The Impacts of the Massachusetts Health Care Reform on Hospital Operating Cost and Quality of Medical Services

An Interactive Qualifying Project Report submitted to the Faculty of

WORCESTER POLYTECHNIC INSTITUTE

in partial fulfillment of the requirements for the

Degree of Bachelor of Science

by

Yizheng Liao, Kate Pellegriti, Kun Peng, and Mingnan Sun

Date: March 4th, 2011

Advisors: Fabienne Miller, Justin Wang

Table of Contents

Table of Figures

Table of Tables

Abstract

In 2006, the Massachusetts legislature passed the landmark health care reform bill, "An Act Providing Access to Affordable, Quality, Accountable Health Care," with the hopes of reforming the state health care industry. The main targets of this reform were to contain hospital costs, to increase insurance rate and to improve quality of medical services. It is essential that we research this reform and determine whether or not it was successful, as it serves as a model and experiment for the national health care reform.

Therefore, the primary focus of this paper is to explore the overall impact of the Massachusetts Health Care Reform on hospital operational costs and quality of medical services. Cost and quality data were collected from Center for Medicare & Medicaid Services and Hospital Compare websites. Three econometric models of cost, salaries and quality were developed to examine the overall impacts of the reform on the hospital cost and quality of medical services. Treatment measures of different diseases were used for quality dependent variables. Hospital department salaries and total operational costs were used for the salaries and cost dependent variables, respectively. Difference-in-differences technique was applied in the models to ensure that the result was due to the reform rather than national trend.

Finally, regression results were analyzed to examine whether the aforementioned targets were met after four years of reform. Consistent with our predictions, we found evidence that the reform had positive effects on the quality of Massachusetts hospital services. We also found evidence consistent with the premise that Massachusetts hospital costs were contained.

1.0 Introduction

The Massachusetts health care insurance reform refers to the legislation passed by the General Court of the Commonwealth of Massachusetts, and signed into law by Governor Mitt Romney on April 12, 2006. This legislation is of great importance, as it not only increases the percentage of insured residents, but it also changed the health care insurance industry of Massachusetts in a number of ways. For example, such legislation expanded subsidized insurance and created a much more consumer-friendly health insurance market. In addition, the results of this reform over the past four years have been mentioned and discussed in the design of the national health care reform bill. There has been much research conducted on the impacts of the reform, but little research has focused on its effects on both hospital cost structure and the quality of medical care.

As demonstrated by Jha, A.K. *et. al*, there is an inevitable relationship between cost and quality (Jha A. K., Orav, Dobson, Book, & Epstein, 2009). The motivation of the reform was to contain hospital costs and improve the quality of health services. However, changing one factor will also affect the other. There are many possible effects that the reform could have on the relationship between cost and quality. For example, if the reform were to decrease the revenue provided to the hospital, quality of health services could potentially decrease in effort to decrease hospital costs. Alternatively, if there is a decrease in revenue, perhaps hospitals will be encouraged to invest in improving health care quality to reduce costs of continued services due to previous incompetent or inefficient care. However, if the reform were to increase hospital revenue due to the increased insured rate, perhaps the hospital can afford to increase the quality of medical services. Although these patterns make sense logically, there are examples of low-cost hospitals that provide a better quality of healthcare than costly hospitals, as well as examples of costly hospitals providing low-quality healthcare (Blumenauer, 2010). Thus, there is clearly a correlation between the two factors, but how they affect each other remains unclear, just as it is not clear how the reform will affect cost and quality (Jha A. K., Orav, Dobson, Book, & Epstein, 2009).

It is expected that the reform will affect both hospital operational costs and the quality of medical services, as there were specific aspects of this legislature that aimed at cost containment

and quality improvement. For example, the Health Care Cost and Quality Council, which will be discussed in more detail later, attempted to make the Massachusetts health care system more efficient by trying to reduce the number of hospital visits for patients with preventable health issues and trying to reduce the rate of nosocomial infection. By reducing these factors, the quality of medical services would increase and hospital costs would be contained, as unnecessary visits are reduced. However, it is also possible that the reform did not succeed in creating a more efficient health care system. Because insurance coverage increased due to the reform, there was a significant increase in the number of patients. Therefore, it is possible that hospital costs raised after the reform due to an increase in demand. As aforementioned, it is possible that an increase in costs could result in a decrease in the quality of medical services for affordability purposes. Currently, both quality and cost are very important for hospitals' daily operations. Without paying attention to quality, hospitals could not compete against others. Without focusing on cost, hospitals could not survive the current economic recession. Hence, how to constantly improve quality and contain costs is becoming a major topic for hospital top managers **(**Eldenburg & Krishnan, 2010).

Because it is not clear how the reform affected hospital costs and health care quality, our research will explore this issue further in order to determine the outcome of such important legislature. This report will first provide the background information of the Massachusetts health care reform, formally known as "An Act Providing Access to Affordable, Quality, Accountable Health Care," which is Chapter 58 of the Acts of 2006. This section will be followed by the literature review section, which will explore the research that has been previously conducted on this topic, and give further details on the specific research question of this project, which will be followed by a methodology section explaining the processes of our research. Lastly, we will be presenting the results of our research and analysis along with our conclusions.

2.0 Background Information

The main goal of the Massachusetts health care reform was to provide a universal coverage plan for the residents of Massachusetts. This was achieved by mandating all the residents to have health insurance, increasing employers' contributions to their employees' health coverage, and creating a more consumer-friendly health insurance market. Since Massachusetts is the first and the only state in the United States to require health insurance coverage for all of its residents, its implementation of such legislation is of interest to policymakers, employers, and individuals across the nation. The next section will provide national background in terms of health care cost and quality, which was a motivation for the Massachusetts health care reform.

2.1 National Background

The United States of America is one of the leading nations in the world and spends more money per capita on health care than any other nation (Roehr, 2008).

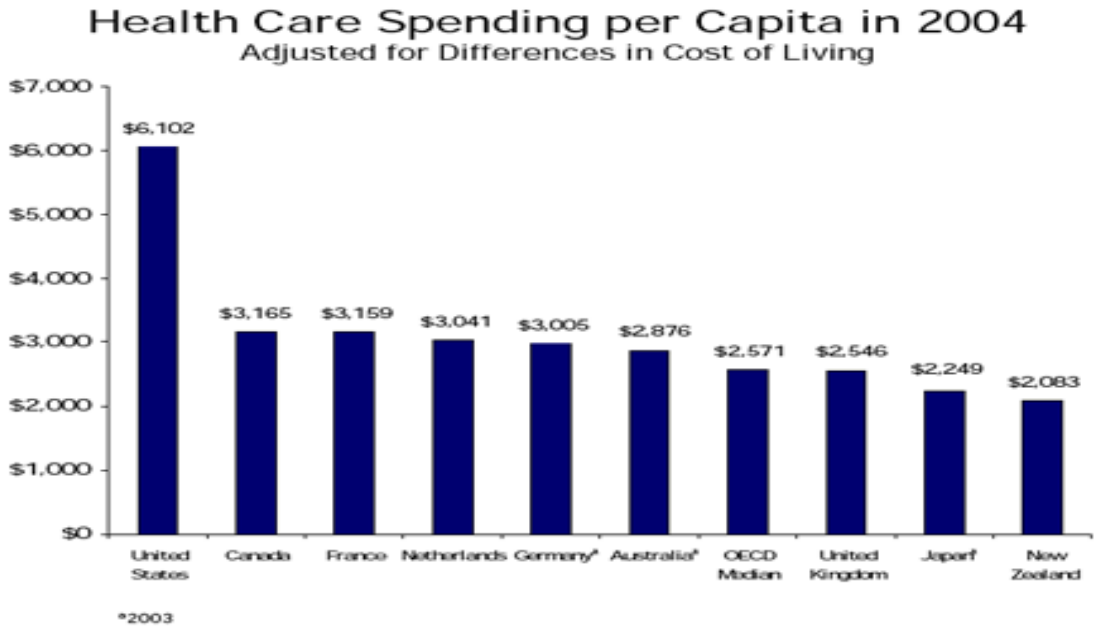

Figure 1 Health Care Spending Per Capita in 2004

As can be seen from Figure 1 above, the cost of health care spending per capita was almost double for the United States than other developed countries. However, the country's health care services lacked in quality, as the U.S ranked one of the lowest in terms of life expectancy and infant mortality amongst developed countries (MacDorman & Mathews, 2008), as shown in Figure 2.

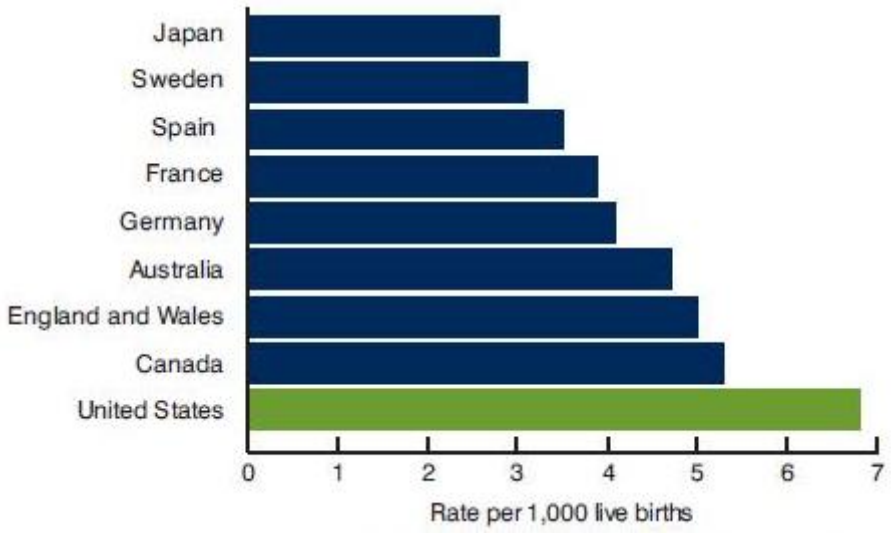

Figure 2 National Infant Mortality Rates in 2004 (MacDorman & Mathews, 2008)

As is demonstrated by Figure 2 above, the infant mortality rate in the United States was the highest among the developed countries by a significant amount. Once again, it was almost double that of most of the other developed countries. In addition, the U.S. is the only industrialized country that does not guarantee universal health care coverage (Waldman, 2010). Access to health care has been a major social, political and economic issue in the U.S. for almost a century. At least 45 million American people, about 15% of the nation's total population, are completely uninsured, as of 2010 (Waldman, 2010). These citizens, therefore, are unable to seek the primary care needed in order to take preventative measures. As a result, most uninsured residents use the emergency room, driving up cost and usage, which burdens the state budget, as the fund comes out of the Safety Net and, therefore, the taxpayers. For example, the cost of an

emergency room visit is anywhere from $373-$1030 compared to the maximum cost of a visit to the primary care physicians of $168 or $220 for a new patient (Harvard Pilgrim Health Care, 2010). There is also data to demonstrate that emergency room visits were increasing between the years 2004 and 2006 (Bigby, 2010).

Today, health care still remains one of the most complex issues in the U.S. The nation is still trying to implement a universal coverage plan, but many obstacles stand in its way. While the nation experienced a lot of pressure surrounding this reform, the state of Massachusetts has received a lot of support from its residents since then (Long & Stockley, 2009).

2.2 Why Massachusetts?

In 2006, the state of Massachusetts enacted new health care reform legislation in order to attempt to address the pivotal health care issue. In contrast with other states in the nation, Massachusetts is a small and wealthy state which has a long history of being generous in giving coverage to its residents. There were numerous reasons why this reform was able to take place in Massachusetts. Amongst those reasons are the idea of pressure from the federal and state government, shared responsibility, the pre-existing regulations of the health care system, and its unique health care industry.

Federal pressure is an important factor to explain why the reform took place in Massachusetts in 2006. Massachusetts received its federal funding through the authorized 1115 Demonstration Waiver, which allowed the state government to fund its own Medicaid program and Uncompensated Care Pool. In 2005, when the state planned to renew its Waiver, the federal government required that the state needed to change its health care system in order to successfully renew the Waiver (Waldman, 2010). This type of pressure from the federal government provided a perfect background for the reform to begin fermenting. The federal support also helped the state to fund its health care reform. Therefore, both the federal pressure and funding through the Section 1115 waiver played key roles in the initial design and the ongoing operation of the Massachusetts reform initiative (Long & Stockley, 2009).

A crucial component of the health care coverage expansion in the health reform law is the concept of shared responsibility. There are many who believed that one of the most important reasons contributing to the passing of the legislation was the consensus between employer and the state government, which did not exist in previous attempts to reform the health care system (Seifert *et. al*, 2009). In 2006, Massachusetts already had the ninth highest rate of Employer-Sponsored Insurance (ESI), which covered 68% of working people under the age of 65 years. This is a relatively high rate compared to other states in the nation (See Table 1). Because the majority of residents were already insured, employers did not need to cover as much of the population as other states. Therefore, it was less expensive for Massachusetts to make such a movement than other states. All of these factors described above make it more reasonable for the government to gain support of this reform from employers.

Table 1 Health Insurance Coverage in 2006 (Steinbrook, 2006)

	Massachusetts	United States
Population in Millions	6.4	293.7
Employer Sponsored	**59.5%**	**53.7%**
Medicaid	12.7%	12.8%
Medicare	11.6%	11.8%
Individual	4.3%	4.8%
Other Public	0.7%	1.1%
Uninsured	**11.2%**	**15.9%**

As one can see from the table above, the number of residents insured through Medicaid, Medicare, Individual and Other public insurers are practically the same in Massachusetts and in the nation. The only significant difference between the two charts is the employer sponsored insurance. In the case of Massachusetts, there is 59.5% of health insurance that is gained by employer-based coverage in contrast to only 53.7% in the nation. Consequently, Massachusetts is the optimal place to start a reform experiment with its low uninsured rate and relatively high ESI rate. However, the Massachusetts Health Care Reform Law of 2006 was not the state's only attempt at making changes to the health care system.

In 1985, the state government had established a "Free Care Pool," which allowed free emergency care to patients who could not afford it. In late 2007, Massachusetts launched a program called the "Safety Net" to replace the Free Care Pool, which is for uninsured residents, in order to reach a goal of universal coverage. The "Safety Net" is different from the Free Care Pool in that it is less subsidized insurance for low-income residents, and those residents are responsible for higher fees. After some argument, the compromise had been made and the reform law finally was passed with a relatively small employer fine of $295 per uncovered employee per year, which made it even easier to increase the number of insured residents.

Massachusetts also already had some relatively strict regulations on the health care insurance market. In Connecticut and Wisconsin, insurance companies have the right to refuse to cover individuals and to increase their premium based on their health history in other states, which is not the case in Massachusetts. (Seifert & Swoboda, 2009). Secondly, the health care insurance market of Massachusetts is mainly controlled by community-focused, non-profit insurance plan providers. Due to these two factors, the Massachusetts health care industry is slightly more consumer-friendly than in other states, making it a more convenient state to initiate reform. The next section will provide a timeline of the reform process.

2.3 Timeline of the Reform

In 2005, politicians and reformists thought that it was time for a second attempt at health care reform. They began advocating for the expansion of coverage. In April 2005 (Health Care For All, 2005), Massachusetts Senate President Robert Travaglini and the State Governor Mitt Romney formed a reform coalition to promote health reform plans (Geenberger, 2005). In June 2005, Romney presented the reform ideas and announced the individual mandate plan in Massachusetts healthcare reform (Health Care For All, 2005). One month later, he introduced the health reform proposal to the Massachusetts legislature. In August 2005, a new policy actor, Affordable Care Today Association, filed a ballot initiative to place their proposal of healthcare reform in the legislation by November 2006 (Health Care For All, 2005). Table 2 below contains important dates and steps of the reform legislation.

Table 2 Timeline of the Massachusetts Health Care Reform (Health Connector, 2009)

APRIL 12, 2006	Health Reform becomes law.
OCTOBER 1, 2006	Commonwealth Care expands to those with incomes below 100% of the Federal Poverty Level (FPL).
JANUARY 1, 2007	Commonwealth Care expands to those with incomes of up to 300% of the FPL.
MAY 1, 2007	The Commonwealth Choice becomes available.
JULY 1, 2007	All employers in Massachusetts are required to offer sufficient plan, according to Health Connector or they will be responsible for employees' emergency medical care costs.
OCTOBER 1, 2007	Employers with 11 or more full-time-equivalent Massachusetts employees must contribute toward an employee health plan or suffer penalty of up to $295 per employee, per year.
DECEMBER 31, 2007	Individual mandate for health insurance is enforced or lose personal income tax deduction on 2007 state taxes.
JANUARY 1, 2008	Penalties will now equal half the premium of the lowest-cost Health Connector-certified insurance plan.
JANUARY 1, 2009	Benefits an adult must carry to avoid penalties now include prescription drug coverage, preventative and primary care, and no annual limit on treatment for any sickness.

2.4 Properties of the Reform

In order for Massachusetts to motivate the start of this universal health plan, the reform legislation included some essential properties, such as: the creation of the Commonwealth Health Insurance Connector, Commonwealth Choice and Commonwealth Care, the increased eligibility for Medicaid, the organization of the Health Care Quality and Cost Council, the mandate for individual health insurance, and laws involving employers' responsibilities. The next few paragraphs will explain the purpose of the properties most significant to our research as well as evaluate them, and explore them in greater detail.

Arguably, the most important part of the reform is the government's new role in the health care industry through their creation of the organizations which allowed the health care industry to be more consumer-friendly. For example, the government created the Health Care Quality and Cost Council, which requires that any cost and patient data of hospitals and physicians are made public (Waldman, 2009). Its purpose is to improve the quality of health care and to control cost inflation. The Council measures the health care quality and cost in Massachusetts by publishing annual reports. These reports provide information and different types of measurements related to quality and cost for each hospital. The Council is also responsible for setting quality and cost targets for the Massachusetts Health Care Reform. In the "Roadmap to Cost Containment" issued by this Council, several key strategies were mentioned to allow Massachusetts state government to control its health care cost inflation and to improve the quality of health care. The Roadmap also suggested that Massachusetts should enact policies that will have maximum impact on cost and quality. All of these measures were taken by the government in order to motivate the movement towards a universal health plan.

Along with the reform legislation of 2006, came the mandate for all residents to have health insurance. The mandate requires every citizen of Massachusetts that is of legal age to obtain some form of health insurance if they are not covered by a government subsidized plan or their employer (Tanner, 2006). Those under the age of eighteen years old are required to be covered by their parents' plan (Steinbrook, 2006). This law was put into effect in July 2007 when individuals who did not abide were not able to receive personal exemption from the state income tax (about $219) (Tanner, 2006). Those who did not purchase insurance due to religious reasons

were exempt from these penalties (Kolstad & Kowalski, 2010), as well as anyone who earned less than 150% of the federal poverty level or who was only without insurance for a period of less than three months (Waldman, 2009). A health care safety net fund (provided by taxpayers) still remained in order to cover those who could not afford insurance or were ineligible for subsidized insurance, such as illegal aliens (Fisher, 2008). In 2007, only 5% of taxpayers were uninsured, of which 40% were exempt from paying any penalty (Waldman, 2009). In 2008, there was a 12% reduction from those who were penalized in 2007 (Waldman, 2009). Although this mandate played an important role in the health reform movement, it still remains a controversial subject to some. Some believe that it could possibly eliminate the discrimination that occurs against some patients due to their health risks and needs by private insurance companies (Blumberg & Holahan, 2009). On the opposing side, some believe that for the government to require individuals to have health insurance is too invasive and may set the precedent for the government to play a role in personal health decision issues (Tanner 2006). For more information on some of the properties of the reform, see Appendix A. We will now move on to the next section which will discuss the short-term effects of the reform.

2.5 The Short-term Results of the Reform

The reform certainly did accomplish an increase in coverage among state residents. In the years leading up to the reform (2004-2006), about 88% had some form of health insurance, which increased by about 5.5% to 93.8% of all residents that were insured in the years after the reform (2008-2009) (Kolstad & Kowalski, 2010). In the few years after the reform, 352,170 more residents were insured (Kolstad and Kowalski, 2010). Figure 3 below depicts the pie chart of coverage among Massachusetts residents.

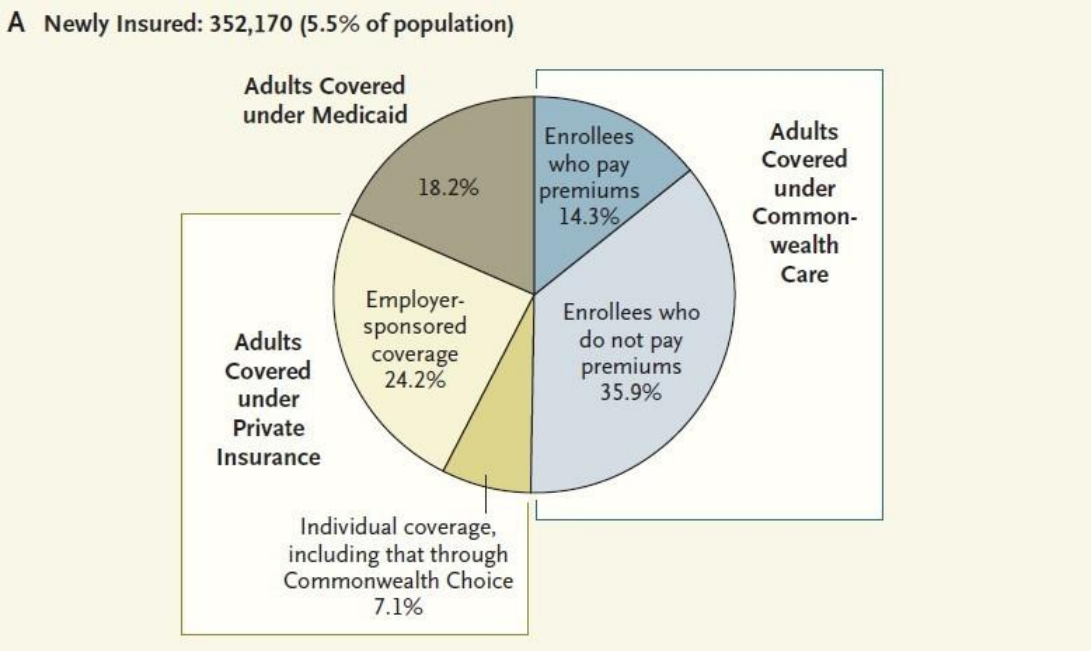

Figure 3 Pie chart of Coverage Amongst Massachusetts Newly Insured Residents in 2007 (Steinbrook, 2008)

As can be seen from Figure 3 above, about half of the newly insured population (50.2%) is covered under Commonwealth Care, which was created as a part of the reform, most of whom (about 80%) do not pay premiums. About 18.2% of the newly insured residents are covered under Medicaid, which is government subsidized. Almost a third, 31.3%, of the newly insured population has private insurance, over a fifth of whom have obtained that insurance through Commonwealth Choice, also a new program created by the reform. The reform significantly increased the number of insured residents as is exemplified by these statistics. As can be seen from the results presented above, the reform seems to have a positive impact on the health care system, but more research is needed in order to assess whether or not it was successful in accomplishing all of its goals. In the following section, we will explore examples of international reform in order to learn about the possible impacts that this reform can have.

2.6 An Example of International Reform

Before their reforms, other countries also faced the issue of providing health care of sufficient quality that was both affordable for hospitals and patients (Chiang, 1997). If we examine the health care reforms in different countries, we can find an increasing competitive trend amongst private hospitals around the world. The advantages of these reforms are a renewed focus on the quality of care. The health care reform that took place in Taiwan will be discussed in this section, chosen for its similar economic conditions to the United States.

After two decades of economic growth from the 1960s to the 1980s, Taiwan began its health care reform in 1987. Initially, the government studied more the health care systems of more than ten countries before combining all of their advantages to form their own system. In 1995, Taiwan founded a model called National Health Insurance (NHI), which is mostly modeled after U.S. Medicare. There are many similarities between these two systems. However, there is one major difference between these two models: the entire population is eligible for NHI, while only the elderly are eligible for Medicare. Thus, NHI achieved universal coverage through a governmentally controlled insurance provider. Employees are responsible for lower rates than their employers. Generally, residents are responsible for a rate that remains stable, while low-income individuals and veterans are fully subsidized. According to the Taiwanese model, every person is free to select the hospital and physician of their choice without being concerned about a waiting list. The package NHI offered covers preventative medical services, prescription drugs, dental services, Chinese medicine and home nurse visits. The previously uninsured increased their usage of medical services, since most preventative services, like annual checkups, are free of charge and other regular services are offered at an affordable price (Lu and Hsiao, 2003). By the end of 2001, 97% of the population was covered by this program. At that time, 70% of patients were satisfied with equal access to health care, financial risk protection and equal quality of the care provided (Chiang, 1997).

While the quality of health care greatly improved, health care costs only increased slightly. Taiwanese spending on health care increased from 4.7% to 5.4% after NHI was enacted (Chiang, 1997). However, the cost of health care per capita is still less than 900 U.S. dollars (Chiang, 1997). The successes of the Taiwanese health care reform, such as the foundation of

NHI, the legislation on the health care industry and the affordable access are all important factors that Massachusetts can take into account for its future. The aforementioned aspects of the Taiwanese health care reform allowed for a better quality of health services, which is essential to health care reform in general. From the international case we discussed above, it is evident that the hospital cost and quality of health care are the two most significant measurements of the success of health care reform. In the following Literature Review section, we will discuss these two factors.

3.0 Literature Review

The objective of this literature review will be to inform the reader of the effects of the Massachusetts health care reform on hospital costs and quality. We will first discuss examples of literature that examine how we could go about defining and researching hospital cost and quality. We will then discuss previous research that explored how hospital cost and quality were affected by the reform.

3.1 How to Measure Hospital Cost

In order to analyze the cost effects of the Massachusetts health care reform, the hospital is the primary focus. According to the "Analysis of Hospital Costs: A Manual for Managers" (Shepard et al., 1998), cost finding and cost analysis are the processes of utilizing accounting data to obtain the costs of hospital services.

Shepard *et al.*'s (1998) article described the concept of cost centers, which are the centers of activity in the hospital to which direct and indirect costs will be assigned. Based on the nature of their work, three different types of cost centers can be identified: Patient Care, Intermediate and Overhead. Patient Care Centers are those departments that provide direct patient services, such as ambulatory care centers and wards. Intermediate cost centers provide ancillary services to support inpatient treatments such as laboratory, pharmacy and radiology departments. The third type, overhead cost centers, provides costs related to overhead support services such as departments of finance and dietetics. It would be useful to explore the Patient Care Centers and Intermediate Care Centers since it is these divisions of the hospital that residents come into direct contact with, which means they will be most likely affect by the reform. Therefore, it is these total operational costs and departments' salaries that will be used in our research, as they will be most informative as to how the reform affected hospital costs. In conclusion, the methods discussed in this article serve as a guide for research to be done on hospitals' operational costs. Based on the different types of cost centers defined by the article, one can identify which of these costs should be included in subsequent research (Shepard et al., 1998). Costs are not only

essential in evaluating the successes of the health care reform, but they are also essential to hospital structure and function, as will be discussed next.

Decades ago, cost was not a primary concern. Consequently, hospitals had no incentive to invest in information and accounting systems. After the change in regulation in 1983, price became the primary basis of competition. Thus, cost became more and more important in measuring a hospital's overall performance. In order to maintain financial viability, hospitals had to increase their revenues by providing high-quality health care and lower their operating costs. As is stated by the DHCFP's "Study of the Reserves, Endowments, and Surpluses of Hospitals in Massachusetts," hospitals need to manage their own financial resources to maintain operations, provide high-quality patient care and make investments in new services, infrastructure and technology (2010). Besides, under the most severe economic recession since Great Depression, many hospitals, with their significant declining profit margins, need to cut costs and lower research budgets and philanthropic giving. Therefore, it is absolutely necessary for hospitals to increase their profitability and to control their costs in order to compete effectively against others. A hospital cannot remain financially viable without earning and maintaining adequate financial resources (Bigby & Morales, 2010). Hospital costs are not the only key factor that can be affected by the reform, however, as the quality of medical services a hospital provides is also very important.

3.2 How to Measure the Quality of Health Services

The definition of health care quality is broad and variable. The Institute of Medicine defines quality as "the degree to which health services for individuals and populations increase the likelihood of desired health outcomes and are consistent with current professional knowledge" (Institute of Medicine, 2010). Specifically, Campbell (2000) separates quality of care for both individual patients and populations into two categories: access and effectiveness. The most basic understanding of access to health care providers is geographic/physical access (Campbell, 2000). Effectiveness of health care is measured by an arrangement of diagnostic and treatment indicators that include the ability to prescribe drugs patients need and the ability to order diagnostic tests or procedures for patients (SteelFisher, 2009).

In SteelFisher's article, the quality of health care was realized as the amount of time patients wait to get an appointment to see physicians, physicians' ability to prescribe drugs the patients need, the costs that patients pay out of pocket for needed care, the amount of time physicians can spend with a patient, physicians' ability to order diagnostic tests or procedures for patients, the amount of time patients wait in the waiting room and other factors (SteelFisher, 2010). Generally, in other research, timeliness and effectiveness of treatment are the key measurements of quality, both of which were present in Steelfisher's article. Other measurements, however, such as cost for patients and detailed measurements and the physician's ability to order diagnostic tests for patients tend to be omitted in a national report. An example of the National Healthcare Quality Report is shown below in which both effectiveness of treatment and timeliness is taken into account.

Our research will take both access and efficiency into account, although our primary concern will be the latter, as it is the most likely factor to be affected by the Massachusetts health care reform. As one of the core federal agencies handling the national health care issue, the Agency for Healthcare Research and Quality publishes the National Healthcare Quality Report annually. In its 2009 report, they used the specific outcomes and processes to measure the quality. Table 3 shows the details of some of these measurements. The measurements are selected from the full core measure set defined in 2005 by the Interagency Work Group. All core measures fall into two categories: process measures, which track receipt of medical services, and outcome measures, which reflect the results of medical care.

Table 3 Measurement of Health Care Quality by National Healthcare Quality Report

Section	Process measures	Outcome measures
Effectiveness: Cancer	• Women age 40 and over who reported they had a mammogram within the past 2 years	• Rate of advanced stage breast cancer per 100,000 women age 40 and over • Breast cancer deaths per 100,000 women
Effectiveness: Diabetes	• Adults age 40 and over with diagnosed diabetes who received all three recommended services for diabetes in the calendar year (hemoglobin A1c measurement, dilated eye examination, and foot examination)	• Hospital admissions for lower extremity amputation per 1,000 population age 18 and over with diabetes
Patient Safety	• Adult surgery patients who received appropriate timing of antibiotics • Adults age 65 and over who received potentially inappropriate prescription medications	• Adult surgery patients with postoperative complications • Bloodstream infections or mechanical adverse events associated with central venous catheter placement
Timeliness	N/A	• Adults who needed care ASAP for an illness, injury, or condition in the last 12 months who did not get care as soon as wanted • Emergency department visits in which patients left w/o being seen

The Health Care Quality and Cost Council (HCQCC) of Massachusetts, the state committee responsible for setting quality and cost policies and missions for the Commonwealth, uses the same table to measure quality of health care in Massachusetts. Their annual report, Measuring Health Care Quality and Cost in Massachusetts, described the health care quality and cost changes in the state (HCQCC, 2009). In our research, only the measurements that exist for all states will be used for comparison. The four major divisions that will be used are: surgery, pneumonia, heart attack and heart failure. Within these four divisions, there are detailed indicators for each hospital that are similar to those described above. The next section explores the various effects of the reform on health care quality.

The aforementioned articles used essential indicators of the quality of hospital medical services, such as lengths of stay in the hospital, usage of emergency room and access to services which will remain important for further research. These articles addressed changes in the quality of Massachusetts health care services before and after the reform, but they neglected the comparison of these trends with other states to support the fact that they were products of the reform instead of a common trend across the nation. In our research, we will compare important measurements of hospital healthcare quality in Massachusetts, as well as Connecticut and Minnesota to determine whether or not the changes observed in Massachusetts can be attributed to the reform.

As Eldenburg and Krishnan's article (2010) stated, the U.S. health care system previously encourage quality-based competition because there were virtually no incentives to control costs. Hospitals only competed to offer superior technology and extensive services to attract patients. The hospitals providing higher quality of health services formerly out-competed those providing lower quality of services in order to contain costs. This demonstrates that quality was extremely important in measuring a hospital's overall performance.

3.3 How to Measure Impacts of Reform on Hospital Cost and Quality

The larger implication of our research is to measure the successes and failures of the reform in hopes that we can then learn from our mistakes before engaging in a national reform. Specifically, we will be measuring the changes in hospital cost and the quality of medical services the hospitals provide over a number of years for better insight on the effects of the reform. Recently, in 2009, the Pioneer Institute for Public Policy Research published an article describing how one might go about assessing the success of the reform based on the specific goals that it had, such as to provide a better quality of health care, while still containing the costs of doing so (Miltenberger & Poftak, 2009). Specifically, the reform addressed issues of cost and quality by mandating that hospitals report cost and quality measures that would be made available to the public and creating the Cost and Quality Council, which aimed to set standards for the quality of health care patients received.

The crux of our research is to focus on these cost containments and improvements in quality of health care efforts and measures. In order to examine the reform's ability to contain costs, Miltenberger and Poftak suggest that research must explore cost and quality data that is available on a "periodic," basis, which we hope to accomplish in our research. Specifically, the authors suggest to look at spending on healthcare as a whole. We will be researching hospital operational costs, as this accounts for half of total healthcare spending along with clinical and physician services (The Henry J. Kaiser Family Foundation, 2009).

It is essential, as these two authors mentioned, to look at data over a period of time. In order to really evaluate the relative successes of the reform, as much pre-reform data as possible needs to be collected in order to be used as a basis for comparison or a control. Although it is important to explore cost containment after the reform, evaluating health care costs on a "whole" basis, as Miltenberger and Poftak mentioned, is not the most effective way to examine cost containment efforts, as there are so many factors that contribute to this spending that the impact of the reform will most likely be obscured. For measurement of hospital costs beyond changes in quantities and charges, Kolstad and Kowalski obtained all-payer cost to charge ratios on the hospital level. This ratio represents the annual total cost of operating the hospital. In order to accurately evaluate the impact of the reform on cost containment, specifically one level will be focused on in our research, which is the hospital, since it is the hospital that provides the medical

services that are also being evaluated in terms of quality. There are also aspects of hospital costs, however, that should not be taken into account, as they would not have been likely to be affected by the reform and will, therefore, add noise to the data. Therefore, it was decided that only hospital operation costs and department salaries over a period of time will be examined, as in Kolstad and Kowalski's research.

In order to examine the progress in quality of care improvement, Miltenberger and Poftak suggest to research various quality indicators, such as mortality rates, rate of nosocomial infections (infections due to medical procedures), and effectiveness of heart surgery, while comparing it to indicators of other states (Miltenberger and Poftak, 2009). Important quality indicators will also be examined in our research. Specifically, the four major divisions of indicators will be heart attack, heart failure, pneumonia and surgery because annual quality data are provided on the treatment of these four conditions by the Medicare Hospital Compare Quality of Care Database. Those indicators will be measured in terms of appropriateness of treatment given, medical advice and preventative measures taken, just as suggested by Miltenberger and Poftak's research. Multiple states will be looked at as this article mentioned, which is essential in order to determine whether or not these impacts were due to the reform or some other trend. This article neglected to mention, however, that the control states used should have similar quality of health care to Massachusetts before the reform, in order to be a meaningful comparison.

A report that was later issued in the Pioneer Institute attempted to respond to Miltenberger and Poftak's suggested techniques for research. In their study, a metric system was used in order to assess their performance and whether or not they achieved their goals (Lischko & Manzolillo, 2010). Grades that they used in their assessment were A, which signifies "excellent performance and that the goal as achieved", B, which signifies "good performance and that the goal was moderately achieved," C, which signifies "mixed results and a need for research," D, which signifies "poor performance and that the goal was not achieved" and lastly, a grade of I, which signifies that enough research is not available in order to assess the performance (Lischko and Manzolillo, 2010). Just like our own research, they addressed changes in the three quality indicators as compared to other states. In similar research, Kolstad and Kowalski assessed changes in the quality of medical services by analyzing the length of stay of patients, as well as the number of discharges. They indicated that both of these factors would be

helpful in determining the overall efficiency of health care (Kolstad & Kowalski, 2010). Although these data give an overall view of how often and for how long patients visit the hospital, these indicators are somewhat general and seem to focus on the accessibility of care. From their findings of decreases in the length of stay and decreases in the number of discharges, they concluded that there was an improvement in the overall quality of medical care given (Kolstad & Kowalski, 2010). However, these data do not directly address effectiveness of treatment, as we will address through our specific quality indicators.

In their data analysis, Lischko and Manzolillo provided graphical analysis on patients' receipt of preventative antibiotics and the end of their treatment after surgery, as compared to other states and the national average. They also specifically compared the percentage of patients receiving effective care and preventative treatments, as well as patients receiving appropriate care for heart attack, heart failure and pneumonia. These percentages, however, were only taken into account for the years 2007 and 2009, both of which are post-reform. It is evident that the measures of treatment for heart attack, heart failure and pneumonia are very important in determining the quality of medical services, however these percentages lack detail in specific indicators within these three divisions that give the reader or other researchers an idea of what medical treatment the patient received. Multiple analyses can be used in order to evaluate the effect of the reform on quality of medical services.

In order to further analyze their findings, Kolstad and Kowalski also used difference-in-differences estimates. The factors analyzed using difference-in-differences analysis were the impact of the reform on the number of medical procedures performed per patient and the total cost per patient. This analysis performed on data before and after the reform, as well as for other control states of New England demonstrated that in Massachusetts the reform reduced the number of medical procedures conducted and that costs per patient also decreased (Kolstad & Kowalski, 2010). This difference-in-differences analysis will also be used in our own research in order to detect any changes in hospital operational costs, salaries or quality indicators after the reform, as compared to the chosen control states, Connecticut and Wisconsin. This type of analysis is significant because it allows one to associate any trends in data with the focus of study, the Massachusetts health care reform.

For further analysis, Kolstad and Kowalski also generated a model, which aimed to demonstrate all of the variables that affect the cost of procedures and how they could be

calculated. In their model, they included such variables as the listed price of a procedure, which is based on the diagnosis related group (a system used to identify prices of particular procedures depending on the medical condition) and the discount due to insurance coverage. In their model, the listed group and the discount due to insurance are multiplied to find the cost of the medical procedure. Because such a model really validates the essential factors in determining cost and quality values, we will be generating our own model for calculating the total hospital operational costs and the quality of medical services, in hopes that it will accurately portray the trends we find.

3.4 Conclusion and Hypotheses

In conclusion, effective methods allow us to quantify both hospital cost and the quality of health care in order to monitor changes over a period of time. The relationship between these two factors and their importance has also been thoroughly researched. However, there is no research focusing on the effects of the current Massachusetts health care reform on cost, quality and salaries. The purpose of our research is to determine the effects of the reform on hospital costs, quality of health care and salaries. One of the main goals of the Massachusetts Health Care Reform is to improve the quality of health care services. In this project, we will try to determine whether or not they were successful in achieving this goal. Our hypothesis is that the Massachusetts quality of health care will improve after the reform, while that for the other states will remain unchanged or improve at a lower rate. The second goal of this reform was to contain hospital costs, according to our preliminary research. We will also try to determine whether or not this was achieved. Our second hypothesis is that the cost of Massachusetts hospital will remain relatively stable compared to other states. The Methodology section will describe the technical methods used to further explore the impacts on hospital cost, quality and salaries after the reform as compared to that of other states.

4.0 Methodology

The main objective of this research is to explore the effects of the Massachusetts health care reform at the hospital level on costs and quality. Data on cost and quality will be collected from before and after the reform in order to determine how they have changed and whether or not the reform has a causal impact on hospital cost and quality of medical service. The hopes of this reform were to increase coverage and access to health care across the state. In order to accomplish this goal, it is possible that hospital costs and, therefore, quality of services will be affected in some way. It is hypothesized that hospital costs were contained and the quality of their service was improved as a result of the reform, but was that true? The analyses performed on the data collected will allow these questions to be answered and will conclude whether or not the results were just a common trend or truly a result of the reform, as hospital data from other states will also be utilized. Two states, Connecticut and Wisconsin, which provide health care of similar quality to Massachusetts and are somewhat similar economically will be used as control groups in order to test these hypotheses (Commonwealth Foundation, 2009). Financial statements of hospitals will be examined, as well as specific data on some indicators of the quality of medical services. The following section will describe the hypothesis testing.

4.1 Hypothesis Testing

The overall hypothesis that was tested is that the Massachusetts health care reform improved the quality of health care services provided by hospitals and contained hospital costs. In order to measure both quality and cost changes due to the reform, hospital-level data will be collected before and after the reform and be analyzed. Cost and quality data will also be collected for Connecticut, as well as for Wisconsin in order to determine whether the changes in Massachusetts can truly be attributed to the reform. The null hypothesis being tested is that the changes in cost and quality in Massachusetts' hospitals are due to a common trend. The alternative hypothesis, however, is that the cost and quality changes in Massachusetts' hospitals are due to the Massachusetts Health Care Reform. If the patterns of hospital cost and quality data

in the control states, Connecticut and Wisconsin, do not mimic those of Massachusetts, the alternative hypothesis will be supported and accepted.

4.2 Data Collection Methods

The data collection of this project is a very important stage. We tried to collect the data from the reliable sources, such as the government office or department. The reason is the unreliable data may affect the analysis results. In addition, we tried to collect the data as much as possible. The following subsection will provide more details about the sources we used and the data we collected.

4.2.1 Hospital Cost Data Collection

In order to collect sufficient hospital cost information, we obtained data from the Center for Medicare & Medicaid Services (CMS), as the Medicare Providers are required to fill out the Hospital and Health Care Complexes, CMS 2552-96. The CMS then publishes all the collected complexes and provide it in electronic format for downloading[1]. Each complex contains several MS Excel worksheets, which are called forms. The table below is a list of these forms.

1. Download address: http://www.cms.hhs.gov/CostReports

Table 4 Components of CMS 2552-96 Form

Form Index	Form Name
Form A	Adjustments
Form B	Cost allocation based on cost center
Form C	Cost-to-Charge Ratios
Form D	Determining Costs
Form F	Financial Statements
Form G	Financial Statements
Form H	Determine provider based HHA Medicare Settlement
Form I	Determine provider based renal dialysis costs (Hospital) and RHC/FQHC (SNF)
Form K	Determine Provider based hospice Medicare costs
Form L	Determine provider Medicare capital payment
Form M	Determine RHC/FQHC Medicare settlement
Form J	Determine provider based CORF Medicare Settlement
Form S	Provider summary information

Currently, on the CMS website, we can access the databases from the Fiscal Year 1996 to the Fiscal Year 2010. Each year's folder contains four Comma-Separated Values (CSV) files. Table 5 below shows the name of each file and the contents of each file. The specific year is indicated by XXXX.

Table 5 Contents of CSV files

File Name	Content
hosp_xxxx_RPT.csv	Report variables and descriptive information, such as the record id, provider id, and the data that the cost report was submitted
hosp_xxxx_ALPHA.csv	The character and numeric values such as the provider address and if the hospital is teaching hospital
hosp_xxxx_NMRC.csv	Only numbers and wound include variables such as number of discharges, total number of beds and total cost by cost center
hosp_xxxx_ROLLUP.csv	

In order to collect the data for each measurement, we input all the CSV files to MS Access and then used Access to query the data. The name and type of each column of each file are defined by the CMS (Appendix B). Each provider is assigned a unique ID, called Provider ID, by CMS. Each year, CMS will assign a unique ID for the submitted report, called Report ID, for each specific provider. Therefore, in this project, we used the Provider ID to organize the hospital and used the Report Record Number to get the data for each measurement. All the files for each year are organized and connected by the Report Record Number, as shown in Figure 4 below.

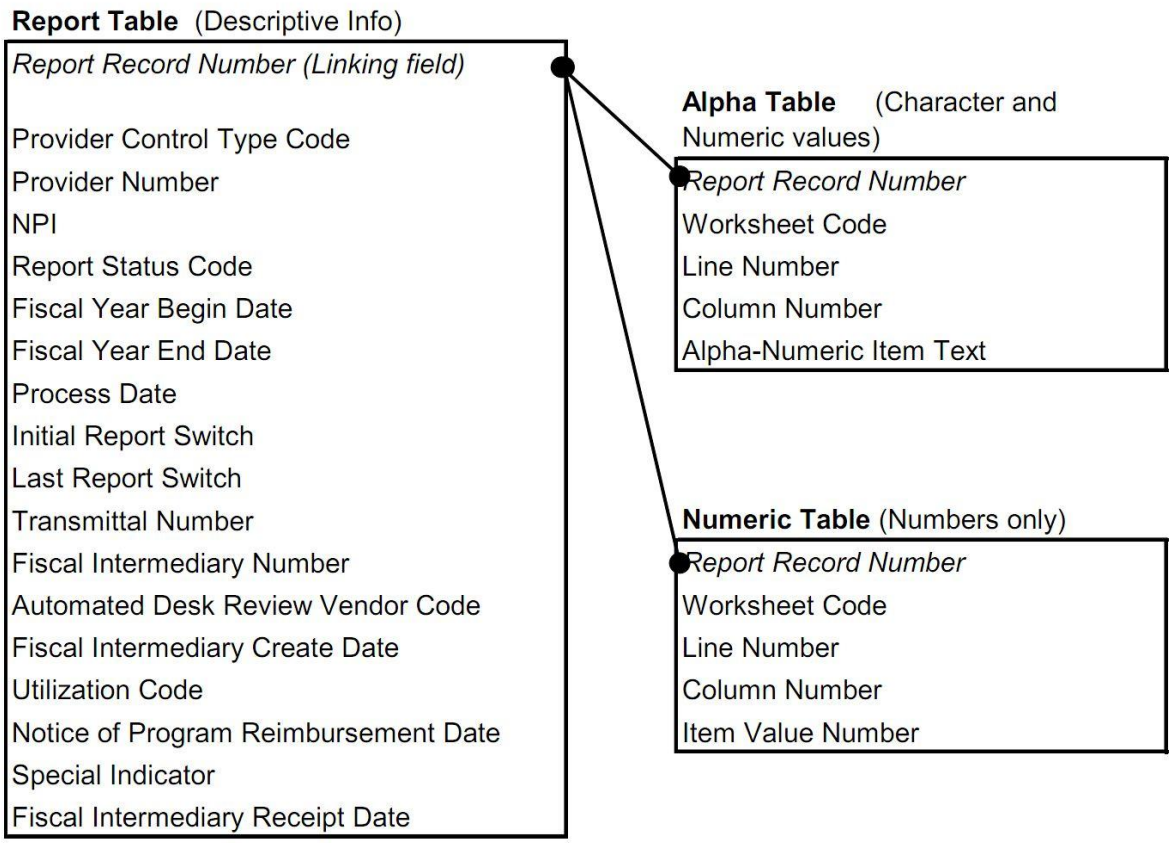

Figure 4 Relational Tables in Access

Because the data in CMS CSV file are organized by the location of the specific data in the Excel form, we needed to locate the costs and salary values first. The coordinate of each measurement includes three filed: worksheet number, line number, and column number, as shown in Figure 5 below.

Report Record Number	Worksheet Code	Column Number	Line Number	Alpha Item Text
9876	S200000	0100	02200	Y
9876	S200000	0400	00101	LOS ANGELES
9876	S300001	0000	02600	00600INTENSIVE CARE UNIT
9876	S300001	0000	02700	00700CORONARY CARE UNIT
9876	S300001	0000	02800	00800BURN INTENSIVE CARE UNIT

Figure 5 Data Organization in CMS

In addition, we needed to identify the variable as either character or numeric because they are included in different tables. For instance, if we would look for the number of beds in the file hosp_xxxx_NUMR.csv because the variable is coded as characters. To determine the teaching status of a hospital, we would check the contents in the file hosp_xxxx_ALPHA.csv because the data should be a character. The table below shows the coordinate of each cost measurement we used for this project.

Table 6 Cost Measurement Used

Measurement Name	File Name	Worksheet Number	Worksheet Code[2]	Line Code[3]	Column Code[4]
Total operation cost	hosp_xxxx_NUMR	Form G2	'G200000'	'04000'	'0200'
Operation room salary	hosp_xxxx_NUMR	Form A	'A000000'	'03700'	'0100'
Radiology room salary	hosp_xxxx_NUMR	Form A	'A000000'	'04200'	'0100'
Respiratory therapy salary	hosp_xxxx_NUMR	Form A	'A000000'	'04900'	'0100'
Physical therapy salary	hosp_xxxx_NUMR	Form A	'A000000'	'05000'	'0100'
Electrocardiology salary	hosp_xxxx_NUMR	Form A	'A000000'	'05300'	'0100'
Emergency room salary	hosp_xxxx_NUMR	Form A	'A000000'	'06100'	'0100'

In Access database, we used the query to collect all the data. Here is an example query of how we collected the total operation cost for the Fiscal Year 2009. The query is shown in SQL format. The queries for the rest of the measurements are shown in Appendix C.

[2] Used for querying
[3] Used for querying, same as the line number in the specific worksheet
[4] Used for querying, same as the column number in the specific worksheet

SELECT Sheet1.[Hospital Provider ID], Hosp_2009_NMRC_new.WKSHT_CD, Hosp_2009_NMRC_new.LINE_NUM, Hosp_2009_NMRC_new.CLMN_NUM, Hosp_2009_NMRC_new.ITM_VAL_NUM

FROM Hosp_2009_NMRC_new INNER JOIN (Sheet1 INNER JOIN Hosp_2009_RPT_new ON Sheet1.[Hospital Provider ID] = Hosp_2009_RPT_new.PRVDR_NUM) ON Hosp_2009_NMRC_new.RPT_REC_NUM = Hosp_2009_RPT_new.RPT_REC_NUM

WHERE (((Hosp_2009_NMRC_new.WKSHT_CD)="G200000") AND ((Hosp_2009_NMRC_new.LINE_NUM)='04000') AND ((Hosp_2009_NMRC_new.CLMN_NUM)='0200'));

Figure 6 below shows the format of the queried data.

Hosptial Pro	WKSHT_CD	LINE_NUM	CLMN_NUM	ITM_VAL_NU
220062	G200000	04000	0200	27642545
520009	G200000	04000	0200	141616813
220016	G200000	04000	0200	83372224
220083	G200000	04000	0200	46873461
070031	G200000	04000	0200	119759030
220001	G200000	04000	0200	156448818
220086	G200000	04000	0200	1231337525

Figure 6 Query Data

4.2.2 Hospital Quality Data

We collected the hospital quality data from the CMS Hospital Compare website[5]. Since 2005, CMS released a hospital quality Access Database every quarter. In order to stay consistent in our research, we used the databases released in March every year.

Each quality database contains several sub-databases. For this project, we only used three of them and Table 7 below describes each sub-database. Table 8 then shows the specific quality of health care indicators that we used.

[5] www.cms.gov/HospitalQualityInits/11_HospitalCompare.asp

Table 7 Quality sub-database

Database Name	Description
Dbo_vwHQI_HOSP	The basic information about each hospital
dbo vwHQI HOSP MSR XWLK	The raw data for each measurement
dbo vwHQI FTNT	The footnote for each raw data item

Table 8 Quality Database Measurements

Measurement Name	Database Name	Variable Type
Heart Attack Patients Given ACE Inhibitor or ARB for Left Ventricular Systolic Dysfunction (LVSD)	dbo vwHQI HOSP MSR XWLK	Dependent Variable
Heart Failure Patients Given Smoking Cessation Advice/Counseling	dbo vwHQI HOSP MSR XWLK	Dependent Variable
Pneumonia Patients Given Smoking Cessation Advice/Counseling	dbo vwHQI HOSP MSR XWLK	Dependent Variable
Pneumonia Patients Given the Most Appropriate Initial Antibiotic(s)	dbo vwHQI HOSP MSR XWLK	Dependent Variable
Surgery Patients Who Received Preventative Antibiotic(s) One Hour Before Incision	dbo vwHQI HOSP MSR XWLK	Dependent Variable
Surgery Patients Whose Preventative Antibiotic(s) are Stopped Within 24 hours After Surgery	dbo vwHQI HOSP MSR XWLK	Dependent Variable

The hospitals in the quality databases share the same Provider ID as the cost database. Therefore, it was convenient for us to connect both databases together. Since the quality database was already generated in MS Access format, we did not have to input the raw data into the database.

4.2.3 Hospital List

For our research, we chose all of the acute hospitals in the Massachusetts, Connecticut and Wisconsin. Also, we checked the quality data for each acute hospital and selected the hospitals which submitted the quality data every year. The detailed hospital list is shown in Appendix D.

4.2.4 Population Data

We also collected the population of the town where the hospital is located from the United States Census Office[6]. Since the last two censuses took place in 2000 and 2010, we used the estimated population given by the U.S. Census Office.

4.2.5 Control Variable Collection

We collected our control variable data from both cost databases and quality databases. Below is Table 9, which shows the coordinate of each variable.

[6] http://www.census.gov/

Table 9 Control Variable Coordinate

Measurement Name	File Name	Form	Worksheet Code	Line Code	Column Code
Number of Beds	hosp_xxxx_NUMR	Form S31	'S300001'	'01200'	'0100'
If the hospital is teaching hospital?	hosp_xxxx_ALPHA	Form S2	'S200000'	'02500'	'0100'
Ownership	Dbo_vwHQI_HOSP	N/A	N/A	N/A	N/A
If the hospital provides emergency service?	Dbo_vwHQI_HOSP	N/A	N/A	N/A	N/A
City	Dbo_vwHQI_HOSP	N/A	N/A	N/A	N/A
County	Dbo_vwHQI_HOSP	N/A	N/A	N/A	N/A

4.3 Statistical Analysis

In this research, statistical techniques were used to analyze data and evaluate the impacts of the reform. The hospital operation cost data, as well as quality and salary data of Massachusetts, Connecticut and Wisconsin was analyzed and the measures of central tendency was calculated. These values helped to determine the trend of hospital operational cost. After computing the operational cost and department salaries, the change of the cost was determined and evaluated based on the reform. Standard deviation helped examine if the samples chosen reflected the general trends of hospital operation cost in these three states.

4.4 Difference-In-Differences

Difference-In-Differences is a statistic and econometric technique used to measure the effect of a treatment at a given period in time (Econometrics, 2006). In our studies, we compared the hospital data before the Massachusetts health care reform against that after the reform to find the overall impacts of the reform on the hospital quality and operational costs. However, there were a lot of factors changing at the same time. For instance, there could have been a national trend for increasing quality and containing cost which may have affected the hospital operations in Massachusetts significantly. Therefore, in order to ensure that the changes in the hospital quality and operational costs were due to the reform rather than the national trend, we decided to use a Difference-in-Differences technique. Connecticut and Wisconsin were used as control states since their hospital quality status, population size and health care coverage were similar to those in Massachusetts before the reform. In addition, these states did not enact any health care reform bill during our study period.

The equation for the Difference-In-Differences regression is the following:

$$Y=\beta_0 + \beta_1*(Time*MA) + \beta_2*Time + \beta_3*MA + \varepsilon$$ (Econometrics, 2006)

In this equation, Y is the measurement of hospital operational cost and quality of medical service. β_2*Time is a time dummy, MA is a state dummy for Massachusetts, and Time*MA is the interaction of the time dummy and the state dummy (a product of the two variables) (Econometrics, 2006).

The chart below shows the time and the changes in hospital quality and cost in each state (Econometrics, 2006). As shown by the table below, “a” represents Connecticut before the reform, “d” represents Connecticut after the reform, “b” represents Wisconsin before the reform, “e” represents Wisconsin after the reform, “c” represents Massachusetts before the reform, “f” represents Massachusetts after the reform.

Table 10 Difference-in-Differences Variables Table (Econometrics, 2006)

	Connecticut (control)	Wisconsin (control)	Massachusetts
Before Reform	A	B	c
After Reform	D	E	f

The following chart in Table 11 describes what each coefficient in the equation represents (Econometrics, 2006).

Table 11 Difference-in-Differences Table comparing CT and MA (Econometrics, 2006)

Coefficient	Calculation
β_0	a; c
β_1	(f-c)*(f-d)
β_2	f-c
β_3	c-a; f-d

From the two charts above, one can see that β_0 is the constant, β_1 represents the causal effect of the reform, β_2 measures the common time trend in all states after the reform, β_3 captures the difference between Massachusetts and the control states (Econometrics, 2006). The difference-in-differences variables described above will be further explained below.

4.5 Econometric Modeling of the Health Industry

Econometric Modeling is "the quantitative analysis of actual economic phenomena based on the concurrent development of theory and observation related by appropriate methods of inference" (Samuelson, 1958). Econometric modeling can be used to estimate the dependent variables and their relationship in an economic system.

4.5.1 Cost Model

The equations below are the econometric models for cost. The difference-in-differences variables, as shown below, are the impact of the reform, whether the data is before or after the reform, and the state from which the data was collected. The control variables include the size of the hospital, the type of the hospital, and city size (population of the city in which the hospital is located), whether it offers emergency services, and whether it is a teaching hospital, which will be explained in the Control Variables section. The dependent variables are total operational cost and salaries cost.

$$Y_{\text{Total Cost}} = \beta_0 + \beta_1 \text{Time*} \text{ MA} + \beta_2 \text{Time} + \beta_3 \text{MA} + \beta_4 \text{Size} + \beta_5 \text{Teaching} + \beta_6 \text{Type} + \beta_7 \text{Emergency} + \beta_8 \text{Population} + \varepsilon$$

$$Y_{\text{Salary}} = \beta_0 + \beta_1 \text{Time*MA} + \beta_2 \text{Time} + \beta_3 \text{MA} + \beta_4 \text{Size} + \beta_5 \text{Teaching} + \beta_6 \text{Type} + \varepsilon$$

Dependent Variables:

The following list includes all of the dependent variables used in the cost model.

Y_{Cost}: Total Operational Cost Adjusted by Inflation

We used total operational cost as the dependent variable in our model. This cost is adjusted with the inflation rate to get the actual values. We then used the real cost to evaluate the overall impacts of the reform on the hospital operational cost.

Y_{Salary}: Salaries Cost Adjusted by Inflation

We used physician salaries from different departments such as the Operating Room, Radiology Room, Respiratory Therapy, Physical Therapy, Electrocardiology and Emergency Room. All these costs were adjusted with the inflation rate to get more realistic values.

Difference-in-Differences Variables:

*MA*Time* (Dummy Variable): MA*Time = 1 if a hospital is in Massachusetts and is after reform. Otherwise, MA*Time = 0

The reform variable described above is the most important variable in our model as it shows the impact of the reform on the cost. We expect β_1 to be close to zero because the target of the Massachusetts health care reform is to contain hospital cost.

Time (Dummy Variable): Time = 1 if the hospital data is after reform (the first 2 years from July 2004 to June 2006 are pre-reform). Time = 0 if the hospital data is after reform (the later 3 years from July 2006 to June 2009 are post-reform).

The time variable compares the pre-reform conditions to the post-reform conditions. In our model, we consider FY2005 and FY2006 as pre-reform and FY2007, FY2008 and FY2009 as post-reform. We expect β_2 to be positive because the hospital operational costs in all three states are expected to increase over time.

MA (Dummy Variable): State = 1 if the hospital data is in Massachusetts. State = 0 if the hospital data is in Connecticut or Wisconsin

MA is the state variable which compares the hospitals in Massachusetts against those in Connecticut and Wisconsin. Our hypothesis is that β_3 of Massachusetts should be close to zero as the operational cost is expected to be contained in Massachusetts compared to Connecticut and Wisconsin.

Control Variables:

$$a_{i1} = b_0 + b_1 \log S_{i0} + b_2 P_i + b_3 M_i + b_4 AT_i + b_5 T_i + b_6 \log AC_{i0} + b_7 \log U_{i0} + e_{it}$$

Cost Equation found in Literature Review

The function above shows the relationship between total cost and different control variables. In the function, a_{i1} is the total cost. S_{io} is the size of the ith hospital in the first period, P_i and M_i are dummy variables indicating the hospital's location; AT_i and T_i are dummy variables representing the hospital's teaching status (Lave & Lave, 1970).

The city size, teaching status hospital size definitely have some effects on the costs and quality of services of a hospital (Lave & Lave, 1970). In addition, in another article written by Sloan *et al.* (2001), the hospital ownership was considered as one of the variables that will impact on the hospital operational cost.

Size (Dummy Variable): Size = Extra Large if >400, Large if <400 and >200, Medium if <200 and >100, Small if <100.

Size is the hospital size variable. We classified all the hospitals into four different categories based on their number of beds. These categories include Extra Large, Large, Medium and Small. We expect β_4 of Extra Large to be positive since big hospitals have higher operational costs.

Teaching (Dummy Variable): Teaching = 1 if the hospital is teaching hospital. Otherwise, Teaching = 0

Teaching is the teaching hospital variable. We expect that β_5 will be positive because teaching hospitals have higher costs than nonteaching hospitals.

Type (Dummy Variable): Proprietary, Governmental and Non-profit.

Type is the hospital type variable. There are three types of hospitals: Proprietary, Non-profit and Governmental . We expect that β_6 of Non-profit are positive because nonprofit hospitals have higher operational costs than other hospitals.

Emergency (Dummy Variable): Emergency Service (Emergency = 1 if the hospital provides emergency service. Otherwise, Emergency = 0)

Emergency is the Emergency Service variable. We expect β_7 to be positive since the hospital with emergency service are expected to have higher operational costs.

City Size (Continuous Variable): The population size of a city divided by fifty thousand

We hypothesize that β_8 will be positive since the bigger the city, the higher the operational cost for the hospital.

4.5.2 Quality Model

The equations below are an econometric model for the quality of medical services. The dependent variables are the different measurements of medical services. The difference-in-differences variables include the impact of the reform, whether the data is before or after the reform, the state from which the data was collected. The control variables are the size of the hospital, whether it is a teaching hospital, its ownership, whether or not it offers emergency services and the population of the city in which the hospital is located. Several articles that are mentioned below show that these control variables above have effects on the Massachusetts

health care reform. Therefore, we can use them in our model to find the overall impacts of the reform on hospital quality (Sloan, Picone, Jr., & Chou, 2001 & Keeler, et al., 1992).

$$Y_{quality} = \beta_0 + \beta_1 Time*MA + \beta_2 Time + \beta_3 MA + \beta_4 Size + \beta_5 Teaching + \beta_6 Type + \beta_7 Emergency + \beta_8 Population + \varepsilon$$

Dependent Variables:

The following list includes all of the dependent variables used in the quality model.

$Y_{quality}$ (Continuous Variable):

Heart Attack Patients Given ACE Inhibitor or ARB for Left Ventricular Systolic Dysfunction (LVSD);

Heart Failure Patients Given Smoking Cessation Advice/Counseling;

Pneumonia Patients Given Smoking Cessation Advice/Counseling;

Pneumonia Patients Given the Most Appropriate Initial Antibiotic(s);

Surgery Patients Who Received Preventative Antibiotic(s) One Hour Before Incision;

Surgery Patients Whose Preventative Antibiotic(s) are Stopped Within 24 hours After Surgery

As demonstrated above, we have six different indicators to measure the quality of medical services in the quality model. We used them separately to see the overall effects of the reform on hospital quality.

Difference-in-Differences Variables:

The following list includes the Difference-in-Differences variables.

*MA*Time* (Dummy Variable): Already described above.

MA* Time is the most important variable in our model, symbolizing the impact of the reform on the quality. Because the target of the Massachusetts health care reform is to improve quality, we expect β_1 to be positive.

Time (Dummy Variable): Already described above

As mentioned before, in our model, we consider 2005 and 2006 as pre-reform and thereafter as post-reform. The quality of health care will be improved over the years, so we expect that β_2 to be positive.

MA (Dummy Variable): Already described above

Our hypothesis is that β_3 should be zero as the hospital quality status in Connecticut and Wisconsin are very similar to that in Massachusetts (State Data Center, 2009).

Control Variables:

Hospital Characteristics	Distribution of Hospitals, % *	Explicit Hospital Process, SD	Implicit Hospital Process, SD	Excess Mortality, %	Observed Mortality, %	Predicted Mortality, %
City size						
Rural	21	−0.30‡	−0.33‡	1.4§	17.4	16.0
SMSA <1 000 000†	33	−0.03	−0.11	0.6	16.1	15.5
SMSA >1 000 000	46	0.16	0.22	−1.1	15.1	16.3
Teaching status						
Major teaching‖	10	0.28‡	0.66‡	−2.5§¶	14.7	17.2
Moderate and limited	26	0.13	0.21	−0.8	14.9	15.7
Nonteaching	64	−0.09	−0.18	0.7	16.5	15.9
State						
A	20	−0.23‡	−0.25‡	2.5§	17.6	15.0
B	20	−0.18	−0.14	−0.0	16.7	16.8
C	20	0.02	−0.00	−0.4	15.1	15.5
D	20	0.15	0.10	−1.3	14.0	15.3
E	20	0.23	0.38	−0.9	16.3	17.1
Ownership						
Nonprofit	62	0.06‡	0.07§	−0.5	15.3	15.8
For-profit	12	0.04	−0.15	−0.4	16.0	16.5
Public	26	−0.17	−0.12	1.2	17.4	16.2
Size, No. of beds						
<100	19	−0.30‡	−0.40‡	1.9§	17.9	15.9
100-200	21	−0.01	−0.09	−0.5	15.6	16.1
201-400	31	0.07	−0.04	−0.1	15.3	15.3
>400	30	0.12	0.32	−0.8	15.6	16.5
Classic city-county#	13	0.13§	0.28§	−1.3	15.7	17.0

Figure 7 Control Variables Used in Previous Research (Keeler, et al., 1992)

Before selecting our control variable, we conducted some preliminary research. As shown above in Figure 7, the city size, teaching status, ownership and hospital size definitely have some meaningful impacts on the effects of the reform (Keeler, et al., 1992). We also included the emergency service in our model because we consider the hospitals which provide emergency room services as ones that provide higher overall quality of care.

Size (Dummy Variable): Already described above

Just as in the cost model, we classified all the hospitals into four different categories based on their number of beds. These categories include Extra Large, Large, Medium and Small. We expect β_4 of Extra Large to be positive since, as the previous table shows, big hospitals have better quality of care. For other variables, we expect that their values are negative.

Teaching (Dummy Variable): Already described above

We expect that β_5 is positive because, as the table shows, teaching hospital offers much better medical services than nonteaching hospitals.

Type (Dummy Variable): Already described above

Just as in the cost model, we classified the three types of hospitals as: Proprietary, Non-profit and Governmental. We expect that β_6 of Non-profit hospitals are positive because according to an article reviewed, nonprofit hospitals provide better quality of cares than other types of hospitals (Sloan, Picone, Jr., & Chou, 2001). We also hypothesize that the beta values of Proprietary and Governmental are negative (Sloan, Picone, Jr., & Chou, 2001).

Emergency (Dummy Variable): Already described above

Emergency is the Emergency Service variable. We expect β_7 to be positive since as we said previously, the hospitals with emergency service are expected to have higher quality of care.

Population (Continuous Variable): Already described above

Population is the city size variable. It measures the population of a city or town in which the hospital operates. In our model, we divided the population size by fifty thousand. We hypothesize that β_8 will be positive as the table above shows that hospitals in bigger cities offer better medical services than those in smaller cities.

4.6 Regression Analysis

Regression techniques were utilized to determine the relationships between hospital operation cost factors, department salaries, as well as quality of medical services, and the reform. The purpose of this regression analysis was to assess the accuracy of the models we generated.

In other words, we determined how well the independent variables could be used to predict the values of the dependent variables (Bell, 2011).

The hospital cost data that was collected from the Centers for Medicare and Medicaid Services (CMS), as well as the hospital quality data collected from the Medicare Hospital Compare Quality of Care Database was entered into "Statistical Package for the Social Sciences" (SPSS) and was organized by variable and hospital. Descriptive statistics were then performed on the data (using SPSS) in order to eliminate any outliers that could skew the results of the regression. Minimum and maximum were used to find such outliers, which included a total operational cost of 0 for Umass Memorial of Massachusetts in 2009 and over 17,000 beds in Mercy Medical Center of Wisconsin in 2009. This number of beds is an outlier, as it is unrealistically large. The total operational cost outlier was deleted and the number of beds of 2008 for Mercy Medical Center was substituted for 2009.

As seen from the models presented above in Section 4.5, the dependent variable for the cost model was the total hospital operational cost and the independent variables included multiple control variables, such as hospital size (determined by the number of beds), whether it is a teaching hospital, ownership of hospital (whether it is non-profit, proprietary or governmental), city size (population of the city the hospital is located in) and whether it offers emergency services. Dependent variables for the salary models include the salary of the emergency room, operating room, radiology department, physical therapy department, and electrocardiology department, while the independent variables remain the same as for total cost except that the emergency services dummy variable and city population are eliminated. All total operational cost and salary values were first adjusted depending on the inflation rate of that year before being used in the regression. The dependent variable for the quality model was the pneumonia, heart attack, heart failure, or surgery patient indicators collected through the database. In the quality model, control variables, such as hospital size, whether it is a teaching hospital, city size and whether it offers emergency services were included. We expect all of the control variables to affect cost and quality, as we have found literature and previous research to support this. However, the most significant variables that are included in both of the cost and quality models are the difference-in-differences variables, which include the state, the year and the "reform variable," β_1MA*Time, which is a product of the two. Separate regressions were run for cost and quality, as well as department salaries, and we the results generated for the reform variable

were used to determine whether or not the reform has truly affected hospital cost and quality. Specifically, we looked at the R-Squared value generated, which measures how successful the regression is. A value of 1.00 means that the independent variables flawlessly predict the dependent variables. The significance of the model was also used to measure how meaningful the results of the regression are, as well as the significance of the specific coefficients. P-values close to 0 symbolize a greater significance. Finally, the beta value was looked at in order to determine specifically how the variables relate to each other. For example, a negative beta value means that the independent variable has a negative effect on the dependent variable, while a positive beta value means just the opposite.

Ideally, we were looking for an R-Squared value close to 1 to indicate that our independent variables do predict our dependent variables. Although, we expected all of the control variables to be significant, we paid most attention to whether or not the reform variable is significant. If the reform really did affect hospital cost and quality in the way that was planned, then the state and time should show significance in determining hospital cost and quality. If this was true, then Massachusetts would have a higher quality of medical services after the reform and contained costs, while the other states would not show such trends.

5.0 Results

The following results will present the collected hospital cost and quality data and analyze the trends found.

5.1 Descriptive Statistics

In total, we collected the hospital quality and cost data from 153 hospitals from Massachusetts, Connecticut and Wisconsin. Specifically, we collected the information from 30 hospitals from Connecticut, 61 hospitals from Massachusetts and 62 from Wisconsin. All of the hospitals are acute care hospitals.

In the following section, we will discuss the hospital ownership in each state based on the definition given by CMS. In CMS list, the hospitals are separated into thirteen classes, which are listed in following table.

Table 12 Hospital Ownership Code

Ownership Code	Description of Ownership
1	Voluntary Nonprofit, Church
2	Voluntary Nonprofit, Other
3	Proprietary, Individual
4	Proprietary, Corporation
5	Proprietary, Partnership
6	Proprietary, Other
7	Governmental, Federal
8	Governmental, City-County
9	Governmental, County
10	Governmental, State
11	Governmental Hospital District
12	Governmental, City
13	Governmental, Other

Table 13 below shows categorizes the hospitals in each state by ownership, size, whether it is a teaching hospital and whether or not it offers emergency services.

Table 13 Descriptive Statistics of Hospital Sample

Variable		Massachusetts	Connecticut	Wisconsin
Ownership	Governmental	1	1	1
	Proprietary	5	1	4
	Non profit	55	28	57
Size	Extra Large	7	4	5
	Large	15	8	9
	Medium	25	11	22
	Small	14	7	26
Teaching		35	17	24
Emergency		56	29	60

In Connecticut, 28 hospitals, which are 93% of total hospital in Connecticut, are voluntary non-profit hospitals and 58% of them are private sector. For the rest hospitals, one of them is a government funded hospital and one is a proprietary hospital. Approximately 36% of the hospitals are medium sized and there is almost an equal number of large and small hospitals. About 57% are teaching hospitals and all but one hospital offer emergency services.

In Massachusetts, the voluntary non-profit hospital is still the largest group, which takes 90% of the total. Among these non-profit hospitals, 34 of them are in the private sector and 6 of them are owned by church. For the rest hospitals, five hospitals are governmental and one of them is proprietary. About 43% of the hospitals are medium sized and there are equal numbers of large and small hospitals. Only about 12% are extra large hospitals. Nearly 60% are teaching hospitals and all but two hospitals offer emergency services.

57 of the Wisconsin hospitals are voluntary non-profit hospitals. More than half of them are private non-profit hospitals and 18 of them are church owned hospitals, which is the largest

amongst these three states. Besides these non-profit hospitals, only one hospital is funded by government, which is different from other states. The other four are proprietary hospitals. Approximately 42% of hospitals are small and 35% are medium sized. About 39% are teaching hospitals and all but two offer emergency services.

5.2 Summary Statistics

The following tables and text will present the summary statistics of the collected data, such as the mean and standard deviation. Table 14 below contains the hospital size data of our sample. The data we analyzed here is from July 2004 till June 2009. We separate these 5 years data into two groups: pre-reform and post-reform. We defined the first 2 years, which is from July 2004 to June 2006 as pre-reform. Then we defined the later 3 years, which is from July 2006 to June 2009 as post-reform.

Table 14 Summary Statistics of Dependent Variables

Dependent Variables	Definition	MA Mean	MA Std. Dev.	MA Sample Size	CT Mean	CT Std. Dev.	CT Sample Size	WI Mean	WI Std. Dev.	WI Sample Size
Cost										
Total Operating Cost (in millions)	Hospital Total Operating Cost	281.892	345.831	302	246.777	205.741	149	169.571	172.442	285
Physician Salaries (in millions)	Hospital Physician Salaries									
Operating Room	Operating Room Physician Salaries	6.522	8.144	294	5.734	4.956	144	3.524	3.474	284
Radiology Room	Radiology Room Physician Salaries	5.548	6.387	298	3.457	3.090	144	2.993	2.969	269
Respiratory Therapy	Respiratory Therapy Physician Salaries	1.478	1.427	295	1.628	1.354	140	1.059	1.055	270
Physical Therapy	Physical Therapy Physician Salaries	1.878	1.937	267	1.766	1.205	119	1.667	1.229	254
Electrocardiology	Electrocardiology Physician Salaries	1.039	1.394	290	0.815	1.217	129	0.691	1.172	193
Emergency Room	Emergency Room Physician Salaries	6.377	5.271	289	7.860	4.725	145	2.710	1.679	267
Quality										
Heart Attack	Heart Attack Patients Given ACE Inhibitor or ARB for Left Ventricular Systolic Dysfunction (LVSD)	0.836	0.210	209	0.828	0.213	106	0.851	0.245	196
Heart Failure	Heart Failure Patients Given Smoking Cessation Advice/Counseling	0.808	0.212	143	0.861	0.221	75	0.869	0.181	183
Pneumonia										
	Pneumonia Patients Given Smoking Cessation Advice/Counseling	0.782	0.250	95	0.817	0.259	40	0.865	0.145	107
	Pneumonia Patients Given the Most Appropriate Initial Antibiotic(s)	0.836	0.135	80	0.772	0.278	42	0.877	0.066	62
Surgery										
	Surgery Patients Who Received Preventative Antibiotic(s) One Hour Before Incision	0.905	0.093	147	0.898	0.061	75	0.923	0.062	156
	Surgery Patients Whose Preventative Antibiotic(s) are Stopped Within 24 Hours After Surgery	0.854	0.134	145	0.845	0.111	72	0.825	0.174	145

The table above is the summary statistics for the dependent variables in our models. As we can see clearly from the table, the total operational cost in Massachusetts is much higher than that in Connecticut and Wisconsin. This rule also applies to the department salaries. Concerning the quality of medical services, all the three states are at a similar level, which is why we decided to use Connecticut and Wisconsin as our control groups. Appendix G presents the trends of these dependent variables in a graphical format.

The table below is the summary statistics of the control variables. As can be seen in the table, there are more small hospitals and fewer big hospitals in Wisconsin than in the other two states. We can also see that the nonprofit is the dominant ownership for all of the three states. The teaching hospital rates are much higher in Massachusetts and Connecticut than in Wisconsin. Most of the hospitals provide emergency care. Finally, the city size in which the hospital operates is much bigger in Massachusetts than in Connecticut or in Wisconsin. Table 16 below contains the statistic results of the dependent variables in Massachusetts and Wisconsin before and after the reform.

Table 15 Summary Statistics of Explanatory Variables

	MA		CT		WI	
Explanatory Variables	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**
Hospital Size						
Hospital_>400	0.115	0.319	0.133	0.341	0.077	0.268
Hospital_200-400	0.249	0.433	0.267	0.444	0.152	0.359
Hospital_100-200	0.403	0.491	0.360	0.482	0.348	0.477
Hospital_<100	0.233	0.423	0.240	0.429	0.423	0.495
Ownership						
Ownership _Governmental	0.016	0.127	0.033	0.180	0.016	0.126
Ownership _Proprietary	0.066	0.248	0.027	0.162	0.052	0.222
Ownership _Nonprofit	0.902	0.298	0.933	0.250	0.916	0.278
Teaching Hospital	0.574	0.495	0.567	0.497	0.387	0.488
Emergency Service	0.921	0.270	0.960	0.197	0.965	0.185
Town Population_50K	3.228	4.441	1.307	0.849	1.880	3.179
Sample Size	305		150		310	

Table 16 Dependent Variables (Before Reform and After Reform)

		MA						CT						Simple DD	
		Before Reform			After Reform			Before Reform			After Reform				
Explanatory Variables	**Definition**	**Mean**	**Std. Dev.**	**Sample Size**	**Mean**	**Std. Dev.**	**Sample Size**	**Mean**	**Std. Dev.**	**Sample Size**	**Mean**	**Std. Dev.**	**Sample Size**	**MA* TIME**	**Std. Err.**
Cost															
Total Operating Cost (in millions)	Hospital Total Operating Cost	272.080	352.266	122	288.505	342.249	180	221.748	177.058	60	263.650	222.388	89	-0.040	[60.416]
Physician Salaries (in millions)	Hospital Physician Salaries														
Operating Room	Operating Room Physician Salaries	5.754	7.068	118	7.038	8.776	176	4.892	3.756	58	6.301	5.573	86	-0.010	[1.444]
Radiology Room	Radiology Room Physician Salaries	5.071	5.681	119	5.866	6.813	179	3.158	2.478	58	3.659	3.441	86	0.022	[1.102]
Respiratory Therapy	Respiratory Therapy Physician Salaries	1.355	1.274	117	1.560	1.519	178	1.499	1.204	56	1.714	1.446	84	-0.008	[0.283]
Physical Therapy	Physical Therapy Physician Salaries	1.680	1.631	109	2.015	2.117	158	1.530	1.034	48	1.925	1.291	71	-0.018	[0.376]
Electrocariology	Electrocardiology Physician Salaries	0.974	1.359	118	1.083	1.420	172	0.732	1.070	52	0.870	1.311	77	-0.013	[0.279]
Emergency Room	Emergency Room Physician Salaries	5.620	4.644	116	6.885	5.608	173	6.870	3.800	59	8.540	5.179	86	-0.035	[1.008]
Quality															
Heart Attack	Heart Attack Patients Given ACE Inhibitor or ARB for Left Ventricular Systolic Dysfunction (LVSD)	0.772	0.259	92	0.887	0.144	117	0.746	0.254	52	0.906	0.120	54	-0.104	[0.048]
Heart Failure	Heart Failure Patients Given Smoking Cessation Advice/Counseling	0.685	0.238	58	0.892	0.143	85	0.808	0.207	28	0.893	0.225	47	0.274	[0.058]**
Pneumonia															
	Pneumonia Patients Given Smoking Cessation Advice/Counseling	0.611	0.288	38	0.896	0.129	57	0.526	0.320	10	0.913	0.139	30	-0.199	[0.086]
	Pneumonia Patients Given the Most Appropriate Initial Antibiotic(s)	0.781	0.110	32	0.873	0.138	48	0.510	0.333	8	0.834	0.228	34	-0.574	[0.081]***
Surgery															
	Surgery Patients Who Received PreventativeAntibiotic(s) One Hour Before Incision	0.803	0.087	16	0.918	0.085	131	0.870	0.000	2	0.899	0.062	73	0.512	[0.060]
	Surgery Patients Whose Preventative Antibiotic(s) are Stopped Within 24 Hours After Surgery	0.731	0.122	16	0.869	0.128	129	0.890	0.000	2	0.843	0.113	70	0.715	[0.094]**

		MA						WI							
		Before Reform			After Reform			Before Reform			After Reform			Simple DD	
Explanatory Variables	**Definition**	**Mean**	**Std. Dev.**	**Sample Size**	**Mean**	**Std. Dev.**	**Sample Size**	**Mean**	**Std. Dev.**	**Sample Size**	**Mean**	**Std. Dev.**	**Sample Size**	**MA* TIME**	**Std. Err.**
Cost															
Total Operating Cost (in millions)	Hospital Total Operating Cost	272.080	352.266	122	288.505	342.249	180	162.558	164.782	124	174.972	178.440	161	0.006	[44.586]
Physician Salaries (in millions)	Hospital Physician Salaries														
Operating Room	Operating Room Physician Salaries	5.754	7.068	118	7.038	8.776	176	3.390	3.265	123	3.627	3.633	161	0.071	[1.023]
Radiology Room	Radiology Room Physician Salaries	5.071	5.681	119	5.866	6.813	179	2.928	2.841	117	3.042	3.072	152	0.057	[0.832]
Respiratory Therapy	Respiratory Therapy Physician Salaries	1.355	1.274	117	1.560	1.519	178	1.010	1.018	118	1.096	1.084	152	0.036	[0.208]
Physical Therapy	Physical Therapy Physician Salaries	1.680	1.631	109	2.015	2.117	158	1.574	1.071	111	1.740	1.338	143	0.050	[0.278]
Electrocariology	Electrocardiology Physician Salaries	0.974	1.359	118	1.083	1.420	172	0.614	0.962	85	0.751	1.316	108	-0.009	[0.237]
Emergency Room	Emergency Room Physician Salaries	5.620	4.644	116	6.885	5.608	173	2.543	1.506	116	2.839	1.797	151	0.100	[0.655]
Quality															
Heart Attack	Heart Attack Patients Given ACE Inhibitor or ARB for Left Ventricular Systolic Dysfunction (LVSD)	0.772	0.259	92	0.887	0.144	117	0.826	0.231	78	0.868	0.253	118	0.392	[0.050]***
Heart Failure	Heart Failure Patients Given Smoking Cessation Advice/Counseling	0.685	0.238	58	0.892	0.143	85	0.753	0.222	54	0.918	0.135	129	0.281	[0.036]*
Pneumonia															
	Pneumonia Patients Given Smoking Cessation Advice/Counseling	0.611	0.288	38	0.896	0.129	57	0.800	0.168	42	0.907	0.111	65	0.399	[0.027]**
	Pneumonia Patients Given the Most Appropriate Initial Antibiotic(s)	0.781	0.110	32	0.873	0.138	48	0.864	0.059	32	0.891	0.072	30	-0.412	[0.051]**
Surgery															
	Surgery Patients Who Received Preventative Antibiotic(s) One Hour Before Incision	0.803	0.087	16	0.918	0.085	131	0.877	0.061	18	0.929	0.060	138	0.392	[0.050]***
	Surgery Patients Whose Preventative Antibiotic(s) are Stopped Within 24 Hours After Surgery	0.731	0.122	16	0.869	0.128	129	0.591	0.266	18	0.858	0.127	127	0.281	[0.036]*

The tables above just compare the dependent variables before reform against those after reform in all the three states. As we can see from the tables above, the cost increases after the reform for all the three states. The total cost, however, was relatively contained in Massachusetts and Wisconsin, where it increased by about 6% and 7.5%, respectively. In Connecticut, the total cost increased by about 19%. The operating room salary increased significantly in Massachusetts and Connecticut by about 23% and 31%, respectively, while it only increased by about 6% in Wisconsin. The emergency room salary increased in Massachusetts and Connecticut by 21% and 25%, respectively, and it only increased in Wisconsin by about 12%. The smaller departments showed similar trends in all of the states and the quality of services increased in all states after the reform. For Connecticut, only three of the simple DD regressions yielded significant values, which were the quality regressions for heart failure, pneumonia patients receiving the most appropriate antibiotic and surgery patients no longer receiving antibiotics 24 hours after surgery. For the heart failure and surgery patients, the reform had a positive impact, while it had a negative impact for pneumonia patients. It also indicates that the quality improves after the reform in all the three states. For the comparison with Wisconsin, all of the quality regressions were significant, indicating that the reform positively impacted all of the quality indicators except for pneumonia patients who are no longer receiving antibiotic. Although, it is useful to run the simple difference-in-differences regressions, one must keep in mind that these p-values are subject to change once all of the control variables are included.

Table 17 below is the comparison table for the control variables before and after the reform in Massahusetts and Connecticut. As we can see from Table 17, there are not many changes between the values before the reform and those after the reform. The next section will describe all of our generated regression analysis results.

Table 17 Control Variables (Before Reform and After Reform)

	MA				CT				WI			
	Before Reform		After Reform		Before Reform		After Reform		Before Reform		After Reform	
Explanatory Variables	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**
Hospital Size												
Hospital_>400	0.115	0.320	0.115	0.320	0.133	0.343	0.133	0.342	0.073	0.260	0.081	0.273
Hospital_200-400	0.246	0.432	0.251	0.435	0.267	0.446	0.267	0.445	0.153	0.362	0.151	0.359
Hospital_100-200	0.410	0.494	0.399	0.491	0.367	0.486	0.356	0.481	0.355	0.480	0.344	0.476
Hospital_<100	0.230	0.422	0.235	0.425	0.233	0.427	0.244	0.432	0.419	0.495	0.425	0.496
Ownership												
Ownership _Governmental	0.016	0.128	0.016	0.127	0.033	0.181	0.033	0.181	0.016	0.126	0.016	0.126
Ownership _Proprietary	0.082	0.275	0.055	0.228	0.033	0.181	0.022	0.148	0.065	0.247	0.043	0.203
Ownership _Nonprofit	0.902	0.299	0.902	0.299	0.933	0.252	0.933	0.251	0.911	0.285	0.919	0.273
Teaching Hospital	0.574	0.497	0.574	0.496	0.567	0.500	0.567	0.498	0.387	0.489	0.387	0.488
Emergency Service	0.926	0.262	0.918	0.275	0.967	0.181	0.956	0.207	0.968	0.177	0.962	0.191
Town Population_50K	3.169	4.342	3.267	4.517	1.304	0.853	1.309	0.850	1.871	3.178	1.886	3.188
Sample Size	122		183		60		90		124		186	

5.3 Results of Regression Analysis

As was previously described above in the Methodology section, a series of three regressions were run: for cost, for quality, and for department salaries. This section will describe the results that were generated by SPSS, starting with total cost in Table 18 below.

5.3.1 Total Cost

The regression run on the total cost model generated an R-Squared value of about 0.736, which means that the dependent variables predicted total cost fairly accurately. As can be seen from Table 16 above, the variable with the reform variable is insignificant, as well as the dummy variable symbolizing which state the data was obtained. The other control variables of hospital size, ownership, whether it is a teaching hospital and city population are all very significant with significance values close to 0. Time and whether the hospital offers emergency services appear to be slightly less important with values closer to 0.1, but are still significant. From the beta values presented in Table 18, it is evident that larger hospitals, teaching hospitals, nonprofit and government-owned hospitals have a higher total cost. Total cost is also higher in Massachusetts and larger towns.

5.3.2 Salaries

We also ran regressions on models for various department salaries. Since we do not expect many of the smaller departments to be affected by the reform because they were not particularly targeted by any of the reform efforts, we will include those in Appendix B. The R-squared value for the regression for the emergency room salary was 0.429, which is somewhat meaningful, considering our independent variables accurately predicted our dependent variable about half of the time. The reform variable is insignificant, as it generated a value of 0.369. As can be seen from the results above, most of the control variables were significant except for the dummy variable indicating nonprofit hospitals. The dummy variable indicating medium hospital size and the dummy variable indicating time were significant with values around 0.05. Beta

values showed that larger hospitals had a larger emergency room salary and that salaries were also higher for teaching hospitals. The emergency room salaries were also higher in Massachusetts. The R-squared value for the operating room salary regression is 0.591, which is slightly higher than that generated for the emergency room salary regression, and very meaningful. The reform variable is insignificant, as it generated a value of 0.362. As exemplified by the values above, there is a lot of variance in the significance of the independent variables in this regression. Variables for size, teaching hospitals, and whether the hospital is located in Massachusetts were most significant with values from 0 to close to 0.05. Other variables, such as the reform variable, whether the hospital is located in Connecticut, and ownership are all insignificant with values between 0.345 and 0.777. Beta values indicated that larger and teaching hospitals had higher salaries. Hospitals in Massachusetts also had higher operating room salaries. Generally, the trend in the cost and salary regressions seemed to be that the reform variable was insignificant, but there were generally higher costs and salaries in Massachusetts.

5.3.3 Quality

Table 18 above also includes the quality results. The R-Squared value for the quality of medical services administered to heart attack patients is much smaller than that above for total cost at a value of 0.105, meaning that the independent variables do not have a very strong correlation with the dependent variable. The reform variable generated a significance value of 0.582, which is insignificant. As can be seen from the significance values above, there is much more variability in the values than those generated from the total cost regression. The variables that were most significant with significance values of 0 were time and whether or not the hospital was a teaching hospital. Whether or not the hospital provided emergency services, was also somewhat significant with a significance value of 0.089. Other variables had much higher p-values, all above 0.2 (except for the dummy value symbolizing if the data was obtained from Massachusetts), and most of which were closer to 0.5 or higher. It is demonstrated by the generated beta values that teaching hospitals provide a higher quality of medical services, which was also supported by our preliminary research. It was also shown that quality generally increased with time for all of the states.

The R-Squared value for the quality model for heart failure patients is still low at 0.326, although it is significantly higher than that for heart attack patients. It is worth noting that the reform variable seems to be significant here with a value of 0.068. It also generated a positive beta value, indicating that the reform had a positive impact on the quality of medical services for heart failure patients. As seen above, the p-values of the variables in this model also greatly vary from 0 to almost 0.7 for the dummy variable "IF_CT." The city population size and the dummy variable "OWN_GOV" also seem to not be significant. However, the other control variables are significant with values close to 0. The beta values indicated that all states had increased quality of medical services over time and that there was increased quality in larger hospitals and larger cities. However, there was a lower level of quality service provided in teaching hospitals, which does not coincide with our preliminary research. There was also a lower level of quality services provided in Massachusetts hospitals.

The R-Squared value for the quality of medical services of pneumonia patients receiving medical advice for smoking cessation is the highest yet for the quality models with a value of 0.438. As can be seen from the values presented above in Table 10, the reform variable was extremely significant with a value of 0.001. This means that the reform almost perfectly predicted the quality of treatment of pneumonia patients, which, in this case, was medical advice concerning smoking cessation. The regression also yielded a positive beta value, demonstrating that the reform increased the quality of services administered to these patients. All of the control variables except for the dummy variable for nonprofit hospitals and that for city population were significant. Whether the hospital offered emergency services and the dummy variable for whether or not the hospital was located in the state of Connecticut were also significant with values closer to 0.03. Beta values indicated that the reform, time, hospitals offering emergency services and larger hospitals all provided a higher quality of medical services for pneumonia patients receiving medical advice. Governmentally owned hospitals and teaching hospitals offered a lower quality of medical services.

The regression for pneumonia patients receiving the most appropriate antibiotic was similar in terms of the R-squared value, which was 0.450. The reform variable was insignificant with a p-value of 0.768. As can be seen above, many of the control variables, such as the dummy variable for ownership, the dummy variable indicating a large hospital, the dummy variable indicating the hospital is located in Massachusetts is insignificant. The reform variable is

insignificant, which is unlike some of the other quality regressions. Variables such as whether the hospital offers emergency services, city population, time and whether the hospital is located in Connecticut generated significant values, all close to 0. Whether the hospital was a teaching hospital and extra large hospitals were also significant. Beta values demonstrated that Connecticut hospitals provided a lower quality of care. The level of quality was increased, however, for larger towns and hospitals that offered emergency services. Quality also increased in all states with time.

The R-squared value generated for surgery patients receiving an antibiotic one hour after incision was 0.139, which is significantly low. Such a low value suggests that our independent variables are not very strong predictors or our dependent variable, quality of medical services of surgery patients. As can be seen from the results above, the reform variable is significant in this regression, along with the other difference-in-differences variables for determining which state the hospital is in and time. It is interesting that the variables relating to reform, such as time and state are significant, which is not common in the other regressions, while some of control variables are insignificant. Quality for surgery patients receiving antibiotics increased with the reform and time. Quality was generally lower, however, in Massachusetts and Connecticut than Wisconsin.

The R-squared value for surgery patients who were no longer on antibiotic after 24 hours is 0.221, which is significantly low, but is consistent with some of the other R-squared values generated from the quality regressions. The reform variable is significant with a value of 0.095. However, this time, a negative bet value was generated, indicating that the reform had a negative impact on the quality of services. As shown above, many more of the control variables are significant than the previous regression with the insignificant variables being city population, ownership and the dummy variable indicating that the hospital is located in Connecticut. Beta values indicated that larger hospitals offered a lower quality of medical services. However, the quality of services increased with time and was higher for teaching hospitals and those that offered emergency services. Generally, it was a trend in all of the quality regressions that the quality of medical services increased in all states with time. It was also a trend in half of the regressions that the reform had a positive effect on the quality of services with the exception of the previous regression in which it had a negative impact. In the following Discussion Section, we will discuss the implications of our results and make conclusions.

Table 18 Full Difference-in-Differences Regression Results

Cost	**Total Cost Adjusted**	**Operation Room Adjusted**	**Radiology Room Adjusted**	**Respiratory Therapy Adjusted**	**Physical Therapy Adjusted**	**Electrocardiology Adjusted**	**Emergency Room Adjusted**
MA*TIME	-0.005	0.039	0.043	0.012	0.022	-0.012	0.046
	[20.335]	[0.592]	[0.579]	[0.148]	[0.220]	[0.181]	[0.529]
TIME	0.037	0.044	0.018	0.043	0.061	0.049	0.070
	[12.979]	[0.376]	[0.373]	[0.095]	[0.141]	[0.125]	[0.338]*
IF_MA	0.080	0.099	0.150	0.064	-0.054	0.093	0.287
	[16.465]**	[0.477]**	[0.467]***	[0.119]	[0.176]	[0.148]	[0.427]***
IF_CT	0.025	0.025	-0.046	0.078	-0.076	-0.022	0.377
	[13.910]	[0.401]	[0.394]	[0.101]**	[0.154]*	[0.127]	[0.355]***
Hospital_>400	0.689	0.696	0.554	0.633	0.439	0.412	0.414
	[21.821]***	[0.592]***	[0.571]***	[0.146]***	[0.226]***	[0.178]***	[0.531]***
Hospital_200-400	0.247	0.274	0.197	0.278	0.313	0.283	0.229
	[17.075]***	[0.494]***	[0.477]***	[0.122]***	[0.183]***	[0.152]***	[0.444]***
Hospital_100-200	0.070	0.060	0.082	0.102	0.112	0.079	0.066
	[12.766]***	[0.370]**	[0.360]**	[0.092]***	[0.139]**	[0.116]*	[0.335]*
Ownership _Governmental	0.079	0.014	0.036	0.086	0.028	0.081	0.070
	[43.903]***	[1.273]	[1.239]	[0.329]***	[0.504]	[0.385]**	[1.170]**
Ownership _Nonprofit	0.046	-0.008	0.047	0.039	0.055	-0.053	0.038
	[19.925]**	[0.605]	[0.585]	[0.156]	[0.221]	[0.190]	[0.552]
Teaching Hospital	0.069	0.121	0.063	0.031	0.010	0.047	0.086
	[13.145]***	[0.366]***	[0.355]*	[0.090]	[0.135]	[0.112]	[0.327]**
Town Population_50K	0.233						
	[1.742]***						
Emergency	0.033						
	[23.230]						
R^2	0.736	0.591	0.371	0.428	0.205	0.232	0.429
Sample Size	736	722	711	705	640	612	701

Quality	**Heart Attack Patients Given ACE Inhibitor or ARB for Left Ventricular Systolic Dysfunction (LVSD)**	**Heart Failure Patients Given Smoking Cessation Advice/Counseling**	**Pneumonia Patients Given Smoking Cessation Advice/Counseling**	**Pneumonia Patients Given the Most Appropriate Initial Antibiotic(s)**	**Surgery Patients Who Received Preventative Antibiotic(s) One Hour Before Incision**	**Surgery Patients Whose Preventative Antibiotic(s) are Stopped Within 24 Hours After Surgery**
MA*TIME	0.040	0.136	0.304	-0.032	0.448	-0.263
	[0.039]	[0.037]*	[0.046]***	[0.041]	[0.026]***	[0.048]*
TIME	0.217	0.341	0.341	0.292	0.195	0.490
	[0.025]***	[0.023]***	[0.029]***	[0.028]***	[0.017]***	[0.032]***
IF_MA	-0.090	-0.197	-0.361	-0.129	-0.536	0.341
	[0.031]	[0.031]***	[0.038]***	[0.032]	[0.025]***	[0.046]**
IF_CT	-0.053	0.019	-0.132	-0.241	-0.158	-0.005
	[0.027]	[0.024]	[0.034]**	[0.030]***	[0.011]***	[0.020]
Hospital_>400	0.016	0.184	0.236	-0.189	-0.066	-0.164
	[0.056]	[0.051]**	[0.051]***	[0.044]*	[0.017]	[0.031]**
Hospital_200-400	0.012	0.281	0.210	-0.008	0.014	-0.173
	[0.034]	[0.036]***	[0.037]***	[0.038]	[0.013]	[0.025]**
Hospital_100-200	0.050	0.093	0.139	0.135	-0.061	-0.163
	[0.023]	[0.020]**	[0.029]***	[0.031]	[0.010]	[0.020]**
Ownership _Governmental	-0.039	-0.058	-0.254	0.056	-0.020	-0.031
	[0.075]	[0.074]	[0.083]***	[0.066]	[0.031]	[0.058]
Ownership _Nonprofit	-0.063	0.117	-0.008	0.110	-0.011	-0.075
	[0.046]	[0.035]**	[0.046]	[0.048]	[0.019]	[0.037]
Teaching Hospital	0.220	-0.194	-0.177	0.144	0.067	0.225
	[0.025]***	[0.023]***	[0.029]***	[0.028]*	[0.010]	[0.019]***
Population Size	-0.032	0.035	0.001	0.332	-0.012	-0.018
	[0.004]	[0.005]	[0.005]	[0.004]***	[0.001]	[0.002]
Emergency Service	0.076	0.235	0.160	0.612	-0.038	0.129
	[0.066]*	[0.057]***	[0.068]**	[0.049]***	[0.020]	[0.039]***
R^2	0.105	0.326	0.438	0.450	0.139	0.221
Sample Size	511	401	242	184	378	362

*** significance *p*-value < 1%

** significance *p*-value < 5%

* significance *p*-value < 10%

6.0 Discussion

This section will provide the conclusions drawn from the results of our research, as well as discuss the limitations of our project and suggestions for further research.

6.1 Our Results

As the previous tables in the summary statistics section show, the operational cost is higher in MA and CT than in WI and the quality of medical service is the same in all the three states. In addition, the overall operational cost and the department salaries have increased and the quality of medical services has been improved since the reform. Also, the control variables have not changed much since the reform in both cost and quality models.

It is evident from the results we obtained that there is a lot of variance between results and their significance. Although the R-Squared value varied highly between regressions, it is clear that the total cost model is somewhat more meaningful than the quality models, which generated values around 0.7 and 0.1-0.600, respectively. The R-Squared values of the emergency room and operating room salary regressions were around 0.5-0.6, which indicates that those models were also somewhat accurate. It is certainly an interesting finding, however, that more of the control variables appear to be significant in the quality models than the total cost model. It is also worth noting that for half of the quality regressions, the reform variable is significant, and has a positive impact on the quality of services. Although, it is significant in a fourth regression, by which a negative beta value was generated. Overall, we do have evidence to believe that the quality of medical services has been affected by the reform, but further research will be needed for our results to be conclusive. Total costs and salaries generally seemed to be higher in Massachusetts and the reform variable was insignificant. Although our research does not give any evidence to support that the reform did impact hospital costs, there is other literature and research that demonstrates otherwise. Therefore, it would also be useful to conduct further research before coming to a conclusion. The limitations of our research that prevent us from

making such concrete conclusions, as well as suggestions for further research will be discussed below.

6.2 Limitation

Just as with many research projects, there were a few limitations concerning ours that may have affected some of our results. The most important of these limitations are those surrounding the quality data, but there also some limitations surrounding other variables that could have been included in the model, such as patient mix and the Hospital Herfendahl Index (HHI).

For the cost data, consistent and detailed data was conveniently provided through the CMS database. Detailed figures, such as total operational costs, specific department salaries, cost of supplies were provided for each hospital, as required by the federal government. However, there are no such requirements for hospitals to report detailed information on the quality of medical services they provide. As a result, many of the hospitals did not report each year of the four year time span that we researched, forcing us to eliminate them from our regression analysis to stay consistent, which led to a very small sample size in many cases. Because our sample was so small, it is difficult to say whether or not the results of our regression could have been affected. Also, because the organization of this data through the Medicare Hospital Compare Quality of Care Database only began recently in 2005, many of their measurements for the four indicators changed from year to year. For example, in the earlier years of 2005 and 2006, one of the measurements for heart attack is whether or not the patient was given the proper treatment in ninety minutes or less, but this changed to sixty minutes or less in later years. Thus, we really narrowed down the data we used to specific measurements of indicators that has the largest number of reported percentages and consistent measurements, which was not many. Lastly, all of the quality data is reported in percentages of patients for which that particular measurements of one of the four indicators holds true. Therefore, it can be very misleading if 100% of patients is reported for a particular measurement when the sample is only 1 patient, which was the case for some indicators. Although these data were somewhat helpful in our exploration of the quality of medical services, it would be even more helpful to

have access to data on patients other than those affected by heart attack, heart failure, pneumonia or receiving surgery. Also, specific numbers, which hospitals are not required to report, such as patient mortality rate, would have been useful.

Although, we tried to include as many control variables as we felt were appropriate for our models, there still are more that we would have preferred to include if we had access to such data, such as patient mix, which would evaluate the risks of patients being treated at a particular hospital, and additional ways to account for competition between hospitals, such as the HHI, both of which will be discussed in our suggestions for further research below.

6.3 Technological Impacts

Although our statistical and regression analysis results were not necessarily conclusive as to how the Massachusetts Health Care Reform impacted hospital costs and quality of medical services, it is clear that the reform has the ability to affect both of these factors according to our preliminary research and own research. Another factor that has the potential to help contain costs and improve quality is an improved electronic record keeping system (Liberto, 2009). For example, Stephen Lieber, who represents technology companies in the health industry through the Healthcare Information and Management Systems Society, mentioned that if a more efficient record keeping were implemented, costs could be contained by avoiding repeats of tests or any unnecessary examinations (Liberto, 2009). Additionally, if costs were contained, hospitals may be able to invest more in improving their quality of medical services.

6.4 Further Research

It is clear from our research, that the topic of how the Massachusetts Health Care Reform of 2006 affects hospital costs and the quality of medical services they provide has not reached a level of saturation, as there is still much more about it that can be explored.

Due to the time constraints of this research project for academic purposes, we chose only two states (both of which had similar quality of medical services to Massachusetts) to research, which were Connecticut and Wisconsin. However, we do not doubt the value of studying even more states, such as all of those in New England or all fifty states of the nation. It would certainly be interesting to determine whether or not these changes were due to some geographic trend. A study of all of the states would certainly be more telling as to whether a trend did occur. There have been previous studies, such as that discussed in our literature review section by Lischko and Manzolillo, that use a national mean to compare to the cost and quality data of Massachusetts, but due to the high variability (economically and for quality of medical services), we think it would be much more meaningful to look at each state individually.

There are also many other factors that may affect hospital cost and quality that individuals conducting future research on this topic could look into. For example, HHI, which is a measurement of competition between hospitals could most certainly have an effect on both cost and quality. Because this data is not just provided, researchers would have to obtain the specific location of each hospital and determine an area (such as a fifteen mile radius, for example) that they would assume to be effective in measuring the HHI, which could possibly require some research in itself. Patient mix, which is a measurement of risks of patients treated at a hospital, would also be something to look into. Again, data does not appear to be easily provided on this subject, so future researchers could explore on possible ways to calculate this with the data that is available.

Bibliography

Agency for healthcare quality and research. (2009). *2009 National Healthcare Quality Report.* Retrieved 10 5, 2010, from Agency for healthcare quality and research: www.ahrq.gov/qual/nhqr09/nhqr09.pdf

Agency of Healthcare Rsearch and Quality. (2009). *2009 National Healthcare Quality Report.* Washington D.C: Agency of Healthcare Rsearch and Quality.

Altman, S. H., & Doonan, M. (2006). Can Massachusetts lead the way in health care reform? *The New England Journal of Medicine* , 2093.

Archer, D. (2009, March 16). *Massachusetts health reform near universal coverage, but no cost controls or guarantee of quality, affordable health care for all*. Retrieved Octobor 5, 2010, from Institute for American's Future: http://ourfuture.org/healthcare/massachusetts

Bell, C. (2010, March 18). *What Is Regression Analysis?* Retrieved February 09, 2011, from EconInformation.com:The Economics and Finance Information Page -- One-clickaccess to Current Economic and Financial Data for Students,journalists, Investors and All Others Interested in Economics Andfinance. : www.econinformation.com/cgi-bin/wea/regression_analysis.cgi

Bigby, J. A. (2010). *Hospital Inpatient and Emergency Department Utilization Trends Fiscal Years 2004-2008.* DHCFP.

Bigby, J. A., & Iselin, S. (2009). *Measuring Health Care Quality and Cost in Massachusetts.* Boston: Department of Health Care Finance and Cost.

Bigby, J. A., & Morales, D. (2010). *Study of the Reserves, Endowments, and Surpluses of Hospitals in Massachusetts.* Boston: Department of Health Care Finance and Cost.

Bigby, J. A., & Weissman, S. J. (2009). Massachusetts Health Care Reform - Near-Universal Coverage at What Cost? *The New England Journal of Medicine* , 2012-2015.

Blendon, R. J., Buhr, T., Sussman, T., & Benson, J. M. (2008). Massachusetts health reform: A public perspective from debate through implementation. *Health Affairs* , 556.

Blumberg, L. J., & Holahan, J. (2009). The individual mandate -- an affordable and fair approach to achieving universal coverage. *The New England Journal of Medicine* , 361.

Blumenauer, E. (2010). *High Quality, Low Spending Medicare Hospitals .*

Campbell, S., Roland, M. O., & Buetow, S. A. (2000). Defining Quality of Care. *Social Science & Medicine* , 1611-1625.

Centers for Medicare & Medicaid Services. (2010). *The emergency medical treatment & labor act*. Retrieved September 15, 2010, from https://www.cms.gov/EMTALA

Chiang, T.-l. (1997). Taiwan's 1995 health care reform. *health Policy* , 225-239.

Commonwealth of Massachusetts. (2006). Massachusetts Act Chapter 58 Section 47. *2006 Massachusetts Act* . Boston, Massachusetts, U.S.A.

Econometrics. (2006, February 11). *Difference in Difference Estimation*. Retrieved November 29, 2010, from Healthcare Economist: http://healthcare-economist.com/2006/02/11/difference-in-difference-estimation/

Eldenburg, L., & Krishnan, R. (2010). *Management Accounting Research in Health Care.*

Freeman, R. (1998). Competition in context: the politics of health care reform in Europe. *International Journal for Quality in Health Care* , 395 - 401.

Gabel, J. R., Whitmore, H., Pickreign, J., Sellhheim, W., Shova, K., & Bassett, V. (2008). After the mandates: Massachusetts employers continue to support health reform as more firms offer coverage. *Health Affairs* , 566.

Geenberger, S. S. (2005, April 6). Top officials to pitch plans to aid uninsured. *Boston Globe* .

Ham, C., & McKee, M. (1997). *Health Care Reform: Learning fromInternational Experience.* Buckingham, UK: Open University Press.

Harvard Pilgrim Health Care. (2010). *Typical Medical Costs in Massachusetts (outpatient only)*. Retrieved November 28, 2010, from Harvard Pilgrim Health Care for Visitors: https://www.harvardpilgrim.org/portal/page?_pageid=213,198311&_dad=portal&_schema=PORTAL

Health Connector. (2010). *Commonwealth care program guide.* Retrieved 9 15, 2010, from Health Connector: https://www.mahealthconnector.org/portal/binary/com.epicentric.contentmanagement.servlet.ContentDeliveryServlet/About%20Us/CommonwealthCare/Commonwealth%20Care%20Program%20Guide.pdf

Health Connector. (2009). *Health Care Reform: Timeline*. Retrieved 10 5, 2010, from Health Connector: https://www.mahealthconnector.org/portal/site/connector/menuitem.aeceb4005a8e46bd7176b66033468a0c/?fiShown=default

Health Connector. (2010). *Health Care Reform: Timeline*. Retrieved 10 5, 2010, from Health Connector: https://www.mahealthconnector.org/portal/site/connector/menuitem.aeceb4005a8e46bd7176b66033468a0c/?fiShown=default

Holahan, J., & Blumberg, L. (2006). Massachusetts health care reform: A look at the issues. *health Affairs* , 432.

Institute of Medicine. (n.d.). Retrieved 10 5, 2010, from Institute of Medicine: Institute of Medicine

Jha, A. e. (2009). Measuring Efficiency: The Association of Hospital Costs and Quality of Care. *Health Affairs* .

Jha, A. K. (2009). Measuring Efficiency: The Association Of Hospital Costs And Quality Of Care. *Health Affairs* , 10.

Jha, A. K., Orav, E. J., Dobson, A., Book, R., & Epstein, A. M. (2009). Measuring Efficiency; The asssociation of hospital costs and quality of care. *Health Affairs* .

Jha, A. K., Orav, E. J., Dobson, A., Book, R., & Epstein, A. (2009). Measuring Efficiency: The Association Of Hospital Costs And Quality Of Care. *Health Affairs* , 10.

Keeler, E. B., Rubenstein, L. V., Kahn, K. L., Draper, D., Harrison, E. R., McGinty, M. J., et al. (1992). Hospital Characteristics and Quality of Care. *JAMA* .

Kolstad, J. T., & Kowalski, A. E. (2010). *The impact of an individual Health insurance mandate on hospital and preventive care: evidence from Massachusetts.* Cambridge, USA: National Bureau of Economic Research.

Lave, J. R., & Lave, L. B. (1970). Hospital Cost Functions. *The American Economic Review* .

Lischko, A., & Manzolillo, K. (2010). An Interim Report Card on Massachusetts Health Care Reform: Cost-Effective Quality. *Pioneer Institute Public Policy Research* .

Long, S. K., & Stockley, K. (2010). Sustaining Health Reform in a Recession: An Update on Massachusetts as of Fall 2009. *Health Affairs , 29* (6), 1234.

Lu, J., & Hsiao, W. (2003). Does universal health insurance make health care unaffordable? Lessons from Taiwan. *Health Affairs* , 77.

MacDorman, M. F., & Mathews, T. (2008). Recent trends in infant mortality in the United States. *NCHS Data Brief* , 1-8.

Massachusetts Division of Health Care Finance and Policy. (2010). *Study of the reserves, endowments, and surpluses of hopsitals in Massachusetts.* Boston: Massachusetts Division of health Care Finance and Policy.

Miltenberger, M., & Poftak, S. (2009). Massachusetts Healthcare Reform: A Framework for Evaluation. *Pioneer Institute Public Policy Research* .

Mobilization for Health Care for All. (2009). *Nine Americans jailed this morning when they tried to confront senator joe liberman for accepting insurance compnay money.* Retrieved 9 16, 2010, from http://www.commondreams.org/newswire/2009/11/05-10

OECD. (2010). *OECD Health Data 2010: How Does the United Kindom Compare.* Paris: Organisation for Economic Co-operation and Development.

Plagnet, M.-A., & Waddle, R. (2001). *Referee report to Health care payment systems: cost and quality incentives.* Toulouse, France: Université des Sciences Sociales.

Roehr, B. (2008). Health Care in US ranks lowest among developed countries. *British Medical Journal* , 889.

Seifert, R., & Swoboda, P. (2009). *Shared Responsiblity -- Government, business, and individuals: who pays what for health reform?* Worcester: Blue Cross Blue Shield of Massachusetts Foundation.

Shepard, D., Kodgkin, D., & Anthony, Y. (1998). *Analysis of Hopsital Costs.* World Health Organization.

Siegrist, R., & Kane, N. M. (2003). Exploring the Relationship Between Inpatient Hospital Costs and Quality of Care. *American Journal of Managed Care* .

Sloan, F. A., Picone, G. A., Jr., D. H., & Chou, S.-Y. (2001). Hospital ownership and cost and quality of care: is there a dime's worth of difference? *Health Economics* .

State Data Center. (2009). Retrieved October 28, 2010, from The Commonwealth Fund: http://www.commonwealthfund.org/Maps-and-Data/State-Data-Center/State-Scorecard.aspx

Steinbrook, R. (2008). health care reform in Massachusetts -- expanding coverage, escalating costs. *New England Journal of Medicine* , 2757.

Steinbrrok, R. (2006). Health Care reform in Massachusetts -- A work in Progress. *New England Journal of Medicine* , 2095.

Tanner, M. (2006). No Miracle in Massachusetts: Why Governor Romney's Health Care Reform Won't Work. *Cato Institute Briefing Paper Series* .

The Henry J. Kaiser Family Foundation. (2009, March). *Trends in Health Care Costs and Spending*. Retrieved February 10, 2011, from www.kff.org: http://www.kff.org/insurance/upload/7692_02.pdf

Waldman, B. (2010). Massachusetts Health Care Reform. *Health and Human Rights* , 1.

Wilson, J. F. (2008). Massachusetts Health Care reform is a poineer effect, but complications remain. *Annals of Internal Medicine* , 489.

Appendix

Appendix A: Additional Information about the Properties of the Reform

Another key aspect of the reform movement is the "shared responsibility" of employers. These laws were created in the hopes that the government would be able to decrease the amount of funding spent on health care and that employers of businesses would be able to contribute to this cost. In the 2006 legislation, employers were held more accountable for the coverage of their employees and were at risk for penalty if they did not abide by the new laws. Although, most state residents were already covered through their employer, the new mandates stated that all employers of eleven or more full-time employees must offer an affordable and decent insurance plan (Fisher Wilson 2008). Employers were required to either have 25% of their employers covered by their plan or to contribute to 33% of the cost of their premium (Fisher Wilson 2008). The alternative is a charge of $295 per employee each year (Mass. Act Chp. 58, sec. 47, 2006). They can also be charged if their employees use more than $50,000 from a safety net fund during a number of visits, known as the "free rider surcharge" (Fisher Wilson 2008). Although these new laws could end up putting quite a burden on owners of small businesses, a survey of 1,056 employers of Massachusetts in 2007 revealed that 75% did feel responsible for offering their employees coverage and 70% supported the reform laws (Fisher Wilson 2008).

The Commonwealth Health Insurance Connector is a government-run organization that is not only in charge of Commonwealth Care and Choice, but also provides information about health insurance options to those who need it, such as those who are not covered by their employer and not able to receive Medicaid (Waldman 2009). Essentially, the Connector provides residents with the help they need to ensure that they can purchase an affordable plan with the benefits they need (Waldman 2009)

Appendix B: CMS Defined Name for CMS Hospital and Health Care Complexes

hosp_xxxx_RPT.csv

Column Name	Column Type
RPT_REC_NUM	NUMBER NOT NULL
PRVDR_CTRL_TYPE_CD	CHAR(2) NULL
PRVDR_NUM	CHAR(6) NOT NULL
NPI	NUMBER NULL
RPT_STUS_CD	CHAR(1) NOT NULL
FY_BGN_DT	DATE NULL
FY_END_DT	DATE NULL
PROC_DT	DATE NULL
INITL_RPT_SW	CHAR(1) NULL
LAST_RPT_SW	CHAR(1) NULL
TRNSMTL_NUM	CHAR(2) NULL
FI_NUM	CHAR(2) NULL
ADR_VNDR_CD	CHAR(1) NULL
FI_CREAT_DT	DATE NULL
UTIL_CD	CHAR(1) NULL
NPR_DT	DATE NULL
SPEC_IND	CHAR(1) NULL
FI_RCPT_DT	DATE NULL

Hosp_xxxx_ALPHA.csv

Column Name	Column Type
RPT_REC_NUM	NUMBER NOT NULL
WKSHT_CD	CHAR(7) NOT NULL
LINE_NUM	CHAR(5) NOT NULL
ALPHNMRC_ITM_TXT	CHAR(4) NOT NULL

Hosp_xxxx_NMRC.csv

Column Name	Column Type
RPT_REC_NUM	NUMBER NOT NULL
WKSHT_CD	CHAR(7) NOT NULL
LINE_NUM	CHAR(5) NOT NULL
ITM_VAL_NUM	NUMBER NOT NULL

Appendix C: SQL Query for the Hospital Cost Data

In this example, we use the data of the Fiscal Year 2009 as the sample.

Number of beds

```
SELECT Sheet1.[Hosptial Provider ID], Hosp_2009_NMRC_new.WKSHT_CD,
Hosp_2009_NMRC_new.LINE_NUM, Hosp_2009_NMRC_new.CLMN_NUM,
Hosp_2009_NMRC_new.ITM_VAL_NUM

FROM Hosp_2009_NMRC_new INNER JOIN (Sheet1 INNER JOIN Hosp_2009_RPT_new ON
Sheet1.[Hosptial Provider ID] = Hosp_2009_RPT_new.PRVDR_NUM) ON
Hosp_2009_NMRC_new.RPT_REC_NUM = Hosp_2009_RPT_new.RPT_REC_NUM

WHERE (((Hosp_2009_NMRC_new.WKSHT_CD)="S300001") AND
((Hosp_2009_NMRC_new.LINE_NUM)='01200') AND ((Hosp_2009_NMRC_new.CLMN_NUM)='0100'));
```

If the hospital is teaching hospital?

```
SELECT Sheet1.[Hosptial Provider ID], Hosp_2009_ALPHA.WKSHT_CD, Hosp_2009_ALPHA.LINE_NUM,
Hosp_2009_ALPHA.CLMN_NUM, Hosp_2009_ALPHA.ALPHNMRC_ITM_TXT

FROM Hosp_2009_ALPHA INNER JOIN (Sheet1 INNER JOIN Hosp_2009_RPT_new ON Sheet1.[Hosptial
Provider ID] = Hosp_2009_RPT_new.PRVDR_NUM) ON Hosp_2009_ALPHA.RPT_REC_NUM =
Hosp_2009_RPT_new.RPT_REC_NUM

WHERE (((Hosp_2009_ALPHA.WKSHT_CD)='s200000') AND ((Hosp_2009_ALPHA.LINE_NUM)='02500')
AND ((Hosp_2009_ALPHA.CLMN_NUM)='0100'));
```

Total operation cost

```
SELECT Sheet1.[Hosptial Provider ID], Hosp_2009_NMRC_new.WKSHT_CD,
Hosp_2009_NMRC_new.LINE_NUM, Hosp_2009_NMRC_new.CLMN_NUM,
Hosp_2009_NMRC_new.ITM_VAL_NUM

FROM Hosp_2009_NMRC_new INNER JOIN (Sheet1 INNER JOIN Hosp_2009_RPT_new ON
Sheet1.[Hosptial Provider ID] = Hosp_2009_RPT_new.PRVDR_NUM) ON
Hosp_2009_NMRC_new.RPT_REC_NUM = Hosp_2009_RPT_new.RPT_REC_NUM

WHERE (((Hosp_2009_NMRC_new.WKSHT_CD)="G200000") AND
((Hosp_2009_NMRC_new.LINE_NUM)='04000') AND ((Hosp_2009_NMRC_new.CLMN_NUM)='0200'));
```

Operation room salary

SELECT Sheet1.[Hosptial Provider ID], Hosp_2009_NMRC_new.WKSHT_CD,
Hosp_2009_NMRC_new.LINE_NUM, Hosp_2009_NMRC_new.CLMN_NUM,
Hosp_2009_NMRC_new.ITM_VAL_NUM

FROM Hosp_2009_NMRC_new INNER JOIN (Sheet1 INNER JOIN Hosp_2009_RPT_new ON
Sheet1.[Hosptial Provider ID] = Hosp_2009_RPT_new.PRVDR_NUM) ON
Hosp_2009_NMRC_new.RPT_REC_NUM = Hosp_2009_RPT_new.RPT_REC_NUM

WHERE (((Hosp_2009_NMRC_new.WKSHT_CD)='A000000') AND
((Hosp_2009_NMRC_new.LINE_NUM)='03700') AND ((Hosp_2009_NMRC_new.CLMN_NUM)='0100'));

Radiology room salary

SELECT Sheet1.[Hosptial Provider ID], Hosp_2009_NMRC_new.WKSHT_CD,
Hosp_2009_NMRC_new.LINE_NUM, Hosp_2009_NMRC_new.CLMN_NUM,
Hosp_2009_NMRC_new.ITM_VAL_NUM

FROM Hosp_2009_NMRC_new INNER JOIN (Sheet1 INNER JOIN Hosp_2009_RPT_new ON
Sheet1.[Hosptial Provider ID] = Hosp_2009_RPT_new.PRVDR_NUM) ON
Hosp_2009_NMRC_new.RPT_REC_NUM = Hosp_2009_RPT_new.RPT_REC_NUM

WHERE (((Hosp_2009_NMRC_new.WKSHT_CD)='A000000') AND
((Hosp_2009_NMRC_new.LINE_NUM)='04200') AND ((Hosp_2009_NMRC_new.CLMN_NUM)='0100'));

Respiratory Therapy Salary

SELECT Sheet1.[Hosptial Provider ID], Hosp_2009_NMRC_new.WKSHT_CD,
Hosp_2009_NMRC_new.LINE_NUM, Hosp_2009_NMRC_new.CLMN_NUM,
Hosp_2009_NMRC_new.ITM_VAL_NUM

FROM Hosp_2009_NMRC_new INNER JOIN (Sheet1 INNER JOIN Hosp_2009_RPT_new ON
Sheet1.[Hosptial Provider ID] = Hosp_2009_RPT_new.PRVDR_NUM) ON
Hosp_2009_NMRC_new.RPT_REC_NUM = Hosp_2009_RPT_new.RPT_REC_NUM

WHERE (((Hosp_2009_NMRC_new.WKSHT_CD)='A000000') AND
((Hosp_2009_NMRC_new.LINE_NUM)='04900') AND ((Hosp_2009_NMRC_new.CLMN_NUM)='0100'));

Physical therapy Salary

SELECT Sheet1.[Hosptial Provider ID], Hosp_2009_NMRC_new.WKSHT_CD,
Hosp_2009_NMRC_new.LINE_NUM, Hosp_2009_NMRC_new.CLMN_NUM,
Hosp_2009_NMRC_new.ITM_VAL_NUM

FROM Hosp_2009_NMRC_new INNER JOIN (Sheet1 INNER JOIN Hosp_2009_RPT_new ON
Sheet1.[Hosptial Provider ID] = Hosp_2009_RPT_new.PRVDR_NUM) ON
Hosp_2009_NMRC_new.RPT_REC_NUM = Hosp_2009_RPT_new.RPT_REC_NUM

WHERE (((Hosp_2009_NMRC_new.WKSHT_CD)='A000000') AND
((Hosp_2009_NMRC_new.LINE_NUM)='05000') AND ((Hosp_2009_NMRC_new.CLMN_NUM)='0100'));

Electrocardiology Salary

SELECT Sheet1.[Hosptial Provider ID], Hosp_2009_NMRC_new.WKSHT_CD,
Hosp_2009_NMRC_new.LINE_NUM, Hosp_2009_NMRC_new.CLMN_NUM,
Hosp_2009_NMRC_new.ITM_VAL_NUM

FROM Hosp_2009_NMRC_new INNER JOIN (Sheet1 INNER JOIN Hosp_2009_RPT_new ON
Sheet1.[Hosptial Provider ID] = Hosp_2009_RPT_new.PRVDR_NUM) ON
Hosp_2009_NMRC_new.RPT_REC_NUM = Hosp_2009_RPT_new.RPT_REC_NUM

WHERE (((Hosp_2009_NMRC_new.WKSHT_CD)='A000000') AND
((Hosp_2009_NMRC_new.LINE_NUM)='05300') AND ((Hosp_2009_NMRC_new.CLMN_NUM)='0100'));

Emergency room salary

SELECT Sheet1.[Hosptial Provider ID], Hosp_2009_NMRC_new.WKSHT_CD,
Hosp_2009_NMRC_new.LINE_NUM, Hosp_2009_NMRC_new.CLMN_NUM,
Hosp_2009_NMRC_new.ITM_VAL_NUM

FROM Hosp_2009_NMRC_new INNER JOIN (Sheet1 INNER JOIN Hosp_2009_RPT_new ON
Sheet1.[Hosptial Provider ID] = Hosp_2009_RPT_new.PRVDR_NUM) ON
Hosp_2009_NMRC_new.RPT_REC_NUM = Hosp_2009_RPT_new.RPT_REC_NUM

WHERE (((Hosp_2009_NMRC_new.WKSHT_CD)='A000000') AND
((Hosp_2009_NMRC_new.LINE_NUM)='06100') AND ((Hosp_2009_NMRC_new.CLMN_NUM)='0100'));

Appendix D: Hospital List

Provider Number	Hospital Name	City	State	Hospital Type	Hospital Owner	Emergency Service
070001	HOSPITAL OF ST RAPHAEL	NEW HAVEN	CT	Acute Care Hospitals	Voluntary non-profit - Other	Yes
070002	ST FRANCIS HOSPITAL & MEDICAL CENTER	HARTFORD	CT	Acute Care Hospitals	Voluntary non-profit - Church	Yes
070003	DAY KIMBALL HOSPITAL	PUTNAM	CT	Acute Care Hospitals	Voluntary non-profit - Other	Yes
070004	SHARON HOSPITAL	SHARON	CT	Acute Care Hospitals	Proprietary	Yes
070005	WATERBURY HOSPITAL	WATERBURY	CT	Acute Care Hospitals	Voluntary non-profit - Private	Yes
070006	STAMFORD HOSPITAL	STAMFORD	CT	Acute Care Hospitals	Voluntary non-profit - Private	Yes
070007	LAWRENCE & MEMORIAL HOSPITAL	NEW LONDON	CT	Acute Care Hospitals	Government - Hospital District or Authority	Yes
070008	JOHNSON MEMORIAL HOSPITAL	STAFFORD SPRINGS	CT	Acute Care Hospitals	Voluntary non-profit - Other	Yes
070010	BRIDGEPORT HOSPITAL	BRIDGEPORT	CT	Acute Care Hospitals	Voluntary non-profit - Private	Yes
070011	CHARLOTTE HUNGERFORD HOSPITAL	TORRINGTON	CT	Acute Care Hospitals	Government - Federal	Yes
070012	ROCKVILLE GENERAL HOSPITAL	ROCKVILLE	CT	Acute Care Hospitals	Voluntary non-profit - Other	Yes
070015	NEW MILFORD HOSPITAL	NEW MILFORD	CT	Acute Care Hospitals	Voluntary non-profit - Private	Yes
070016	ST MARYS HOSPITAL	WATERBURY	CT	Acute Care Hospitals	Voluntary non-profit - Church	Yes
070017	MIDSTATE MEDICAL CENTER	MERIDEN	CT	Acute Care Hospitals	Voluntary non-profit - Private	Yes
070018	GREENWICH HOSPITAL ASSOCIATION	GREENWICH	CT	Acute Care Hospitals	Voluntary non-profit - Private	Yes
070019	MILFORD HOSPITAL, INC	MILFORD	CT	Acute Care Hospitals	Government - Federal	Yes
070020	MIDDLESEX HOSPITAL	MIDDLETOWN	CT	Acute Care Hospitals	Voluntary non-profit - Private	Yes
070021	WINDHAM COMM MEM HOSP & HATCH HOSP	WILLIMANTIC	CT	Acute Care Hospitals	Voluntary non-profit - Other	Yes
070022	YALE-NEW HAVEN HOSPITAL	NEW HAVEN	CT	Acute Care Hospitals	Voluntary non-profit - Private	Yes
070024	WILLIAM W BACKUS HOSPITAL	NORWICH	CT	Acute Care Hospitals	Voluntary non-profit - Other	Yes
070025	HARTFORD HOSPITAL	HARTFORD	CT	Acute Care Hospitals	Voluntary non-profit - Private	Yes
070027	MANCHESTER MEMORIAL HOSPITAL	MANCHESTER	CT	Acute Care Hospitals	Voluntary non-profit - Private	Yes
070028	ST VINCENT'S MEDICAL CENTER	BRIDGEPORT	CT	Acute Care Hospitals	Voluntary non-profit - Church	Yes
070029	BRISTOL HOSPITAL	BRISTOL	CT	Acute Care Hospitals	Voluntary non-profit - Private	Yes
070031	GRIFFIN HOSPITAL	DERBY	CT	Acute Care Hospitals	Voluntary non-profit - Other	Yes
070033	DANBURY HOSPITAL	DANBURY	CT	Acute Care Hospitals	Voluntary non-profit - Private	Yes
070034	NORWALK HOSPITAL ASSOCIATION	NORWALK	CT	Acute Care Hospitals	Voluntary non-profit - Other	Yes
070035	HOSPITAL OF CENTRAL CONNECTICUT, THE	NEW BRITAIN	CT	Acute Care Hospitals	Voluntary non-profit - Other	Yes
070036	JOHN DEMPSEY HOSPITAL	FARMINGTON	CT	Acute Care Hospitals	Government - Local	Yes
070039	MASONIC HOME AND HOSPITAL	WALLINGFORD	CT	Acute Care Hospitals	Voluntary non-profit - Other	No
220001	HEALTHALLIANCE HOSPITALS, INC	FITCHBURG	MA	Acute Care Hospitals	Voluntary non-profit - Other	Yes
220002	MOUNT AUBURN HOSPITAL	CAMBRIDGE	MA	Acute Care Hospitals	Voluntary non-profit - Private	Yes
220008	STURDY MEMORIAL HOSPITAL	ATTLEBORO	MA	Acute Care Hospitals	Voluntary non-profit - Other	Yes
220010	LAWRENCE GENERAL HOSPITAL	LAWRENCE	MA	Acute Care Hospitals	Voluntary non-profit - Private	Yes
220011	CAMBRIDGE HEALTH ALLIANCE	CAMBRIDGE	MA	Acute Care Hospitals	Government - Local	Yes
220012	CAPE COD HOSPITAL	HYANNIS	MA	Acute Care Hospitals	Voluntary non-profit - Private	Yes
220015	COOLEY DICKINSON HOSPITAL INC,THE	NORTHAMPTON	MA	Acute Care Hospitals	Voluntary non-profit - Other	Yes
220016	BAYSTATE FRANKLIN MEDICAL CENTER	GREENFIELD	MA	Acute Care Hospitals	Voluntary non-profit - Other	Yes
220017	CARITAS CARNEY HOSPITAL INC	BOSTON	MA	Acute Care Hospitals	Voluntary non-profit - Church	Yes
220019	HARRINGTON MEMORIAL HOSPITAL	SOUTHBRIDGE	MA	Acute Care Hospitals	Voluntary non-profit - Private	Yes

220020	ST ANNE'S HOSPITAL CORPORATION	FALL RIVER	MA	Acute Care Hospitals	Voluntary non-profit - Church	Yes
220024	HOLYOKE MEDICAL CENTER	HOLYOKE	MA	Acute Care Hospitals	Voluntary non-profit - Private	Yes
220029	ANNA JAQUES HOSPITAL	NEWBURYPORT	MA	Acute Care Hospitals	Voluntary non-profit - Private	Yes
220030	WING MEMORIAL HOSPITAL AND MEDICAL CENTER	PALMER	MA	Acute Care Hospitals	Voluntary non-profit - Other	Yes
220031	BOSTON MEDICAL CENTER CORPORATION	BOSTON	MA	Acute Care Hospitals	Voluntary non-profit - Private	Yes
220033	BEVERLY HOSPITAL CORPORATION	BEVERLY	MA	Acute Care Hospitals	Voluntary non-profit - Private	Yes
220035	NORTH SHORE MEDICAL CENTER	SALEM	MA	Acute Care Hospitals	Voluntary non-profit - Private	Yes
220036	CARITAS ST ELIZABETH'S MEDICAL CENTER	BRIGHTON	MA	Acute Care Hospitals	Voluntary non-profit - Church	Yes
220046	BERKSHIRE MEDICAL CENTER INC	PITTSFIELD	MA	Acute Care Hospitals	Voluntary non-profit - Other	Yes
220049	MARLBOROUGH HOSPITAL	MARLBOROUGH	MA	Acute Care Hospitals	Voluntary non-profit - Private	Yes
220050	BAYSTATE MARY LANE HOSPITAL	WARE	MA	Acute Care Hospitals	Voluntary non-profit - Private	Yes
220051	NORTH ADAMS REGIONAL HOSPITAL	NORTH ADAMS	MA	Acute Care Hospitals	Voluntary non-profit - Private	Yes
220052	BROCKTON HOSPITAL	BROCKTON	MA	Acute Care Hospitals	Voluntary non-profit - Other	Yes
220058	CLINTON HOSPITAL ASSOCIATION	CLINTON	MA	Acute Care Hospitals	Voluntary non-profit - Other	Yes
220060	JORDAN HOSPITAL INC	PLYMOUTH	MA	Acute Care Hospitals	Voluntary non-profit - Private	Yes
220062	ADCARE HOSPITAL OF WORCESTER INC	WORCESTER	MA	Acute Care Hospitals	Government - State	No
220063	LOWELL GENERAL HOSPITAL	LOWELL	MA	Acute Care Hospitals	Voluntary non-profit - Private	Yes
220065	NOBLE HOSPITAL	WESTFIELD	MA	Acute Care Hospitals	Voluntary non-profit - Other	Yes
220066	MERCY MEDICAL CENTER	SPRINGFIELD	MA	Acute Care Hospitals	Voluntary non-profit - Private	Yes
220067	QUINCY MEDICAL CENTER	QUINCY	MA	Acute Care Hospitals	Voluntary non-profit - Private	Yes
220070	HALLMARK HEALTH SYSTEM	MELROSE	MA	Acute Care Hospitals	Voluntary non-profit - Private	Yes
220071	MASSACHUSETTS GENERAL HOSPITAL	BOSTON	MA	Acute Care Hospitals	Voluntary non-profit - Other	Yes
220073	MORTON HOSPITAL & MEDICAL CENTER	TAUNTON	MA	Acute Care Hospitals	Voluntary non-profit - Private	Yes
220074	SOUTHCOAST HOSPITAL GROUP, INC	FALL RIVER	MA	Acute Care Hospitals	Voluntary non-profit - Private	Yes
220075	MASSACHUSETTS EYE AND EAR INFIRMARY	BOSTON	MA	Acute Care Hospitals	Voluntary non-profit - Private	Yes
220077	BAYSTATE MEDICAL CENTER	SPRINGFIELD	MA	Acute Care Hospitals	Voluntary non-profit - Private	Yes
220080	CARITAS HOLY FAMILY HOSPITAL AND MEDICAL CENTER	METHUEN	MA	Acute Care Hospitals	Voluntary non-profit - Church	Yes
220082	SAINTS MEMORIAL MEDICAL CENTER INC	LOWELL	MA	Acute Care Hospitals	Voluntary non-profit - Church	Yes
220083	BETH ISRAEL DEACONESS HOSPITAL - NEEDHAM	NEEDHAM	MA	Acute Care Hospitals	Government - Local	Yes
220084	EMERSON HOSPITAL	W CONCORD	MA	Acute Care Hospitals	Voluntary non-profit - Private	Yes
220086	BETH ISRAEL DEACONESS MEDICAL CENTER	BOSTON	MA	Acute Care Hospitals	Voluntary non-profit - Private	Yes
220088	NEW ENGLAND BAPTIST HOSPITAL	BOSTON	MA	Acute Care Hospitals	Voluntary non-profit - Private	No
220090	MILFORD REGIONAL MEDICAL CENTER	MILFORD	MA	Acute Care Hospitals	Voluntary non-profit - Other	Yes
220095	HEYWOOD HOSPITAL	GARDNER	MA	Acute Care Hospitals	Voluntary non-profit - Private	Yes
220098	NASHOBA VALLEY MEDICAL CENTER	AYER	MA	Acute Care Hospitals	Voluntary non-profit - Private	Yes
220100	SOUTH SHORE HOSPITAL	SOUTH WEYMOUTH	MA	Acute Care Hospitals	Voluntary non-profit - Private	Yes
220101	NEWTON-WELLESLEY HOSPITAL	NEWTON	MA	Acute Care Hospitals	Voluntary non-profit - Other	Yes
220105	WINCHESTER HOSPITAL	WINCHESTER	MA	Acute Care Hospitals	Voluntary non-profit - Other	Yes
220108	MILTON HOSPITAL INC	MILTON	MA	Acute Care Hospitals	Voluntary non-profit - Private	Yes
220110	BRIGHAM AND WOMEN'S HOSPTIAL	BOSTON	MA	Acute Care Hospitals	Voluntary non-profit - Private	Yes
220111	CARITAS GOOD SAMARITAN MEDICAL CENTER	BROCKTON	MA	Acute Care Hospitals	Voluntary non-profit - Other	Yes
220116	TUFTS-NEW ENGLAND MEDICAL CENTER	BOSTON	MA	Acute Care Hospitals	Voluntary non-profit - Private	Yes
220119	FAULKNER HOSPITAL	BOSTON	MA	Acute Care Hospitals	Voluntary non-profit - Private	Yes
220126	CARITAS NORWOOD HOSPITAL, INC	NORWOOD	MA	Acute Care Hospitals	Voluntary non-profit - Other	Yes

220135	FALMOUTH HOSPITAL	FALMOUTH	MA	Acute Care Hospitals	Voluntary non-profit - Private	Yes
220162	DANA-FARBER CANCER INSTITUTE	BOSTON	MA	Acute Care Hospitals	Voluntary non-profit - Private	No
220163	UMASS MEMORIAL MEDICAL CENTER INC	WORCESTER	MA	Acute Care Hospitals	Voluntary non-profit - Private	Yes
220171	LAHEY CLINIC HOSPITAL	BURLINGTON	MA	Acute Care Hospitals	Voluntary non-profit - Other	Yes
220174	MERRIMACK VALLEY HOSPITAL	HAVERHILL	MA	Acute Care Hospitals	Proprietary	Yes
220175	METROWEST MEDICAL CENTER	FRAMINGHAM	MA	Acute Care Hospitals	Voluntary non-profit - Private	Yes
220176	ST VINCENT HOSPITAL	WORCESTER	MA	Acute Care Hospitals	Voluntary non-profit - Private	Yes
520002	ST MICHAELS HSPTL	STEVENS POINT	WI	Acute Care Hospitals	Voluntary non-profit - Church	Yes
520004	FRANCISCAN SKEMP LA CROSSE HSPTL	LA CROSSE	WI	Acute Care Hospitals	Voluntary non-profit - Church	Yes
520008	WAUKESHA MEMORIAL HOSPITAL	WAUKESHA	WI	Acute Care Hospitals	Voluntary non-profit - Private	Yes
520009	ST ELIZABETH HSPTL	APPLETON	WI	Acute Care Hospitals	Voluntary non-profit - Church	Yes
520011	LAKEVIEW MED CTR	RICE LAKE	WI	Acute Care Hospitals	Voluntary non-profit - Private	Yes
520013	SACRED HEART HSPTL	EAU CLAIRE	WI	Acute Care Hospitals	Voluntary non-profit - Church	Yes
520017	ST JOSEPHS HSPTL	CHIPPEWA FALLS	WI	Acute Care Hospitals	Voluntary non-profit - Church	Yes
520019	ST MARYS HOSPITAL	RHINELANDER	WI	Acute Care Hospitals	Voluntary non-profit - Church	Yes
520021	UNITED HSPTL SYS	KENOSHA	WI	Acute Care Hospitals	Voluntary non-profit - Private	Yes
520027	COLUMBIA ST MARYS OZAUKEE CAMPUS	MEQUON	WI	Acute Care Hospitals	Voluntary non-profit - Church	Yes
520028	MONROE CLINIC	MONROE	WI	Acute Care Hospitals	Voluntary non-profit - Church	Yes
520030	ASPIRUS WAUSAU HOSPITAL	WAUSAU	WI	Acute Care Hospitals	Proprietary	Yes
520033	RIVERVIEW HSPTL ASSOC	WISCONSIN RAPIDS	WI	Acute Care Hospitals	Voluntary non-profit - Private	Yes
520034	AURORA MED CTR MANITOWOC CTY	TWO RIVERS	WI	Acute Care Hospitals	Voluntary non-profit - Private	Yes
520035	AURORA SHEBOYGAN MEM MED CTR	SHEBOYGAN	WI	Acute Care Hospitals	Voluntary non-profit - Private	Yes
520037	ST JOSEPHS HSPTL	MARSHFIELD	WI	Acute Care Hospitals	Voluntary non-profit - Church	Yes
520038	AURORA MED CENTER-WASHINGTON COUNTY	HARTFORD	WI	Acute Care Hospitals	Voluntary non-profit - Private	Yes
520041	DIVINE SAVIOR HLTHCARE	PORTAGE	WI	Acute Care Hospitals	Voluntary non-profit - Church	Yes
520044	ST NICHOLAS HOSPITAL	SHEBOYGAN	WI	Acute Care Hospitals	Voluntary non-profit - Church	Yes
520045	THEDA CLARK MED CTR	NEENAH	WI	Acute Care Hospitals	Voluntary non-profit - Private	Yes
520048	MERCY MED CTR OF OSHKOSH	OSHKOSH	WI	Acute Care Hospitals	Voluntary non-profit - Church	Yes
520049	BELLIN MEMORIAL HSPTL	GREEN BAY	WI	Acute Care Hospitals	Voluntary non-profit - Church	Yes
520051	COLUMBIA ST MARYS HSPTL MILW (COL & MILW CAMPUS)	MILWAUKEE	WI	Acute Care Hospitals	Voluntary non-profit - Church	Yes
520057	ST CLARE HSPTL HLTH SVCS	BARABOO	WI	Acute Care Hospitals	Voluntary non-profit - Church	Yes
520059	AURORA MEMORIAL HSPTL BURLINGTON	BURLINGTON	WI	Acute Care Hospitals	Voluntary non-profit - Private	Yes
520062	OCONOMOWOC MEM HSPTL	OCONOMOWOC	WI	Acute Care Hospitals	Voluntary non-profit - Private	Yes
520063	ST JOSEPHS COM HSPTL WEST BEND	WEST BEND	WI	Acute Care Hospitals	Voluntary non-profit - Private	Yes
520066	MERCY HLTH SYS CORP	JANESVILLE	WI	Acute Care Hospitals	Voluntary non-profit - Private	Yes
520070	LUTHER HOSPITAL MAYO HEALTH SYSTEM	EAU CLAIRE	WI	Acute Care Hospitals	Voluntary non-profit - Other	Yes
520071	FORT HEALTHCARE	FORT ATKINSON	WI	Acute Care Hospitals	Voluntary non-profit - Private	Yes
520075	ST VINCENT HSPTL	GREEN BAY	WI	Acute Care Hospitals	Voluntary non-profit - Church	Yes
520076	BEAVER DAM COM HSPTL	BEAVER DAM	WI	Acute Care Hospitals	Voluntary non-profit - Private	Yes
520078	WHEATON FRANCISCAN HEALTHCARE- ST FRANCIS	MILWAUKEE	WI	Acute Care Hospitals	Voluntary non-profit - Church	Yes
520083	ST MARY'S HOSPITAL	MADISON	WI	Acute Care Hospitals	Voluntary non-profit - Other	Yes
520087	GUNDERSEN LUTH MED CTR	LA CROSSE	WI	Acute Care Hospitals	Voluntary non-profit - Private	Yes
520088	ST AGNES HSPTL	FOND DU LAC	WI	Acute Care Hospitals	Voluntary non-profit - Church	Yes
520089	MERITER HSPTL	MADISON	WI	Acute Care Hospitals	Voluntary non-profit - Private	Yes

520091	HOWARD YOUNG MED CTR	WOODRUFF	WI	Acute Care Hospitals	Voluntary non-profit - Church	Yes
520095	SAUK PRAIRIE MEM HSPTL	PRAIRIE DU SAC	WI	Acute Care Hospitals	Voluntary non-profit - Private	Yes
520096	WHEATON FRANCISCAN HEALTHCARE- ALL SAINTS	RACINE	WI	Acute Care Hospitals	Voluntary non-profit - Church	Yes
520097	ST MARYS HSPTL MED CTR	GREEN BAY	WI	Acute Care Hospitals	Voluntary non-profit - Other	Yes
520098	UW HEALTH UW HOSPITALS AND CLINICS	MADISON	WI	Acute Care Hospitals	Government - Hospital District or Authority	Yes
520100	BELOIT MEM HSPTL	BELOIT	WI	Acute Care Hospitals	Voluntary non-profit - Private	Yes
520102	AURORA LAKELAND MED CTR	ELKHORN	WI	Acute Care Hospitals	Voluntary non-profit - Private	Yes
520103	COMMUNITY MEM HSPTL	MENOMONEE FALLS	WI	Acute Care Hospitals	Voluntary non-profit - Private	Yes
520107	HOLY FAMILY MEMORIAL	MANITOWOC	WI	Acute Care Hospitals	Voluntary non-profit - Other	Yes
520109	HESS MEM HSPTL	MAUSTON	WI	Acute Care Hospitals	Proprietary	Yes
520113	BAY AREA MED CTR	MARINETTE	WI	Acute Care Hospitals	Voluntary non-profit - Private	Yes
520116	WATERTOWN MEM HSPTL	WATERTOWN	WI	Acute Care Hospitals	Voluntary non-profit - Private	Yes
520136	WHEATON FRANCISCAN HEALTHCARE- ST JOSEPH	MILWAUKEE	WI	Acute Care Hospitals	Voluntary non-profit - Church	Yes
520138	AURORA ST LUKES MED CTR	MILWAUKEE	WI	Acute Care Hospitals	Voluntary non-profit - Private	Yes
520139	WEST ALLIS MEM HSPTL	WEST ALLIS	WI	Acute Care Hospitals	Voluntary non-profit - Private	Yes
520160	APPLETON MED CTR	APPLETON	WI	Acute Care Hospitals	Voluntary non-profit - Other	Yes
520170	WHEATON FRANCISCAN HEALTHCARE- ELMBROOK MEMORIAL	BROOKFIELD	WI	Acute Care Hospitals	Voluntary non-profit - Church	Yes
520177	FROEDTERT MEM LUTHERAN HSPTL	MILWAUKEE	WI	Acute Care Hospitals	Voluntary non-profit - Private	Yes
520189	AURORA MED CTR KENOSHA	KENOSHA	WI	Acute Care Hospitals	Voluntary non-profit - Private	Yes
520193	AURORA BAYCARE MED CTR	GREEN BAY	WI	Acute Care Hospitals	Government - State	Yes
520194	ORTHOPAEDIC HSPTL OF WI	GLENDALE	WI	Acute Care Hospitals	Proprietary	No
520195	COLUMBIA CENTER	MEQUON	WI	Acute Care Hospitals	Voluntary non-profit - Private	No
520196	OAK LEAF SURGCL HSPTL	EAU CLAIRE	WI	Acute Care Hospitals	Proprietary	No
520198	AURORA MED CTR OSHKOSH	OSHKOSH	WI	Acute Care Hospitals	Voluntary non-profit - Private	Yes
520199	WISCONSIN HEART HSPTL	WAUWATOSA	WI	Acute Care Hospitals	Proprietary	Yes

Appendix E: Regression Tables

Table E1: Cost Model (Total Cost) R^2 Value

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.858[a]	.736	.732	1.3349034646E2

Table E2: Results of Variables in Cost (Total Cost) Model

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-47.727	29.930		-1.595	.111
	TIME*IF_MA	-3.070	20.335	-.005	-.151	.880
	IF_MA	41.818	16.465	.080	2.540	.011
	IF_CT	16.305	13.910	.025	1.172	.242
	HOSP_EXTRA_LARGE	590.358	21.821	.689	27.055	.000
	HOSP_LARGE	155.054	17.075	.247	9.081	.000
	HOSP_MEDIUM	37.356	12.766	.070	2.926	.004
	OWN_NONPROF	42.917	19.925	.046	2.154	.032
	OWN_GOV	160.777	43.903	.079	3.662	.000
	TEACH	35.612	13.145	.069	2.709	.007
	TIME	19.397	12.979	.037	1.495	.135
	Pop_50T	17.149	1.742	.233	9.842	.000
	EMER	37.315	23.230	.033	1.606	.109

a. Dependent Variable: Inflation_Adjusted_Total

Table E3: Cost Model (Operating Room Salary) R^2 Value

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.769[a]	.591	.586	3.83910390967E0

Table E4: Results of Variables in Cost (Operating Room Salary) Model

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.870	.667		1.306	.192
	TIME*IF_MA	.540	.592	.039	.912	.362
	TIME	.526	.376	.044	1.400	.162
	IF_MA	1.200	.477	.099	2.517	.012
	IF_CT	.379	.401	.025	.945	.345
	HOSP_EXTRA_LARGE	13.526	.592	.696	22.845	.000
	HOSP_LARGE	3.950	.494	.274	8.001	.000
	HOSP_MEDIUM	.739	.370	.060	1.996	.046
	OWN_GOV	.651	1.273	.014	.512	.609
	OWN_NONPROF	-.172	.605	-.008	-.284	.777
	TEACH	1.447	.366	.121	3.952	.000

a. Dependent Variable: Inflation_Adjusted_OP

Table E5: Cost Model (Radiology Room Salary) R^2 Value

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.609[a]	.371	.362	3.741694080454E0

Table E6: Results of Variables in Cost (Radiology Room Salary) Model

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.570	.647		.881	.379
	TIME*IF_MA	.462	.579	.043	.798	.425
	TIME	.170	.373	.018	.457	.648
	IF_MA	1.426	.467	.150	3.050	.002
	IF_CT	-.537	.394	-.046	-1.363	.173
	HOSP_EXTRA_LARGE	8.394	.571	.554	14.711	.000
	HOSP_LARGE	2.244	.477	.197	4.701	.000
	HOSP_MEDIUM	.798	.360	.082	2.218	.027
	OWN_GOV	1.301	1.239	.036	1.050	.294
	OWN_NONPROF	.808	.585	.047	1.383	.167
	TEACH	.589	.355	.063	1.657	.098

a. Dependent Variable: Inflation_Adjusted_RADIO

Table E7: Cost Model (Respiratory Room Salary) R^2 Value

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.654[a]	.428	.420	.95385471248

Table E8: Results of Variables in Cost (Respiratory Room Salary) Model

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.322	.173		1.865	.063
	TIME*IF_MA	.035	.148	.012	.235	.814
	TIME	.109	.095	.043	1.137	.256
	IF_MA	.162	.119	.064	1.354	.176
	IF_CT	.245	.101	.078	2.422	.016
	HOSP_EXTRA_LARGE	2.553	.146	.633	17.506	.000
	HOSP_LARGE	.845	.122	.278	6.934	.000
	HOSP_MEDIUM	.263	.092	.102	2.858	.004
	OWN_GOV	.866	.329	.086	2.630	.009
	OWN_NONPROF	.189	.156	.039	1.211	.226
	TEACH	.077	.090	.031	.856	.393

a. Dependent Variable: Inflation_Adjusted_RES

Table E9: Cost Model (Physical Therapy Department Salary) R^2 Value

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.453[a]	.205	.193	1.348772636678E0

Table E10: Results of Variables in Cost (Physical Therapy Department Salary) Model

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.802	.247		3.242	.001
	TIME*IF_MA	.076	.220	.022	.347	.729
	TIME	.185	.141	.061	1.310	.191
	IF_MA	-.163	.176	-.054	-.923	.357
	IF_CT	-.291	.154	-.076	-1.895	.059
	HOSP_EXTRA_LARGE	2.208	.226	.439	9.784	.000
	HOSP_LARGE	1.127	.183	.313	6.145	.000
	HOSP_MEDIUM	.346	.139	.112	2.488	.013
	OWN_GOV	.362	.504	.028	.718	.473
	OWN_NONPROF	.307	.221	.055	1.388	.166
	TEACH	.031	.135	.010	.229	.819

a. Dependent Variable: Inflation_Adjusted_PHY

Table E11: Cost Model (Electrocardiology Room Salary) R^2 Value

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.481[a]	.232	.219	1.1033408300654E0

Table E12: Results of Variables in Cost (Electrocardiology Room Salary) Model

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.381	.212		1.795	.073
	TIME*IF_MA	-.032	.181	-.012	-.178	.858
	TIME	.123	.125	.049	.986	.324
	IF_MA	.232	.148	.093	1.569	.117
	IF_CT	-.069	.127	-.022	-.540	.590
	HOSP_EXTRA_LARGE	1.578	.178	.412	8.876	.000
	HOSP_LARGE	.844	.152	.283	5.556	.000
	HOSP_MEDIUM	.203	.116	.079	1.748	.081
	OWN_GOV	.761	.385	.081	1.975	.049
	OWN_NONPROF	-.244	.190	-.053	-1.286	.199
	TEACH	.118	.112	.047	1.052	.293

a. Dependent Variable: Inflation_Adjusted_ELEC

Table E13: Cost Model (Emergency Room Salary) R^2 Value

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.655[a]	.429	.421	3.38703459266E0

Table E14: Results of Variables in Cost (Emergency Room Salary) Model

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.230	.613		.375	.708
	TIME*IF_MA	.476	.529	.046	.900	.369
	TIME	.634	.338	.070	1.876	.061
	IF_MA	2.593	.427	.287	6.079	.000
	IF_CT	4.146	.355	.377	11.671	.000
	HOSP_EXTRA_LARGE	5.963	.531	.414	11.232	.000
	HOSP_LARGE	2.442	.444	.229	5.504	.000
	HOSP_MEDIUM	.607	.335	.066	1.810	.071
	OWN_GOV	2.510	1.170	.070	2.146	.032
	OWN_NONPROF	.644	.552	.038	1.166	.244
	TEACH	.764	.327	.086	2.333	.020

a. Dependent Variable: Inflation_Adjusted_EMER

Table E15: Quality Model (Heart Attack) R^2 Value

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.324[a]	.105	.083	.2147102

Table E16: Results of Variables in Quality (Heart Attack) Model

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.697	.084		8.278	.000
	TIME*IF_MA	.022	.039	.040	.550	.582
	IF_MA	-.041	.031	-.090	-1.300	.194
	IF_CT	-.029	.027	-.053	-1.086	.278
	HOSP_EXTRA_LARGE	.017	.056	.016	.304	.762
	HOSP_LARGE	.008	.034	.012	.224	.823
	HOSP_MEDIUM	.023	.023	.050	.974	.330
	OWN_NONPROF	-.054	.046	-.063	-1.152	.250
	OWN_GOV	-.052	.075	-.039	-.693	.489
	TEACH	.101	.025	.220	4.118	.000
	TIME	.098	.025	.217	3.872	.000
	Pop_50T	-.003	.004	-.032	-.614	.540
	EMER	.112	.066	.076	1.706	.089

Table E17: Quality Model (Heart Failure) R^2 Value

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.571[a]	.326	.306	.1682777

Table E18: Results of Variables in Quality (Heart Failure) Model

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.399	.073		5.497	.000
	TIME*IF_MA	.067	.037	.136	1.830	.068
	IF_MA	-.083	.031	-.197	-2.703	.007
	IF_CT	.010	.024	.019	.410	.682
	HOSP_EXTRA_LARGE	.130	.051	.184	2.570	.011
	HOSP_LARGE	.196	.036	.281	5.453	.000
	HOSP_MEDIUM	.039	.020	.093	1.969	.050
	OWN_NONPROF	.086	.035	.117	2.413	.016
	OWN_GOV	-.084	.074	-.058	-1.128	.260
	TEACH	-.082	.023	-.194	-3.567	.000
	TIME	.144	.023	.341	6.353	.000
	Pop_50T	.003	.005	.035	.507	.612
	EMER	.278	.057	.235	4.861	.000

Table E19: Quality Model (Pneumonia-Receiving Smoking Cessation Advice) R^2 Value

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.662[a]	.438	.409	.1647462

Table E20: Results of Variables in Quality (Pneumonia-Receiving Smoking Cessation Advice) Model

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.628	.089		7.067	.000
	TIME*IF_MA	.153	.046	.304	3.338	.001
	IF_MA	-.158	.038	-.361	-4.197	.000
	IF_CT	-.076	.034	-.132	-2.238	.026
	HOSP_EXTRA_LARGE	.136	.051	.236	2.658	.008
	HOSP_LARGE	.117	.037	.210	3.201	.002
	HOSP_MEDIUM	.067	.029	.139	2.322	.021
	OWN_NONPROF	-.006	.046	-.008	-.125	.901
	OWN_GOV	-.325	.083	-.254	-3.911	.000
	TEACH	-.076	.029	-.177	-2.627	.009
	TIME	.151	.029	.341	5.136	.000
	Pop_50T	4.922E-5	.005	.001	.011	.992
	EMER	.142	.068	.160	2.092	.038

a. Dependent Variable: P_ADV

Table E21: Quality Model (Pneumonia-Receiving the Most Appropriate Antibiotic) R^2 Value

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.671[a]	.450	.412	.12865

Table E22: Results of Variables in Quality (Pneumonia-Receiving the Most Appropriate Antibiotic) Model

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.359	.067		5.329	.000
	TIME*IF_MA	-.012	.041	-.032	-.295	.768
	IF_MA	-.044	.032	-.129	-1.359	.176
	IF_CT	-.096	.030	-.241	-3.160	.002
	HOSP_EXTRA_LARGE	-.075	.044	-.189	-1.727	.086
	HOSP_LARGE	-.003	.038	-.008	-.081	.935
	HOSP_MEDIUM	.049	.031	.135	1.577	.117
	OWN_NONPROF	.060	.048	.110	1.270	.206
	OWN_GOV	.041	.066	.056	.625	.533
	TEACH	.050	.028	.144	1.767	.079
	TIME	.100	.028	.292	3.511	.001
	Pop_50T	.013	.004	.332	3.584	.000
	EMER	.363	.049	.612	7.369	.000

Table E23: Quality Model (Surgery-Patients Receiving Antibiotic within 1 Hour After Incision) R^2 Value

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.373[a]	.139	.111	.07127

Table E24: Results of Variables in Quality (Surgery--Patients Receiving Antibiotic within 1 Hour After Incision) Model

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.897	.032		28.316	.000
	TIME*IF_MA	.071	.026	.448	2.735	.007
	IF_MA	-.083	.025	-.536	-3.357	.001
	IF_CT	-.030	.011	-.158	-2.821	.005
	HOSP_EXTRA_LARGE	-.015	.017	-.066	-.920	.358
	HOSP_LARGE	.002	.013	.014	.184	.854
	HOSP_MEDIUM	-.009	.010	-.061	-.906	.366
	OWN_NONPROF	-.003	.019	-.011	-.178	.859
	OWN_GOV	-.010	.031	-.020	-.326	.744
	TEACH	.010	.010	.067	1.030	.304
	TIME	.050	.017	.195	2.933	.004
	Pop_50T	.000	.001	-.012	-.197	.844
	EMER	-.015	.020	-.038	-.739	.460

Table E25: Quality Model (Surgery-Patients Stopping Antibiotic within 24 Hour After Surgery) R^2 Value

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.470[a]	.221	.194	.1327271

Table E26: Results of Variables in Quality (Surgery-Patients Stopping Antibiotic within 24 Hour After Surgery) Model

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.563	.062		9.008	.000
	TIME*IF_MA	-.081	.048	-.263	-1.675	.095
	IF_MA	.103	.046	.341	2.223	.027
	IF_CT	-.002	.020	-.005	-.095	.924
	HOSP_EXTRA_LARGE	-.075	.031	-.164	-2.384	.018
	HOSP_LARGE	-.059	.025	-.173	-2.365	.019
	HOSP_MEDIUM	-.049	.020	-.163	-2.500	.013
	OWN_NONPROF	-.045	.037	-.075	-1.212	.226
	OWN_GOV	-.030	.058	-.031	-.506	.613
	TEACH	.067	.019	.225	3.597	.000
	TIME	.242	.032	.490	7.555	.000
	Pop_50T	-.001	.002	-.018	-.306	.760
	EMER	.102	.039	.129	2.595	.010

a. Dependent Variable: S24

Appendix F: Indicators Abbreviation

TIME: If the data is collected after the reform? 1 – Yes 0 - No

IF_MA: If the hospital is in MA? 1 – Yes 0 - No

IF_CT: If the hospital is in CT? 1 – Yes 0 - No

IF_WI: If the hospital is in WI? 1 – Yes 0 - No

HOSP_EXTRA_LARGE: If the hospital is extra large? 1 – Yes 0 - No

HOSP_LARGE: If the hospital is large? 1 – Yes 0 - No

HOSP_MEDIUM: If the hospital is medium? 1 – Yes 0 - No

HOSP_SMALL: If the hospital is medium? 1 – Yes 0 - No

OWN_GOV: if the hospital is governmental hospital? 1 – Yes 0 – No

OWN_NONPROF: If the hospital is nonprofit hospital? 1 – Yes 0 – No

OWN_PROP: If the hospital is proprietary hospital? 1 – Yes 0 – No

EMER: If the hospital provides emergency service? 1 – Yes 0 - No

TEACH: If the hospital is teaching hospital? 1 – Yes 0 - No

Pop_50T: Town population in fifty thousand where the hospital is located

TOTAL_COST: total operation cost in dollars

TOTAL_COST_MIL: total operation cost in million dollars

OP_ROOM: operation room salary in dollar

OP_ROOM_MIL: operation room salary in million dollars

RADIO_ROOM: radiology room salary in dollar

RADIO_ROOM_MIL: radiology room salary in million dollar

RES_THE: Respiratory Therapy Salary in dollar

RES_THE_MIL: Respiratory Therapy Salary in million dollar

PHY_THE: Physical therapy Salary in dollar

PHY_THE_MIL: Physical therapy Salary in million dollars

ELEC: electrocardiology Salary in dollar

ELEC_MIL: electrocardiology Salary in million dollars

EMER_SAL: emergency room salary in dollar

EMER_SAL_MIL: emergency room salary in million dollars

HA: Heart Attack Patients Given ACE Inhibitor or ARB for Left Ventricular Systolic Dysfunction (LVSD)

HF: Heart Failure Patients Given Smoking Cessation Advice/Counseling

P_ADV: Pneumonia Patients Given Smoking Cessation Advice/Counseling

P_ANTI: Pneumonia Patients Given the Most Appropriate Initial Antibiotic(s)

S1: Surgery Patients Who Received Preventative Antibiotic(s) One Hour Before Incision

S24: Surgery Patients Whose Preventative Antibiotic(s) are Stopped Within 24 hours After Surgery

Appendix G: Graphs of Trends of Dependent Variables in Massachusetts, Connecticut and Wisconsin

Figure G1: Inflation Adjusted Hospital Total Operating Cost (Million Dollars) from Fiscal Year 2005 to 2009 in Massachusetts, Connecticut and Wisconsin

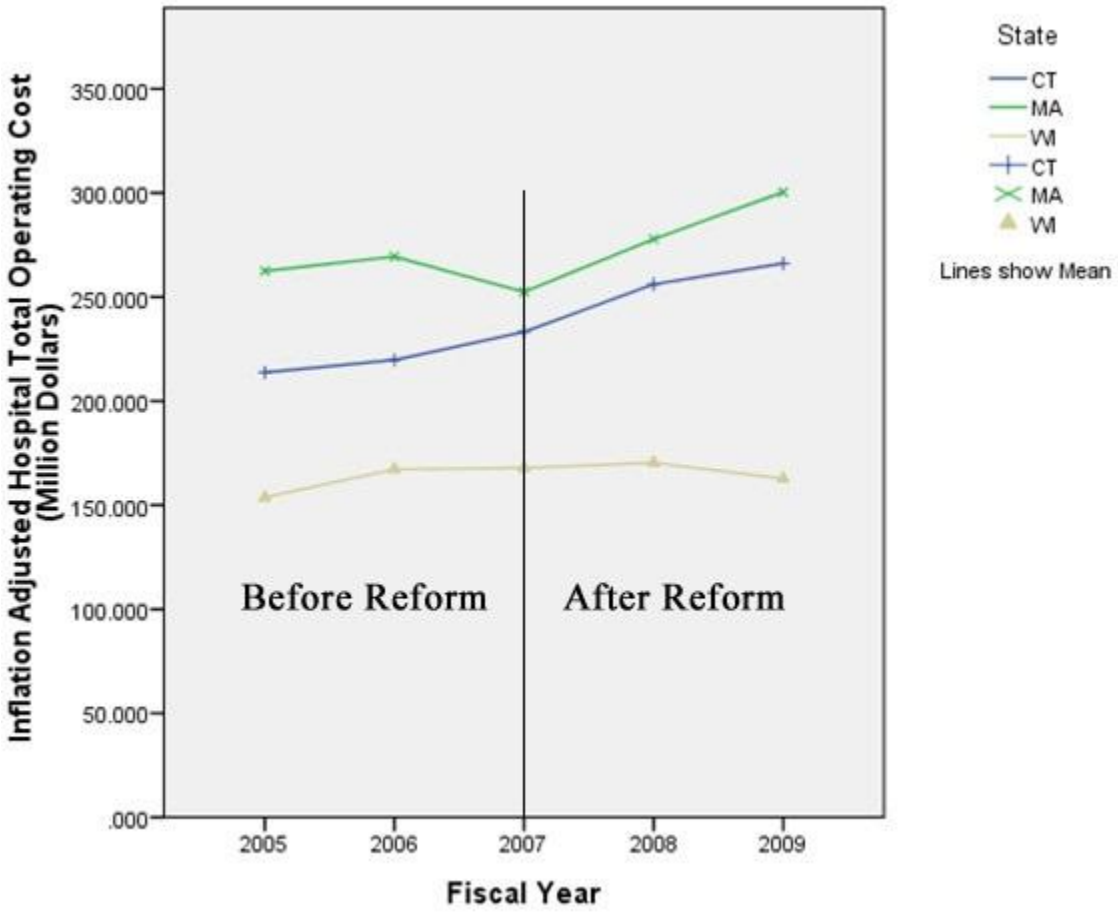

Figure G2: Inflation Adjusted Hospital Operating Room Salaries (Million Dollars) from Fiscal Year 2005 to 2009 in Massachusetts, Connecticut and Wisconsin

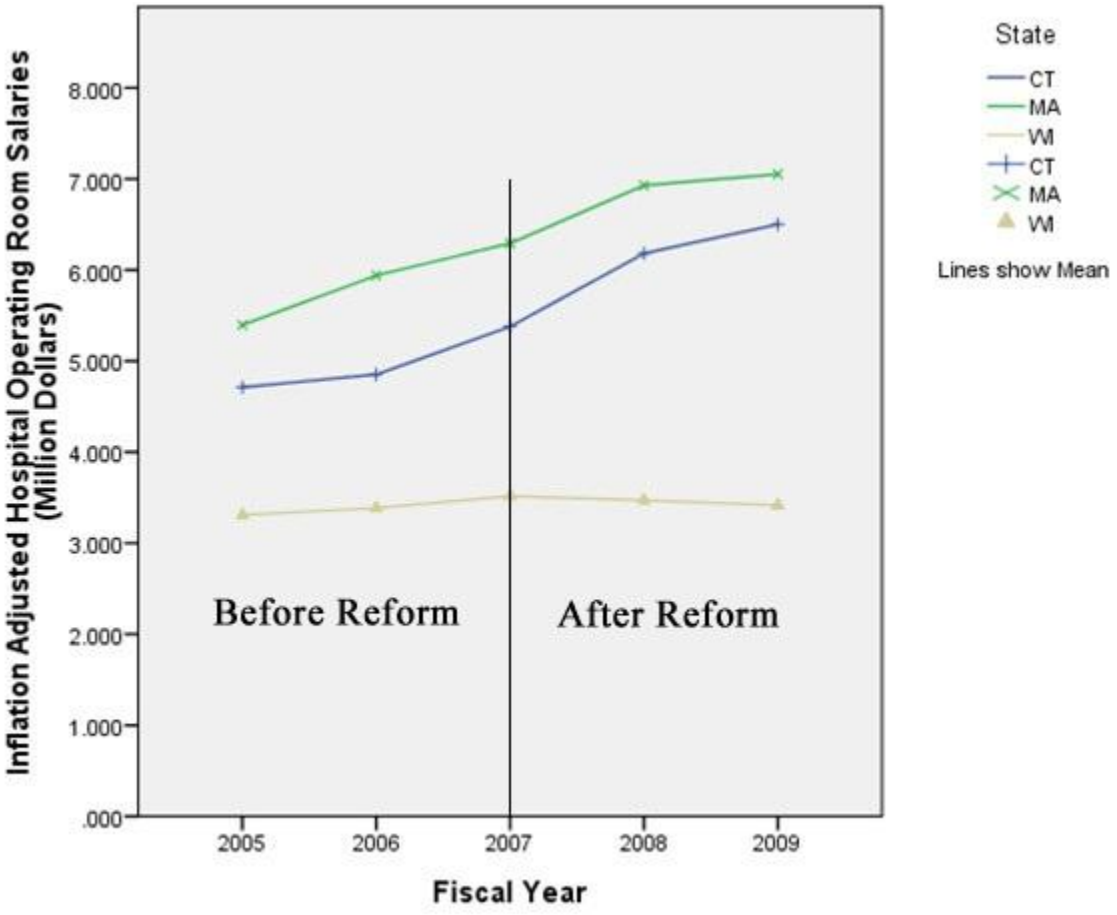

Figure G3: Inflation Adjusted Hospital Radiology Room Salaries (Million Dollars) from Fiscal Year 2005 to 2009 in Massachusetts, Connecticut and Wisconsin

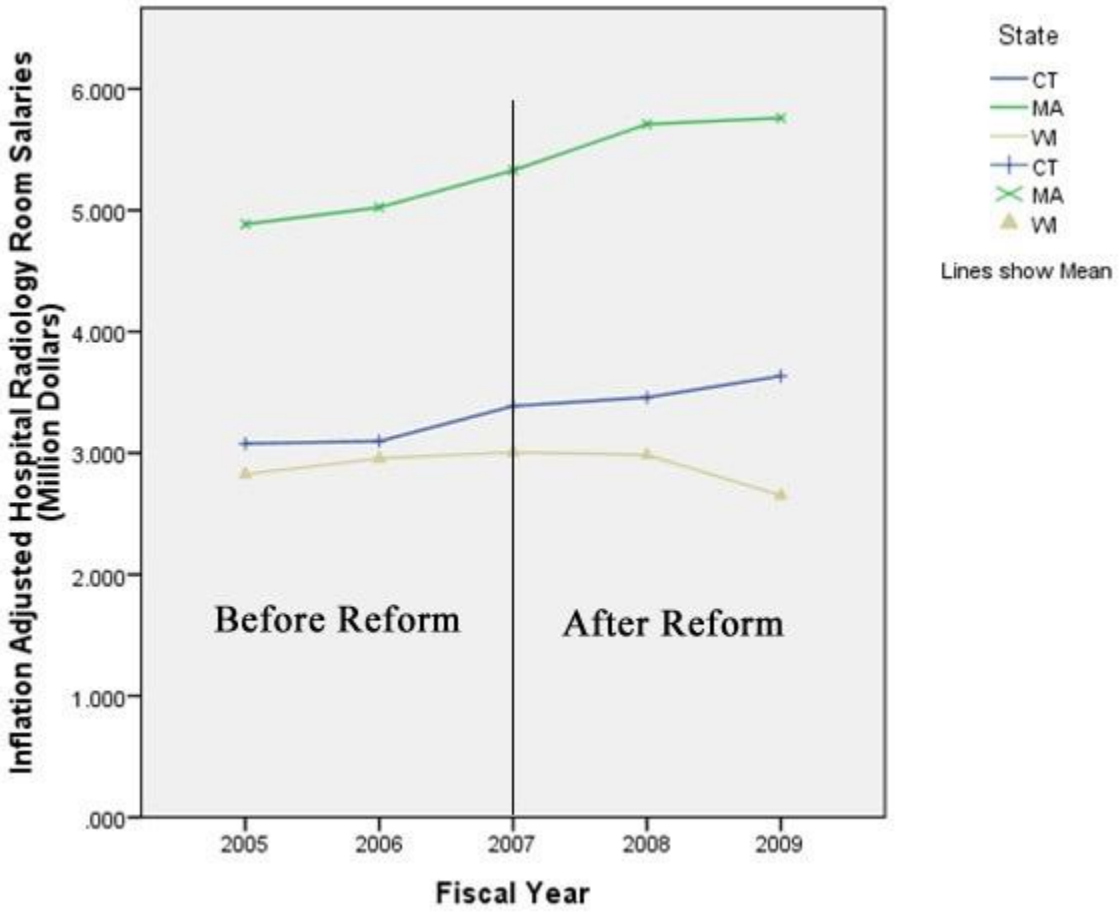

Figure G4: Inflation Adjusted Hospital Respiratory Room Salaries (Million Dollars) from Fiscal Year 2005 to 2009 in Massachusetts, Connecticut and Wisconsin

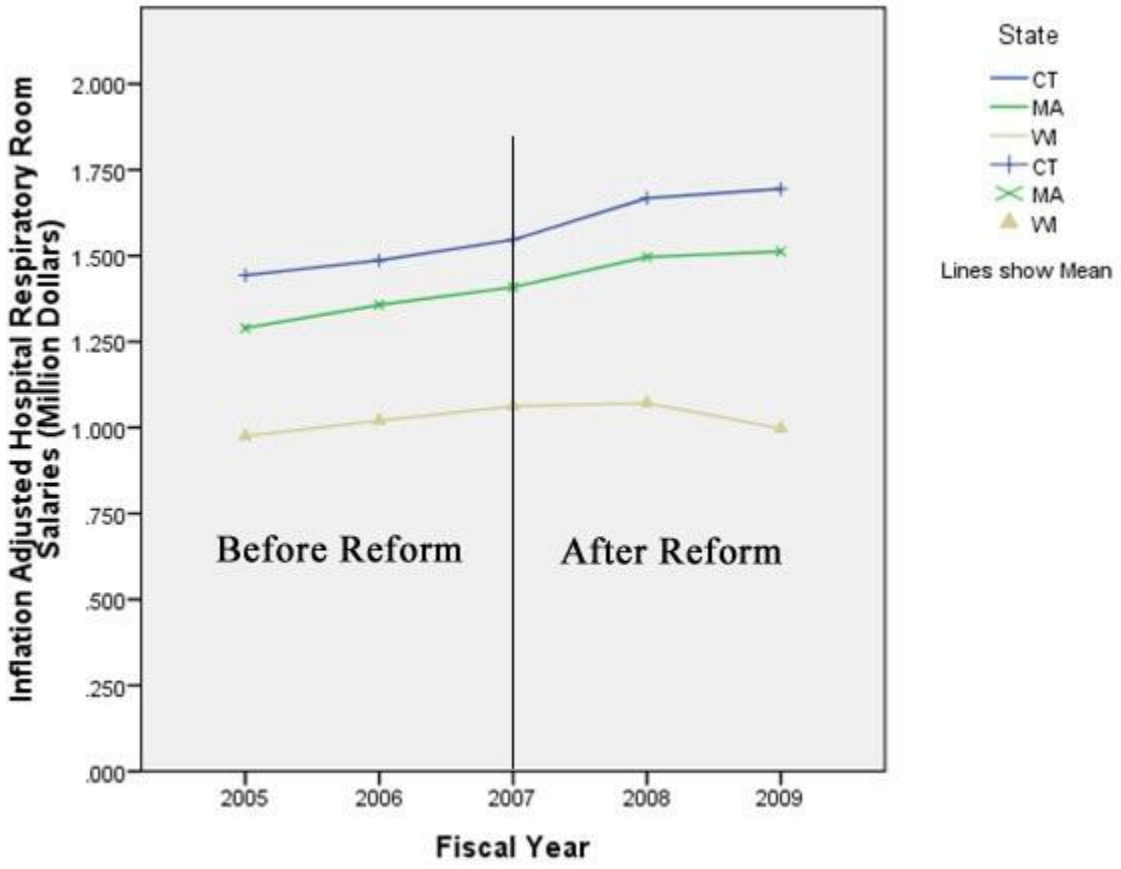

Figure G5: Inflation Adjusted Hospital Physical Therapy Salaries (Million Dollars) from Fiscal Year 2005 to 2009 in Massachusetts, Connecticut and Wisconsin

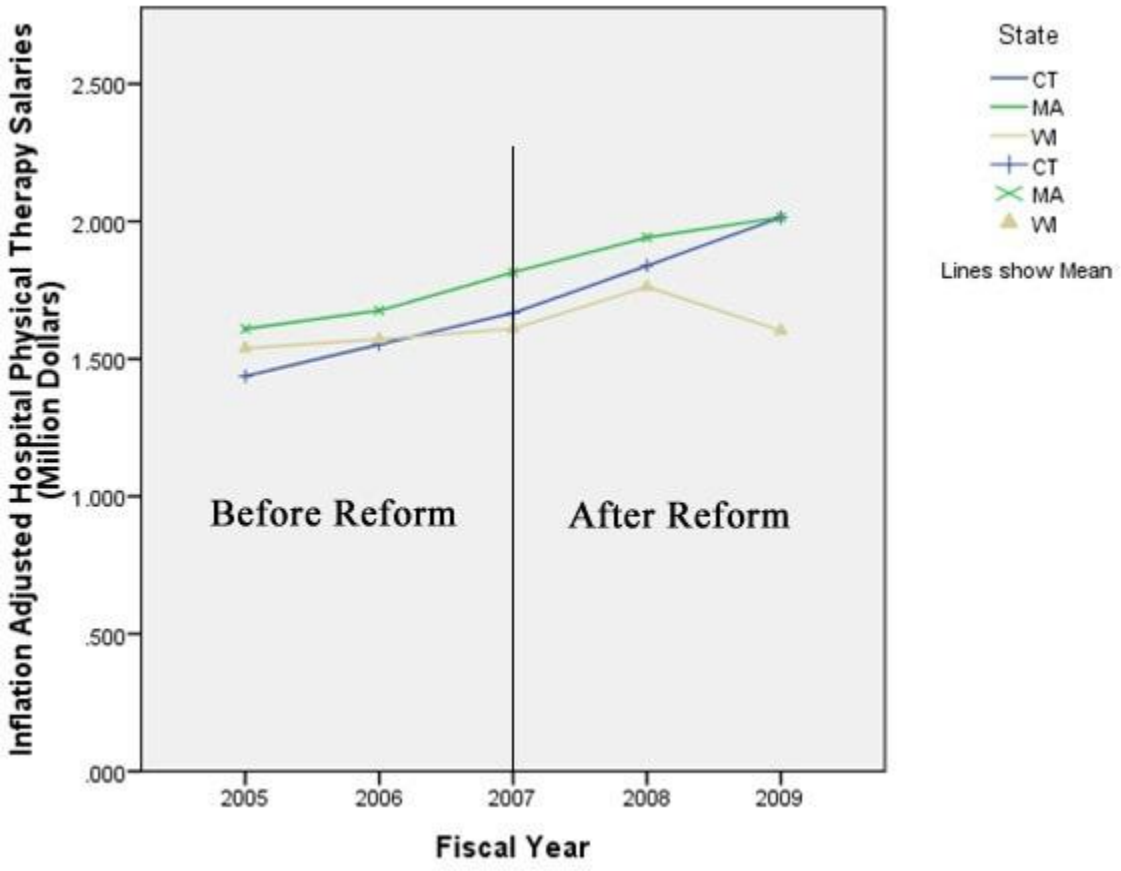

Figure G6: Inflation Adjusted Hospital Electrocardiology Room Salaries (Million Dollars) from Fiscal Year 2005 to 2009 in Massachusetts, Connecticut and Wisconsin

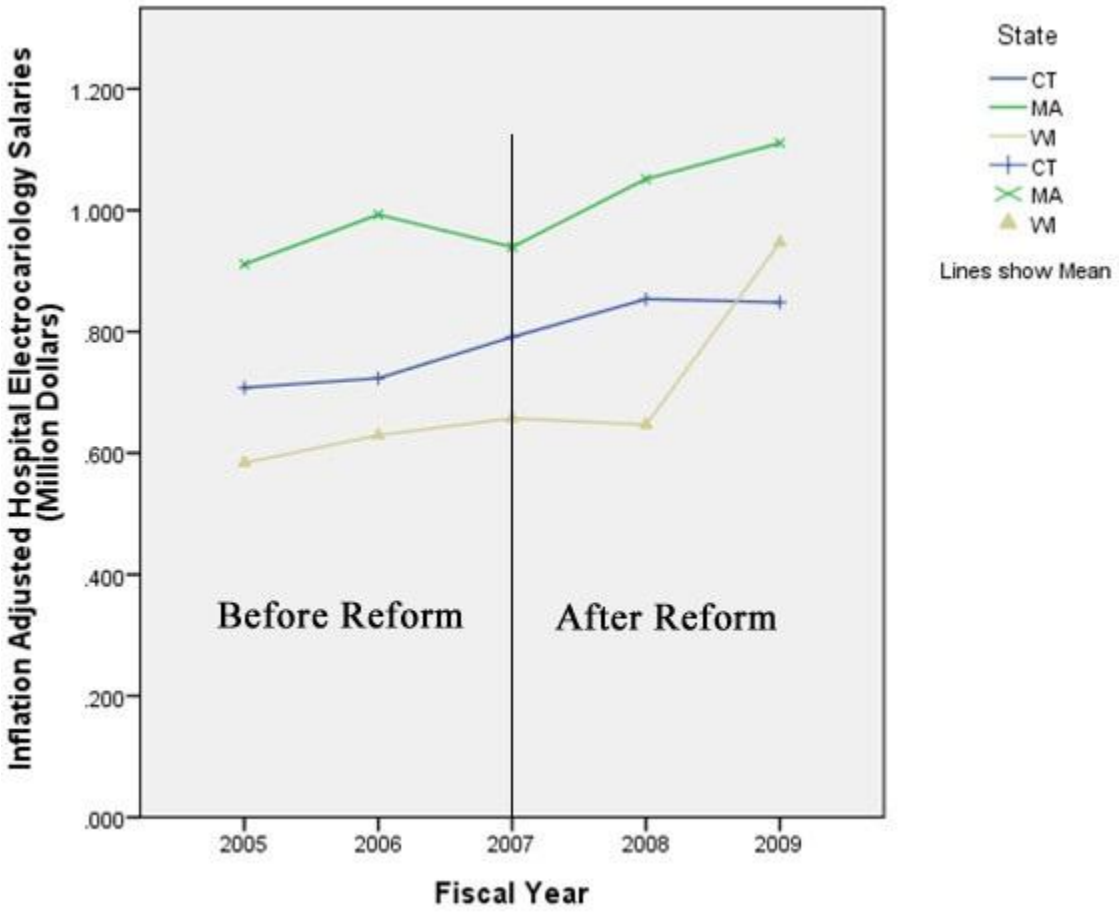

Figure G7: Inflation Adjusted Hospital Emergency Room Salaries (Million Dollars) from Fiscal Year 2005 to 2009 in Massachusetts, Connecticut and Wisconsin

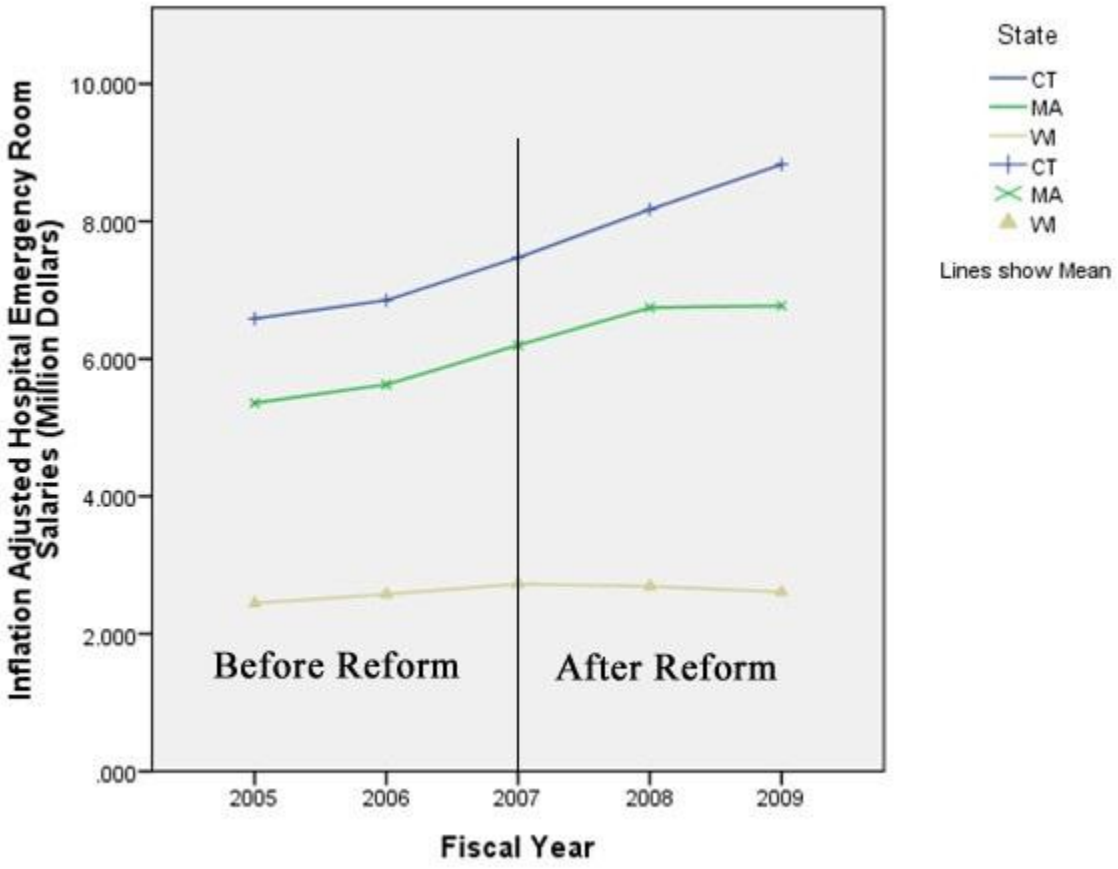

Figure G8: Heart Attack Patients Given ACE Inhibitor or ARB for Left Ventricular Systolic Dysfunction (LVSD) (100%) from Fiscal Year 2005 to 2009 in Massachusetts, Connecticut and Wisconsin

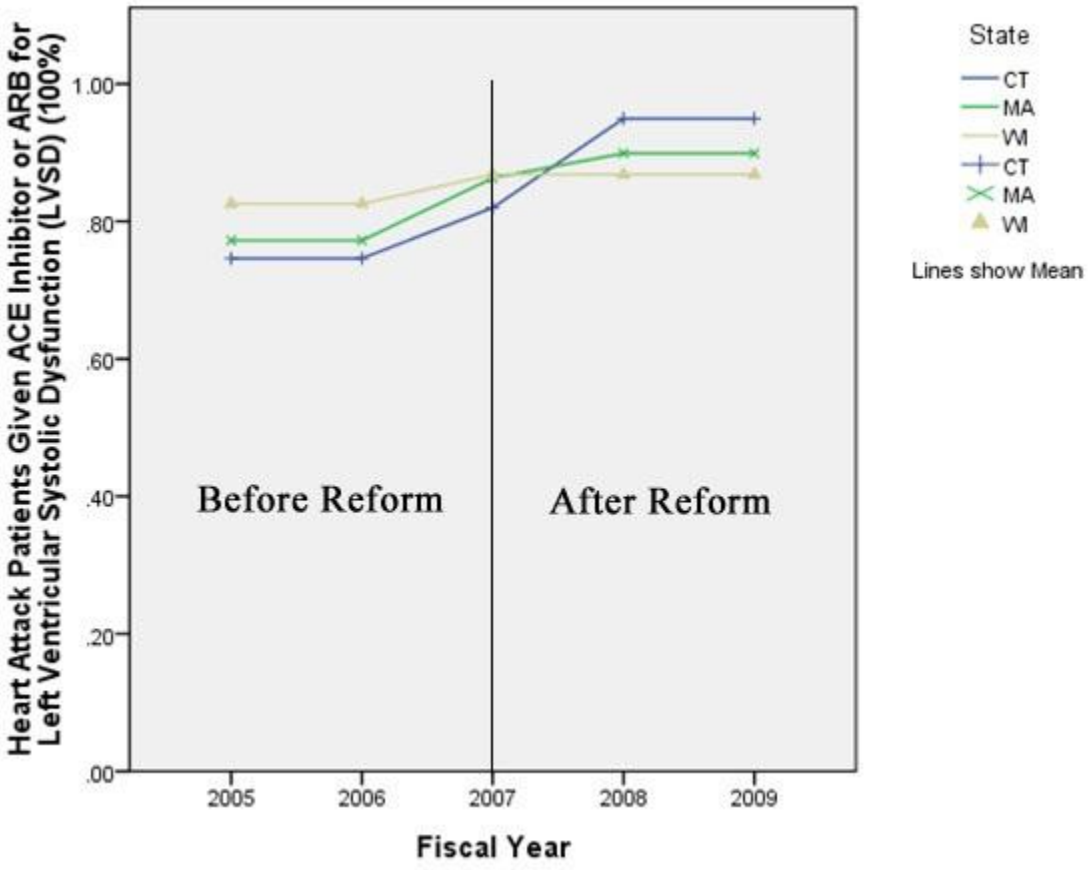

Figure G9: Heart Failure Patients Given Smoking Cessation Advice / Counseling (100%) from Fiscal Year 2005 to 2009 in Massachusetts, Connecticut and Wisconsin

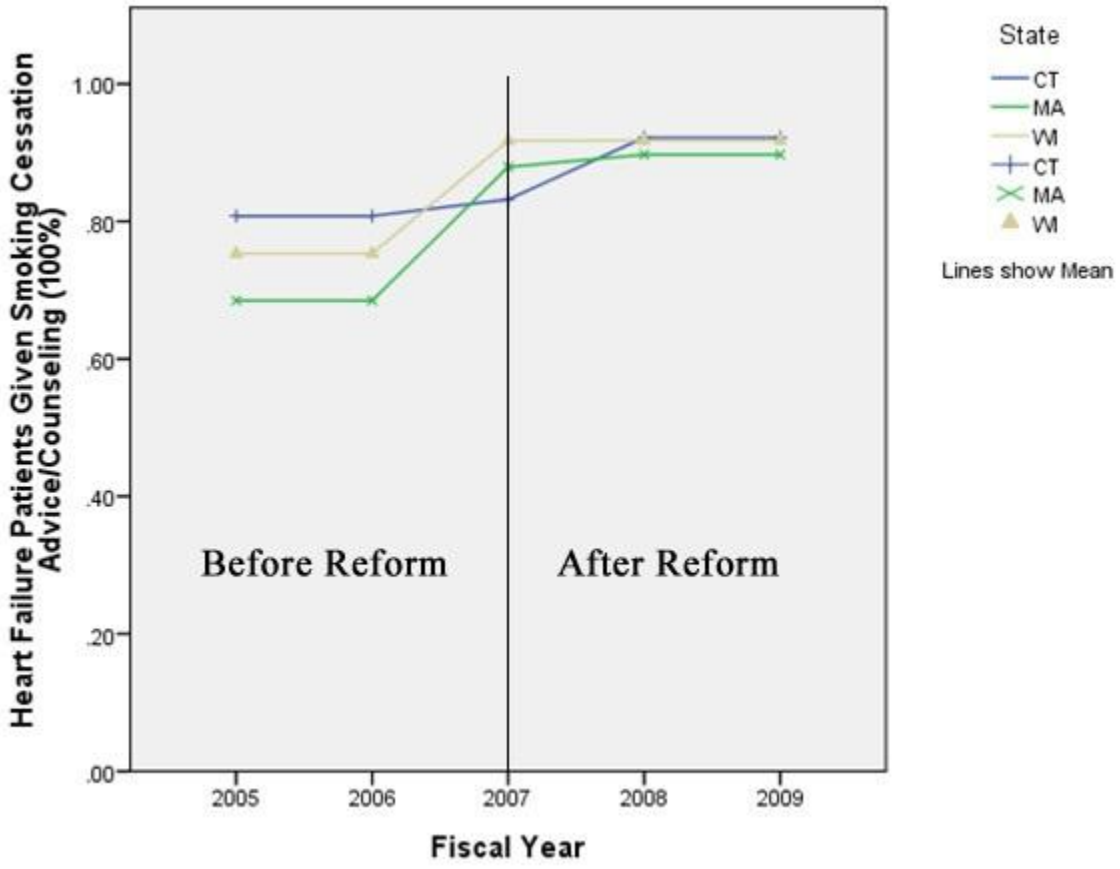

Figure G10: Pneumonia Patients Given Smoking Cessation Advice / Counseling (100%) from Fiscal Year 2005 to 2009 in Massachusetts, Connecticut and Wisconsin

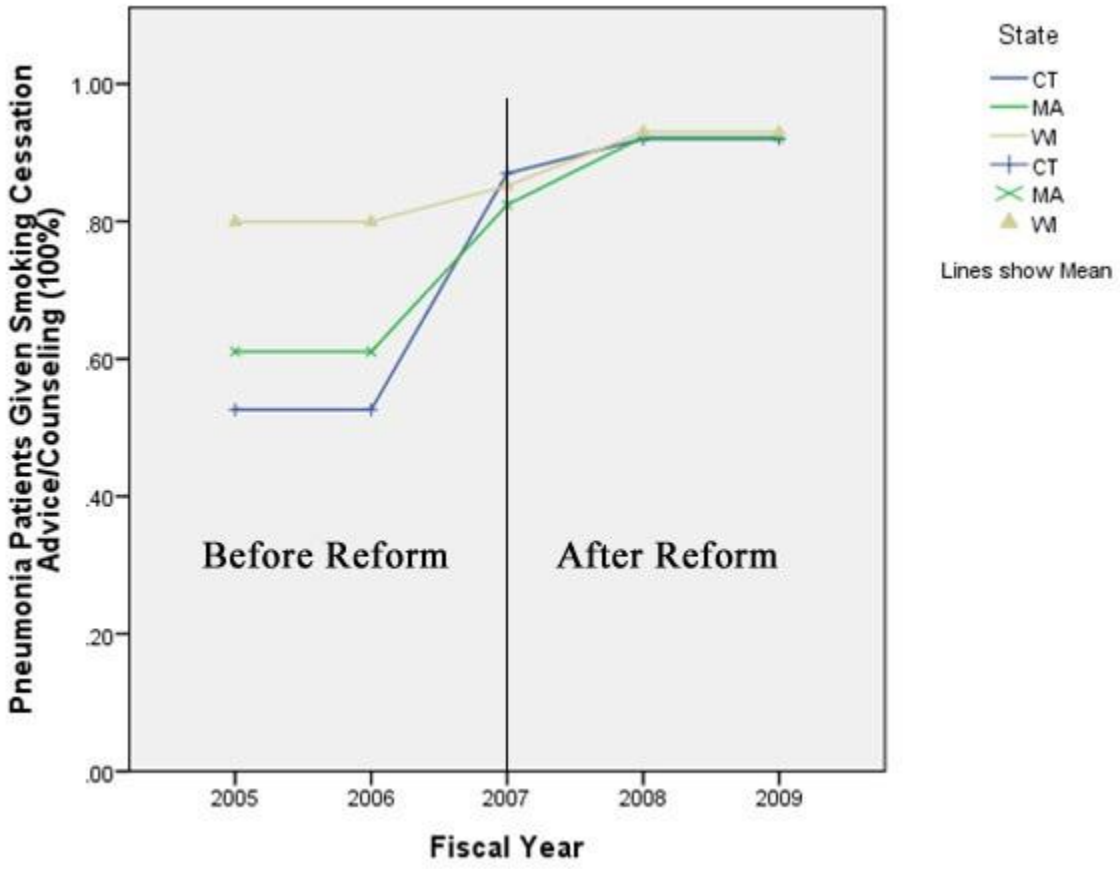

Figure G11: Pneumonia Patients Given the Most Appropriate Initial Antibiotic(s) (100%) from Fiscal Year 2005 to 2009 in Massachusetts, Connecticut and Wisconsin

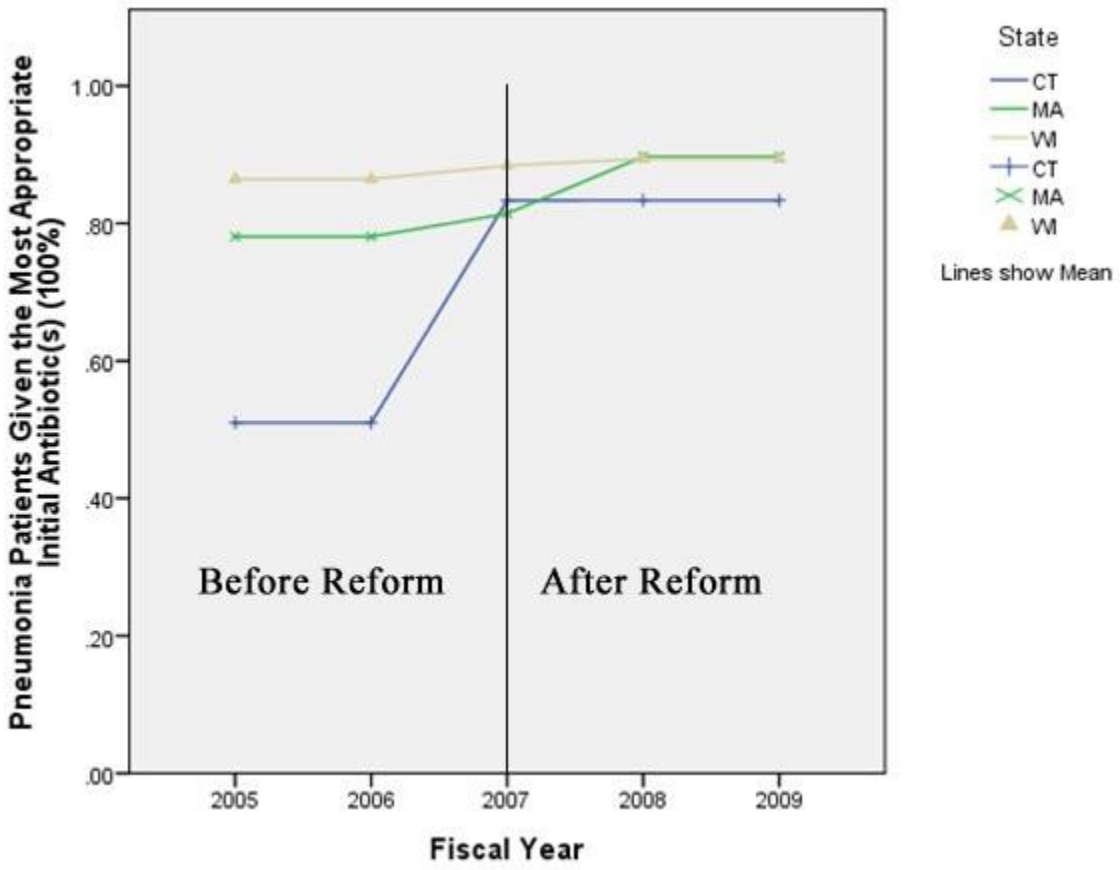

Figure G12: Surgery Patients Who Received Preventative Antibiotic(s) One Hour Before Incision (100%) from Fiscal Year 2005 to 2009 in Massachusetts, Connecticut and Wisconsin

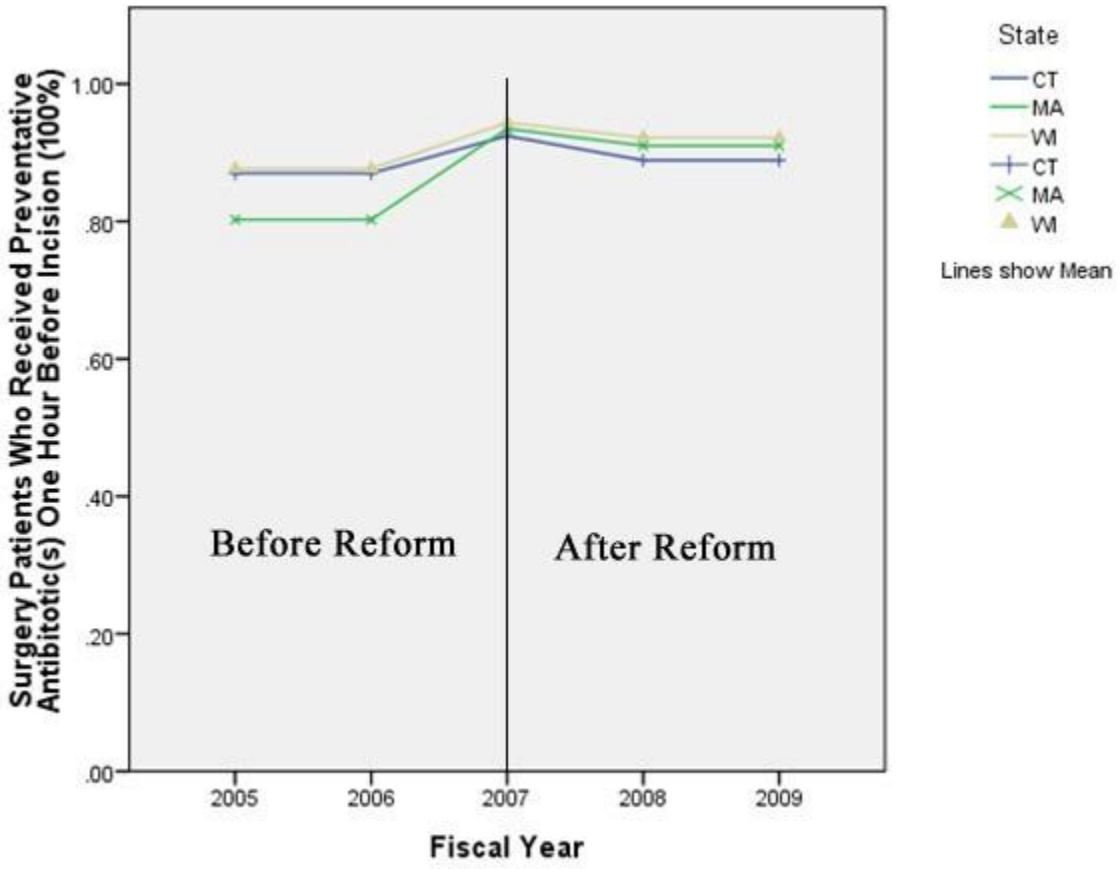

Figure G13: Surgery Patients Whose Preventative Antibiotic(s) are Stopped Within 24 Hours After Surgery (100%) from Fiscal Year 2005 to 2009 in Massachusetts, Connecticut and Wisconsin