Effect of disease management programs on Medicaid costs

Matthew Stephen Conti
University of Notre Dame
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Advisor: Dr. William Evans
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I. BACKGROUND

A. Introduction

Americans spend over 16.2% ($2.3 trillion) of U.S. gross domestic product (GDP) on health care, or approximately twice as much as most other developed nations. After many of the baby boomers retire by 2035, health care costs will approximately double to 31% of GDP (CBO 2007). Medicaid and Medicare spending is projected to grow from 4% of GDP, which is 26% of total spending on health care, to 9% of GDP, or 30% of total health care spending, by 2035 (CBO 2007). The Centers for Disease Control and Prevention (CDC) estimates that 75% ($1.72 trillion) of health care spending goes to treating chronic conditions (CDC 2009). Additionally, 80% of this spending treats just 20% of the population (Stanton 2002). Only fifteen medical conditions, most of which were chronic illnesses, accounted for roughly 50% of the increase in health care costs and spending between 1987 and 2000 (Thorpe et al. 2004).

As a result of increasing costs for those chronic illnesses, disease management programs have been put forward as a potential way to control costs and improve the quality of care of chronic diseases. Disease management programs are coordinated health care interventions for patients with chronic conditions in which self-care efforts have significant impacts on health outcomes (Bott et al. 2009). Their primary purpose is to improve health outcomes and reduce the costs that occur due to acute aggravations or worsening symptoms by aligning patient care with the evidence base (Bott et al. 2009). This means that their treatment of chronic illnesses relies heavily on preventative and primary care (Medicaid and Managed Care 2011). Most of these programs pay a fixed

monthly capitation rate per enrollee to providers to treat patients using a set of services

defined by Medicaid (Medicaid and Managed Care 2011). This payment system

encourages providers to treat health complications before they become more difficult and

expensive to control (Medicaid and Managed Care 2011). These programs typically use

telephonic inventions by nurses to manage low-risk patients while provider-based

interventions in physicians' offices are used to manage high-risk patients (Bott et al.

2009).

Recently, states have implemented disease management programs for Medicaid

patients in order to improve the quality of care and control the costs of treating clients

with chronic diseases. Medicaid spending is of particular interest to state and federal

governments because it consumes about 8% of federal and 16% of state budgets (Key

Questions 2011). It also accounts for one-sixth of total health care spending in America

(Key Questions 2011). Currently, over fifty-eight million Americans are enrolled in

Medicaid, which represents 19% of the total population, and this number is expected to

increase by 27.4% over the next ten years with 16 of the 32 million Americans who will

receive health insurance through the Affordable Care Act obtaining their coverage from

state Medicaid programs (Medicaid & CHIP 2011 and Key Questions 2009). High

medical costs relative to income level, such as those generated by chronic conditions, is

one avenue through which many recipients become eligible for the Medicaid program.

Disease management programs will be one of the most common ways Medicaid

enrollees, especially those with chronic illnesses, will access care; consequently, the

impact that managed care has on effectively controlling costs and improving the quality

of care is an important area of research, which has as of yet been underdeveloped.

Prevention and early interventions to avoid the high costs associated with acute aggravations of chronic illnesses will play a more central role in health care in the future. It has been reported that spending approximately $10 per person on preventative care could result in savings of over $16 billion in five years (Inclusion of Prevention 2009). The most recent economic stimulus package included $2.2 billion for cost-effectiveness work in health care focusing on chronic disease prevention and disease management initiatives (Jutkowitz 2009). These programs look to address increasing health care costs for a number of diseases including obesity, diabetes, heart disease, cancer, and smoking-related illnesses (Inclusion of Prevention 2009). In addition, some of this funding has been appropriated for health information and technology improvements in order to better manage chronic diseases (Inclusion of Prevention 2009).

About $1 in $10 health care dollars is used to treat diabetes and diabetes-related complications (Economic Costs of Diabetes 2008). In 2007, over $174 billion in health care expenditures were attributed to diabetes, which accounts for approximately 7.6% of overall health care spending in the United States (Economic Costs of Diabetes 2008). Additionally, the prevalence of diabetes is expected to more than double from 5.6% to 12% of the United States population between 2005 and 2050 (Economic Costs of Diabetes 2008). There is therefore increasing concern about managing the costs associated with treating this chronic disease.

This paper studies diabetic disease management programs in three states, Washington, Texas, and Georgia, and it uses difference-in-differences models and ordinary least squares regressions to determine the effects of these programs, which began in 2002, 2004, and 2005, respectively. Difference-in-differences models compare

outcomes before and after the intervention in treated states against the same changes in

states without reforms. The non-reform states act as a comparison sample establishing

the time trend in outcomes that would have existed in the absence of intervention. After

controlling for state and year effects with dummy variables, median state income, state

obesity rate, and state Medicaid enrollment, there are no statistically significant results

for any of the outcome variables with the exception of Texas in which there is a decrease

in the number of admissions after the implementation of its disease management

program. Graphical analyses using time-series plots also illustrate that trends in costs and

admissions in treatment states do not vary significantly after the intervention and tend to

follow the same pattern of the control states, which had no change in disease

management status over the same period. Consequently, diabetic Medicaid disease

management programs are ineffective at reducing costs, inpatient admissions, and

emergency admissions.

B. Literature Review

Aligning care with evidence-based practices through disease management

programs has been shown to improve the quality of care of chronic conditions. By

studying changes in health status metrics such as low-density lipoprotein (LDL) levels,

which are a measure of cholesterol, and glycated hemoglobin (hemoglobin A_1C) levels,

which are a test of plasma glucose concentrations over time, numerous studies including

Lind and Kaplan (2007), McEwen et al. (2009), Morisky et al. (2009), and Rosenzweig et

al. (2010) have found significant improvements in health care outcomes and quality. For

example, Rosenzweig et al. (2010) found that the percentage of diabetics who had an A_1C

test increased from 26.0% before the program was implemented to 49.2% after their care had been taken over by a disease management program. They also found that the number of diabetic patients who had been given an LDL test approximately doubled after they had been enrolled in a disease management program (Rosenzweig et al. 2010). Considerably less work has focused on improved health outcomes such as a higher survival rate, an increase in the patient's quality of life, or a decreased number of emergency room visits.

However, the cost-effectiveness of disease management programs has not been well established. Lind and Kaplan (2007) looked at the disease management program of Washington. They found that diseases such as heart failure and asthma took four years before savings occurred, but diabetes and chronic obstructive pulmonary disease provided savings to the state after only one year (Lind and Kaplan 2007). Katz et al. (2009) also found that the Indiana Medicaid disease management programs were cost-effective by slowing the rate of increase in costs. Additionally, Rosenzweig et al. (2010) show that these programs assist in slowing the rate of increase or even decrease spending for chronic illnesses. In contrast, Esposito et al. (2008) and Bott et al. (2009) did not find substantial cost savings or reductions in the increase in the rate of growth of health care costs when disease management programs were implemented. Another study by Holmes et al. (2008) found that the Indiana Medicaid program reduced costs for congestive heart failure (CHF) but not for diabetes. Many of these studies lack sufficient controls in their models and only focus on the cost-effectiveness of managed care for an individual state. They also suffer from small datasets that provide only a few years of information before and after the implementation of the disease management program.

The Congressional Budget Office (CBO) in 2004 analyzed peer-reviewed literature about the cost-effectiveness of disease management programs. The CBO concluded that disease management programs have not been found to reduce overall health spending, and many of the studies that promote the effectiveness of these programs on spending fail due to selection bias, regression to the mean, or other factors (CBO 2004). For diabetes, the authors report that a few studies have noted cost-savings in the short run; however, the results are not robust enough to be applied to disease management programs (CBO 2004). Many of these studies suffered from selection bias due to optional enrollment and neglect including the cost of the disease management program (CBO 2004). Thus, the overall effects on costs of disease management programs for chronic illnesses have not been established.

This paper focuses on the cost controlling aspect of Medicaid disease management programs for diabetes because reducing health care spending remains a significant issue in America, and effective ways to control costs must be determined and put into practice. Although managed care initiatives have been proposed as one way to control costs, there is not sufficient evidence to substantiate this claim. Consequently, a more thorough examination of disease management programs is warranted. This paper will examine the implementation of disease management programs in three states, Georgia, Texas, and Washington, and compare the change in costs for treating inpatients with diabetes before and after the programs are put into practice. These changes in costs for diabetics requiring inpatient care will then be compared to a number of control states that have not changed the status of their diabetic disease management programs from 2000 to 2008. Additionally, these analyses will be used to determine if implementing

disease management programs reduces total costs or slows the rate of increase in costs for treating diabetes.

This paper will first present the National In-Patient Sample data from the Agency for Health care Research and Quality that was used and then explicate the difference-in-differences regression models used. Subsequently, the results will be explained followed by a conclusion.

II. DATA

A. Data

State Medicaid plans began to implement disease management programs over the last ten to fifteen years. Consequently, the analysis for this research needed to use a nationwide dataset over this period that was separated by state and year and included total costs, length of stay, payer, and conditions for each patient. The National In-Patient Sample (NIS) from the Health care Cost and Utilization Project (HCUP) met these requirements. HCUP is a group of health care databases and software tools, which include patient-level and longitudinal hospital care data, sponsored by the Agency for Health care Research and Quality (AHRQ). The NIS is a specific database within HCUP that contains information on patient-level hospital inpatient stays including cost and payer. Other variables contained in this dataset are admission type (e.g. emergency, urgent, elective, newborn, and other), age, sex, length of stay, primary payer, and total charges.

In order to be useful for this study, state Medicaid disease management programs had to meet certain requirements. For example, the disease management program of the state must cover diabetes. Additionally, the programs must be mandatory or opt-out in order to ensure that patients whose care is paid by Medicaid are likely to be enrolled in the disease management program, and states must have data for a few years before and after the implementation of the disease management program in the NIS. Finally, a diabetic disease management program had to be well defined, which means that information about its program had to be widely available with clearly established steps to reduce acute aggravations such as the distribution of educational materials on diabetes.

These criteria led to Washington (2002), Texas (2004), and Georgia (2005) being selected as states that implemented disease management programs from 2000 to 2008 that could be analyzed. The years in parentheses are the years that the state began its disease management program. In contrast, the criterion for the control group was that there was no change in disease management status over this period. States in the NIS dataset that had established disease management programs before 2000 include Florida (1998), North Carolina (1998), Tennessee (1994), and Maryland (1997). Because Indiana entered the dataset in 2003, which is the same year it implemented its disease management program, there was no change in its disease management status, so it was used as a control state. States in the NIS dataset that did not implement well-defined disease management programs include Massachusetts, Pennsylvania (which dropped out of the dataset in 2004 and returned in 2008), Kansas, Hawaii, Utah, Maine (which dropped out the dataset in 2003 and returned in 2007), Kentucky, South Carolina, Nebraska, and Vermont. All of the states remained in the dataset unless otherwise noted. The change in costs for treating

diabetes in Washington, Texas, and Georgia will be compared to the change in costs for

treating those chronic illnesses in the control group using a difference-in-differences

model.

B. Disease Management Programs of Washington, Texas, and Georgia

The disease management programs chosen as treatment states varied by

implementation and the type of interventions used to prevent costly acute aggravations in

patients with chronic diseases, and each program will be briefly discussed in turn here.

The Washington disease management program began in 2002 for clients in its fee-for-

service program (Lind and Kaplan 2007). Washington contracted its program to external

vendors who were to take on patients with asthma, heart failure, chronic obstructive

pulmonary disease, and diabetes (Lind and Kaplan 2007). Patients were automatically

enrolled in the program unless they opted out (Lind and Kaplan 2007). However, only

35% of the target population participated in the disease management program at any

point in time (Lind and Kaplan 2007). The patients who were in the program received a

phone call from a nurse who performed an initial health assessment, that included such

information as health risks of the patients, their primary care physician and future

appointments, recent hospitalizations, and the existence of an action plan to be used if the

client's symptoms worsened (Lind and Kaplan 2007). Results of the health assessment

then allowed the patient to be put into a high risk, medium risk, or low risk group (Lind

and Kaplan 2007). Following the initial health assessment, enrollees received a home

visit or additional phone call providing education such as avoiding risk and self-

management skills (Lind and Kaplan 2007). A reassessment of clients' health occurred

every six months; thus, all data for the health assessments was self-reported (Lind and

Kaplan 2007).

The Texas disease management program began in 2004 and included patients that

were diagnosed with asthma, diabetes, congestive heart failure, coronary artery disease,

and chronic obstructive pulmonary disease (Implementing Medicaid Disease and Care

Management Programs 2008). The state decided to contract to an outside vendor to

manage the program (Implementing Medicaid Disease and Care Management Programs

2008). The Texas program is an opt-out program in which eligible clients are

automatically enrolled but can choose to opt-out of the program (Implementing Medicaid

Disease and Care Management Programs 2008). The interventions conducted by the

Texas disease management program include an initial health assessment, education

materials, telephone calls by community-based nurses with a few visits to patients'

homes, a 24 hour nurse call line, self-management guidelines for patients, and education

for providers (Implementing Medicaid Disease and Care Management Programs 2008).

The Georgia disease management program, which began in 2005, is similar to the Texas

program with interventions that include a 24 hour nurse call center, education materials,

an initial health assessment, development of an action plan, and education for providers

(Disease Management Contracts 2005). The Georgia program is managed by outside

vendors as well (Disease Management Contracts 2005).

C. Limitations

This study is limited by the NIS data because the data only includes treatment

costs for diabetic patients whose care requires an overnight (inpatient) stay. Thus, the

costs associated with simple outpatient procedures or visits to a physician's office cannot

be calculated. If disease management programs prevent overnight stays so that only the

sickest patients require inpatient care, then the costs associated with inpatient stays might

increase but overall costs of caring for all diabetic patients in a state may decline.

However, inpatient care for treating diabetes-related complications accounts for greater

than 60% of spending on diabetes, and people with diabetes have a high incidence of

hospitalizations (Jiang et al. 2003). Thus, inpatient observations provide a good

indication of the effectiveness of disease management programs for diabetes.

This study also could not differentiate between patients who were enrolled in

disease management programs and those who were not. However, in the states that were

chosen, large percentages of Medicaid patients with diabetes were enrolled in the disease

management programs so that the effects of cost-savings, if present, could be observed.

In addition, the data is not longitudinal for patients, so this study cannot monitor the same

patient over time, which would be helpful to decide whether the costs of care for an

individual patient has increased or decreased. The sample does not attempt to standardize

the number of observations by state each year; thus, the sample may contain large

variations in the number of observations for each state over time, which may affect

outcomes such as the total number of hospital admissions. This study eliminated any

states that had large fluctuations in the proportion of admissions to total Medicaid

enrollment and tried to remove the sampling problem by using proportions in the

outcome variables (e.g. total number of admissions / total Medicaid enrollment or total

charges / total number of admissions). The data does not include outcomes data so health

quality, with the exception of average length of stay and the number of emergency

admissions, cannot be measured. Furthermore, the amount of information on state

Medicaid disease management is limited and not easily accessible, which partly limited

the number of treatment states that could be used.

III. METHODS

This study uses difference-in-differences models to explore the effects of a

disease management program in states that implemented these programs between 2000

and 2008. A difference-in-differences model simulates a random assignment experiment

with treatment and comparison groups. In the ideal situation, the comparison group

provides an estimate of the time-path of outcomes that would have occurred in the

treatment group without the intervention. Thus, difference-in-differences models allow

for analysis of results before and after the implementation of disease management

program within the state and analysis of results between the treatment and comparison

groups. The regressions were performed using ordinary least squares (OLS). A variety

of outcomes were used. In order to determine whether these programs were effective at

reducing costs, two outcome variables were used: ln(total charges / state Medicaid

enrollment) and ln(total charges / number diabetic Medicaid inpatient admissions). The

outcome variables that were used in the regression to determine a measure of quality

include ln(number diabetic Medicaid inpatient admissions / state Medicaid enrollment),

total length of inpatient stays in days / number diabetic Medicaid inpatient admissions,

total number of emergency visits by diabetics in Medicaid / state Medicaid enrollment,

and total number of emergency visits by diabetics in Medicaid / number of diabetic

Medicaid inpatient admissions. The models used to estimate the outcome variables by

year (i) and state (j) is of the form

$$Y_{ij} = \theta_1 REFORM_{ij} + \beta_1 MED\_AGE_{ij} + \beta_2 OBESE\_RATE_{ij} + \beta_3 ln\_MEDINC_{ij}$$

$$(+ \beta_4 MEDENROLL_{ij}) + \gamma_j + \lambda_i + \varepsilon_{ij}$$

(1)

where Y_{ij} is the dependent or outcome variable, $REFORM_{ij} = 1$ if the state is a treatment

state and has a disease management program that year, MED_AGE_{ij} is the median age of

the state population by year, $OBESE\_RATE_{ij}$ is the obesity rate of the state population by

year, ln_MEDINC_{ij} is the ln(median income of the state population by year), and

$MEDENROLL_{ij}$ is the state Medicaid enrollment by year. The variables γ_j and λ_i

measure state and year effects, which are captured by a set of mutually exclusive dummy

variables. State dummy variables are used to capture the differences between the states

that are constant over time, and year dummy variables are used to capture the differences

over time that are common to all of the states. The covariates MED_AGE_{ij},

$OBESE\_RATE_{ij}$, ln_MEDINC_{ij}, γ_j, and λ_i were used to control for differences among

states in order to isolate the effect of disease management programs on total costs per

admission or per Medicaid enrollee. $MEDENROLL_{ij}$ is in parentheses because it was not

used as a covariate in all regressions. $MEDENROLL_{ij}$ was used in models in which the

dependent variable did not have state Medicaid enrollment as a denominator including

ln(total charges / number diabetic Medicaid inpatient admissions) and total length of

inpatient stays in days / number diabetic Medicaid inpatient admissions. Consequently,

the $REFORM_{ij}$ variable should account for any changes between states that implemented

disease management programs and those that did not. These models were also estimated

with specific state interactions with the REFORM variable:

$$Y_{ij} = \theta_1 REFORM_{ij}*TX + \theta_2 REFORM_{ij}*GA + \theta_3 REFORM_{ij}*WA + \beta_1 MED\_AGE_{ij} +$$

$$\beta_2 OBESE\_RATE_{ij} + \beta_3 ln\_MEDINC_{ij} (+ \beta_4 MEDENROLL_{ij}) + \gamma_j + \lambda_i + \varepsilon_{ij}$$

(2)

where the outcome and covariates are the same as in Eq. (1) except that TX=1 if the state

is Texas and 0 otherwise, GA=1 if the state is Georgia and 0 otherwise, and WA=1 if the

state is Washington and 0 otherwise and that $MEDENROLL_{ij}$ is included for the outcome

variable total number of emergency visits by diabetics in Medicaid / number of diabetic

Medicaid inpatient admissions, which does not affect comparison to the $REFORM_{ij}$

specification of the model.

IV. RESULTS

A. Summary Statistics

The difference-in-differences methodology isolates the effect of the disease

management programs by comparing the time series in outcomes for these programs to

the same values in states that did not undergo the transition to managed care. The unit of

observation is a state/year value, and there are a total of 131 observations in each

regression. Some states do not have data for all years, and these incomplete series

include Pennsylvania, which is missing data from 2004 to 2007, and Maine, which is

missing data from 2003 to 2006. Every other state was in the dataset continuously from

2000 to 2008.

Table 1 shows summary statistics for each of the outcome variables. These summary statistics include both treatment and control states. All dollar values are converted into real 2008 dollars using the Consumer Price Index. The number of admissions reported only includes diabetic Medicaid inpatient admissions. The fraction of state Medicaid populations (number of admissions / state Medicaid enrollment) that were admitted to the hospital for diabetes-related complications within one standard deviation was between 0.019 and 0.044 with an average 0.029, or 2.9% of the Medicaid population. The minimum for this outcome variable was 0.65% and occurred in Vermont, which does not have a disease management program, in 2008. The highest proportion of the number of admissions to state Medicaid enrollment was 5.7% in Maryland in 2002, which has had a disease management program since 1997. The average cost for diabetic-related inpatient stays (total charges / state Medicaid enrollment) accounted for approximately $455 per Medicaid enrollee, and the cost within one standard deviation was between $255 and $814. The total charges were divided by the state Medicaid enrollment in order to standardize this number across states. Vermont in 2008 had the lowest cost at $59 for a diabetic inpatient per Medicaid enrollee. Florida, which has had a disease management program since 1998, had the maximum cost for the dataset set at $1599 in 2007. The mean of total charges / number of admissions was $15,815. The range of this value within one standard deviation is $10,971 and $22,799. Additionally, the minimum of $6592 occurred in Texas in 2000 before it implemented its disease management program. The maximum occurred in Pennsylvania in 2003, which was used as a control state, and the cost per diabetic admission was $43,837.

The next set of outcome variables could be considered rough estimates of the

quality of care. For example, if patients in treatment states have a longer length of stay

before the disease management program was implemented, then disease management

programs may have an effect on the severity of acute aggravations in diabetic Medicaid

patients. The average length of stay is 4.7 days per diabetic inpatient admission with a

standard deviation of 0.55. The maximum length of stay in days was in Pennsylvania in

2000, and the minimum occurred in Vermont in 2008. Using the averages for total cost

Table 1
Summary Statistics

Summary Statistics

Outcome Variables	Number of Observations	Mean	Standard Deviation	Minimum	Maximum
ln(Number of Admissions / State Medicaid Enrollment)	131	-3.547411	0.4190053	-5.039985	-2.870621
ln(Total Charges / State Medicaid Enrollment)	131	6.121324	0.5811264	4.073039	7.376873
ln(Total Charges / Number of Admissions)	131	9.668735	0.3657465	8.793596	10.68824
Length of Stay / Number of Admissions	131	4.672668	0.5544933	2.756824	6.007302
Number of Emergency Admissions / State Medicaid Enrollment	131	0.012115	0.006691	0.0007977	0.0339803
Number of Emergency Admissions / Number of Admissions	131	0.3771826	0.1165522	0.0690007	0.6197239

Table 1 presents the summary statistics for all of the outcome variables studied in this
paper.

per inpatient visit and average length of stay per visit, the average cost per day per

diabetic Medicaid inpatient from 2000 through 2008 was approximately $3365.

Similarly, the number of emergency visits for diabetics could also be an indicator of

quality because a decrease in emergency visits might indicate that these programs are

preventing serious and expensive problems that require immediate attention. The average

proportion of emergency room visits for diabetic Medicaid inpatients to state Medicaid

enrollment is 0.012 with a standard deviation 0.0067, and the average proportion of

emergency visits for diabetic Medicaid inpatients to the number of admissions is 0.38

with a standard deviation of 0.12. The minimum for both of the outcome variables

occurred in Maine in 2008, which does not have a disease management program. The

maximum of emergency room visits per diabetic Medicaid enrollment occurred in

Maryland in 2002, and the maximum of emergency room visits per inpatient admissions

occurred in Hawaii in 2008, which does not have a disease management program. In

addition to these summary statistics illustrating the strain that diabetic patients put on

Medicaid, they also are rough indicators that disease management does not have an

impact on cost or quality. These conclusions will be corroborated in subsequent sections.

B. Graphical Analysis

A time-series plot of outcomes for treatment and comparison states provides

evidence of the likely impact of disease management programs on outcomes. In the first

graph, the proportion of diabetic admissions compared to total Medicaid enrollment is

plotted for each of the three treatment states from 2000 to 2008, and each plot contains

this proportion for the control states over that same period of time (Figure 1). The

proportion in Washington follows the trend in the control states very closely; thus, this would indicate that disease management programs did not have an effect on the proportion of diabetic admissions compared to total Medicaid enrollment. Similarly, in Georgia, the fluctuations in diabetic admissions do not provide conclusive evidence that the implementation of the disease management program had any effect on this proportion. The disease management program in Texas, however, did seem to have an impact on diabetic admissions and provided a notable decrease in the proportion of admissions after the first year of implementation. This may indicate that the Texas disease management program has had some effect on diabetic care by preventing acute aggravations of diabetes-related complications.

In the next set of graphs, the emergency admissions divided by total admissions as an indicator of the ability of disease management programs to prevent acute aggravations does not indicate that disease management programs have any effect (Figure 2). The three treatment states closely follow the trend of the control states, and consequently, there again seems to be no improvement in diabetic care after a disease management program has been put into practice.

The final set of graphs illustrate that disease management programs have not had any significant effects on costs (Figure 3). Costs in the control states rise steadily from 2000 to 2008. All of the treatment states follow this upward trend, and disease management programs do not appear to have any impact on costs. Washington's costs again closely mirror the course of the costs of the control states. The costs per diabetic admission in Georgia and Texas follow a similar pattern. Thus, this indicates that disease management programs do not affect the costs of diabetic care in Medicaid. Disease

Figure 1
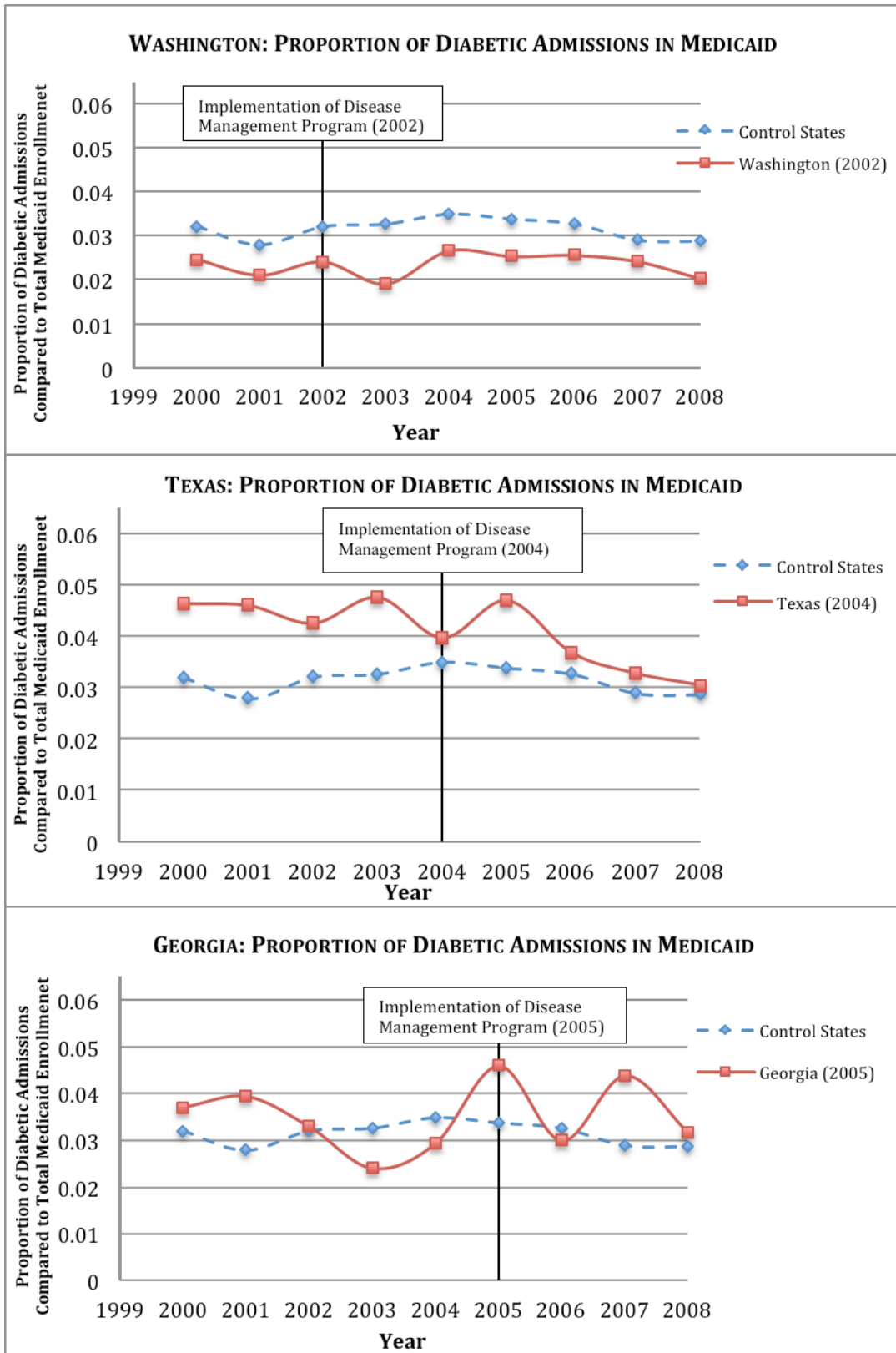Proportion of Diabetic Admissions in Medicaid

Figure 1 shows how the proportion of diabetic admissions compared to total Medicaid
enrollment for both the treatment and control states changes from 2000 to 2008.

Figure 2
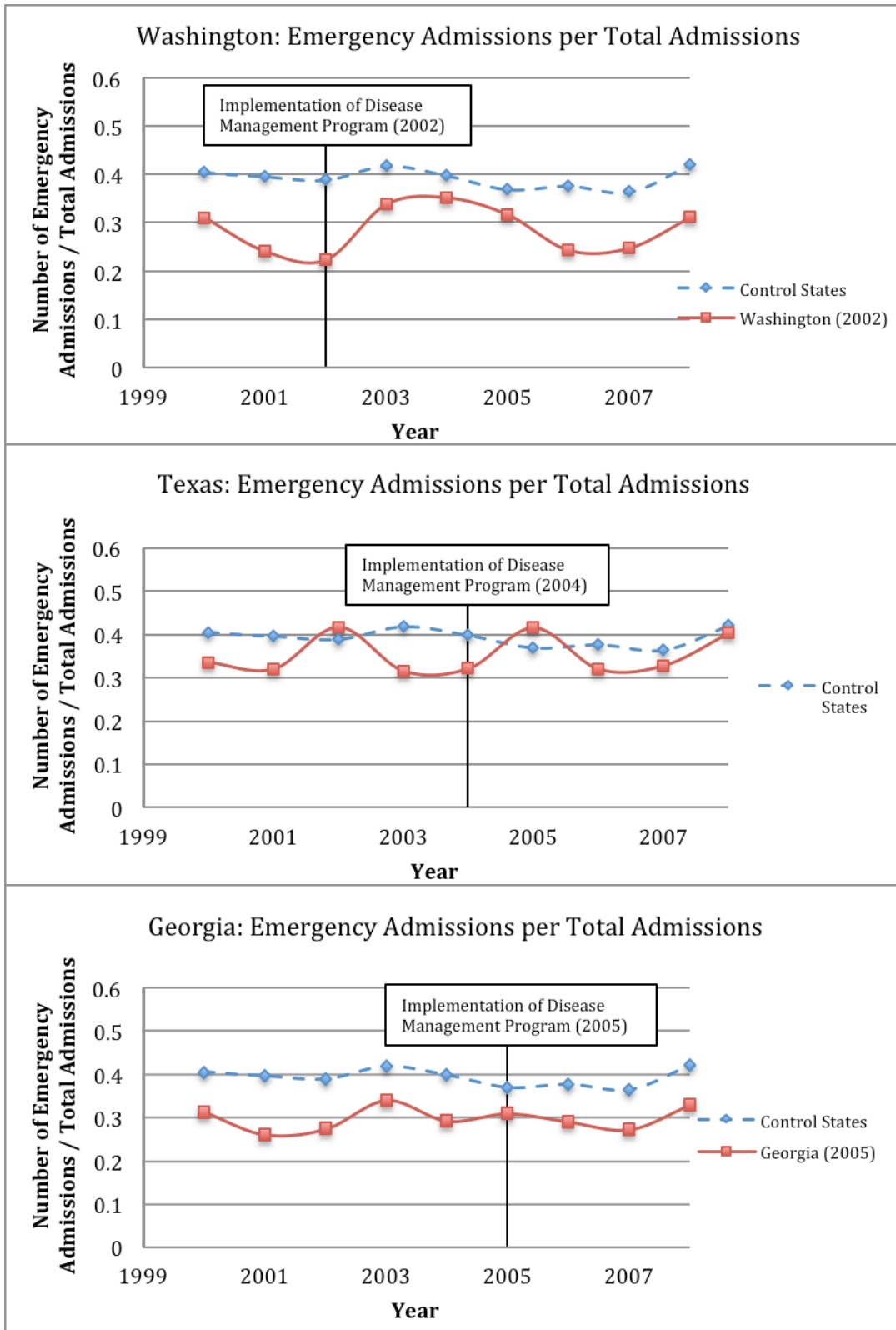Emergency Admissions per Total Admissions

Figure 3 shows how emergency admissions per total admissions for both the treatment and control states changes from 2000 to 2008.

Figure 3
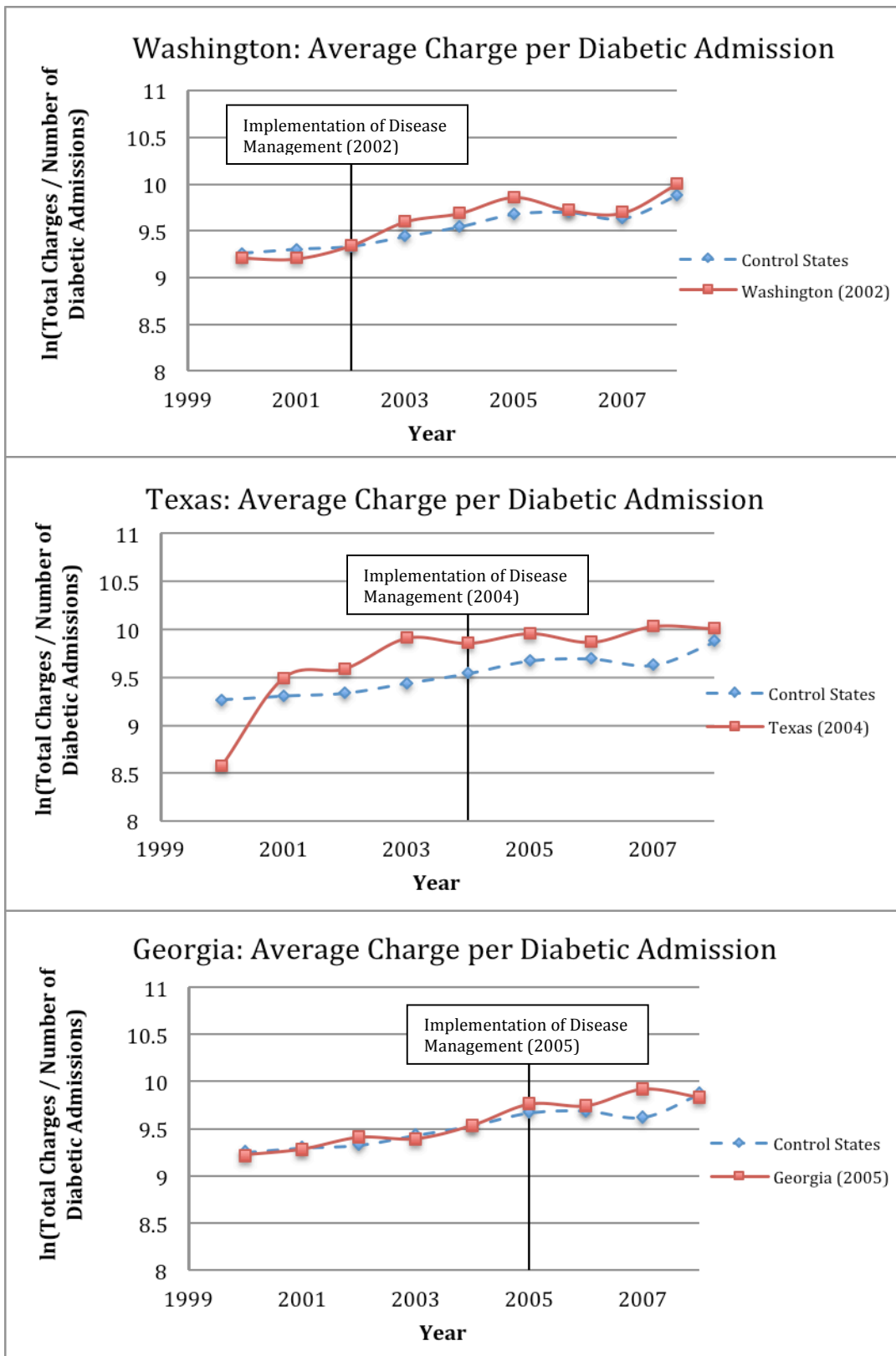Average Charge per Diabetic Admission

Figure 2 shows how the average charge per diabetic admission for both the treatment and control states changes from 2000 to 2008.

management programs do not appear to change the costs that Medicaid must pay per

diabetic inpatient in the years after a program has been implemented. In general, this

paper finds that disease management programs do not have any effect on the cost or

admission outcome variables defined here.

C. OLS Regression Results

A difference-in-differences model estimated via ordinary least squares regressions

was employed to produce estimates for the effects of disease management programs on

the outcome variables. The graphical evidence presented above suggests that disease

management programs do not have a significant effect on any of the outcome variables

with the exception of the proportion of diabetic admissions in Medicaid for Texas, and

these results are borne out in the regression models as well. The Reform variable was

used to determine the isolated effects of having a disease management program compared

to the control states. The Reform variable was estimated for each outcome variable, and

Table 2 shows these values with the standard errors in the parentheses. Additionally, the

R-squared and F-test values are given to show how well each model fits the data. The

Reform*Hospital State interaction variables (e.g. Reform*Texas) comprise a different

model. These interaction variables are used to separate the effects of a disease

management program in each of the three treatment states, and Table 2 shows these

values with the standard errors in parentheses. The R-squared and F-test values are again

shown.

Table 2 summarizes the major results all of the regressions performed in this

paper. If disease management programs were successful in affecting any of the outcome

Table 2

OLS Regression Estimates for Reform and Reform*State Interaction Variables for Outcomes

	Outcomes					
Covariates	ln(Number of Admissions / State Medicaid Enrollment)	ln(Number of Charges / State Medicaid Enrollment)	ln(Total Charges / Number of Admissions)	Length of Stay / Number of Admissions	Number of Emergency Admissions / State Medicaid Enrollment	Number of Emergency Admissions / Number of Admissions
Reform	-0.1719272 (0.1358938)	-0.0809164 (0.1859577)	-0.0431323 (0.0987813)	0.1231095 (0.2252878)	-0.0017694 (0.0015082)	-0.0099723 (0.0283173)
R^2	0.6094	0.6445	0.8013	0.4663	0.8120	0.7806
F-test (*p*-value)	5.89 (0.0000)	6.85 (0.0000)	14.54 (0.0000)	3.15 (0.0000)	16.32 (0.0000)	13.44 (0.0000)
Reform*Texas	-0.4552836 (0.2186586)	-0.3587525 (0.3017121)	-0.0949023 (0.1898331)	-0.2921791 (0.4312997)	-0.0048594 (0.0024228)	-0.0218833 (0.0586351)
Reform*Georgia	0.0503822 (0.2057315)	0.101743 (0.283875)	0.025298 (0.1424559)	0.3718558 (0.3236591)	0.0010611 (0.0022795)	-0.0011293 (0.0440014)
Reform*Washington	-0.1247562 (0.2603018)	0.0178847 (0.3591728)	0.1761621 (0.1802791)	0.1085436 (0.409593)	-0.0018599 (0.0028842)	-0.0067896 (0.0556841)
R^2	0.6213	0.6496	0.8033	0.4757	0.8183	0.7809
F-test (*p*-value)	5.66 (0.0000)	6.39 (0.0000)	13.47 (0.0000)	2.99 (0.0000)	15.53 (0.0000)	13.44 (0.0000)

Table 2 provides the ordinary least squares regression coefficients for the Reform and Reform*Hospital State variables for each model. In addition, R-squared, F-test, and p-values are reported for each regression. Standard errors are in parentheses.

variables that were tested, then one would expect to see a negative value for the coefficient of the Reform or Reform*Hospital State variable indicating that the implementation of a disease management decreases costs or the number of admissions.

For the Reform variable specified models, the Reform variable, while in most situations it is negative, is not statistically significant in any of the models. The p-value for the Reform variable is never less than 0.20 for any of the outcome variables. These results suggest that disease management programs do not have a significant impact on costs or quality of care. The high R-squared values suggest that the models fit the data well.

Similarly, for the Reform*Hospital State specified models, the only state and outcome for which the Reform*Hospital State variable is statistically significant is the ln(number of admissions / state Medicaid enrollment) for Texas with a p-value of 0.04. This outcome suggests that the disease management program in Texas decreases the proportion of the number of admissions to state Medicaid enrollment by 0.46%. The Reform*Hospital State variable is not statistically significant in any other model for any of the treatments states. The disease management program for Texas, therefore, appears to have some effect on the number of diabetic Medicaid patients admitted to the hospital; however, these programs do not have a similar effect in Georgia or Washington. Additionally, the disease management programs for all three treatment states do not show any impact on costs, length of stay, or number of emergency admissions. In fact, the Reform*Hospital State interaction variable is actually positive in some cases. This outcome is especially common for the Reform*Georgia variable.

The difference-in-differences models using ordinary least squares regressions provide a statistical foundation for the trends that can be seen readily in the time-series plots above. The OLS regression results corroborate these visual results presented in the "Graphical Analysis" section. Consequently, disease management programs in the three treatment states do not have any effect on the outcome variables that were presented in this paper.

V. CONCLUSION

In this paper, the effectiveness of disease management programs was studied using individual inpatient observations from the National In-Patient Sample from 2000 to 2008. Disease management programs have been proposed as a way to increase the quality of care of chronic conditions while simultaneously decreasing the costs of treating these illnesses; however, there has not been conclusive evidence in determining the impact on costs of these programs.

A difference-in-differences model was used to isolate the effects of diabetic disease management programs in three states: Washington (2002), Texas (2004), and Georgia (2005). Ordinary least squares regressions were used to estimate the coefficients of the Reform and Reform*Hospital State variables. The regression models controlled for state and year effects with dummy variables as well as median state income, state obesity rate, and state Medicaid enrollment in order to isolate the effects of the disease management programs on numerous outcome variables. These outcomes include ln(number of admissions / state Medicaid enrollment), ln(total charges / state Medicaid

enrollment), ln(total charges / number of admissions), length of stay / number of admissions, number of emergency admissions / state Medicaid enrollment, and number of emergency admissions / number of admissions. Graphical analysis using a time-series plot of the change in the number of diabetic Medicaid admissions, costs of care, and emergency admissions in Washington, Georgia, and Texas illustrate that the trends in the three treatment states are closely correlated with the trends in the control states. OLS regression analysis supports this claim because the Reform variable is not statistical significant for any of the outcomes. Additionally, the Reform*Hospital State coefficients in similar models are not statistically significant with the exception of Reform*Texas for the outcome variable ln(number of admissions / state Medicaid enrollment) in which there is a decrease in the proportion of the number of admissions to state Medicaid enrollment in Texas by 0.46%. However, in general, diabetic disease management programs were not found to be effective at reducing costs, limiting the number of admissions, or decreasing the number of emergency room visits. The results of this paper suggest that these programs do not produce the desired outcomes of limiting costs while increasing the quality of care of chronic diseases.

Previous studies have focused on the improvements made by individual state disease management programs, and they have often studied costs by looking at aggregate state data. This study has the advantage of using individual patient-level observations in a national dataset. A difference-in-differences model was then used to isolate the effects of implementing a disease management program over time by controlling for changes in health care costs and admissions in states that did not implement a new Medicaid disease management program for diabetic patients between 2000 and 2008. In addition, trends in

costs, admissions, and emergency admissions could be observed before and after the

implementation of the disease management programs in Washington, Texas, and

Georgia. This paper argues that disease management programs are not an effective way

to control costs or reduce admissions. Thus, other methods should be sought to reduce

the burden that chronic diseases in Medicaid place on the American health care system.

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