles further on average than teen mothers. Patients insured by Medi-Cal traveled an average of 1.4 miles less than those with private insurance. There did not appear to be differences in the distances traveled by different ethnic groups.

There was a general trend toward shorter travel distances over time for obstetrics care, as indicated by the coefficients of the dummy variables for year of birth. Patients in 2002 traveled an average of 1.3 miles less than patients in 1995, all other factors held equal. Note that this is not consistent with Table 6.9, which demonstrates that there was a small increase in distances traveled over this time period. This net increase may result from both increases in the distance to the nearest and next-nearest hospitals (due to closures of obstetrics services) as well as increases in the age of the maternal population. Holding these factors constant, there was a trend toward shorter travel distances.

The second and third columns of Table 6.10 present the coefficients of the equations for distance traveled by urban and rural patients. These were some differences between these populations. First, the distance between the patient and the nearest hospital had a significant effect on travel distance for urban patients, but not for rural patients. Rather, rural patient travel distance was significantly affected by the distance to the next-nearest hospital. As with the combined patient population, the distance to the nearest NICU did not affect travel distance.

Among urban patients, the volume of deliveries at the nearest hospital had a negative effect on travel distance. However, for rural patients the delivery volume at the nearest hospital had no effect on travel distance. The technology indices of nearby hospitals did not affect either urban or rural patient travel distances. Hospital ownership was in general unimportant in determining travel distance, except for urban patients who tended to travel a greater distance if the next-nearest hospital was for-profit.

The age of urban patients significantly affected their travel distance for obstetrics care, while the age of rural patients had no influence on travel distance. Other studies have found that rural

patients travel longer distances with age (Bronstein and Morrisey, 1990). Bronstein and Morrisey speculate that this relationship arises because older patients have better access to transportation and perhaps also information about the quality of care at local hospitals. It could be that in the markets we analyzed, rural patients have equal access to both information and transportation across age groups.

The insurance coverage of urban patients had different effects on travel distance than it does for rural patients. Among urban patients, those with Medi-Cal insurance had a shorter average travel distance than those with private insurance. This finding could result from Medi-Cal patients being less likely to have a car, and hence less able to travel to receive care. There was no statistically significant difference in the travel distances of Medi-Cal and privately insured rural patients. Rural patients whose deliveries were covered by county indigent programs tended to travel shorter distances than privately insured rural patients. Finally, rural patients who were insured by HMOs traveled an average of 4.4 miles further than those with non-HMO coverage. This finding is consistent with the information obtained in our rural case study hospital; HMOs are usually based in cities, and enrollees who live in rural communities are often forced by the HMO to travel to the nearest city for care.

Urban Hispanic obstetrics patients had shorter travel distances than urban White patients, while rural patients who are in an "other" racial group traveled an average of 4.1 miles farther than White patients. We are not able to ascertain possible explanations for either of these findings from our data.

The trend toward shorter travel distances for obstetrics care observed for the full population is largely driven by a statistically significant trend among urban patients. Among rural patients, there was not a statistically significant trend over time in distance traveled for obstetrics care.

Table 6.11 presents coefficients of equations estimated separately for patients who had cesarean and vaginal deliveries. These populations exhibit similar coefficients of the factors that affect their travel distances. For both groups, travel distances increased as the distances to the nearest and next-nearest hospitals increased. Travel distance decreased with the volume of deliveries at

the nearest hospital, and was not significantly affected by the technology indices or ownership of nearby hospitals.

Travel distance increased with age for both cesarean and vaginal delivery patients, but the relationship is stronger for patients who have cesarean sections. This suggests that patients who have cesarean deliveries have better access to information about hospital quality and are able to travel to the best hospital. Since many cesarean deliveries are scheduled in advance, such as those for breech presentation, older patients who anticipate cesarean delivery might have greater ability and/or incentive to research the best hospital for their obstetrics needs.

Patients who were insured by Medi-Cal had shorter travel distances than did privately insured patients, and this effect was stronger for patients who had cesarean deliveries. Medi-Cal patients who had cesarean sections traveled an average of 1.7 miles less than privately insured c-section patients, while Medi-Cal patients who had vaginal deliveries traveled 1.3 miles less than privately insured patients who had vaginal deliveries. There did not appear to be variations across racial and ethnic groups in travel distances.

Finally, distances traveled for obstetrics care decreased over time for both cesarean and vaginal deliveries. The trend is more consistent toward shorter distances for vaginal births, but is observed for both groups of patients.

Table 6.12 presents the coefficients of equations estimating distances traveled for obstetrics care for patients with complicated and uncomplicated deliveries. The results of these equations are generally consistent with those reported for other patient groups. The distance traveled increased with distances to the nearest and next-nearest hospitals, as expected. Travel distance declined with the volume of births at the nearest hospital, with this effect being larger for patients who had complicated deliveries. The technology indices of nearby hospitals had no significant effect on distance traveled, which is surprising; we anticipated that patients with complicated deliveries would favor more technologically sophisticated hospitals. Hospital ownership also did not affect travel distance.

Patient age had a significant effect on the distance traveled by patients with uncomplicated births, with all age groups from 20 years through 39 years traveling farther than younger or older patients. Among patients with complicated deliveries, only those aged 35 to 39 years had a significantly greater travel distance (0.4 miles). We expected that travel distance would increase with age for complicated deliveries, much as for cesarean deliveries. However, many complicated births are unanticipated, and thus perhaps patients are less able to plan accordingly as compared to patients who have cesarean deliveries.

Patients who were insured by Medi-Cal traveled an average of 1.4 miles less than patients with private insurance, regardless of whether they had complicated or uncomplicated births. Other types of insurance did not have significant relationships with travel distance, nor did race or ethnicity.

There was a trend toward decreasing travel distances over time for both complicated and uncomplicated deliveries. The trend has been more notable for patients with complicated deliveries. Patients with complicated deliveries traveled an average of 1.8 miles less in 2002 than in 1995. Patients with uncomplicated deliveries traveled an average of 1.3 miles less in 2002 than in 1995.

The equations estimating distance traveled for obstetrics care are generally consistent with those predicting the probability of a patient bypassing the nearest hospital. Maternal age was a consistently important factor, increasing both the likelihood of bypassing the nearest hospital and distance traveled. Travel patterns were significantly affected by volumes of deliveries at each hospital, with patients favoring facilities with greater volumes. HMO patients were more likely to bypass the nearest hospital, and rural HMO patients traveled significantly greater distances than other patients. Rural Medi-Cal patients were less likely to bypass the nearest hospital, and urban Medi-Cal patients tended to travel shorter distances for obstetrics care.

Were the patterns of travel distance and bypass of the nearest hospital different for patients whose nearest hospital closed obstetrics services? Table 6.13 (in Appendix F) examines this question by presenting regression equation coefficients when the analysis is limited to patients

whose nearest hospital closed its labor and delivery unit. For this group, many of the coefficients were similar to those observed for the entire population. The probability of bypassing the nearest hospital rose as the distance to that hospital increased, and dropped as the distance to the next-nearest hospital fell. The volumes of patients at nearby hospitals affected the decision to bypass the nearest hospital, as expected. The only unexpected finding is that the probability of bypassing the nearest hospital decreased as the volume of deliveries at the nearest hospital with a NICU increased. We anticipated that the volume of deliveries at the nearest hospital with a NICU would increase the likelihood of bypass.

Similarly, travel distance increased with the distances to the nearest and next-nearest hospitals, and the volume of patients at nearby hospitals affected travel distances. As in the bypass equation, the coefficient of the volume of deliveries at the nearest hospital with a NICU is contrary to expectations. Travel distances for patients whose nearest hospital closed obstetrics were lower when the technology indices for the nearest and next-nearest hospitals rose; technology did not have an effect on travel distances for the general population.

Most demographic characteristics were not statistically significantly associated with bypass probability or travel distance for the group of patients whose nearest hospital closed labor and delivery. Unlike in the general population, age was not associated with bypass or travel distance. Medi-Cal patients traveled fewer miles on average for obstetrics care.

The most important difference between the regression coefficients for the general population and those for patients whose nearest hospital closed obstetrics is that there was not a general trend toward shorter travel distances. In fact, travel distances appeared to have been lower in 1996 and 1997 than in later years, holding other factors constant.

Overall, patients whose nearest hospitals closed labor and delivery services may have experienced greater travel distances than the rest of the population, as indicated both by the averages in Table 6.9 and the coefficients of the time dummy variables in Table 6.13. However, the increases in distance traveled as compared to the general population are small, and the findings of the case studies indicate that there are few transportation barriers for obstetrics

patients. Thus, although obstetrics closures increased travel distances somewhat, the practical importance of this change is likely small.

Travel Distances, Patient and Hospital Characteristics, and Birth Outcomes

Although the distances traveled by obstetrics patients did not change much as a result of closures of hospital services, changes in availability of services might have effects on patient outcomes. Patients might find it more difficult to access prenatal care as a result of the hospital service closure, or the need to travel for labor and delivery could change the quality of care provided.

We explored whether the distance to the nearest hospital affected patient outcomes using multivariate regression analysis. Specifically, we focus on two outcomes: whether the patient had a cesarean delivery, and whether she had a delivery with complications. The underlying theory is that if a patient has to travel farther to a hospital, the patient faces barriers both in access to inpatient care and to primary care. For example, if the closure of an obstetrics unit results in local obstetricians moving their offices away from the hospital that closed the service, then patients have to travel farther both for prenatal care and delivery. Lack of primary care is associated with poor birth outcomes. Moreover, if a patient has a precipitous or problematic labor, increased travel could increase the likelihood of a poor birth outcome. Buchmueller, Jacobson, and Wold (2004) have explored these issues in an analysis of hospital closures in the Los Angeles region, and we follow their approach closely.

We focus on two outcomes, whether the patient had a cesarean delivery and whether the patient had a complicated delivery. Although these outcomes result from a variety of factors that we cannot measure accurately with the OSHPD Patient Discharge Data, we thought these outcomes might provide some suggestion of whether hospital service closures affect patient outcomes.

We estimated the regression equations three ways. First, we estimated a linear probability model. The coefficients of these equations are presented in the first columns of Tables 6.14 and 6.15 (both tables are printed in Appendix F). Second, we estimated the same equation using a Probit model, which is a nonlinear model that may be more appropriate when the dependent

variable is dichotomous. The probability derivatives (or, change in probability of having a cesarean section or complication that results from a one-unit change in the explanatory variable) are presented in the second columns of Tables 6.14 and 6.15. Finally, we estimated the Probit models including dummy variables for each market (with markets defined according to the hospital that closed its obstetrics service). The probability derivatives from these equations are in the third columns of the tables.

Table 6.14 presents the regression coefficients and probability derivatives for the cesarean section probability equations. The equations estimated without market dummy variables are similar to each other, as expected. The probability of a cesarean section rose slightly with the distance to the nearest hospital; a one-mile increase in distance resulted in a 0.2 percentage point increase in the probability of cesarean section. Since we could not accurately control for complications that might also contribute to the probability of a cesarean section, this increase might not be clinically important. Moreover, the relationship between distance and probability of cesarean delivery was not statistically different from zero when market dummy variables were included in the equation.

A larger volume of deliveries at the nearest hospital reduced the probability of cesarean delivery. Each additional 1,000 births reduced the probability of cesarean section by 0.37 to 0.48 percentage points. Hospitals with greater birth volumes may have more experience in determining when cesarean sections are warranted. Moreover, since the probability of selecting the nearest hospital for delivery increased with the volume of deliveries at that hospital, there may be an endogenous (non-causal) relationship between the probability of cesarean delivery and patient choice of the nearest hospital.

The probability of cesarean delivery decreased with the technology levels of the nearest and next-nearest hospitals, but increased with the technology level at the nearest hospital with a NICU. Hospitals with higher levels of technology, but not intensive neonatal intensive care services, may be better able to accurately assess a patient's status, thus avoiding unneeded cesarean sections. Conversely, more sophisticated hospitals might attract patients who are at

higher risk for cesarean delivery. These relationships were not statistically significant when market dummy variables were included in the equation.

Hospital ownership had a minor effect on the probability of cesarean delivery. When market dummy variables were included in the equation, the probability of a cesarean delivery was higher if the nearest hospital was owned by a government entity. Conversely, if the nearest hospital with a NICU was government-controlled, the probability of a cesarean delivery was lower. This last relationship was also observed when market dummy variables were not included in the model.

Insurance coverage affected the probability of cesarean delivery, and the relationships between insurance and cesarean probability did not vary across equations. Patients whose deliveries were paid for by an indigent care program or who paid directly for care were about 5 percentage points less likely to have a cesarean delivery. Patients insured by HMOs were 2 percentage points less likely to have a c-section, while those who had another government payer were 1 to 2 percentage points more likely to have a cesarean delivery.

As expected, the demographic characteristics of patients affected the likelihood of cesarean delivery. The probability of cesarean delivery consistently rose with age. Blacks were about 4 percentage points more likely to have cesarean deliveries than Whites, while Asians were 2 to 3 percentage points less likely than Whites.

Finally, there was a general trend toward increasing probability of cesarean section delivery. This trend has been documented in various analyses, and is thought to have arisen from increased fear of attempting vaginal births after cesarean sections, the increasing share of multiple births (twins) due to assisted conception, and increased fear of malpractice lawsuits.

Table 6.15 presents coefficients from equations that estimate the probability of a patient having a complicated delivery. The distance to the nearest hospitals did not affect the probability of having a complicated delivery. The probability of complication decreased a small amount as the volumes of deliveries increased at the nearest hospital, and at the nearest hospital with a NICU.

The changes are so small as to be clinically irrelevant, since the risk faced by each patient is not well controlled in this analysis.

The availability of high-technology services at nearby hospitals increases the likelihood of having a complicated delivery, when market dummy variables are not included in the equation. Conversely, the probability of complication decreases with the technology index of the nearest NICU, again only when market dummy variables are not included. The rationale for excluding market dummy variables when computing the likelihood of complications is that these dummy variables control for risks of complications that are constant for all patients in the market.

Government ownership of the nearest hospital appears to increase the probability of having a delivery complication by about 1 percentage point, when market dummy variables are included in the equation. However, the probability of complication declines if the nearest hospital with a NICU is operated by the government.

Insurance coverage affects the probability of having a complicated delivery. Patients who are insured by an indigent program are slightly more likely to have a complication, as are those insured by HMOs and other government programs. These patterns are particularly interesting since those insured by indigent programs and HMOs are substantially less likely to have cesarean deliveries. Patients who expect to pay for their own care are less likely to have a complication.

The probability of having a complication rises with age, as expected. Black patients are 3 to 3.5 percentage points more likely to have complications, which is consistent with their higher cesarean delivery rate. Finally, there has been a trend toward fewer delivery complications in recent years, although the magnitude of this trend is extremely small.

Concluding Comments on Consumer Impacts of Obstetrics Closures

Despite the large number of labor and delivery unit closures during the study period, we find little evidence of negative impacts on health care consumers. In the 26 hospital service markets we analyzed, the average distance traveled for childbirth increased only fractionally, by just over

two-tenths of a mile. This increase is statistically significant, but given the very large number of persons in the dataset, almost any difference in average travel distance would attain statistical significance. The more important question is whether the increase in travel distance has any real substantive significance. That broader question is beyond the scope of this study; however, at an intuitive level, it seems unlikely that such a small additional travel distance is burdensome.

There is also no evidence that the distance to the patient's nearest hospital has any effect on the probability of cesarean delivery of having a delivery complication. The probabilities of complication and of cesarean delivery declined if the nearest hospital had a larger volume of deliveries. Thus, if the closure of a nearby hospital increases the volume of deliveries at the hospital that is subsequently the closest, patients might benefit. As was stated by key informants in the case studies, it seems that closures of obstetrics services do not have negative effects on either access to care or quality of care. In fact, service closures at hospitals with the smallest delivery volumes could improve the overall quality of care received.

CHAPTER 7: CONCLUSIONS, POLICY IMPLICATIONS, AND RECOMMENDATIONS FOR FUTURE RESEARCH

As California hospitals struggle to maintain financial viability in the state's complex and challenging health care marketplace, one strategy hospital administrators will undoubtedly consider is changing their service offerings. Basic economic theory suggests that hospitals will seek to eliminate money-losing services, and to add profitable ones. Of course, hospitals, and health care providers generally, have multiple motivations aside from financial performance; but, as business enterprises, hospitals must achieve financial stability as a precursor to the broader goal of serving the medical needs of the community. Our research has uncovered a moderate level of hospital service changes during our study period, and we have documented a number of interesting trends that may well represent a leading edge of more widespread changes to come. This final chapter will briefly summarize our findings, draw out some policy implications for both hospitals and health care policymakers, and suggest future directions for research on the topic of tracking and assessing hospital service changes and their impacts.

Principal Findings on Hospital Service Changes

According to our analysis of OSHPD's discharge data, just over half of the short-term, general acute care hospitals in our study population made at one or more service changes during the 1995-2002 period. All together, 88 hospitals closed one or more services over the study period, while 123 hospitals added one or more; only 22 hospitals combined closures and openings. The 368 hospitals in our study population closed and opened roughly the same number of services: they closed a total of 189 services and opened 185, an average of just over 0.5 services per hospital. Very few hospitals closed or opened substantial numbers of services: only 10 hospitals closed four or more services, and only 13 added three or more new services (these are the slightly different criteria for "high-closers" and "high-openers" used in Chapter 3). These two groups become smaller still if we exclude hospitals with what we have termed "phantom" service changes, that is, apparent service changes, according to the OSHPD discharge data, that actually reflect mergers, system reorganizations, and administrative changes affecting discharge data

reporting, rather than actual service closures or additions. There were only six such "legitimate" high-closers, and eight high-openers.

Characteristics of High-Closers and High-Openers

While the vast majority of hospitals made either no change at all, or only one or two changes, the characteristics and experiences of the (legitimate) high-closer and high-opener hospital groups suggest several potentially important findings. Because of the small numbers of hospitals in these two groups, any conclusions drawn are not statistically generalizable. Nonetheless, these findings should help guide future research in this area, and indeed may suggest potential strategies to help hospital administrators protect the financial viability of their facilities.

Interestingly, hospitals in both the high-closer and the high-opener groups tended to be small in terms of bed size, and located in rural areas. This finding, while reflecting the experiences of only a small number of hospitals, does suggest that potentially vulnerable small, rural hospitals are choosing one of two strategies for achieving financial sustainability: aggressively closing, or opening, substantial numbers of services. The strategy of closing money-losing services may be thought of as a defensive, or reactive, response to financial losses, while opening new (and presumably profitable) services represents an offensive, or proactive, response.

Service Changes and Hospital Financial Health

Based on the differences in financial performance over the study period for the high-closer and higher-opener groups of hospitals, it appears that the proactive response of adding new services had the stronger association with good financial performance. The six hospitals legitimately closing four or more services experienced a sharp decline in their finances, according to all three of the indicators used in the analysis in Chapter 4: operating margins, total margins, and net patient revenues per bed. This stands in sharp contrast to the relatively stable financial status of the group of 368 hospitals in the study population as a whole. The decline in net patient revenues per bed for these six hospitals is perhaps the most dramatic indicator of their dire situation. While per bed revenues for all the hospitals as a group increased by 40-50% during the

study period, they fell by over one-third for the six high-closers. Thus, despite the high rate of increase in health care costs (and hence net revenues) during the period, these six hospitals saw revenue declines in absolute terms.

By contrast, the eight hospitals that legitimately opened three or more services saw an improvement in their finances, according to two of the three financial measures. In terms of operating margins, the high-openers saw improvement in both absolute terms, and relative to the hospital population as a whole. Their net patient revenues per bed more than doubled, while the study group's increased by 40-50%. (Changes in total margins followed a pattern similar to that of the broader hospital population.) For these eight hospitals, operating margins and net per bed revenues improved considerably during the same time period in which they added several new services.

As discussed in Chapter 4, it is critical to note that our analysis has not identified a direct, causal relationship between these service changes and the financial performance of the hospitals making them. This analysis only identifies an association between the two phenomena; more extensive research in the future will be required to draw a causal connection. Nonetheless, for the two small groups of hospitals that closed or opened a significant number of services, several points stand out. Multiple service closures appear at the very least to be an indication of severe financial distress. They may in fact exacerbate, rather than help, the situation; further research in this area is needed. Small rural hospitals that opened new services, rather than cutting back on existing offerings, did much better financially; indeed, their financial indicators came into line with those of the broader hospital population. While the small numbers of hospitals in the high-closer and high-opener groups preclude any generalizable conclusions, this study's findings strongly suggest that aggressive cutbacks in service offerings may not be the best strategy for financial stabilization. Indeed, it is easy to envision a sort of downward spiral taking place at small, financially vulnerable hospitals, in which reduction of services leads to a further decline in patient volume, accompanied by decreased interest on the part of physicians in practicing at the hospital.

Impacts of Service Changes on Communities and Consumers

In our interviews with hospital administrators and physician leaders at the four case study sites, along with other health care providers in the surrounding communities, respondents generally felt that the closure of obstetrics services, while regrettable, was financially necessary, and had only limited effects on access to care. (One hospital's respondents thought it had a negative effect; those at the other three saw little or no effect.) The analysis of travel distance and birth outcome data in Chapter 6 supports the more optimistic view expressed by the respondents at three of the four case study sites. The analysis of patient ZIP Code data shows that obstetrics unit closures did not add to travel distances for consumers in these 26 hospital markets in any substantively meaningful way. Many consumers were apparently bypassing these hospitals prior to the service closures. There were no negative effects in terms of birth outcomes, either. In fact, there is some evidence that birth outcomes may be better at hospitals with larger delivery volumes – precisely the type of hospital that would potentially receive more patients following service closures at nearby hospitals with low delivery volumes.

Policy Implications

In the American health care system, hospitals have the primary responsibility for determining their mix of service offerings. Government policies, however, do have a role to play, and this section will present some recommendations to guide future policymaking. In addition, we will make recommendations applicable to hospital administrators, as they make decisions about service offerings in light of their facilities' financial status.

At the most general level, we recommend that health care policymakers in California begin regularly monitoring hospital service changes, particularly service closures. The data analyzed in this study show that, among the small group of hospitals that closed four or more services, extensive service closures were accompanied by a sharp deterioration in these hospitals' already precarious financial positions. This strongly suggests that hospitals in the high-closer group are vulnerable to closing their doors entirely in the near future. Since hospital closures have been a source of great concern among policymakers, community leaders, and the media, monitoring of

service closures could serve as an early-warning system, indicating that facility closure could be imminent.

The case of labor and delivery services, which were closed most frequently, suggests other policy recommendations. As a long-term strategy for improving hospital finances, closing obstetrics units may not be optimal, even though these units often lose money. Labor and delivery could function as a "loss leader" for hospitals: though the hospital may lose money up front, a high-quality childbirth experience can result in strong loyalty to the hospital, making it the favored health care provider for entire families for many years to come.

In the broader arena of health care policy, the continued closure of obstetrics units must be monitored closely. Policymakers should pay particular attention to closures in rural areas. While three of our four case study interview respondents did not believe their hospitals' service closures had negative impacts on expectant mothers, this issue obviously deserves close and sustained attention. Policymakers (and other researchers) should extend the work done here, by analyzing markets in which hospitals have closed obstetrics units. They should work to quantify the impacts of these closures, in terms of variables such as travel distances and birth outcomes (rates of complications and Caesarian delivery).

Some level of labor and delivery unit closure may be appropriate. The existence of substantial numbers of units with low delivery volumes, and the resulting financial losses, may indicate overcapacity. In urban areas, closure of such units is far less problematic than in rural areas, where travel distances could begin to have measurable negative effects. If too many closures take place in sparsely populated but geographically large rural areas, for example in the High Sierra or Central Valley regions, then access to care could be compromised. Even if there has been little evidence of this to date, the issue of rural access to obstetrics (and all health care) deserves careful scrutiny. Additional state and/or federal government support for small, rural hospitals, perhaps targeting obstetrics specifically, may be warranted in the future. Some rural obstetrics units may never reach a volume of deliveries sufficient for profitability, but still be necessary to provide critical services for rural populations. Policymakers should work to

determine minimum standards of adequate service for rural areas in labor and delivery, and other types of health care services.

The very large number of hospitals opening inpatient rehabilitation units during the study period suggests other policy recommendations. Clearly, this service is one that will continue to expand, as California's (and the nation's) population ages, and ever-improving treatments for heart attacks, strokes, and other conditions increase demand for rehabilitative services. However, it is not clear that the surprisingly rapid growth of rehabilitation units within general acute care hospitals – 57 of the 368 hospitals in our study population added the service between 1995 and 2002 – was a response to community needs. Instead, many hospitals likely added this service because of its potential profitability, stemming from the exemption of inpatient rehabilitation units from the restrictive Medicare Prospective Payment System.

Given their financial difficulties, it is understandable that many general acute care hospitals would be eager to move into more profitable service areas. However, there is cause for concern in the case of inpatient rehabilitation. If the enthusiasm among general hospitals for opening inpatient rehabilitation units stems largely from what is essentially a loophole in Medicare reimbursement policy, what will happen if the federal government closes this loophole, as they have done in this case? Now that this service is subject to the restrictions of the Prospective Payment System, will hospitals respond to sharply reduced reimbursements by closing their recently opened rehabilitation units? Given the amount of planning and investment necessary to open such a unit, hospitals will not make any hasty moves in this direction, but over the medium term (say, the next 5 or 10 years), a substantial number of inpatient rehabilitation units could close, leading to insufficient capacity at precisely the point when the "baby boom" generation would start to have great demand for such services.

The case of inpatient rehabilitation points to a broader policy issue. As hospitals struggle for financial viability, they naturally will respond to the economic incentives embedded in the reimbursement policies of public payers, especially those of the federal government (Medicare and Medicaid/Medi-Cal). In 2002, federal government spending on health care accounted for 32.5% of all national health spending; total public expenditure on health care, including state and

local government spending (much of which consists of states' shares of Medicaid spending), was 45.9% of the national total (Heffler et al. 2004). The federal government share of health spending is likely to rise in the coming years, due to the expanding proportion of the population that is eligible for the program, and to increases in program benefits (such as the recently passed prescription drug benefit). As such, Medicare and Medicaid/Medi-Cal reimbursement policies will increasingly drive the decisionmaking processes of hospital executives.

The leading role of public payer reimbursement policies suggests that these policies must be more closely connected to health care needs, taking into account projections of demand for specific services as well as clinical evidence on the effectiveness of various treatment modalities. Unfortunately, the complexity of both the scientific issues, and of the legislative and regulatory processes involved in federal government health policies, makes this goal exceedingly difficult to achieve. Health policymakers must strive for improvement here nonetheless. The issue of inappropriate matches between reimbursement policies and community needs certainly plays a role in the two service changes most frequently observed in this study. As discussed above, California general acute care hospitals moved decisively into the field of inpatient rehabilitation services between 1995 and 2002, presumably because of its potential profitability as a growth area with (at the time) an attractive Medicare reimbursement formula. Similarly, Medicaid/Medi-Cal reimbursement policies for obstetrics services are likely a factor in driving small, rural hospitals to eliminate their labor and delivery units.

In general, there is a serious tension in our health care system between the competing ideals of a market-driven system for determining supply and a needs-based system for doing so. This tension is endemic to our essentially hybrid system, in which providers are primarily within the private sector, but the huge influence of public sector payers such as Medicare subjects the market to a high degree of regulation. Policymakers must continue to address the imbalance between these two influences on health care supply, and seek ways to bridge this gap.

Recommendations for Future Research

This study was intended as an initial assessment of hospital service changes and their impacts on hospitals and communities. Researchers should pursue a number of the issues raised here. Future research in this area should address the policy questions raised in the previous section, to provide policymakers and hospital executives with insights into the complex relationships between service mix, profitability, and the health care needs of communities.

First, we recommend that future researchers address the financial impacts on hospitals of service mix changes. In Chapter 4, we provided basic data on the financial performance of hospitals that eliminated, or added, multiple services, as compared with the rest of our study population of general acute care hospitals in California. However, we are unable to demonstrate a causal relationship between service changes and financial variables within the scope of the present research; to do so, future research must perform this analysis both more deeply and more broadly. An obvious first step is to collect and analyze hospital-level financial data in sufficient detail to match costs and revenues for specific services, so that researchers can directly assess the financial effects of service changes within individual hospitals. In addition, future work should aim for statistical validity in specifying the effects of service changes on hospital finances across groups of facilities. To do so, such work will have to pool much larger groups of hospitals than we have analyzed here, since the number of hospitals in our study population that made extensive changes is so small. Ideally, a large sample of hospitals nationwide would both provide sufficient data for statistical inference (and generalizability), and control for state- or region-specific factors (such as California state government mandates on nurse staffing levels or seismic retrofitting).

Second, future research should continue to address the community impacts of service changes, particularly service closures. In Chapters 5 and 6, we studied the effects of labor and delivery service closures on communities, hospitals, and health care consumers. Researchers and policymakers should continue to monitor this issue. Obstetrics unit closures are likely to continue, especially in small, rural hospitals, and such closures have the potential to reduce access to critical prenatal care if they force women to travel considerably longer distances to

receive care. If such closures in fact restrict access to prenatal care, and as a result lead to poor birth outcomes (increased rates of complications, and so forth), this is a critical public health issue that policymakers must address. Other researchers might want to replicate this type of analysis for specific service additions, such as inpatient rehabilitation. Here, the goal would be to determine if there are added benefits to consumers as a result of the new rehabilitation units.

In both of these types of analysis (financial impacts and effects on consumers and communities), researchers will have to pay careful attention to the issue of "legitimate" and "phantom" service changes. In assessing the impact of service changes, it is critical to filter out instances in which an apparent service change, according to the data, is actually an artifact of mergers between hospitals, or administrative reorganizations within hospital systems that consolidate data reporting of separate, but nearby, facilities. This presents a number of serious methodological challenges to researchers – how can one best distinguish between legitimate and phantom service changes? Moreover, any potential rule for making this distinction will be difficult to apply: in the case of this research, information on hospital mergers and data reporting consolidations had to be obtained from sources other than the discharge data used in the analysis. As a result of this difficulty, we did not verify all of the service changes found in the data, though we did point out members of the high-closer and high-opener groups that were most likely examples of phantom service changes. Ideally, future researchers would develop and apply a more systematic approach, i.e., one that could be made part of the data analysis itself, rather than the more ad hoc, retrospective approach used here.

A third recommendation is that future work on hospital services should deal with a critical issue we have not examined here: the role of specialty hospitals, particularly new facilities that are owned by physician investors. This is a relatively new phenomenon, but one that has already attracted considerable attention. Many health care analysts are concerned that, because specialty hospitals tend to treat patients needing more profitable services such as cardiac care, such hospitals could drain away the most profitable patients from general community hospitals (Devers, Brewster, and Ginsburg 2003). Moreover, there may be incentives for such hospitals to take only those patients that are likely to incur lower costs (within a given diagnostic category), and those with private health insurance. A federal government study of specialty hospitals

indeed found evidence of both types of favorable patient selection (U.S. General Accounting Office 2003).

Concerns about patient selection are magnified by the fact that physicians often have ownership interests in specialty hospitals. Physicians could refer patients that they first encounter in a general acute care hospital setting to specialty facilities in which they (the physicians) have a financial interest. While Medicare regulations intended to limit such practices are in place, the rules have exceptions that may allow such practices under certain circumstances (Ibid.). According to the federal government study cited above, California had 11 specialty hospitals as of June 2003, the second highest number among the states. If the pace of new specialty hospital construction accelerates, this trend could further undermine the already difficult financial positions of general community hospitals.

Finally, we make a broad recommendation concerning research efforts centered on the supply side of the health care system, of which this report is an example. Generally, researchers have tackled the question of health care supply from a workforce perspective: are there enough, or too many, physicians or other providers in geographic areas, or of specific types (generalist, specialist, and the like)? Recent work by researchers at the Nicholas C. Petris Center has addressed this issue (Coffman, Quinn, Brown, and Scheffler 2004; Scheffler and Kirby 2003), and workforce issues will continue to be of great interest. The present research, however, strongly suggests that health care policy analysis should also look at supply issues from a facilities perspective. The availability of medical services to specific communities is determined not only by the number of physicians living in these communities, but by the presence or absence of appropriate inpatient facilities in which physicians can practice. To return to an example from our research, if the sole hospital in a small, rural community closes its labor and delivery unit, this will very likely push local obstetricians to relocate their practices. These two key aspects of health care supply are closely related, and researchers should study them in tandem.

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APPENDIX A

List of Hospitals Included in Study Population

(list begins on next page)

OSHPD ID	HOSPITAL NAME	CITY	COUNTY
10846	Alameda County Medical Center	Oakland	Alameda
10735	Alameda Hospital	Alameda	Alameda
190017	Alhambra Hospital - Alhambra	Alhambra	Los Angeles
10739	Alta Bates Summit Medical Center-Alta Bates Campus	Berkeley	Alameda
10937	Alta Bates Summit Med Center-Summit Campus-Hawthorne	Oakland	Alameda
370652	Alvarado Hospital Medical Center	San Diego	San Diego
301097	Anaheim General Hospital	Anaheim	Orange
301098	Anaheim Memorial Medical Center	Anaheim	Orange
190034	Antelope Valley Hospital Medical Center	Lancaster	Los Angeles
364231	Arrowhead Regional Medical Center	Colton	San Bernardino
400466	Arroyo Grande Community Hospital	Arroyo Grande	San Luis Obispo
190045	Avalon Municipal Hospital	Avalon	Los Angeles
150722	Bakersfield Memorial Hospital	Bakersfield	Kern
361105	Barstow Community Hospital	Barstow	San Bernardino
90793	Barton Memorial Hospital	South Lake Tahoe	El Dorado
361110	Bear Valley Community Hospital	Big Bear Lake	San Bernardino
190066	Bellflower Medical Center	Bellflower	Los Angeles
190081	Beverly Hospital	Montebello	Los Angeles
40802	Biggs-Gridley Memorial Hospital	Gridley	Butte
301126	Brea Community Hospital	Brea	Orange
190110	Brotman Medical Center	Culver City	Los Angeles
190125	California Hospital Medical Center	Los Angeles	Los Angeles
380929	California Pacific Medical Center	San Francisco	San Francisco
190555	Cedars-Sinai Medical Center	Los Angeles	Los Angeles
190148	Centinela Hospital Medical Center	Inglewood	Los Angeles
160787	Central Valley General Hospital	Hanford	Kings
190155	Century City Hospital	Los Angeles	Los Angeles
301140	Chapman Medical Center	Orange	Orange
382715	Chinese Hospital	San Francisco	San Francisco
361144	Chino Valley Medical Center	Chino	San Bernardino
200692	Chowchilla District Memorial Hospital	Chowchilla	Madera
190413	Citrus Valley Medical Center – Inter-Community Campus	Covina	Los Angeles
190636	Citrus Valley Medical Center – Queen of the Valley Campus	West Covina	Los Angeles
100697	Coalinga Regional Medical Center	Coalinga	Fresno
190766	Coast Plaza Doctors Hospital	Norwalk	Los Angeles
301258	Coastal Communities Hospital	Santa Ana	Orange
301155	College Hospital Costa Mesa	Costa Mesa	Orange
361458	Colorado River Medical Center	Needles	San Bernardino
60870	Colusa Regional Medical Center	Colusa	Colusa
190197	Community & Mission Hospitals of Huntington Park	Huntington Park	Los Angeles
190196	Community Hospital of Gardena	Gardena	Los Angeles
190475	Community Hospital of Long Beach	Long Beach	Los Angeles
430743	Community Hospital of Los Gatos	Los Gatos	Santa Clara
270744	Community Hospital of the Monterey Peninsula	Monterey	Monterey
361323	Community Hospital of San Bernardino	San Bernardino	San Bernardino

OSHPD ID	HOSPITAL NAME	CITY	COUNTY
100005	Community Medical Center - Clovis	Clovis	Fresno
100717	Community Medical Center - Fresno	Fresno	Fresno
560473	Community Memorial Hospital - San Buenaventura	Ventura	Ventura
70924	Contra Costa Regional Medical Center	Martinez	Contra Costa
160702	Corcoran District Hospital	Corcoran	Kings
331152	Corona Regional Medical Center	Corona	Riverside
390846	Dameron Hospital	Stockton	San Joaquin
190500	Daniel Freeman Marina Hospital	Marina Del Rey	Los Angeles
190230	Daniel Freeman Memorial Hospital	Inglewood	Los Angeles
150706	Delano Regional Medical Center	Delano	Kern
331164	Desert Regional Medical Center	Palm Springs	Riverside
364144	Desert Valley Hospital	Victorville	San Bernardino
361166	Doctors' Hospital Medical Center Of Montclair	Montclair	San Bernardino
392287	Doctors Hospital Of Manteca	Manteca	San Joaquin
190857	Doctors Hospital Of West Covina	West Covina	Los Angeles
500852	Doctors Medical Center	Modesto	Stanislaus
70904	Doctors Medical Center - San Pablo	San Pablo	Contra Costa
440755	Dominican Santa Cruz Hospital - Soquel	Santa Cruz	Santa Cruz
240853	Dos Palos Memorial Hospital	Dos Palos	Merced
190243	Downey Regional Medical Center	Downey	Los Angeles
190256	East Los Angeles Doctor's Hospital	Los Angeles	Los Angeles
190328	East Valley Hospital Medical Center	Glendora	Los Angeles
320859	Eastern Plumas Health Care	Portola	Plumas
10805	Eden Medical Center	Castro Valley	Alameda
331168	Eisenhower Medical Center	Rancho Mirage	Riverside
430763	El Camino Hospital	Mountain View	Santa Clara
130699	El Centro Regional Medical Center	El Centro	Imperial
500867	Emanuel Medical Center	Turlock	Stanislaus
190280	Encino-Tarzana Regional Medical Center - Encino	Encino	Los Angeles
190517	Encino-Tarzana Regional Medical Center - Tarzana	Tarzana	Los Angeles
40962	Enloe Medical Center-Esplanade Campus	Chico	Butte
474007	Fairchild Medical Center	Yreka	Siskiyou
370705	Fallbrook Hospital District	Fallbrook	San Diego
40875	Feather River Hospital	Paradise	Butte
190298	Foothill Presbyterian Hospital	Glendora	Los Angeles
301175	Fountain Valley Regional Hospital & Medical Center - Euclid	Fountain Valley	Orange
230949	Frank R. Howard Memorial Hospital	Willits	Mendocino
510882	Fremont Medical Center	Yuba City	Sutter
400480	French Hospital Medical Center	San Luis Obispo	San Luis Obispo
104047	Fresno Surgery Center	Fresno	Fresno
301283	Garden Grove Hospital & Medical Center	Garden Grove	Orange
190315	Garfield Medical Center	Monterey Park	Los Angeles
120981	General Hospital (Eureka)	Eureka	Humboldt
270777	George L. Mee Memorial Hospital	King City	Monterey
190323	Glendale Adventist Medical Center	Glendale	Los Angeles
190522	Glendale Memorial Hospital & Health Center	Glendale	Los Angeles
110889	Glenn Medical Center	Willows	Glenn

OSHPD ID	HOSPITAL NAME	CITY	COUNTY
420483	Goleta Valley Cottage Hospital	Santa Barbara	Santa Barbara
150775	Good Samaritan Hospital - Bakersfield	Bakersfield	Kern
190392	Good Samaritan Hospital - Los Angeles	Los Angeles	Los Angeles
430779	Good Samaritan Hospital - San Jose	San Jose	Santa Clara
190348	Granada Hills Community Hospital	Granada Hills	Los Angeles
190352	Greater El Monte Community Hospital	South El Monte	Los Angeles
370714	Grossmont Hospital	La Mesa	San Diego
160725	Hanford Community Medical Center	Hanford	Kings
350784	Hazel Hawkins Memorial Hospital	Hollister	San Benito
490964	Healdsburg General Hospital	Healdsburg	Sonoma
331194	Hemet Valley Medical Center	Hemet	Riverside
190949	Henry Mayo Newhall Memorial Hospital	Valencia	Los Angeles
362041	Hi-Desert Medical Center	Joshua Tree	San Bernardino
301205	Hoag Memorial Hospital Presbyterian	Newport Beach	Orange
190380	Hollywood Community Hospital of Hollywood	Hollywood	Los Angeles
301209	Huntington Beach Hospital	Huntington Beach	Orange
190400	Huntington Memorial Hospital	Pasadena	Los Angeles
320874	Indian Valley Hospital	Greenville	Plumas
334001	Inland Valley Regional Medical Center	Wildomar	Riverside
304045	Irvine Regional Hospital and Medical Center	Irvine	Orange
121031	Jerold Phelps Community Hospital	Garberville	Humboldt
220733	John C. Fremont Healthcare District	Mariposa	Mariposa
331216	John F. Kennedy Memorial Hospital	Indio	Riverside
70988	John Muir Medical Center	Walnut Creek	Contra Costa
301132	Kaiser Foundation Hospital - Anaheim	Anaheim	Orange
190430	Kaiser Foundation Hospital - Bellflower	Bellflower	Los Angeles
361223	Kaiser Foundation Hospital - Fontana	Fontana	San Bernardino
104062	Kaiser Foundation Hospital - Fresno	Fresno	Fresno
380857	Kaiser Foundation Hospital - Geary (S.F.)	San Francisco	San Francisco
190431	Kaiser Foundation Hospital - Harbor City	Harbor City	Los Angeles
10858	Kaiser Foundation Hospital - Hayward	Hayward	Alameda
10856	Kaiser Foundation Hospital - Oakland Campus	Oakland	Alameda
190432	Kaiser Foundation Hospital - Panorama City	Panorama City	Los Angeles
410804	Kaiser Foundation Hospital - Redwood City	Redwood City	San Mateo
334025	Kaiser Foundation Hospital - Riverside	Riverside	Riverside
340913	Kaiser Foundation Hospital - Sacramento	Sacramento	Sacramento
370730	Kaiser Foundation Hospital - San Diego	San Diego	San Diego
210992	Kaiser Foundation Hospital - San Rafael	San Rafael	Marin
430805	Kaiser Foundation Hospital - Santa Clara	Santa Clara	Santa Clara
494019	Kaiser Foundation Hospital - Santa Rosa	Santa Rosa	Sonoma
431506	Kaiser Foundation Hospital - Santa Teresa Community Hospital	San Jose	Santa Clara
342344	Kaiser Foundation Hospital - South Sacramento	Sacramento	Sacramento
410806	Kaiser Foundation Hospital - South San Francisco	South San Francisco	San Mateo
190429	Kaiser Foundation Hospital - Sunset	Los Angeles	Los Angeles
480989	Kaiser Foundation Hospital - Vallejo	Vallejo	Solano
70990	Kaiser Foundation Hospital - Walnut Creek	Walnut Creek	Contra Costa
190434	Kaiser Foundation Hospital - West L.A.	Los Angeles	Los Angeles

OSHPD ID	HOSPITAL NAME	CITY	COUNTY
191450	Kaiser Foundation Hospital - Woodland Hills	Woodland Hills	Los Angeles
540734	Kaweah Delta District Hospital	Visalia	Tulare
150736	Kern Medical Center	Bakersfield	Kern
150737	Kern Valley Healthcare District	Lake Isabella	Kern
100745	Kingsburg Medical Hospital	Kingsburg	Fresno
301234	La Palma Intercommunity Hospital	La Palma	Orange
190240	Lakewood Regional Medical Center - South Street	Lakewood	Los Angeles
190455	Lancaster Community Hospital	Lancaster	Los Angeles
180919	Lassen Community Hospital	Susanville	Lassen
190468	Lincoln Hospital Medical Center	Los Angeles	Los Angeles
190680	Little Company of Mary-San Pedro Hospital	San Pedro	Los Angeles
190470	Little Company of Mary Hospital	Torrance	Los Angeles
390923	Lodi Memorial Hospital	Lodi	San Joaquin
361246	Loma Linda University Medical Center	Loma Linda	San Bernardino
420491	Lompoc Healthcare District	Lompoc	Santa Barbara
190525	Long Beach Memorial Medical Center	Long Beach	Los Angeles
301248	Los Alamitos Medical Center	Los Alamitos	Orange
190198	Los Angeles Community Hospital	Los Angeles	Los Angeles
191227	L.A. County/Harbor-UCLA Medical Center	Torrance	Los Angeles
191261	L.A. County/High Desert Hospital	Lancaster	Los Angeles
191230	L.A. County/Martin Luther King Jr./Drew Medical Center	Los Angeles	Los Angeles
191231	L.A. County/Olive View-UCLA Medical Center	Sylmar	Los Angeles
191228	L.A. County/USC Medical Center	Los Angeles	Los Angeles
190854	Los Angeles Metropolitan Medical Center	Los Angeles	Los Angeles
560492	Los Robles Regional Medical Center	Thousand Oaks	Ventura
121002	Mad River Community Hospital	Arcata	Humboldt
201281	Madera Community Hospital	Madera	Madera
260011	Mammoth Hospital	Mammoth Lakes	Mono
420493	Marian Medical Center	Santa Maria	Santa Barbara
211006	Marin General Hospital	Greenbrae	Marin
50932	Mark Twain St. Joseph's Hospital	San Andreas	Calaveras
90933	Marshall Medical Center	Placerville	El Dorado
450936	Mayers Memorial Hospital	Fall River Mills	Shasta
240924	Memorial Hospital Los Banos	Los Banos	Merced
500939	Memorial Hospital Medical Center Modesto	Modesto	Stanislaus
190521	Memorial Hospital Of Gardena	Gardena	Los Angeles
231013	Mendocino Coast District Hospital	Fort Bragg	Mendocino
334018	Menifee Valley Medical Center	Sun City	Riverside
340947	Mercy General Hospital	Sacramento	Sacramento
150761	Mercy Hospital - Bakersfield	Bakersfield	Kern
344029	Mercy Hospital - Folsom	Folsom	Sacramento
240942	Mercy Medical Center Merced - Community Campus	Merced	Merced
240948	Mercy Medical Center Merced - Dominican Campus	Merced	Merced
470871	Mercy Medical Center - Mt. Shasta	Mount Shasta	Siskiyou
450949	Mercy Medical Center - Redding	Redding	Shasta
340950	Mercy San Juan Hospital	Carmichael	Sacramento
150830	Mercy Westside Hospital	Taft	Kern

OSHPD ID	HOSPITAL NAME	CITY	COUNTY
340951	Methodist Hospital Of Sacramento	Sacramento	Sacramento
190529	Methodist Hospital Of Southern California	Arcadia	Los Angeles
190534	Midway Hospital Medical Center	Los Angeles	Los Angeles
410852	Mills-Peninsula Medical Center	Burlingame	San Mateo
190524	Mission Community Hospital - Panorama Campus	Panorama City	Los Angeles
301262	Mission Hospital Regional Medical Center	Mission Viejo	Orange
250956	Modoc Medical Center	Alturas	Modoc
190541	Monrovia Community Hospital	Monrovia	Los Angeles
190547	Monterey Park Hospital	Monterey Park	Los Angeles
334048	Moreno Valley Community Hospital	Moreno Valley	Riverside
190552	Motion Picture & Television Hospital	Woodland Hills	Los Angeles
361266	Mountains Community Hospital	Lake Arrowhead	San Bernardino
71018	Mt. Diablo Medical Center	Concord	Contra Costa
481357	North Bay Medical Center	Fairfield	Solano
141273	Northern Inyo Hospital	Bishop	Inyo
190568	Northridge Hospital Medical Center	Northridge	Los Angeles
190810	Northridge Hospital Medical Center - Sherman Way	Van Nuys	Los Angeles
190570	Norwalk Community Hospital	Norwalk	Los Angeles
500967	Oak Valley District Hospital	Oakdale	Stanislaus
430837	O'Connor Hospital	San Jose	Santa Clara
560501	Ojai Valley Community Hospital	Ojai	Ventura
300225	Orange Coast Memorial Medical Center	Fountain Valley	Orange
301242	Orange County Community Hospital - Buena Park	Buena Park	Orange
40937	Oroville Hospital	Oroville	Butte
190307	Pacific Alliance Medical Center	Los Angeles	Los Angeles
190587	Pacific Hospital Of Long Beach	Long Beach	Los Angeles
190696	Pacifica Hospital of the Valley	Sun Valley	Los Angeles
491338	Palm Drive Hospital	Sebastopol	Sonoma
331288	Palo Verde Hospital	Blythe	Riverside
370755	Palomar Medical Center	Escondido	San Diego
370759	Paradise Valley Hospital	National City	San Diego
331293	Parkview Community Hospital	Riverside	Riverside
454013	Patient's Hospital Of Redding	Redding	Shasta
491001	Petaluma Valley Hospital	Petaluma	Sonoma
130760	Pioneers Memorial Hospital	Brawley	Imperial
301297	Placentia-Linda Hospital	Placentia	Orange
320986	Plumas District Hospital	Quincy	Plumas
370977	Pomerado Hospital	Poway	San Diego
190630	Pomona Valley Hospital Medical Center	Pomona	Los Angeles
190631	Presbyterian Intercommunity Hospital	Whittier	Los Angeles
190385	Providence Holy Cross Medical Center	Mission Hills	Los Angeles
190758	Providence Saint Joseph Medical Center	Burbank	Los Angeles
190382	Queen of Angels-Hollywood Presbyterian Medical Center	Los Angeles	Los Angeles
281047	Queen of the Valley Hospital	Napa	Napa
171049	Redbud Community Hospital	Clearlake	Lake
450940	Redding Medical Center	Redding	Shasta
361308	Redlands Community Hospital	Redlands	San Bernardino

OSHPD ID	HOSPITAL NAME	CITY	COUNTY
121051	Redwood Memorial Hospital	Fortuna	Humboldt
430705	Regional Medical Center Of San Jose	San Jose	Santa Clara
580996	Rideout Memorial Hospital	Marysville	Yuba
150782	Ridgecrest Regional Hospital	Ridgecrest	Kern
331312	Riverside Community Hospital	Riverside	Riverside
334487	Riverside County Regional Medical Center	Moreno Valley	Riverside
190366	Robert F. Kennedy Medical Center	Hawthorne	Los Angeles
301317	Saddleback Memorial Medical Center	Laguna Hills	Orange
270875	Salinas Valley Memorial Hospital	Salinas	Monterey
361318	San Antonio Community Hospital	Upland	San Bernardino
301325	San Clemente Hospital & Medical Center	San Clemente	Orange
190673	San Dimas Community Hospital	San Dimas	Los Angeles
380939	San Francisco General Hospital Medical Center	San Francisco	San Francisco
190200	San Gabriel Valley Medical Center	San Gabriel	Los Angeles
331326	San Gorgonio Memorial Hospital	Banning	Riverside
150788	San Joaquin Community Hospital	Bakersfield	Kern
391010	San Joaquin General Hospital	French Camp	San Joaquin
430879	San Jose Medical Center	San Jose	Santa Clara
13619	San Leandro Hospital	San Leandro	Alameda
400511	San Luis Obispo General Hospital	San Luis Obispo	San Luis Obispo
410782	San Mateo Medical Center	San Mateo	San Mateo
74017	San Ramon Regional Medical Center	San Ramon	Contra Costa
190681	San Vicente Hospital	Los Angeles	Los Angeles
100791	Sanger General Hospital	Sanger	Fresno
301314	Santa Ana Hospital Medical Center	Santa Ana	Orange
420514	Santa Barbara Cottage Hospital	Santa Barbara	Santa Barbara
430883	Santa Clara Valley Medical Center	San Jose	Santa Clara
190685	Santa Marta Hospital	Los Angeles	Los Angeles
190687	Santa Monica - UCLA Medical Center	Santa Monica	Los Angeles
560521	Santa Paula Memorial Hospital	Santa Paula	Ventura
491064	Santa Rosa Memorial Hospital	Santa Rosa	Sonoma
190691	Santa Teresita Hospital	Duarte	Los Angeles
420522	Santa Ynez Valley Cottage Hospital	Solvang	Santa Barbara
371256	Scripps Green Hospital	La Jolla	San Diego
370658	Scripps Memorial Hospital - Chula Vista	Chula Vista	San Diego
371394	Scripps Memorial Hospital - Encinitas	Encinitas	San Diego
370771	Scripps Memorial Hospital - La Jolla	La Jolla	San Diego
370744	Scripps Mercy Hospital	San Diego	San Diego
100793	Selma Community Hospital	Selma	Fresno
321016	Seneca Healthcare District	Chester	Plumas
410891	Sequoia Hospital	Redwood City	San Mateo
410817	Seton Medical Center	Daly City	San Mateo
410828	Seton Medical Center - Coastside	Moss Beach	San Mateo
370693	Sharp Cabrillo Hospital	San Diego	San Diego
370875	Sharp Chula Vista Medical Center	Chula Vista	San Diego
370689	Sharp Coronado Hospital & Healthcare Center	Coronado	San Diego

OSHPD ID	HOSPITAL NAME	CITY	COUNTY
370694	Sharp Memorial Hospital	San Diego	San Diego
190708	Sherman Oaks Hospital & Health Center	Sherman Oaks	Los Angeles
100797	Sierra Kings District Hospital	Reedley	Fresno
291023	Sierra Nevada Memorial Hospital	Grass Valley	Nevada
461024	Sierra Valley District Hospital	Loyalton	Sierra
540798	Sierra View District Hospital	Porterville	Tulare
400524	Sierra Vista Regional Medical Center	San Luis Obispo	San Luis Obispo
560525	Simi Valley Hospital - Sycamore	Simi Valley	Ventura
491076	Sonoma Valley Hospital	Sonoma	Sonoma
551034	Sonora Community Hospital	Sonora	Tuolumne
301337	South Coast Medical Center	Laguna Beach	Orange
141338	Southern Inyo Hospital	Lone Pine	Inyo
334068	Southwest Healthcare System-Murrieta	Murrieta	Riverside
100899	St. Agnes Medical Center	Fresno	Fresno
361339	St. Bernardine Medical Center	San Bernardino	San Bernardino
394009	St. Dominic's Hospital	Manteca	San Joaquin
521041	St. Elizabeth Community Hospital	Red Bluff	Tehama
190754	St. Francis Medical Center	Lynwood	Los Angeles
420528	St. Francis Medical Center - Santa Barbara	Santa Barbara	Santa Barbara
380960	St. Francis Memorial Hospital	San Francisco	San Francisco
281078	St. Helena Hospital	Deer Park	Napa
190756	St. John's Hospital And Health Center	Santa Monica	Los Angeles
560508	St. John's Pleasant Valley Hospital	Camarillo	Ventura
560529	St. John's Regional Medical Center	Oxnard	Ventura
121080	St. Joseph Hospital - Eureka	Eureka	Humboldt
301340	St. Joseph Hospital - Orange	Orange	Orange
391042	St. Joseph's Medical Center Of Stockton	Stockton	San Joaquin
301342	St. Jude Medical Center	Fullerton	Orange
434138	St. Louise Regional Hospital	Gilroy	Santa Clara
190759	St. Luke Medical Center	Pasadena	Los Angeles
380964	St. Luke's Hospital	San Francisco	San Francisco
190053	St. Mary Medical Center	Long Beach	Los Angeles
361343	St. Mary Regional Medical Center	Apple Valley	San Bernardino
380965	St. Mary's Medical Center-San Francisco	San Francisco	San Francisco
10967	St. Rose Hospital	Hayward	Alameda
190762	St. Vincent Medical Center	Los Angeles	Los Angeles
430905	Stanford University Hospital	Palo Alto	Santa Clara
190599	Suburban Medical Center	Paramount	Los Angeles
250955	Surprise Valley Community Hospital	Cedarville	Modoc
34002	Sutter Amador Hospital	Jackson	Amador
310791	Sutter Auburn Faith Hospital	Auburn	Placer
84001	Sutter Coast Hospital	Crescent City	Del Norte
574010	Sutter Davis Hospital	Davis	Yolo
70934	Sutter Delta Medical Center	Antioch	Contra Costa
341051	Sutter General Hospital	Sacramento	Sacramento
171395	Sutter Lakeside Hospital	Lakeport	Lake
490919	Sutter Medical Center Of Santa Rosa	Santa Rosa	Sonoma

OSHPD ID	HOSPITAL NAME	CITY	COUNTY
341052	Sutter Memorial Hospital	Sacramento	Sacramento
311000	Sutter Roseville Medical Center	Roseville	Placer
481094	Sutter Solano Medical Center	Vallejo	Solano
391056	Sutter Tracy Community Hospital	Tracy	San Joaquin
491103	Sutter Warrack Hospital	Santa Rosa	Sonoma
291053	Tahoe Forest Hospital	Truckee	Nevada
150808	Tehachapi Hospital	Tehachapi	Kern
190784	Temple Community Hospital	Los Angeles	Los Angeles
190422	Torrance Memorial Medical Center	Torrance	Los Angeles
370780	Tri-City Medical Center	Oceanside	San Diego
190159	Tri-City Regional Medical Center	Hawaiian Gardens	Los Angeles
531059	Trinity General Hospital	Weaverville	Trinity
540816	Tulare District Hospital	Tulare	Tulare
551061	Tuolumne General Hospital	Sonora	Tuolumne
301357	Tustin Hospital Medical Center	Tustin	Orange
400548	Twin Cities Community Hospital	Templeton	San Luis Obispo
190796	UCLA Medical Center	Los Angeles	Los Angeles
374141	UCSD/La Jolla - Thornton Hospital	La Jolla	San Diego
381154	UCSF Medical Center	San Francisco	San Francisco
231396	Ukiah Valley Medical Center - Hospital Drive	Ukiah	Mendocino
370787	University Community Medical Center	San Diego	San Diego
100822	University Medical Center	Fresno	Fresno
341006	University of California Davis Medical Center	Sacramento	Sacramento
301279	University of California Irvine Medical Center	Orange	Orange
370782	University of California San Diego Medical Center	San Diego	San Diego
194219	USC University Hospital	Los Angeles	Los Angeles
484001	Vaca Valley Hospital	Vacaville	Solano
10983	Valley Memorial Hospital	Livermore	Alameda
332172	Valley Plaza Doctors Hospital	Perris	Riverside
190812	Valley Presbyterian Hospital	Van Nuys	Los Angeles
560481	Ventura County Medical Center	Ventura	Ventura
190818	Verdugo Hills Hospital	Glendale	Los Angeles
361370	Victor Valley Community Hospital	Victorville	San Bernardino
10987	Washington Hospital - Fremont	Fremont	Alameda
444013	Watsonville Community Hospital	Watsonville	Santa Cruz
301379	West Anaheim Medical Center	Anaheim	Orange
190859	West Hills Hospital & Medical Center	Canoga Park	Los Angeles
301188	Western Medical Center - Anaheim	Anaheim	Orange
301566	Western Medical Center - Santa Ana	Santa Ana	Orange
190878	White Memorial Medical Center	Los Angeles	Los Angeles
190883	Whittier Hospital Medical Center	Whittier	Los Angeles
571086	Woodland Memorial Hospital	Woodland	Yolo

APPENDIX B

Hospital Service Category (HSC) Groupings of Diagnosis Related Groups (DRGs)

HSC Number	HSC Type and Name	Diagnosis-Related Groups in the Service Category
1	General Medicine (GM)	73, 74, 96-102, 121-123, 141, 276, 283, 284
2	GM, Cardiology	126, 127, 129-134, 140, 142-145
3	GM, Endocrinology	294-298
4	GM, Gastroenterology	174-178, 180-184, 188-190, 202, 204-206
5	GM, Miscellaneous	66-71, 128, 238, 240-249, 256, 277-279, 320-322, 411, 416-423, 447-456, 463-467
6	GM, Neurology	20-22, 24-26, 31, 34, 35, 65
7	GM, Pulmonology	78-81, 85-91, 475
8	Med, Dermatology	271-273
9	Med, Neonatology	385-390
10	Med, Ophthalmology	43-48
11	Med, Psychiatry	425-432
12	Med, Rehabilitation	462
13	Med, Substance Abuse	433-437, 521-523
14	Sp Svc, Chemotherapy	410
15	Sp Svc, Endoscopy	199, 200, 207, 208, 412
16	Sp Svc, Inv Cardiology	115-118, 124, 125
17	Sp Svc, Oncology w/ OR	400-402, 406-408
18	Sp Svc, Radiology	409
19	Sp Svc, Renal F, Dialysis	317
20	Sp Svc, Renal Failure	316
21	Sp Svc, Sp Neurology	12-14
22	Spec, Cardiology	135-139
23	Spec, Endocrinology	299-301
24	Spec, Gastroenterology	179
25	Spec, Neurology	15-19, 23
26	Spec, Oncology	10, 11, 64, 82, 172, 173, 203, 239, 274, 275, 318, 319, 346, 347, 366, 367, 395-399, 403-405, 413, 414, 473, 481, 489, 490, 492
27	Spec, Pulmonology	92, 93
28	Surg, Burns	457
29	Surg, Cardiology	104-109, 514, 515
30	Surg, ENT	50, 51, 53-55, 57-63, 72, 291, 482, 483
31	Surg, ENT Tertiary	49
32	Surg, General	94, 95, 113, 114, 119, 146-167, 170, 171, 192-198, 201, 216, 257-262, 267, 269, 270, 285, 287-290, 292, 293, 392-394, 415, 440, 461, 468, 477, 488, 493, 494
33	Surg, Gastroenterology	191

HSC Number	HSC Type and Name	Diagnosis-Related Groups in the Service Category
34	Surg, Neurology	7, 8
35	Surg, Neurology w/ Cran	1-3, 286, 424, 484
36	Surg, OB/Gynecology	353-365, 368-384
37	Surg, Ophthalmology	36-42
38	Surg, Oral	168, 169, 185-187
39	Surg, Orthopedics	4, 6, 9, 210-215, 218-237, 250-255, 441, 471, 485, 491, 496-503, 519, 520
40	Surg, Orthotics	209
41	Surg, Plastic	52, 56, 217, 263-266, 268, 439, 458-460, 504, 506
42	Surg, Thoracic	75-77, 109
43	Surg, Transplant	103, 302, 480, 495, 512, 513
44	Surg, Urology	303-315, 323-345, 348-352, 476
45	Surg, Vascular	5, 110-112, 120, 478, 479, 516-518
46	Trauma, Major	27-30, 83, 84, 442-446, 486, 487
47	Trauma, Minor	32, 33, 280-282
48	Med, Normal Newborn	391

APPENDIX C

Hospital Service Categories (HSCs) – Frequency of Closure Using 85%, 95%, and 99% Decrease Criteria

1. 95% Decrease Criterion – Full Results

HSC Number	HSC Type and Name	# Hospitals Closing HSC
48	Med, Normal Newborn	28
9	Med, Neonatology	24
14	Sp Svc, Chemotherapy	18
12	Med, Rehabilitation	14
36	Surg, OB/Gynecology	12
11	Med, Psychiatry	8
40	Surg, Orthotics	8
18	Sp Svc, Radiology	7
45	Surg, Vascular	7
32	Surg, General	6
13	Med, Substance Abuse	5
16	Sp Svc, Inv Cardiology	5
29	Surg, Cardiology	4
35	Surg, Neurology w Craniotomy	4
42	Surg, Thoracic	4
15	Sp Svc, Endoscopy	3
22	Spec, Cardiology	3
37	Surg, Opthalmology	3
5	GM, Miscellaneous	2
8	Med, Dermatology	2
21	Sp Svc, Sp Neurology	2
30	Surg, ENT	2
34	Surg, Neurology	2
44	Surg, Urology	2
46	Trauma, Major	2
1	General Medicine	1
2	GM, Cardiology	1
3	GM, Endocrinology	1
4	GM, Gastroenterology	1
7	GM, Pulmonology	1
17	Sp Svc, Oncology w/ OR	1
20	Sp Svc, Renal Failure	1
23	Spec, Endocrinology	1
26	Spec, Oncology	1
27	Spec, Pulmonology	1

HSC Number	HSC Type and Name	# Hospitals Closing HSC
41	Surg, Plastic	1
43	Surg, Transplant	1
6	GM, Neurology	0
10	Med, Opthalmology	0
19	Sp Svc, Renal Failure, Dialysis	0
24	Spec, Gastroenterology	0
25	Spec, Neurology	0
28	Surg, Burns	0
31	Surg, ENT Tertiary	0
33	Surg, Gastroenterology	0
38	Surg, Oral	0
39	Surg, Orthopedics	0
47	Trauma, Minor	0

2. Sensitivity Analysis – 85% Decrease Criterion

HSC Number	HSC Type and Name	# Hospitals Closing HSC
14	Sp Svc, Chemotherapy	38
9	Med, Neonatology	28
36	Surg, OB/Gynecology	28
48	Med, Normal Newborn	28
11	Med, Psychiatry	19
12	Med, Rehabilitation	14
13	Med, Substance Abuse	14
18	Sp Svc, Radiology	10
32	Surg, General	10
45	Surg, Vascular	10
40	Surg, Orthotics	9
37	Surg, Opthalmology	8
42	Surg, Thoracic	8
1	General Medicine	7
16	Sp Svc, Inv Cardiology	7
22	Spec, Cardiology	7
35	Surg, Neurology w Craniotomy	7
39	Surg, Orthopedics	7
15	Sp Svc, Endoscopy	5
29	Surg, Cardiology	5
44	Surg, Urology	5
46	Trauma, Major	5
4	GM, Gastroenterology	4

HSC Number	HSC Type and Name	# Hospitals Closing HSC
7	GM, Pulmonology	4
21	Sp Svc, Sp Neurology	4
41	Surg, Plastic	4
2	GM, Cardiology	3
5	GM, Miscellaneous	3
8	Med, Dermatology	3
17	Sp Svc, Oncology w/ OR	3
26	Spec, Oncology	3
30	Surg, ENT	3
34	Surg, Neurology	3
3	GM, Endocrinology	2
6	GM, Neurology	2
20	Sp Svc, Renal Failure	2
23	Spec, Endocrinology	2
24	Spec, Gastroenterology	2
25	Spec, Neurology	2
19	Sp Svc, Renal Failure, Dialysis	1
27	Spec, Pulmonology	1
33	Surg, Gastroenterology	1
38	Surg, Oral	1
43	Surg, Transplant	1
47	Trauma, Minor	1
10	Med, Opthalmology	0
28	Surg, Burns	0
31	Surg, ENT Tertiary	0

3. Sensitivity Analysis – 99% Decrease Criterion

HSC Number	HSC Type and Name	# Hospitals Closing HSC
48	Med, Normal Newborn	26
9	Med, Neonatology	23
12	Med, Rehabilitation	12
14	Sp Svc, Chemotherapy	12
18	Sp Svc, Radiology	6
36	Surg, OB/Gynecology	5
16	Sp Svc, Inv Cardiology	4
35	Surg, Neurology w Craniotomy	4
40	Surg, Orthotics	4
11	Med, Psychiatry	3
29	Surg, Cardiology	3

HSC Number	HSC Type and Name	# Hospitals Closing HSC
42	Surg, Thoracic	3
45	Surg, Vascular	3
13	Med, Substance Abuse	2
15	Sp Svc, Endoscopy	2
32	Surg, General	2
34	Surg, Neurology	2
37	Surg, Opthalmology	2
1	General Medicine	1
4	GM, Gastroenterology	1
8	Med, Dermatology	1
17	Sp Svc, Oncology w/ OR	1
20	Sp Svc, Renal Failure	1
22	Spec, Cardiology	1
23	Spec, Endocrinology	1
27	Spec, Pulmonology	1
30	Surg, ENT	1
41	Surg, Plastic	1
43	Surg, Transplant	1
44	Surg, Urology	1
46	Trauma, Major	1
2	GM, Cardiology	0
3	GM, Endocrinology	0
5	GM, Miscellaneous	0
6	GM, Neurology	0
7	GM, Pulmonology	0
10	Med, Opthalmology	0
19	Sp Svc, Renal Failure, Dialysis	0
21	Sp Svc, Sp Neurology	0
24	Spec, Gastroenterology	0
25	Spec, Neurology	0
26	Spec, Oncology	0
28	Surg, Burns	0
31	Surg, ENT Tertiary	0
33	Surg, Gastroenterology	0
38	Surg, Oral	0
39	Surg, Orthopedics	0
47	Trauma, Minor	0

APPENDIX D

Hospital Service Categories (HSCs) – Frequency of Opening Using 500%, 1000%, and 1500% Increase Criteria

1. 1000% Increase Criterion – Full Results

HSC Number	HSC Type and Name	# Hospitals Opening HSC
12	Med, Rehabilitation	57
19	Sp Svc, Renal Failure, Dialysis	12
9	Med, Neonatology	9
29	Surg, Cardiology	9
48	Med, Normal Newborn	8
14	Sp Svc, Chemotherapy	7
11	Med, Psychiatry	6
13	Med, Substance Abuse	6
24	Spec, Gastroenterology	5
28	Surg, Burns	5
40	Surg, Orthotics	5
20	Sp Svc, Renal Failure	4
27	Spec, Pulmonology	4
6	GM, Neurology	3
34	Surg, Neurology	3
36	Surg, OB/Gynecology	3
39	Surg, Orthopedics	3
41	Surg, Plastic	3
45	Surg, Vascular	3
1	General Medicine	2
4	GM, Gastroenterology	2
8	Med, Dermatology	2
15	Sp Svc, Endoscopy	2
22	Spec, Cardiology	2
25	Spec, Neurology	2
26	Spec, Oncology	2
33	Surg, Gastroenterology	2
38	Surg, Oral	2
2	GM, Cardiology	1
3	GM, Endocrinology	1
5	GM, Miscellaneous	1
7	GM, Pulmonology	1
16	Sp Svc, Inv Cardiology	1
18	Sp Svc, Radiology	1
21	Sp Svc, Sp Neurology	1
23	Spec, Endocrinology	1
32	Surg, General	1

HSC Number	HSC Type and Name	# Hospitals Opening HSC
43	Surg, Transplant	1
44	Surg, Urology	1
47	Trauma, Minor	1
10	Med, Opthalmology	0
17	Sp Svc, Oncology w/ OR	0
30	Surg, ENT	0
31	Surg, ENT Tertiary	0
35	Surg, Neurology w Craniotomy	0
37	Surg, Opthalmology	0
42	Surg, Thoracic	0
46	Trauma, Major	0

2. Sensitivity Analysis – 500% Increase Criterion

HSC Number	HSC Type and Name	# Hospitals Opening HSC
12	Med, Rehabilitation	67
27	Spec, Pulmonology	17
28	Surg, Burns	16
13	Med, Substance Abuse	15
19	Sp Svc, Renal Failure, Dialysis	15
20	Sp Svc, Renal Failure	13
11	Med, Psychiatry	11
14	Sp Svc, Chemotherapy	11
8	Med, Dermatology	10
29	Surg, Cardiology	10
34	Surg, Neurology	10
9	Med, Neonatology	9
24	Spec, Gastroenterology	9
23	Spec, Endocrinology	8
38	Surg, Oral	8
48	Med, Normal Newborn	8
10	Med, Opthalmology	7
47	Trauma, Minor	7
40	Surg, Orthotics	6
6	GM, Neurology	4
15	Sp Svc, Endoscopy	4
18	Sp Svc, Radiology	4
25	Spec, Neurology	4
39	Surg, Orthopedics	4
41	Surg, Plastic	4
42	Surg, Thoracic	4
1	General Medicine	3

HSC Number	HSC Type and Name	# Hospitals Opening HSC
16	Sp Svc, Inv Cardiology	3
21	Sp Svc, Sp Neurology	3
22	Spec, Cardiology	3
33	Surg, Gastroenterology	3
36	Surg, OB/Gynecology	3
44	Surg, Urology	3
45	Surg, Vascular	3
4	GM, Gastroenterology	2
26	Spec, Oncology	2
30	Surg, ENT	2
31	Surg, ENT Tertiary	2
35	Surg, Neurology w Craniotomy	2
37	Surg, Opthalmology	2
2	GM, Cardiology	1
3	GM, Endocrinology	1
5	GM, Miscellaneous	1
7	GM, Pulmonology	1
17	Sp Svc, Oncology w/ OR	1
32	Surg, General	1
43	Surg, Transplant	1
46	Trauma, Major	0

3. Sensitivity Analysis – 1500% Increase Criterion

HSC Number	HSC Type and Name	# Hospitals Opening HSC
12	Med, Rehabilitation	54
9	Med, Neonatology	9
29	Surg, Cardiology	9
19	Sp Svc, Renal Failure, Dialysis	8
48	Med, Normal Newborn	8
14	Sp Svc, Chemotherapy	6
11	Med, Psychiatry	5
28	Surg, Burns	4
40	Surg, Orthotics	4
6	GM, Neurology	3
13	Med, Substance Abuse	3
36	Surg, OB/Gynecology	3
39	Surg, Orthopedics	3
1	General Medicine	2
4	GM, Gastroenterology	2
15	Sp Svc, Endoscopy	2
20	Sp Svc, Renal Failure	2

HSC Number	HSC Type and Name	# Hospitals Opening HSC
22	Spec, Cardiology	2
24	Spec, Gastroenterology	2
25	Spec, Neurology	2
26	Spec, Oncology	2
41	Surg, Plastic	2
2	GM, Cardiology	1
3	GM, Endocrinology	1
5	GM, Miscellaneous	1
7	GM, Pulmonology	1
16	Sp Svc, Inv Cardiology	1
18	Sp Svc, Radiology	1
32	Surg, General	1
33	Surg, Gastroenterology	1
34	Surg, Neurology	1
43	Surg, Transplant	1
44	Surg, Urology	1
45	Surg, Vascular	1
8	Med, Dermatology	0
10	Med, Opthalmology	0
17	Sp Svc, Oncology w/ OR	0
21	Sp Svc, Sp Neurology	0
23	Spec, Endocrinology	0
27	Spec, Pulmonology	0
30	Surg, ENT	0
31	Surg, ENT Tertiary	0
35	Surg, Neurology w Craniotomy	0
37	Surg, Opthalmology	0
38	Surg, Oral	0
42	Surg, Thoracic	0
46	Trauma, Major	0
47	Trauma, Minor	0

APPENDIX E

Case Study Site Visit Key Informant Interview Guide

The following are guide questions for the semi-structured interviews.

1) [For focal hospitals] What led your hospital to decide to close the service?

2) [For local entities] What is the relationship between your hospital/organization and the facility that closed services?

3) How did this service closure affect your hospital/organization?

4) Have there been changes in the prices of services as a result of this service closure?

5) How did the service closure affect the financial status of your hospital/organization?

6) What other changes resulted at your hospital/organization as a result of this service closure?

7) Have there been changes in *access to care* for the general population served by your hospital/organization as a result of this service closure?

8) Have there been changes in *access to care* for vulnerable populations served by your hospital/organization as a result of this service closure?

9) Have there been changes in the *quality of care* for the general population served by your hospital/organization as a result of this service closure?

10) Have there been changes in the *quality of care* for vulnerable populations served by your hospital/ organization as a result of this service closure?

11) What has your hospital/organization done in response to these changes?

12) What was the mix of payers for the patients who were served previously? Did this mix have any effect on the decision to close the service?

13) How did the community respond to the closure? Were any community groups active or involved in issues surrounding the closure?

14) Did you inform other local health providers that you would be closing this service? How did they respond? What providers picked up the patient load from the service you closed?

APPENDIX F

Additional Tables from Chapter 6

Table 6.6: Linear Probability Models of Bypass of Nearest Hospital for Obstetrics Care, for All Patients, Urban Patients, and Rural Patients

	All patients		Urban patients		Rural patients	
	Coefficient	Standard Error	Coefficient	Standard Error	Coefficient	Standard Error
Distance to nearest hosp	**0.014**	0.006	0.012	0.008	**0.009**	0.001
Distance to next-nearest hosp	**-0.016**	0.007	**-0.020**	0.005	-0.004	0.002
Distance to NICU	-0.002	0.001	0.000	0.009	0.000	0.001
Deliveries at nearest hosp	**-0.000056**	0.000014	**-0.000057**	0.000013	**-0.000328**	0.000060
Deliveries at next-nearest hosp	**0.000015**	0.000005	**0.000010**	0.000005	0.000079	0.000054
Deliveries at NICU	-0.000004	0.000007	-0.000004	0.000007	0.000047	0.000033
Tech index at nearest hosp	-0.006	0.006	-0.003	0.006	0.024	0.027
Tech index at next-nearest hosp	0.005	0.003	**0.006**	0.003	0.028	0.023
Tech index at NICU	**-0.009**	0.004	**-0.011**	0.005	-0.027	0.018
For-profit nearest hospital	0.047	0.026	**0.058**	0.023	-0.110	0.050
For-profit next-nearest hosp	0.033	0.020	0.032	0.019	-0.159	0.063
For-profit NICU	-0.026	0.021	-0.010	0.021	0.026	0.082
Gov't owned nearest hosp	-0.029	0.046	-0.058	0.049	0.149	0.081
Gov't owned NICU	0.031	0.028	**0.047**	0.020	**0.231**	0.070
Age 20-24	**0.013**	0.002	**0.013**	0.002	0.017	0.011
Age 25-29	**0.022**	0.005	**0.020**	0.005	**0.026**	0.004
Age 30-34	**0.028**	0.008	**0.025**	0.008	**0.038**	0.005

	All patients		Urban patients		Rural patients	
	Coefficient	Standard Error	Coefficient	Standard Error	Coefficient	Standard Error
Age 35-39	**0.031**	0.009	**0.028**	0.008	**0.020**	0.006
Age 40-49	**0.033**	0.010	**0.029**	0.008	0.032	0.026
Medi-Cal	-0.034	0.021	-0.040	0.022	**-0.054**	0.014
Indigent program	-0.005	0.075	-0.002	0.079	**-0.150**	0.007
Other gov't payer	0.000	0.049	0.003	0.052	0.042	0.080
Self pay	-0.027	0.020	-0.035	0.021	-0.014	0.022
HMO	**0.065**	0.024	**0.057**	0.025	0.018	0.037
PPO	**0.051**	0.018	**0.045**	0.018	-0.003	0.069
Hispanic	0.015	0.021	0.004	0.018	**-0.049**	0.004
Black	**0.055**	0.024	**0.045**	0.021	-0.008	0.027
Native American	0.033	0.032	0.000	0.027	**0.136**	0.025
Asian	0.046	0.024	0.038	0.023	-0.041	0.059
Other race	**0.058**	0.021	**0.048**	0.019	**0.087**	0.015
1996	0.006	0.004	0.007	0.005	**0.024**	0.006
1997	0.003	0.011	0.001	0.011	**0.161**	0.043
1998	0.002	0.011	-0.001	0.010	**0.172**	0.046
1999	-0.005	0.011	-0.005	0.011	0.133	0.069
2000	0.009	0.011	0.011	0.011	0.082	0.062
2001	-0.001	0.013	0.001	0.014	-0.076	0.124
2002	**-0.049**	0.018	**-0.046**	0.019	-0.135	0.148
Constant	**0.866**	0.064	**0.893**	0.067	**0.572**	0.190
R-squared	0.079		0.084		0.246	
Number of observations	732,277		716,530		15,747	

Bold numbers are significant at the 0.05 level.

Source: Petris Center analysis of OSHPD patient discharge data.

Table 6.7: Linear Probability Models of Bypass of Nearest Hospital for Obstetrics Care, for Cesarean and Vaginal Deliveries

	Cesarean deliveries		Vaginal deliveries	
	Coefficient	Standard Error	Coefficient	Standard Error
Distance to nearest hosp	0.010	0.006	**0.015**	0.006
Distance to next-nearest hosp	-0.014	0.007	**-0.016**	0.007
Distance to NICU	-0.003	0.001	-0.002	0.001
Deliveries at nearest hosp	**-0.000058**	0.000015	**-0.000056**	0.000014
Deliveries at next-nearest hosp	**0.000016**	0.000005	**0.000014**	0.000005
Deliveries at NICU	-0.000005	0.000007	-0.000003	0.000007
Tech index at nearest hosp	-0.007	0.007	-0.005	0.006
Tech index at next-nearest hosp	0.005	0.003	0.005	0.003
Tech index at NICU	**-0.010**	0.005	-0.008	0.004
For-profit nearest hospital	0.039	0.024	0.049	0.027
For-profit next-nearest hosp	0.034	0.023	0.032	0.019
For-profit NICU	-0.024	0.024	-0.026	0.020
Gov't owned nearest hosp	-0.051	0.055	-0.023	0.044
Gov't owned NICU	0.013	0.030	0.035	0.027
Age 20-24	**0.020**	0.007	**0.013**	0.002
Age 25-29	**0.032**	0.009	**0.020**	0.006
Age 30-34	**0.039**	0.010	**0.026**	0.009
Age 35-39	**0.047**	0.011	**0.027**	0.009
Age 40-49	**0.045**	0.012	**0.031**	0.010
Medi-Cal	-0.035	0.021	-0.034	0.021
Indigent program	0.025	0.083	-0.011	0.074
Other gov't payer	0.015	0.043	-0.005	0.051
Self pay	-0.032	0.024	-0.025	0.020
HMO	**0.057**	0.023	**0.067**	0.024
PPO	**0.052**	0.016	**0.051**	0.019
Hispanic	0.018	0.021	0.014	0.021
Black	**0.066**	0.025	**0.052**	0.023
Native American	0.062	0.039	0.024	0.031
Asian	**0.048**	0.023	0.045	0.025
Other race	**0.058**	0.021	**0.058**	0.021
1996	0.006	0.006	0.007	0.004
1997	0.005	0.012	0.002	0.011
1998	0.001	0.012	0.002	0.011
1999	0.001	0.012	-0.007	0.012
2000	0.016	0.010	0.007	0.012
2001	0.010	0.013	-0.004	0.014
2002	**-0.045**	0.020	**-0.051**	0.018
Constant	**0.873**	0.067	**0.863**	0.064
R-squared	0.085		0.078	

	Cesarean deliveries	Vaginal deliveries
Number of observations	159,972	572,305

Bold numbers are significant at the 0.05 level.
Source: Petris Center analysis of OSHPD patient discharge data.

Table 6.8: Linear Probability Models of Bypass of Nearest Hospital for Obstetrics Care, for Complicated and Uncomplicated Deliveries

	Complicated deliveries		Uncomplicated deliveries	
	Coefficient	Standard Error	Coefficient	Standard Error
Distance to nearest hosp	0.008	0.006	**0.015**	0.007
Distance to next-nearest hosp	-0.012	0.007	**-0.016**	0.007
Distance to NICU	-0.003	0.002	-0.002	0.001
Deliveries at nearest hosp	**-0.000055**	0.000013	**-0.000056**	0.000015
Deliveries at next-nearest hosp	**0.000017**	0.000006	**0.000014**	0.000005
Deliveries at NICU	0.000002	0.000009	-0.000004	0.000007
Tech index at nearest hosp	-0.009	0.007	-0.005	0.006
Tech index at next-nearest hosp	0.004	0.004	0.005	0.003
Tech index at NICU	-0.006	0.004	**-0.009**	0.004
For-profit nearest hospital	0.046	0.029	0.047	0.026
For-profit next-nearest hosp	0.026	0.028	0.034	0.019
For-profit NICU	0.001	0.023	-0.029	0.020
Gov't owned nearest hosp	-0.006	0.036	-0.034	0.048
Gov't owned NICU	0.028	0.031	0.031	0.027
Age 20-24	**0.017**	0.006	**0.013**	0.002
Age 25-29	**0.027**	0.007	**0.021**	0.005
Age 30-34	**0.034**	0.009	**0.027**	0.008
Age 35-39	**0.029**	0.010	**0.031**	0.009
Age 40-49	**0.027**	0.011	**0.033**	0.010
Medi-Cal	-0.023	0.021	-0.036	0.021
Indigent program	0.025	0.092	-0.010	0.073
Other gov't payer	0.052	0.046	-0.010	0.050
Self pay	-0.048	0.027	-0.023	0.020
HMO	**0.066**	0.025	**0.064**	0.024
PPO	**0.041**	0.017	**0.053**	0.018
Hispanic	0.034	0.022	0.012	0.021
Black	**0.054**	0.025	**0.054**	0.024
Native American	0.009	0.029	0.037	0.033
Asian	**0.051**	0.021	0.045	0.025
Other race	**0.061**	0.024	**0.058**	0.021
1996	**0.016**	0.008	0.005	0.005
1997	0.005	0.012	0.002	0.012
1998	0.006	0.014	0.001	0.011
1999	0.005	0.016	-0.007	0.011
2000	0.010	0.011	0.009	0.012
2001	0.004	0.012	-0.002	0.014
2002	-0.032	0.019	**-0.052**	0.018
Constant	**0.861**	0.073	**0.867**	0.063
R-squared	0.084		0.079	

	Complicated deliveries	Uncomplicated deliveries
Number of observations	93,815	638,462

Bold numbers are significant at the 0.05 level.
Source: Petris Center analysis of OSHPD patient discharge data.

Table 6.10: Linear Regression Equations of Distance Traveled for Obstetrics Care, for All Patients, Urban Patients, and Rural Patients

	All patients		Urban patients		Rural patients	
	Coefficient	Standard Error	Coefficient	Standard Error	Coefficient	Standard Error
Distance to nearest hosp	**0.466**	0.097	**0.395**	0.069	0.231	0.153
Distance to next-nearest hosp	**0.444**	0.139	0.322	0.155	**0.717**	0.189
Distance to NICU	0.037	0.036	0.202	0.126	-0.012	0.024
Distance to closed hospital	0.110	0.066	0.081	0.049	0.206	0.192
Deliveries at nearest hosp	**-0.000331**	0.000086	**-0.000252**	0.000093	-0.000013	0.000981
Deliveries at next-nearest hosp	-0.000063	0.000051	-0.000027	0.000057	0.000477	0.000898
Deliveries at NICU	0.000124	0.000105	0.000048	0.000111	-0.000706	0.002403
Tech index at nearest hosp	-0.096	0.065	-0.022	0.079	-0.431	1.531
Tech index at next-nearest hosp	-0.056	0.051	-0.015	0.061	-0.234	1.322
Tech index at NICU	0.038	0.062	-0.001	0.071	0.463	0.629
For-profit nearest hospital	0.204	0.212	0.338	0.261	-0.912	2.689
For-profit next-nearest hosp	0.386	0.192	**0.440**	0.197	-1.475	3.476
For-profit NICU	0.049	0.268	-0.096	0.297	0.388	2.413
Gov't owned nearest hosp	0.070	0.338	-0.259	0.320	0.950	3.038
Gov't owned NICU	-0.127	0.290	0.118	0.296	0.750	3.416
Age 20-24	**0.237**	0.070	**0.202**	0.067	1.590	0.633
Age 25-29	**0.235**	0.069	**0.213**	0.069	0.533	0.405
Age 30-34	**0.319**	0.096	**0.274**	0.088	0.537	0.987
Age 35-39	**0.324**	0.139	0.243	0.126	2.022	0.972

	All patients		Urban patients		Rural patients	
	Coefficient	Standard Error	Coefficient	Standard Error	Coefficient	Standard Error
Age 40-49	0.310	0.189	0.224	0.176	1.167	1.227
Medi-Cal	**-1.374**	0.268	**-1.460**	0.288	-0.719	0.536
Indigent program	1.504	1.063	1.699	1.148	**-2.926**	0.954
Other gov't payer	0.855	0.672	0.399	0.461	8.296	4.909
Self pay	0.010	0.348	-0.095	0.355	1.360	2.239
HMO	0.144	0.219	0.056	0.221	**4.434**	1.330
PPO	0.153	0.293	0.092	0.297	0.646	0.672
Hispanic	-0.358	0.209	**-0.430**	0.203	-0.312	0.981
Black	0.187	0.209	0.165	0.224	1.893	1.045
Native American	0.860	0.727	0.629	0.607	0.607	1.125
Asian	-0.180	0.247	-0.200	0.242	1.587	0.905
Other race	0.674	0.333	0.599	0.317	**4.140**	0.428
1996	-0.139	0.072	**-0.164**	0.076	0.524	0.447
1997	**-0.292**	0.122	**-0.308**	0.122	0.860	1.305
1998	**-0.362**	0.139	**-0.336**	0.139	1.400	1.775
1999	**-0.392**	0.176	**-0.396**	0.185	2.037	3.559
2000	**-0.624**	0.151	**-0.509**	0.173	1.457	3.025
2001	**-0.790**	0.203	**-0.627**	0.223	-0.087	5.678
2002	**-1.328**	0.319	**-1.133**	0.251	0.453	7.237
Constant	**4.207**	0.635	**4.193**	0.702	1.696	8.332
R-squared	0.114		0.099		0.173	
Number of observations	727,347		711,601		15,746	

Bold numbers are significant at the 0.05 level.
Source: Petris Center analysis of OSHPD patient discharge data.

Table 6.11: Linear Regression Equations of Distance Traveled for Obstetrics Care, for Cesarean and Vaginal Deliveries

	Cesarean deliveries		Vaginal deliveries	
	Coefficient	Standard Error	Coefficient	Standard Error
Distance to nearest hosp	**0.429**	0.111	**0.476**	0.094
Distance to next-nearest hosp	**0.432**	0.157	**0.449**	0.135
Distance to NICU	0.075	0.040	0.024	0.035
Distance to closed hospital	0.118	0.067	0.108	0.067
Deliveries at nearest hosp	**-0.000310**	0.000088	**-0.000337**	0.000089
Deliveries at next-nearest hosp	-0.000047	0.000056	-0.000068	0.000052
Deliveries at NICU	0.000062	0.000105	0.000142	0.000106
Tech index at nearest hosp	-0.068	0.055	-0.104	0.069
Tech index at next-nearest hosp	-0.032	0.058	-0.062	0.050
Tech index at NICU	0.005	0.053	0.047	0.067
For-profit nearest hospital	0.161	0.216	0.214	0.216
For-profit next-nearest hosp	0.366	0.209	0.389	0.194
For-profit NICU	0.053	0.308	0.044	0.271
Gov't owned nearest hosp	0.079	0.419	0.066	0.333
Gov't owned NICU	-0.190	0.336	-0.106	0.289
Age 20-24	**0.228**	0.124	**0.236**	0.069
Age 25-29	**0.331**	0.110	**0.203**	0.074
Age 30-34	**0.451**	0.149	**0.262**	0.095
Age 35-39	**0.439**	0.166	0.248	0.142
Age 40-49	0.420	0.259	0.207	0.171
Medi-Cal	**-1.727**	0.342	**-1.262**	0.286
Indigent program	0.718	1.226	1.718	1.162
Other gov't payer	0.552	0.965	0.937	0.643
Self pay	0.516	0.455	-0.044	0.380
HMO	-0.224	0.273	0.263	0.246
PPO	0.071	0.382	0.177	0.306
Hispanic	-0.381	0.194	-0.352	0.221
Black	0.291	0.231	0.142	0.212
Native American	-0.253	0.632	1.174	0.930
Asian	-0.206	0.290	-0.166	0.247
Other race	0.881	0.448	0.625	0.315
1996	-0.134	0.134	-0.139	0.071
1997	-0.213	0.180	**-0.311**	0.129
1998	**-0.464**	0.171	**-0.331**	0.141
1999	-0.390	0.234	**-0.396**	0.170
2000	**-0.633**	0.223	**-0.625**	0.142
2001	**-0.682**	0.211	**-0.833**	0.215
2002	**-1.452**	0.374	**-1.295**	0.310
Constant	**4.589**	0.652	**4.103**	0.651

	Cesarean deliveries	Vaginal deliveries
R-squared	0.106	0.117
Number of observations	159,045	568,302

Bold numbers are significant at the 0.05 level.
Source: Petris Center analysis of OSHPD patient discharge data.

Table 6.12: Linear Regression Equations of Distance Traveled for Obstetrics Care, for Complicated and Uncomplicated Deliveries

	Complicated deliveries		Uncomplicated deliveries	
	Coefficient	Standard Error	Coefficient	Standard Error
Distance to nearest hosp	**0.329**	0.113	**0.488**	0.095
Distance to next-nearest hosp	**0.548**	0.171	**0.426**	0.134
Distance to NICU	0.061	0.044	0.033	0.035
Distance to closed hospital	0.073	0.081	0.116	0.065
Deliveries at nearest hosp	**-0.000466**	0.000121	**-0.000312**	0.000086
Deliveries at next-nearest hosp	-0.000103	0.000093	-0.000056	0.000048
Deliveries at NICU	0.000263	0.000151	0.000106	0.000101
Tech index at nearest hosp	-0.160	0.096	-0.091	0.062
Tech index at next-nearest hosp	-0.073	0.077	-0.055	0.048
Tech index at NICU	0.088	0.091	0.035	0.059
For-profit nearest hospital	0.138	0.347	0.206	0.207
For-profit next-nearest hosp	0.664	0.315	0.347	0.183
For-profit NICU	0.673	0.484	-0.031	0.264
Gov't owned nearest hosp	-0.140	0.362	0.087	0.339
Gov't owned NICU	-0.273	0.416	-0.107	0.278
Age 20-24	0.208	0.193	**0.248**	0.077
Age 25-29	0.242	0.133	**0.240**	0.076
Age 30-34	0.195	0.146	**0.337**	0.100
Age 35-39	**0.435**	0.192	**0.294**	0.138
Age 40-49	0.154	0.197	0.314	0.198
Medi-Cal	**-1.430**	0.406	**-1.366**	0.260
Indigent program	1.122	1.392	1.558	1.092
Other gov't payer	1.110	1.052	0.794	0.662
Self pay	0.524	0.721	-0.056	0.327
HMO	0.073	0.377	0.152	0.208
PPO	0.078	0.426	0.167	0.287
Hispanic	-0.257	0.215	-0.365	0.217
Black	0.138	0.231	0.183	0.216
Native American	1.756	2.459	0.716	0.790
Asian	-0.267	0.268	-0.166	0.253
Other race	0.765	0.551	0.661	0.323
1996	-0.239	0.220	-0.131	0.070
1997	-0.426	0.263	**-0.277**	0.115
1998	**-0.708**	0.316	**-0.316**	0.133
1999	-0.742	0.395	**-0.345**	0.163
2000	**-0.918**	0.314	**-0.580**	0.139
2001	**-1.060**	0.344	**-0.749**	0.192
2002	**-1.808**	0.483	**-1.251**	0.307
Constant	**4.853**	1.023	**4.130**	0.622

	Complicated deliveries	Uncomplicated deliveries
R-squared	0.113	0.114
Number of observations	92,803	634,544

Bold numbers are significant at the 0.05 level.
Source: Petris Center analysis of OSHPD patient discharge data.

Table 6.13: Regression Coefficients for Equations Estimated for Patients Whose Nearest Hospitals Closed Between 1995 and 2002

	Bypass equation		Distance equation	
	Coefficient	Standard Error	Coefficient	Standard Error
Distance to nearest hosp	**0.016**	0.007	**0.427**	0.055
Distance to next-nearest hosp	**-0.020**	0.007	**0.600**	0.060
Distance to NICU	0.000	0.001	0.027	0.013
Deliveries at nearest hosp	**-0.000069**	0.000011	0.000324	0.000290
Deliveries at next-nearest hosp	**0.000046**	0.000018	**0.000356**	0.000150
Deliveries at NICU	**-0.000044**	0.000015	**-0.000467**	0.000153
Tech index at nearest hosp	0.003	0.007	**-0.137**	0.056
Tech index at next-nearest hosp	-0.002	0.005	**-0.209**	0.095
Tech index at NICU	0.002	0.006	0.022	0.098
For-profit nearest hospital	0.014	0.025	0.237	0.384
For-profit next-nearest hosp	**0.075**	0.031	0.548	0.445
For-profit NICU	**-0.167**	0.060	-0.642	0.343
Gov't owned nearest hosp	0.029	0.025	-0.143	0.274
Gov't owned NICU	-0.128	0.063	-0.698	0.376
Age 20-24	0.006	0.005	0.188	0.189
Age 25-29	0.006	0.008	0.118	0.198
Age 30-34	0.010	0.010	0.149	0.207
Age 35-39	0.016	0.010	0.123	0.213
Age 40-49	0.019	0.012	0.532	0.348
Medi-Cal	-0.038	0.052	**-1.928**	0.340
Indigent program	0.076	0.037	2.791	1.631
Other gov't payer	-0.061	0.094	-0.017	1.362
Self pay	-0.040	0.040	-0.541	0.508
HMO	0.034	0.038	-0.589	0.453
PPO	0.032	0.045	-0.437	0.466
Hispanic	0.007	0.020	-0.325	0.239
Black	-0.027	0.031	0.538	0.388
Native American	0.037	0.049	-0.506	0.858
Asian	0.017	0.020	0.524	0.341
Other race	-0.033	0.037	0.722	0.470
1996	-0.019	0.012	**-0.331**	0.140
1997	-0.021	0.022	**-0.656**	0.232
1998	-0.020	0.014	-0.377	0.218
1999	0.002	0.021	-0.353	0.233
2000	0.010	0.026	-0.385	0.263
2001	0.017	0.048	-0.204	0.504
Constant	**0.918**	0.097	**6.015**	1.007
R-squared	0.084		0.088	
Number of observations	118,491		117,843	

Bold numbers are significant at the 0.05 level. Source: Petris Center analysis of OSHPD patient discharge data.

Table 6.14: Regression Equations of Probability of Cesarean Delivery

	Linear Probability Model		Probit Model (Probability Derivatives)		Probit Model with Fixed Effects (Probability Derivatives)	
	Coefficient	Standard Error	Coefficient	Standard Error	Coefficient	Standard Error
Distance to nearest hosp	0.0021	0.0010	**0.0021**	0.0010	0.0002	0.0006
Distance to next-nearest hosp	-0.0005	0.0007	-0.0005	0.0007	-0.0005	0.0007
Distance to NICU	-0.0001	0.0004	-0.0001	0.0003	0.0002	0.0002
Deliveries at nearest hosp	**-0.0000048**	0.0000018	**-0.0000046**	0.0000017	**-0.0000037**	0.0000009
Deliveries at next-nearest hosp	0.0000003	0.0000014	0.0000004	0.0000015	0.0000002	0.0000008
Deliveries at NICU	**0.0000072**	0.0000022	**0.0000071**	0.0000022	0.0000009	0.0000013
Tech index at nearest hosp	**-0.0033**	0.0016	**-0.0033**	0.0016	-0.0010	0.0006
Tech index at next-nearest hosp	**-0.0041**	0.0015	**-0.0042**	0.0015	-0.0007	0.0005
Tech index at NICU	**0.0049**	0.0018	**0.0050**	0.0018	0.0005	0.0009
For-profit nearest hospital	0.0117	0.0063	0.0115	0.0063	0.0043	0.0037
For-profit next-nearest hosp	0.0071	0.0070	0.0069	0.0070	0.0023	0.0026
For-profit NICU	-0.0020	0.0070	-0.0014	0.0069	-0.0020	0.0032
Gov't owned nearest hosp	0.0009	0.0084	0.0011	0.0088	**0.0074**	0.0033
Gov't owned NICU	**-0.0250**	0.0084	**-0.0255**	0.0086	**-0.0122**	0.0033
Age 20-24	**0.0329**	0.0017	**0.0406**	0.0020	**0.0414**	0.0019
Age 25-29	**0.0743**	0.0022	**0.0878**	0.0029	**0.0892**	0.0026
Age 30-34	**0.1184**	0.0032	**0.1372**	0.0036	**0.1399**	0.0029
Age 35-39	**0.1736**	0.0037	**0.2024**	0.0040	**0.2062**	0.0033
Age 40-49	**0.2282**	0.0058	**0.2678**	0.0068	**0.2718**	0.0068
Medi-Cal	0.0025	0.0059	0.0033	0.0056	0.0022	0.0046
Indigent program	**-0.0567**	0.0118	**-0.0542**	0.0120	**-0.0542**	0.0114
Other gov't payer	**0.0199**	0.0096	**0.0210**	0.0098	**0.0263**	0.0080
Self pay	**-0.0529**	0.0076	**-0.0521**	0.0067	**-0.0537**	0.0061
HMO	**-0.0199**	0.0073	**-0.0194**	0.0069	**-0.0178**	0.0059
PPO	-0.0005	0.0061	-0.0006	0.0057	-0.0015	0.0046
Hispanic	-0.0025	0.0039	-0.0031	0.0039	**-0.0075**	0.0026
Black	**0.0426**	0.0045	**0.0433**	0.0046	**0.0449**	0.0034
Native American	-0.0030	0.0120	-0.0035	0.0117	0.0082	0.0076

	Linear Probability Model		Probit Model (Probability Derivatives)		Probit Model with Fixed Effects (Probability Derivatives)	
	Coefficient	Standard Error	Coefficient	Standard Error	Coefficient	Standard Error
Asian	**-0.0288**	0.0061	**-0.0287**	0.0060	**-0.0222**	0.0069
Other race	**-0.0135**	0.0039	**-0.0143**	0.0039	**-0.0123**	0.0034
Patient lives in urban county	-0.0243	0.0233	-0.0254	0.0246	0.0055	0.0110
Nearest hospital closed	0.0030	0.0038	0.0034	0.0039	-0.0002	0.0031
1996	0.0003	0.0017	0.0003	0.0018	0.0009	0.0021
1997	-0.0020	0.0028	-0.0021	0.0029	-0.0005	0.0024
1998	0.0029	0.0036	0.0030	0.0038	0.0057	0.0035
1999	**0.0174**	0.0041	**0.0179**	0.0044	**0.0192**	0.0043
2000	**0.0200**	0.0038	**0.0206**	0.0040	**0.0263**	0.0035
2001	**0.0340**	0.0050	**0.0348**	0.0053	**0.0438**	0.0048
2002	**0.0499**	0.0054	**0.0505**	0.0057	**0.0574**	0.0053
Constant	**0.1474**	0.0270				
R-squared	0.0231		0.0219		0.0245	
Number of observations	732,277		732,277		732,277	

Bold numbers are significant at the 0.05 level.

Source: Petris Center analysis of OSHPD patient discharge data.

Table 6.15: Regression Equations of Probability of Complicated Delivery

	Linear Probability Model		Probit Model (Probability Derivatives)		Probit Model with Fixed Effects (Probability Derivatives)	
	Coefficient	Standard Error	Coefficient	Standard Error	Coefficient	Standard Error
Distance to nearest hosp	0.0009	0.0009	0.0008	0.0008	0.0003	0.0003
Distance to next-nearest hosp	0.0009	0.0005	0.0009	0.0004	-0.0002	0.0004
Distance to NICU	-0.0001	0.0002	-0.0001	0.0002	0.0002	0.0001
Deliveries at nearest hosp	**-0.0000029**	0.0000020	**-0.0000028**	0.0000021	**-0.0000004**	0.0000015
Deliveries at next-nearest hosp	-0.0000023	0.0000018	-0.0000024	0.0000018	0.0000003	0.0000009
Deliveries at NICU	**-0.0000022**	0.0000015	**-0.0000022**	0.0000016	-0.0000002	0.0000012
Tech index at nearest hosp	**0.0044**	0.0014	**0.0045**	0.0014	0.0016	0.0007
Tech index at next-nearest hosp	**0.0026**	0.0010	**0.0026**	0.0010	0.0003	0.0003
Tech index at NICU	**-0.0048**	0.0010	**-0.0049**	0.0010	-0.0007	0.0008
For-profit nearest hospital	0.0008	0.0063	0.0005	0.0063	0.0071	0.0034
For-profit next-nearest hosp	-0.0044	0.0066	-0.0048	0.0065	-0.0008	0.0020
For-profit NICU	-0.0097	0.0044	-0.0098	0.0043	-0.0075	0.0044
Gov't owned nearest hosp	0.0247	0.0092	0.0246	0.0091	**0.0113**	0.0041
Gov't owned NICU	**0.0002**	0.0075	**0.0001**	0.0068	**-0.0034**	0.0029
Age 20-24	**-0.0112**	0.0023	**-0.0113**	0.0023	**-0.0112**	0.0023
Age 25-29	**-0.0112**	0.0021	**-0.0113**	0.0020	**-0.0110**	0.0019
Age 30-34	**0.0008**	0.0028	**0.0007**	0.0028	**0.0007**	0.0024
Age 35-39	**0.0185**	0.0033	**0.0177**	0.0034	**0.0177**	0.0033
Age 40-49	**0.0520**	0.0042	**0.0504**	0.0045	**0.0511**	0.0049
Medi-Cal	0.0019	0.0045	0.0016	0.0045	0.0013	0.0046
Indigent program	**0.0008**	0.0097	**0.0015**	0.0099	**0.0014**	0.0100
Other gov't payer	**0.0161**	0.0114	**0.0164**	0.0113	**0.0189**	0.0112
Self pay	**-0.0028**	0.0059	**-0.0031**	0.0058	**-0.0022**	0.0059
HMO	**0.0108**	0.0050	**0.0106**	0.0048	**0.0092**	0.0044
PPO	-0.0097	0.0035	-0.0095	0.0033	-0.0089	0.0036
Hispanic	-0.0113	0.0036	-0.0118	0.0038	**-0.0045**	0.0028
Black	**0.0335**	0.0047	**0.0325**	0.0043	**0.0357**	0.0042
Native American	-0.0029	0.0165	-0.0035	0.0152	0.0033	0.0144

	Linear Probability Model		Probit Model (Probability Derivatives)		Probit Model with Fixed Effects (Probability Derivatives)	
	Coefficient	Standard Error	Coefficient	Standard Error	Coefficient	Standard Error
Asian	**0.0023**	0.0076	**0.0021**	0.0073	**-0.0045**	0.0066
Other race	**-0.0044**	0.0031	**-0.0041**	0.0029	**-0.0029**	0.0026
Patient lives in urban county	-0.0127	0.0145	-0.0133	0.0149	-0.0093	0.0061
Nearest hospital closed	-0.0079	0.0049	-0.0074	0.0047	-0.0020	0.0043
1996	0.0026	0.0033	0.0028	0.0033	0.0020	0.0032
1997	0.0053	0.0031	0.0054	0.0032	0.0036	0.0030
1998	0.0061	0.0033	0.0063	0.0033	0.0037	0.0028
1999	**0.0014**	0.0031	**0.0017**	0.0031	**0.0002**	0.0032
2000	**-0.0016**	0.0039	**-0.0015**	0.0040	**-0.0057**	0.0031
2001	**0.0011**	0.0038	**0.0013**	0.0039	**-0.0058**	0.0036
2002	**0.0000**	0.0051	**-0.0001**	0.0051	**-0.0058**	0.0035
Constant	**0.1433**	0.0201				
R-squared	0.0065		0.0084		0.0131	
Number of observations	732,277		732,277		732,277	

Bold numbers are significant at the 0.05 level.
Source: Petris Center analysis of OSHPD patient discharge data.