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AN ABSTRACT OF THE DISSERTATION OF

Steven W. Howard for the degree of Doctor of Philosophy in Public Health presented on December 7, 2011.

Title: Medicare Managed Care:
Market Penetration and the Resulting Health Outcomes

Abstract approved:

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Stephanie L. Bernell

Managed care plans purport to improve the health of their members with chronic diseases. How has the growing adoption of Medicare Advantage (MA), the managed care program for Medicare beneficiaries, affected the progression of chronic disease? The literature is rich with articles focusing on managed care organizations' impacts on quality of care, access, patient satisfaction, and costs. However, few studies have analyzed these impacts with respect to market penetration of Medicare managed care.

The objective of this research has been to analyze the relationships between the market penetration of MA plans and the progression of chronic diseases among Medicare beneficiaries. The Chronic Disease Severity Index scale (CDSI) was constructed to represent beneficiaries' overall chronic disease states for survey or claims-based data, when more direct clinical measures of disease progression are not available. Using the CDSI on the

MEPS survey dataset from AHRQ, we sought to assess the impacts of MA market penetration and other covariates on the overall chronic disease state of Medicare beneficiaries from 2004 through 2008.

Though the model explains much of the variation in CDSI change, the author expected the multilevel model would show that MA penetration explains a significant level of variation in CDSI change. However, this hypothesis was not substantiated, and the findings suggest that unmeasured factors may be contributing to additional unexplained heterogeneity.

Policymakers should explore opportunities to refine the current MA program. The MA program costs the federal government more than the Traditional Fee-for-Service Medicare program, and there is no definitive evidence that outcomes differ. Within both programs, there is opportunity to experiment with different models of payment, healthcare service delivery and care coordination.

The Patient Protection and Affordable Care Act (ACA) contains provisions for innovative demonstration projects in delivery and payment. The effectiveness of these ACA initiatives must be monitored, both for impacts on health outcomes and for economic effects. This research can inform future approaches to outcomes assessment using the CDSI, and multilevel modeling methodologies similar to those employed here.

Firms offering MA health plans would be prudent to proactively demonstrate their value to beneficiaries and taxpayers. They should explore means of better monitoring and reporting the longitudinal outcomes of their

enrolled beneficiaries. Demonstrating that they can bring value in terms of improved health outcomes will help insure their long-term survival, both in the marketplace and in the political arena.

Medicare Managed Care:
Market Penetration and the Resulting Health Outcomes

by
Steven W. Howard

A DISSERTATION

submitted to

Oregon State University

in partial fulfillment of
the requirements for the
degree of

Doctor of Philosophy

Presented December 7, 2011
Commencement June 2012

Doctor of Philosophy dissertation of Steven W. Howard presented on December 7, 2011.

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I understand that my dissertation will become part of the permanent collection of Oregon State University libraries. My signature below authorizes release of my dissertation to any reader upon request.

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Steven W. Howard, Author

ACKNOWLEDGEMENTS

The author expresses sincere appreciation to his mentor and major professor, Stephanie Bernell, PhD. Throughout the past seven years, she has been an excellent teacher and the most supportive guide I could have imagined. I will forever be grateful to Stephanie for the hundreds of hours and numerous late nights she dedicated to molding me into the best PhD candidate and researcher I could be. Stephanie Bernell has been an inspiration, and I only hope that I can invest in the lives and development of future PhD students the way she has so diligently done for me.

I thank the members of my PhD dissertation committee, Chunhuei Chi, PhD, Nancy Seifert, PhD, Sam Vuchinich, PhD, and David Bernell, PhD, for sharing their wisdom and guidance throughout my academic journey.

Great appreciation goes to my longsuffering wife, Christine, for all her support over the past seven years. She has endured my absence during many late nights spent working on research in the library. Without her patient, loving support, this accomplishment would be a hollow victory.

Most of all, I profoundly thank my Heavenly Father who carried me many times when I could no longer persevere on my own. His call to get wisdom and understanding regardless of the cost (Proverbs 4:7) has been a great motivation during difficult times. He has taught me to be content in whatever circumstances, and reminded me that I can do all things through Him who gives me strength (Philippians 4:12-13).

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Chapter 1: Introduction

Chronic disease rates are at record levels among American seniors (Pleis et al., 2009; Lakdawalla et al., 2005). Cardiovascular diseases (including heart disease, heart failure, stroke and hypertension) affect as many as 80% of those over age 60, and approximately 23% of seniors have diabetes (Pleis et al., 2009; CDC diabetes press release, 2008; CDC Health U.S., table 68, 2009; AHA Statistics, p.6, 2009; CDC National Diabetes Fact Sheet, 2007). Disease management practices, when effectively implemented, have positively impacted the incidence and the progression of chronic diseases (Knowler et al., 2002; Hamman et al., 2006; DPP Research Group, 2002; Venditti et al., 2008; Eriksson & Lindgarde, 1991; Dijkstra et al., 2005; CDC National Diabetes Fact Sheet, 2007). Medicare Advantage (MA) plans typically provide some level of disease management information or programs for their enrollees, particularly since policy changes implemented in the MA program in 2004 (Orszag, 2007; Miller, 2008; McDowell & Sheingold, 2009; AHIP, 2010; Berenson p. 36, 2008).

Disease management programs vary widely in scope. They may be as simple and passive as health plan member newsletters and health education mailings, or as active as regular nurse consultations, special diet and exercise programs, disease-specific self-management classes and gym memberships (Orszag, 2007; Miller, 2008; McDowell & Sheingold, 2009; AHIP, 2010). If

these programs are proving successful, areas of the country with greater MA market penetration should also experience lower rates of chronic disease progression. While such benefits have long been hypothesized, little has been done to evaluate whether such benefits actually accrue to Medicare beneficiaries in areas of the country with high MA market penetration (Orszag, 2007; McDowell & Sheingold, 2009). The objective of this study is to analyze the relationships between the market penetration of MA plans and the progression of chronic diseases among Medicare beneficiaries, with a focus on diabetes and cardiovascular disease (primarily stroke and heart disease).

I hypothesize that areas of the country with higher MA market penetration will experience slower rates of chronic disease progression. Previous research has analyzed relationships between MA market penetration and inpatient outcomes and Medicare spending. No studies to date have examined the longitudinal associations between chronic disease progression and market penetration of Medicare Advantage.

The Chronic Disease Burden

The four most common chronic diseases among seniors under the age of eighty-five (in order of prevalence) are: arthritis, heart disease, diabetes and respiratory disorders (CDC Health US, fig.16, 2007). Heart disease and stroke are taken together to mean cardiovascular disease by the CDC and in most of the literature reviewed here (AHA Statistics, p.2&6, 2009). Hypertension and

high cholesterol are usually identified separately, and are common comorbidities and precursors to other cardiovascular diseases (CDC Heart Disease Factsheet, 2009). Heart disease is further defined as including heart attacks (myocardial infarctions), angina, coronary heart disease, congestive heart failure, heart valve diseases, arrhythmia and other heart problems (Lakdawalla et al., 2005). Seventy-five percent of seniors have a chronic disease, and half have more than one such condition (Green, 2009).

The prevalence of chronic disease leads to high rates of health service use. For example, 6 million hospitalizations are caused by chronic disease each year (CDC Heart Disease and Stroke Prevention, 2009).

There are methods by which chronic diseases can be controlled. Diet, exercise, smoking cessation, medications, and cholesterol and blood pressure reduction are the most common elements of disease management for both diabetes and heart disease (Knowler et al., 2002; Hamman et al., 2006; DPP Research Group, 2002; Venditti et al., 2008; Eriksson & Lindgarde, 1991; Dijkstra et al., 2005). In fact, lowering cholesterol by 10% would lower the rate of heart attacks and stroke by as much as 30% (NCCDPHP, 2008).

Diabetes, both diagnosed and undiagnosed, is another rapidly growing public health concern, and an estimated 24 million Americans (almost 8% of the population) were afflicted with the disease in 2007, nearly 15% more than in 2005 (CMS CCDW, 2009; CDC diabetes press release, 2008; CDC National Diabetes Fact Sheet, 2007; DPPOSRG, p.4, 2009). Twice that number are

estimated to be pre-diabetic – at risk of developing the disease because of elevated blood sugar levels (CDC diabetes press release, 2008).

Diabetes is a considerable threat to the health of seniors (DPPOSRG, p.4, 2009; CDC diabetes press release, 2008). The CDC reports that 37% of all diabetics are seniors (CDC-Diabetes Data & Trends, 2006), and nearly 26% of all American seniors have the disease (CDC National Diabetes Fact Sheet, 2007; CMS CCDW, 2009; CDC diabetes press release, 2008). Further, having diabetes is highly correlated with other chronic comorbidities (DPPOSRG, p.4, 2009; CDC National Diabetes Fact Sheet, 2007; AHA Statistics, p.8 & 12, 2009; Arvanitakis et al., 2004; Moritz et al., 1994; Hayes et al., 1994).

- 75% of adults with diabetes also have high blood pressure.
- 60% to 70% of diabetics also have some degree of nerve damage.
- Diabetics over the age of 60 are 2-3 times more likely than those without the disease to report difficulty with basic daily physical activities.

The growing chronic disease epidemic also brings with it considerable financial implications. The CDC estimates that 75% of U.S. health care costs are driven by chronic disease (NCCDPHP website, 2009). The CDC reports that heart disease and stroke contributed approximately $296 billion of direct healthcare costs in the United States in 2008 (NCCDPHP, Preventing Heart Disease & Stroke, 2008). An additional $174-$176 billion is associated with diabetes, nearly 12% of all U.S. healthcare expenditures (DPPOSRG, p.4,

2009; CDC National Diabetes Fact Sheet, 2007). For Medicare beneficiaries alone, the hospital costs incurred from heart disease and stroke exceeded $29 billion in 2001, predominantly related to complications and comorbidities (NCCDPHP Preventing Heart Disease & Stroke, 2008; Moritz et al., 1994).

Since diabetes is disproportionately prevalent among the aged, the disease is a major cost driver for the already-troubled Medicare program (Moritz et al., 1994; CDC National Diabetes Fact Sheet, p.7, 2007; CDC diabetes press release, 2008; DPPOSRG, p.4, 2009). Most disease management programs, including those implemented in the Medicare population, are designed to empower patients to better manage their conditions and to improve communication with their healthcare providers. The intended goals typically include lifestyle changes, such as diet and exercise, better compliance with prescribed medications, and improving biomarkers (i.e., lower cholesterol, reducing blood glucose levels, etc.) (McCall et al., 2008; CDC heart disease and stroke prevention, 2009; DPPOSRG, 2009; Venditti et al., 2008; Mattke et al., 2007; Hamman et al., 2006; Knowler et al., 2002; DPP Research Group, 2002; Eriksson & Lindgarde, 1991; Dijkstra et al, 2005). If disease management programs like these can reduce Medicare's future expenditures, it is possible they can play a role in assuring the long-term solvency of the program (Orszag, p.10, 2007; McDowell & Sheingold, p.16, 2009).

Disease Management

While programs vary in their approaches, the Disease Management Association of America defines disease management (DM) as "a system of coordinated health care interventions and communications for populations with conditions in which patient self-care efforts are significant" (DMAA, 2010). DM systems or programs should be evidence-based and focus on the physician-patient relationship and patient empowerment to slow the progression of the patient's disease or diseases (DMAA, 2010; Mattke et al., p.2, 2007). The most effective disease management programs address the early risk factors contributing to the development and advance of chronic disease (CDC heart disease and stroke prevention, 2009; Dijkstra et al., 2005; Knowler et al., 2002; Hamman et al., 2006; DPP Research Group, 2002; Venditti et al., 2008; and Eriksson & Lindgarde, 1991). Disease management programs implement any number of the following types of intervention strategies:

- medication therapies
- provider training in evidence-based practices
- in-person and/or telephonic support of patients
- educating patients on their disease, as well as self-management techniques, including diet, exercise, and healthy behaviors
- enhancing communication between patients and providers

Typical improvements include reductions in participants' weights, cholesterol, blood glucose and blood pressure levels, and increases in healthy

personal habits such as diet modification and routine exercise (CDC heart disease and stroke prevention, 2009; DPPOSRG, 2009; Venditti et al., 2008; McCall et al., p.76, 2008; Hamman et al., 2006; Knowler et al., 2002; DPP Research Group, 2002; Eriksson & Lindgarde, 1991; Dijkstra et al., 2005).

Prior DM studies focused primarily on risk factors such as high blood pressure, diabetes, obesity, and high cholesterol (DPPOSRG, 2009; CDC heart disease and stroke prevention, 2009; McCall et al., 2008; Mattke et al., 2007; Hamman et al., 2006; Dijkstra et al., 2005; Knowler et al., 2002; DPP Research Group, 2002). Of the literature I have reviewed, only the Atherly et al. study (2005) combined an element of disease management with the Medicare Advantage penetration variable, and a measure of quality of care. However, Atherly et al. (2005) only explored the relationship between type of Medicare plan (Traditional FFS Fee-for-Service versus MA) and effectiveness or quality of care received by beneficiaries (Atherly et al., 2005; Edwards, 2004). Atherly et al. (2005) did not explore the relationship between MA market penetration and disease progression. The current research will contribute to filling this gap in the literature by analyzing the associations between levels of MA market penetration and the progression of chronic disease (emphasizing diabetes and cardiovascular diseases).

MCOs have begun to more broadly implement disease management programs (McDowell & Sheingold, 2009). In 2005, 144 of the top 150 health insurers in the U.S. had disease management programs in place (Mattke et

al., 2007). By 2008, 97%-99% of Medicare MCOs were estimated to have implemented some degree of chronic disease education or management program (Green, p.42, 2009; Berenson, p.24 2008). If disease management practices being employed by Medicare Advantage MCOs slow the advance of diabetes, heart disease, and other chronic conditions among the elderly, their benefits to the Medicare program could be substantial (McDowell & Sheingold, p.25, 2009; Orszag, p.10, 2007). The current study contributes to the research by evaluating the connections between MA market penetration and chronic disease progression.

History of Medicare Managed Care Market Penetration

The federal government debuted the original Medicare program in 1966 (Mayes, p.25, 2007; Oliver et al., p.291, 2004; Iglehart, 1999). The traditional Medicare program, as administered directly from the federal government, is a 'fee-for-service' model (FFS), reimbursing each provider only after each service is performed. Initially, the program was implemented strictly through the federal government, though the private insurance industry has gained an increasing role in the decades since (McDowell & Sheingold, p.v, 2009; Oliver et al., p.291, 2004; Iglehart, 1999).

'Market penetration,' the rate of adoption of privately administered Medicare plans by consumers in a defined market, has increased substantially over this period (McDowell & Sheingold, p.37, 2009, CMS Annual Report,

2009). CMS calculates the rate of MA market penetration “by dividing the number of (MA) enrollees by the number of eligibles (all those eligible for Medicare) and multiplying the result by 100” (CMS market penetration file, May 2010).

The market penetration of MA has increased since the passage of the MMA in 2004 (McDowell & Sheingold, p.37, 2009, CMS Annual Report, p.49-50, 2010; CMS Annual Report, 2009; Berenson, p.w32, 2008). By 2009 nearly one in four Medicare beneficiaries was receiving benefits through a private MA plan, such as an MCO (CMS Annual Report, p.49-50, 2010; CMS Annual Report, p.173, 2009; McDowell & Sheingold, p.v,29, 2009).

Private health plans were first allowed a place in administering Medicare after the Social Security Amendments of 1972 (McDowell & Sheingold, p.2, 2009). Initially, this role was confined to special demonstration projects (CMS Annual Report, 2009). Opportunities for private Medicare plans were improved and expanded by the Tax Equity and Fiscal Responsibility Act (TEFRA) in 1982, including more beneficial risk-sharing and compensation arrangements with the government (McDowell & Sheingold, p.2, 2009). TEFRA included language requiring CMS to contract with private MCOs, namely Health Maintenance Organizations (HMOs), to administer Medicare’s Part A and B benefits in their markets. The intent of this legislation was to reduce the traditional Medicare program’s costs (McDowell & Sheingold, p.2, 2009).

In Medicare's original HMO model, CMS calculated its geographically-adjusted average monthly cost of providing care to beneficiaries under the traditional FFS model, and then paid the MCO that average amount, or some percentage of it (McDowell & Sheingold, 2009). Under TEFRA, the HMO reimbursement was originally set at 95% of the traditional Medicare FFS reimbursement level, establishing a 5% projected program savings for each beneficiary enrolling in a Medicare HMO (CMS Annual Report, 2009; (McDowell & Sheingold, p.2, 2009). By 1995, Medicare HMO enrollment had reached nearly 3.5 million nationwide (CMS Annual Report, p.173, 2009), and by 1997, a pivotal year in the evolution of the Medicare program, that number had risen to 6 million individuals (McDowell & Sheingold, p.2, 2009).

The Balanced Budget Act of 1997 (BBA) brought the most sweeping change the Medicare program had seen in its 31 year history. The BBA enabled Medicare MCOs to offer more benefits than those traditionally provided by Parts A and B, and introduced new types of plans, including Preferred Provider Organizations (PPOs) and Private Fee For Service plans (PFFS) (McDowell & Sheingold, p.2, 2009; CMS Annual Report, p.171, 2009). This legislation significantly modified the Medicare managed care compensation structure in four important ways (McDowell & Sheingold, p.2, 2009). The BBA empowered CMS to:

- establish a means of reimbursing MCOs at monthly capitation rates above the 95% of FFS levels

- establish ‘floors’ to protect MCO monthly capitation levels in counties with low Medicare FFS costs
- offer a minimum annual capitation rate increase of at least 2%
- implement a risk-adjustment mechanism to provide higher reimbursement for beneficiaries with costly health conditions.

Initially, changes from the BBA were not sufficient to keep many private plans in every market, and enrollment numbers continued to decline for three years. In 2000, the Benefits Improvement and Protection Act (BIPA) was passed to raise floor levels and the annual reimbursement rate increases. In spite of this legislation, Medicare+Choice enrollments continued to fall, and private firms continued to withdraw from counties in which it was less financially viable for them to offer these health plans to Medicare beneficiaries (McDowell & Sheingold, p.2, 2009; Pope et al., p.120, 2004).

In the context of this research, the most important change resulting from the BBA was the introduction of a risk adjustment structure to better compensate plans for their higher risk enrollees. Although the risk adjustment formula initially only considered inpatient codes, it created momentum for risk adjustment in a way that would eventually make the MA market more attractive to private insurers. By the end of the decade, the accumulated effect of the BBA, BIPA and other reforms led to steady increases in MA market penetration, in particular among PPO and PFFS plan types (CMS

Annual Report, 2009; McDowell & Sheingold, p.2, 2009). This research seeks to evaluate the effects of these policy changes.

The Medicare Modernization Act of 2003 (MMA) formally categorized all private MCOs contracting to administer Medicare as 'Medicare Advantage.' One major objective of the MMA was to greatly increase beneficiaries' enrollment in private MA plans (McDowell & Sheingold, p.2, 2009; CMS Annual Report, p.49-50, 2010; CMS Annual Report, p.169, 2009). Doing so required increases in the monthly capitation rates to the Medicare Advantage plans. In addition, MA plans could now offer more generous benefit packages to their enrollees (CMS Annual Report, p.49-50, 2010; CMS Annual Report, p.36, 168-169, 2009; McDowell & Sheingold, 2009).

In 1995, approximately 3.5 million individuals were enrolled in Medicare managed care plans (just over 9% penetration) (CMS Annual Report, p.173, 2009). By 1997, that figure had risen to 6 million (McDowell & Sheingold, p.2, 2009). By 2008 that number had increased to 10 million, more than 22% market penetration at the national level (CMS Annual Report, p.173, 2009; McDowell & Sheingold, p.29, 2009). Of the 6.5 million increase in membership from 1995 to 2008, 3.7 million occurred from 2005 through 2008, the result of the policy changes brought by the MMA act of 2003 (CMS Annual Report, p.135, 2009). Of the 3.7 million new MA enrollees, approximately 2 million were in the new Private Fee For Service (PFFS) plans (McDowell & Sheingold, p.12-13, 2009). PFFS plans differed initially from PPO plans in that

they were not required to have contracted provider networks, report quality metrics, or undergo the CMS annual bidding process. Beneficiaries enrolling in PFFS plans could see any healthcare service provider willing to accept payment from the PFFS plan. For the protection of beneficiaries, however, CMS began requiring most PFFS plans to provide contracted networks in 2011, and enrollment began to decline as a number of plans exited the market (KFF MA Fact Sheet, 2010). Because the current study focuses on 2004-2008, the growth of PFFS plans in the MA marketplace during that time is an important influence.

The BBA, BIPA, and MMA sought to strengthen the Medicare managed care program and increase enrollment, and the new PFFS program was an important tool in that effort (McDowell & Sheingold, 2009). For years, Medicare MCOs had struggled to be financially viable in rural areas and other parts of the country in which Medicare FFS costs were low (MA compensation was based on FFS costs) (Miller, 2008). Most MCOs, such as HMOs and PPOs, were required to establish contracted networks of healthcare service providers. Doing so required significant time and monetary investments to assemble and contract comprehensive provider networks. This could become particularly costly in physician shortage areas where MCOs oftentimes needed to pay more than traditional Medicare FFS. This provider network requirement by CMS hindered greater expansion of MA enrollment. Through the MMA, PFFS plans were exempted from the provider network requirement, enabling

many new insurers to enter the market (Miller, 2008). These more lenient CMS requirements helped make PFFS plans more competitive in many markets, resulting in lower premiums for Medicare beneficiaries choosing to switch from HMO or PPO to PFFS plans (McDowell & Sheingold, 2009).

The rapid increase in MA enrollment after the MMA of 2003 was driven largely by PFFS plans (Miller, 2008). Between 2004 and 2008, approximately half the growth in MA enrollment came in PFFS, compared to only about 22% for the more established HMO and PPO category (CMS Annual Report, p.171-173, 2009). Before the MMA of 2003, MA plans were required to ensure contracted provider panels for their members. This became a barrier to greater market penetration, particularly in areas of physician shortage where providers were able to negotiate for higher reimbursement than Traditional FFS rates. The MMA removed this barrier for PFFS plans. With no requirement to ensure a network of contracted providers, the PFFS plans could expand more quickly and easily than their PPO and HMO competitors (McDowell & Sheingold, p.4-6, 2009; Miller, 2008). With no provider contracts, the PFFS plans were able to reimburse providers at rates lower than that of many of their HMO and PPO competitors. This led many healthcare service providers to refuse service to patients with Medicare PFFS plans. Many PFFS enrollees encountered great difficulty accessing care and complained to CMS (McDowell & Sheingold, 2009). Provider network requirements are now being imposed on all plans in most counties, and many PFFS plans chose to exit the

market rather than develop contracted provider networks (CMS 2010 MA Announcement, 2009; McDowell & Sheingold, p.5, 2009). A decline in PFFS enrollment occurred in the 2009-2010 enrollment seasons, and the trend is expected to continue during 2010-2011 enrollment seasons (CMS Annual Report, p.172, 2009).

Proliferation of MA plans has not been uniform across the country. Due to county-level differences in the monthly payments made by CMS to private health plans (the per-member-per-month capitation or "pmpm"), MA plans have selectively chosen the most profitable counties in which to offer their Medicare health plans. Federal policy changes over the history of Medicare private health plans have led to significant differences in the attractiveness of different areas of the country. Since 2006, the capitation rate has been based upon "bids" submitted by the private plans to CMS. The bidding process is not truly competitive, but rather involves a detailed actuarial submission of historical and projected financials related to providing care to beneficiaries and the administrative costs of operating the company (McDowell & Sheingold, 2009).

In large part due to these CMS policies and administrative processes, the growth in MA market penetration since the mid-1990's has varied greatly from state to state and county to county (McDowell & Sheingold, 2009). In the current research, I hypothesize that areas of the country with higher MA

market penetration will experience slower rates of chronic disease progression.

Nationwide, the prevalence of chronic disease, including cardiovascular disease and diabetes, has increased dramatically (NCCDPHP – CVD Prevalence & Trends Data, 2008; NCCDPHP – Diabetes Prevalence & Trends Data, 2008; NCCDPHP – Diabetes Prevalence & Trends Data, 1998). However, a more localized analysis is needed to better understand the relationships between MA market penetration rates and chronic disease progression at the census region, state, and county levels.

Market Penetration and Disease Progression

As discussed earlier, national-level MA market penetration grew from 9% in 1995 to 22% in 2008 (CMS Annual Report, p.173, 2009). During this period, the nationwide prevalence of diabetes among those aged 65 and above also grew substantially, rising from 11.1% in 1995 to 19.1% in 2008 (NCCDPHP – Diabetes Prevalence & Trends Data, 2008; NCCDPHP – Diabetes Prevalence & Trends Data, 1995). During these 13 years, the prevalence rates of heart disease and hypertension among seniors rose from 30.8% to 32.4%, and 40.3% to 57.4%, respectively (Benson & Marano, p.78, 1998; Pleis et al., p.16, 2009).

As depicted in Figures 1a, 1b, and 1c, prevalence of these chronic conditions is highly variable across the country (CDC BRFSS maps, 2008).

The CDC's Behavioral Risk Factor Surveillance System (BRFSS) offers prevalence statistics for diabetes and hypertension from 2002-2008 (cardiovascular diseases were not monitored separately in BRFSS until 2007).

In general, the area from Louisiana to West Virginia has had the highest prevalence rates in the country for hypertension (HTN), diabetes, and heart disease. From 2002-2008, the neighboring states of Oklahoma, Missouri and Ohio have also experienced rapid increases in prevalence rates, as have Nevada, Hawaii, and Maine (CDC BRFSS maps, 2008). During this period, some states had steady or declining prevalence rates for HTN, diabetes and heart disease, including Minnesota, Wisconsin, and South Dakota. Though South Carolina has had high prevalence rates, the state has seen flat and declining rates over time, unlike most of its neighboring states in the Southeast census region (CDC BRFSS maps, 2008).

In theory, if Medicare MCOs achieve higher levels of market penetration in an area, that area should experience lower rates of chronic disease progression (or slower growth of progression rates) compared with areas of lower Medicare MCO penetration. In areas of higher MCO penetration, we would also anticipate increasing rates of diagnosis for the underlying condition (diabetes or heart disease diagnosis at time-zero), but stable or lower rates of diagnosis of additional comorbidities or complications (Barrett interview, 2009). However, as managed care practices diffuse into a physician community, patients' chronic conditions will be discovered and coded more quickly, be

better controlled, and result in slower progression of the disease (lower rate of development of additional chronic diseases and complications), even for those individuals not enrolled in managed care (Barrett interview, 2009; Chernew et al., 2008; Nicholas, 2009; Meara et al., 2004; Baker et al., 2004; Baker, 1997; Berenson, 2008). If such a relationship is observed, then an opportunity exists for Medicare to realize cost savings and better beneficiary health status through broader adoption of Medicare managed care plans (McDowell & Sheingold, 2009).

Previous studies have examined the relationship between MCO market penetration and inpatient outcomes, including those related to chronic diseases, but the outpatient relationship to MCO market penetration is less well understood (Rogowski et al., 2007; Escarce et al., 2006; Meara et al., 2004; Baker et al., 2004; Scanlon et al., 2006; Sari, 2002; Gillies et al., 2006).

Policy Implications

There are important policy implications in the proposed research. By 2007 CMS had fully instituted a risk adjustment payment mechanism for their contracting managed care organizations (MCOs) (Berenson, p.574, 2004; Pope et al., p.120, 2004; McDowell & Sheingold, p.37, 2009). This entailed higher capitated payments for plans enrolling Medicare beneficiaries with diagnoses correlated with higher expense ratios, such as heart disease, diabetes, or both (Berenson, p.574, 2004; McDowell & Sheingold, p.37, 2009). Prior to 2004, CMS payments to Medicare MCOs were adjusted by CMS

region and beneficiary demographics, but not using beneficiaries' individual diagnoses from the ambulatory care setting (Berenson, p.574, 2004; McDowell & Sheingold, p.37, 2009).

Beginning in 2004, the CMS risk adjustment policy began to recognize that providing care to less-healthy beneficiaries costs more. The policy now provides incentive for MCOs to seek out these vulnerable populations and better serve them (McDowell & Sheingold, 2009; Berensen, p.579, 2004). None of the literature identified to this point has analyzed the effects of MA market penetration on the prevalence or progression of chronic disease since the beginning of risk adjustment policy implementation in 2004.

Medicare Policy

Proponents of private sector involvement in government-sponsored health insurance argue that Medicare Advantage plans provide more choices to beneficiaries and greater levels of benefits, including costly coordination of care. Advocates believe that these additional benefits and functions are worth the additional costs to the federal government (McDowell & Sheingold, p.17-19, 2009; Moffit & Owcharenko, 2008). The findings of this research will be a significant contribution to this policy debate in the future. If increasing MA market penetration slows the progression of chronic disease, then advocates of private sector involvement may point to the findings to support their position. If no relationship is found between MA market penetration and chronic disease

progression, opponents of the Medicare Advantage program will have additional support for their calls to curtail the program.

National Health Policy

On March 23, 2010, the final version of the Patient Protection and Affordable Care Act (ACA) was passed by Congress and signed into law by President Obama (an amended version, the "Health Care and Education Reconciliation Act of 2010" was signed March 30, 2010). ACA has 5 major elements related to the research presented in this dissertation: Coordination of Care and Wellness Promotion, Comparative Effectiveness Research, Pay-for-Performance Quality Incentives, Promotion of Health Information Systems, and changes to Medicare Advantage payments.

ACA includes provisions for insurers to implement 'medical home' coordinated care elements into their health plans by March 2012 (PPACA, p.17-18, 2010). The medical home model integrates chronic disease management, case management, patient-compliance efforts, and quality reporting to produce a more comprehensive and prevention-focused approach to primary care delivery. ACA specifies eight prevention activities that should be a part of providers' and insurers' programs, including diabetes and heart disease prevention (PPACA, p.17-18, 2010).

Comparative effectiveness research was expanded under ACA with the recommendation that CMS establish a "Quality Improvement Network

Research Program." This new program is tasked with studying and communicating findings regarding health quality improvements, including the care management practices that are the subject of the current research (PPACA, p.391-392, 2010).

Pay for Performance (P4P) measures were put in place through ACA, but were primarily focused on long-term care, hospice, and psychiatric hospitals. There was no specification to implement P4P in outpatient care settings for those with chronic disease (PPACA, p.843, 2010).

ACA contains strong provisions for the advancement of healthcare information technology (HIT). The law directed the Secretary of the Department of Health and Human Services (HHS) to establish HIT industry standards by September 2010, and provided grant funding for development and expansion of HIT (PPACA, p.144-145, 2010).

The Medicare Advantage program was directly affected by ACA. MA 'overpayments' were eliminated, including reducing CMS payments to MAOs to levels closer to traditional FFS costs (Cutler, p.2, 2010). Network requirements had already been announced for PFFS plans in 2009 as a measure to protect beneficiaries joining that type of plan and to ensure access to healthcare providers (CMS 2010 MA Announcement, 2009; McDowell & Sheingold, p.5, 2009; CMS Annual Report, p.172, 2009). Although the MA program came under pressure in some respects, the combination of spending reductions and new Medicare revenues have added twelve years of solvency

to the Medicare Trust Fund, extending it to 2029 (Mussey-CMS, 2010). In addition, new funds are being made available for MAOs for quality-improvement processes and programs (PPACA, p.329-332, 2010; Cutler, p.4, 2010). With new funding streams fueling expansion of quality-improvement among MAOs, the need for research and a better understanding of managed care practices' effects on the prevalence and progression of chronic disease will be influential in future health policy development.

Potential Savings

Although this research will not directly measure expenditures, discussions of the scale of public spending and potential savings opportunities are warranted. In 2008, Medicare's traditional FFS program spent a total of $461.6 billion on direct medical expenses (CMS Annual Report, p.2, 2009), while only $6.5 billion (1.41%) went to administrative costs (CMS Annual Report, p.2, 5, 88, 115, 140, 155, 157, 2009). Medicare Advantage is often criticized because private health plans' costs of delivering services to beneficiaries are approximately 12%-13% greater than the Medicare FFS average (McDowell & Sheingold, p.29, 2009; Berenson, p.w156, 2008). This includes 4.1 to 6.6 percentage-points of profit margin, which does not exist in traditional Medicare FFS (McDowell & Sheingold, p.v & 16-19, 2009).

On one hand, Medicare MCOs could be considered the more costly policy option. On the other, since 97%-99% of them have some sort of

disease management program (Green, p.42, 2009; Berensen, p.24 2008), Medicare MCOs may be producing long-term savings for the Medicare program. While assessments of cost savings are outside the scope of the current research, this study will evaluate the effects of Medicare MCO growth on chronic disease progression. If disease management and other managed care practices can reduce long-term spending, then significant savings could be at stake.

Estimates reveal that a single-percentage point reduction in the traditional Medicare program's direct medical expenses (2008) would yield a savings of $4.6 billion annually (1% of $461.6 billion) (CMS Annual Report, p.2, 5, 88, 115, 2009). With 35 million total Medicare FFS beneficiaries, this equates to approximately $131 per beneficiary per year (CMS Annual Report, p.37, 2009). If savings of this magnitude are possible using managed care strategies, such a policy shift could produce savings greater than or equal to the costs of implementation.

How much could be saved in Medicare's medical expense ratio by implementing managed care practices? A study by RAND demonstrated that while obese seniors have similar life expectancies as their lower-weight peers, their cost of health care averages approximately $39,000 more over the remainder of their lives (of which an average of $36,000 is paid by Medicare). This higher spending was driven primarily by the disabilities caused by diabetes, cardiovascular disease and hypertension and equated to a 35%

higher cost to Medicare for those overweight beneficiaries[1] (Lakdawalla et al., p.R38-39, 2005).

Could savings of this magnitude be realized by implementing care management techniques like those employed by many MA plans (McDowell & Sheingold, 2009)? The proposed research cannot directly answer this question, but will explore the relationship between levels of MA market penetration and the progression of chronic diseases among Medicare beneficiaries.

Study Objectives and Dissertation Organization

The primary objective of this study is to determine the direction and strength of the relationship between the market penetration of Medicare Advantage plans in counties across the United States and the progression of chronic diseases among American seniors.

In Chapter Two, we review the literature on existing studies of managed care market penetration, research on the relationships between managed care and health outcomes for patients with chronic diseases, and any relationships between market penetration and health outcomes. The chapter separately discusses the theoretical underpinnings of the research related to disease management, managed care, and market penetration.

[1] The RAND study predates Medicare's Part D drug coverage, so future costs to the program should be expected to rise over 2004 levels.

Chapter Three details the research methods being employed to analyze the research objective and relationships between the variables. This section includes a review of existing studies that have used the Medical Expenditure Panel Survey (MEPS) or addressed medical coding for different manifestations of chronic diseases.

In Chapter Four, we present and discuss the results of the analyses. Finally, Chapter Five discusses the implications this research has for health policy in the United States, presents recommendations for Medicare Advantage plans, CMS, and policymakers, and recommends areas for future research on this topic.

Chapter 2: Literature Review

This study analyzes the relationships between the market penetration of Medicare Advantage (MA) plans and the progression of chronic diseases among Medicare beneficiaries, with a focus on diabetes and cardiovascular disease (primarily stroke and heart disease). I hypothesize that areas of the country with higher MA market penetration will experience slower rates of chronic disease progression.

With chronic disease prevalence at record levels among Medicare beneficiaries, the need to research the relationships between seniors' chronic conditions and MA market penetration is more important than ever (Pleis et al., 2009; Lakdawalla et al., 2005). MA plans normally provide their enrollees with some level of chronic disease management information or disease management program (Orszag, 2007; Miller, 2008; McDowell & Sheingold, 2009; AHIP, 2010; Berensen, 2004). However, little research exists to evaluate the results produced by such programs in areas of higher or lower MA market penetration (Orszag, 2007; McDowell & Sheingold, 2009; Atherly et al., 2005; Edwards, 2004).

This chapter presents a review of the literature. Three specific areas will be discussed. First discussed is the literature that focuses on the theoretical basis of my research. Second, I address studies that focus on the market penetration in managed care. Finally, a review of the disease management literature most relevant to cardiovascular disease and type II diabetes is

provided. The Methods section in Chapter 3 contains a review of the literature on measurement of disease progression and the AHRQ Medical Expenditure Panel Survey (MEPS).

Theoretical Review

There are numerous articles addressing the effects of market penetration of MA plans on processes of care and effects on Medicare spending. Predominantly, these studies employ either market penetration theory or economic theory. To my knowledge, none have addressed changes in chronic diseases in relation to MA market penetration.

Market Penetration Theory

A number of researchers have used market penetration theory in their analyses of Medicare spending (Nicholas, 2009; Chernew et al., 2008; Baker et al., 2004; Bundorf et al., 2004; Baker, 1997; Welch, 1994). Frequently referred to as 'spill-over effects' (and sometimes 'diffusion of innovation'), this theory suggests that measures implemented by health care providers contracted with MCOs 'spill over' to those providers' patients who are not members of MCOs (including FFS beneficiaries). These beneficial measures are primarily processes of care that are preventive in nature, such as immunizations or screening for chronic diseases and cancers (Gillies et al.,

2006; Baker et al., 2004), but also include promotion of appropriate use of inpatient procedures (Meara et al., 2004; Sari, 2002).

Research by Lauren Nicholas presents a theoretical basis for the belief that MA penetration should produce spill-over effects and reduce total Medicare spending (2009). From an economic perspective, higher Medicare payments to MA plans operating in a county (relative to actual costs of providing care) should attract more MA plans to that county. MA plans' medical expense ratios and profit levels are regulated by CMS. When profit levels become too high, MA plans must increase the level of benefits they provide to members.

With richer benefit packages, MA plans are believed to attract members with more complicated health conditions away from Medicare FFS. In turn, the costs for these beneficiaries would shift from FFS to MA plans (Nicholas, p.10, 2009). With more chronically ill members, MA plans develop care management protocols and programs (including disease management programs) to minimize the financial impact of attracting sicker enrollees (Chernew et al., p.1459, 2008). As the MA plans' contracted physicians implement the plans' care management protocols, practice patterns evolve and begin to affect all patients seen by those physicians, creating the 'spill-over' of beneficial care management practices (Nicholas, p.4, 2009; Chernew et al., p.1451, 2008; Atherly et al., 2005; Edwards, 2004; Berenson, p.w160, 2008).

A 2008 study by Chernew et al. sought to quantify Medicare's economic benefit realized through this spill-over. The researchers theorized spill-over advantages would be observed and that benefits could take many forms, including direct savings to Medicare for FFS beneficiaries, increased quality of care, and lower premiums or richer benefit packages for enrollees. Data included 1994-2001 FFS beneficiary annual expense data from CMS, county-level MA market penetration data, and multiple covariates from the Medicare Current Beneficiary Survey (MCBS).

Chernew et al. (2008) found strong associations between MA market penetration and FFS beneficiary spending. Though outcomes varied by county and chronic disease status, a 1-percentage point increase in MA market penetration was associated with between 0.3% to 0.8% reductions in Medicare spending for Traditional FFS beneficiaries. The authors found this effect was only statistically significant for beneficiaries with 1 or more chronic conditions, whom they termed "high-use" individuals.

While Chernew et al.'s (2008) methodologies were strong, and the findings important for Medicare's economic policies, it is important to study more disease-specific effects of MA market penetration. Chernew et al. (2008) note that recent increases in MA PPO and PFFS market penetration relative to HMO enrollment limit the applicabilit of their findings. In addition, the authors cite the potential impact of risk adjustment policies enacted through the MMA act in 2003 and implemented in 2004. Risk adjustment was

designed to provide additional incentives for MA plans to enroll the chronically ill. If Chernew et al.'s (2008) spill-over theory is correct, and if CMS risk adjustment policies increased MA enrollment among the chronically ill, then spill-over effects may be even greater today (Chernew et al., p.1459-1460, 2008).

Like Lauren Nicholas (2009), Chernew et al. (2008) projected that the recent growth in even less-managed forms of MA plans (PPOs and PFFS) would further increase the cost differences between MA and FFS. Beyond that similarity, however, Nicholas' conclusions diverged from theory and from Chernew et al.'s (2008) findings. Nicholas found that total Medicare spending actually increased by 1.1% for each 1-percentage point increase in MA market penetration. For counties with MA penetration rates greater than 10%, the effect more than doubled, and each 1 point increase in MA market penetration equated to a 2.8% increase in total Medicare spending (Nicholas, p.11, 2009).

Nicolas' findings may have differed because she used more recent data, and did not focus her analysis on higher-cost, chronically ill beneficiaries. Chernew et al. (2008) found cost-reducing spill-over effects only among those with 1 or more chronic conditions. When he included all Medicare FFS beneficiaries, the spill-over effect was not statistically significant. It may be that when MA plans enroll high-use, high-cost beneficiaries, but are paid the lower, local area CMS benchmark (originally based on the average cost of providing care), then MA plans and their network providers work harder to

manage costs, and their care management practices spill-over more significantly to chronically ill FFS beneficiaries. Conversely, when MA plans enroll low-use, low-cost beneficiaries, but are paid the higher, local area CMS benchmark, then they are taking low-cost individuals out of the FFS population and raising overall Medicare costs (because they are paid for those members at the higher rates).

Medicare Advantage Market Penetration Literature

MA market penetration is the rate of adoption of privately administered Medicare plans by consumers in a defined market (McDowell & Sheingold, p.37, 2009; CMS Annual Report, 2009). CMS monitors and reports MA market penetration rates monthly and this information is widely used in research and by policymakers. Throughout the last decade, scholars have used this data in studies relating MCO market penetration to healthcare services utilization (Meara et al., 2004; Baker et al., 2004), quality of care or health outcomes (Scanlon et al., 2006; Escarce et al., 2006; Rogowski et al., 2007; Atherly et al., 2005; Edwards, 2004; Sari, 2002), risk selection (Mehrotra et al., 2006; Atherly et al., 2005; Edwards, 2004), and access (Marquis, Rogowski & Escarce, 2004). None of the existing research, however, has analyzed the relationship between MA market penetration and the progression of chronic disease. The most applicable studies are reviewed below, and

have focused on quality of care (or similar measure of health outcomes), or utilization of health care services.

Research on Quality of Care and Outcomes

One of the most important issues when studying quality in health care is defining the term itself. Earlier research focused on the inpatient setting and often used inpatient mortality or inpatient complications as quality metrics. This was driven largely by data availability, as hospital discharge information was readily available (Rogowski et al., 2007; Escarce et al., 2006; Shen, 2003; Sari, 2002; Mukamel et al., 2001; Kessler & McClellan, 2000; Shortell & Hughes, 1988).

Quality: Inpatient Measures

Two recent articles analyzed HMO market penetration and post-discharge mortality from 1994 to 1999 (Rogowski et al., 2007; Escarce et al., 2006). The studies began with 25 metropolitan areas in California (Rogowski et al., 2007), and were subsequently expanded to include additional cities in Wisconsin and New York (Escarce et al., 2006). The primary objective was to assess the impacts of hospital market structure and managed care market penetration on quality of patient care. Covariates included HMO penetration rates, patients' type of insurance, various hospital characteristics, patient severity level, and six chronic and acute conditions (including those being

studied in this dissertation). The dependent variable was simply 30-day mortality after discharge.

The researchers found mixed relationships between HMO market penetration and mortality. In California and Wisconsin, greater penetration had a statistically significant effect on reduced mortality for patients admitted for congestive heart failure (CHF). While associations for the other disease variables were not statistically significant (including heart attack, stroke and diabetes), their estimates indicated some protective effect for patients in high-penetration areas. In New York, the findings were quite different. Greater HMO market penetration was associated with greater 30-day mortality for all 6 diseases (4 of which were statistically significant). However, Escarce et al. (2006) caution that the smaller number of New York metropolitan areas included in the study (n=13), compared to the 25 California metro areas is a limitation to making any strong inferences from this association. The authors further note that the California and Wisconsin markets had longer histories with managed care, whereas New York had recently undergone rapid growth in MCO market penetration.

Escarce et al. (2006) hypothesized that MCOs in mature markets place greater emphasis on quality of care in their provider contract negotiations. Therefore, the authors believe the lack of maturity of the managed care market in New York was the cause of the observed differences in mortality (Escarce et al., p.133S-134S, 2006).

The Escarce et al. (2006) research contributed greatly to the field by linking market penetration to vital statistics records and hospital discharge information for multiple states, which allowed for the inclusion of data on post-discharge deaths and analysis of differences between states. This is important since HMO patients are discharged more quickly than non-HMO patients, and are less likely to die while still in the hospital.

In their conclusions about the differences in outcomes between California and New York, Escarce et al. (2006) make an important recommendation for future research: "(effects) may vary across geographic areas, depending on the maturity of managed care markets or other factors. No study has directly addressed this possibility." This recommendation reinforces the need to consider longitudinal changes in MA market share.

The findings of Nazri Sari's 2002 study of MCO market penetration and associated inpatient complications were similar to those of Escarce et al. (2006). Drawing data from over 600 hospitals in 16 states, Sari also found a protective effect in high penetration areas. This work built upon the earlier analyses of mortality rates and was one of the first to measure MCO quality of care as an outcome other than death (Sari, 2002).

Quality: Non-Inpatient Measures

The work by Scanlon et al. (2006) also added value to the research on outcomes and quality of care in relation to MCO market penetration. Rather

than focusing on mortality, this study used multivariate growth models to assess the impacts of health plan and market attributes, including MCO market penetration, on the plans' performance. Performance was evaluated using the Health Plan Employer Data and Information Set (HEDIS) and Consumer Assessment of Health Plan Survey (CAHPS) quality of care measures over 5 years. The researchers' goal was similar to that of this dissertation in that they sought to better understand relationships between health plans, markets, and health outcomes. However, there is one major difference between the Scanlon et al. (2006) analysis and the research conducted in this study. In Scanlon et al. (2006), the unit of analysis was the health plan rather than the individual enrollee. This study assesses the relationships between market penetration, specifically Medicare Advantage market penetration, and disease progression at the individual level.

Scanlon et al.'s (2006) study found strong positive associations between MCO market penetration and a plan's HEDIS performance on 4 of the 7 process measures (diabetes and cholesterol screenings) and 6 of the 7 outcome measures (biometrics for diabetes and cholesterol control). These findings have informed the primary hypothesis in the current research, and the expectation that higher MCO market penetration will be associated with improved health outcomes. Interestingly, the *competitiveness* of the MCO market was not statistically significant, indicating that a market with only one or two strongly penetrated MCO firms could produce the same, higher

performance as an area with similar market penetration and many individual MCO firms. This finding supports the decision in my research to focus on market penetration, not on the competitiveness index.

Scanlon et al. (2006) added to the literature through use of longitudinal growth modeling, and by focusing on preventive care measures rather than inpatient outcomes. Scanlon et al. (2006) used the MCO as the unit of analysis, leaving a gap from the patient perspective. This dissertation will advance the body of knowledge by studying actual changes in progression of chronic disease among Medicare beneficiaries in relation to the changes in levels of MAO market penetration over time.

Research on Health Care Service Utilization

A number of articles in the market penetration literature have focused specifically on health care service utilization. One such frequently-cited study is the 2004 research by Baker et al. The authors specifically analyzed the relationships between MCO market penetration at the metropolitan statistical area (MSA) level and cancer screening rates (3 for women and 1 for men). Baker et al. (2004) chose to use the AHRQ MEPS-HC for screening service utilization data and insurance type, lending support for my choice to use MEPS. Baker et al. (2004) differentiated their study from earlier work by examining the data by plan type (HMO vs. non-HMO).

Baker et al. (2004) concluded that mammography, clinical breast exams, and pap tests were significantly more common in areas of high HMO market penetration, a finding confirmed in two HEDIS studies by Scanlon et al. and Gillies et al. two years later (Scanlon et al., 2006; Gillies et al., 2006). The relationship Baker et al. (2004) found between PPO market penetration and preventive screening was statistically different, however. While the associations were generally positive, they were weaker, less consistent, and less statistically significant than they had been for HMOs. The Baker et al. (2004) findings support concerns raised by Chernew et al. (2008) and Nicholas (2009) regarding the recent disproportionate growth of these unmanaged PPO and PFFS MA plans.

In addition, Baker et al. (2004) found evidence that the physician practice patterns in areas of high MCO market penetration 'spill-over' to benefit patients in the area who are not enrolled in an MCO. This suggests that the physician practice patterns for MCO members and non-MCO patients begin to converge over time as the managed care market matures in an area. Baker et al. (2004) found the market penetration rate of the geographic area to be more predictive of screening rates than the actual type of MCO membership of the individuals themselves.

Like the Baker et al. (2004) study, Meara et al. (2004) researched the relationship between MCO market penetration and utilization of screening procedures. While Baker et al. (2004) had used MEPS, a nationally

representative sample of the general U.S. population, Meara at al. (2004) focused on Medicare FFS beneficiaries. The quality measure of the Meara et al. (2004) analysis was appropriate use of angiography, an in-hospital screening for coronary heart disease (CHD). The researchers hypothesized that spill-over effects would occur due to MCOs' care management guidelines and through physician learning models that diffuse commonly-accepted practices across the physician community.

The data were drawn from hospital medical records of 109,824 Traditional Medicare FFS beneficiaries between the ages of 65 and 89. All had hospital discharge diagnoses of AMI (heart attack) and had been potential candidates for an angiogram. Meara et al. (2004) found that higher levels of MA market penetration were associated with a statistically significant lower utilization of angiography among FFS beneficiaries. A 10-percentage point increase in MA market share within a county was associated with an approximately 1% decline in FFS angiography rates among patients for whom an angiogram was indicated. The authors considered this effect small in practical terms. The reduction was slightly higher among patients for whom angiography was not clearly appropriate (Meara et al., p.153-154, 2004).

The research by Baker et al. (2004) and Meara et al. (2004) has played an important role in guiding this dissertation research. Both found that higher MCO market penetration can have positive effects for patients enrolled in non-managed, FFS health plans. However, both focused primarily on health care

service processes – not on longitudinal effects on Medicare beneficiaries' chronic conditions.

My research will build upon the Baker et al. (2004) and Meara et al. (2004) studies by analyzing not solely health care service utilization, but actual disease progression among Medicare beneficiaries. Informed by Baker et al.'s (2004) approach, I will include not only the area Medicare MCO market penetration rates and respondent-level Medicare eligibility status, but also a MEPS insurance type indicator variable for each respondent. Baker et al. (2004) noted that maturity of the managed care market in a local area could have an effect on screening rates and physician practice patterns. By analyzing the data longitudinally, my research will help assess the impact of changes in managed care market maturity. If my findings parallel those of Baker et al. (2004), Meara et al. (2004), and Escarce et al. (2006), we should see the differences in disease progression rates between MA and FFS beneficiaries narrow over time as the local managed care market matures.

Other Managed Care Literature

Perhaps the most respected and comprehensive managed care literature analysis is the series of articles by Robert Miller and Harold Luft (2002, 1997, 1994). Their three reviews analyze the body of HMO plan performance literature from 1980 through 2001. Their most recent article, published in 2002, focused on 79 articles published between 1997 and 2001 (Miller & Luft,

2002). The authors' goal was to assess the performance of managed care plans relative to more traditional indemnity plans.

The majority of studies conducted during this five-year period showed mixed results (41 of 79 articles). Sixteen showed superior performance by HMOs, and 16 indicated better performance by FFS or indemnity plans. Miller and Luft (2002) explain that results often depended upon how quality and access are measured. When assessing the implementation or use of preventive care initiatives, HMO plans tended to produce better results in terms of cost and utilization. When measuring hospital admissions or post-hospitalization outcomes, HMOs and non-managed plans scored similarly.

Miller and Luft (2002) reviewed 14 articles that focused on the market penetration variable. Of those 14, higher MCO market penetration generally equated to greater focus on preventive care, lower premiums, lower FFS costs (spill-over effects), lower use of expensive resources (typically high-tech equipment), and reduced rates of hospital cost growth. However, MCOs had lower ratings for access to care and customer satisfaction (Miller & Luft, 2002).

Miller and Luft (2002) found that the aforementioned benefits of managed care varied widely by geographic area, and MCOs tended to perform better in California and other parts of the West than elsewhere. The authors also found results differ greatly between providers or delivery systems, and between individual MCOs (Miller & Luft, 2002).

Miller and Luft (2002) note that the number of managed care studies are increasing, but that more research is needed to bring clarity to the differences between managed and non-managed care and the lack of consistency between studies. The authors suggest that HMOs' varying use of disease management practices could be a root of this inconsistency. In early 2002, the authors explain that many of the processes necessary for MCOs to produce the results expected of them had yet to be broadly implemented. Performance would have to be measured and communicated to consumers and purchasers, risk-adjustment mechanisms would have to be implemented, and more EMRs should be in place (Miller & Luft, 2002).

The Miller and Luft (2002) research showed us that managed care could produce benefits in the healthcare system, but that improvements were needed. Nearly 10 years later, CMS has risk adjustment fully in place for Medicare MCOs (phased in from 2004-2007) (McDowell & Sheingold, 2009; CMS Annual Report, 2009; Blumenthal et al., 2005; Berenson, p.574, 2004; Pope et al., p.120, 2004). More quality reporting systems have evolved and become publicly available on the internet. EMRs have experienced rapid adoption, enabling better performance measurement (PPACA, 2010). Disease management programs have evolved and become more common (Green, p.42, 2009; Mattke et al., 2007); however, most MA growth has been in the PPO and PFFS plan types, which conduct less-intensive disease

management (or none at all) (McDowell & Sheingold, p.12-13, 2009; Nicholas, 2009; Chernew et al., 2008; Miller, 2008).

Disease Management Literature

Effectiveness of DM has been defined and measured in multiple ways. Clinical trials and programs administered by those in direct contact with patients often emphasize improvements in patients' biomarkers, such as cholesterol levels, blood pressure, blood glucose levels, or weight loss (DDPOSRG, 2009; Hamman et al., 2006; Knowler et al., 2002; DPP Research Group, 2002). Other studies have examined effectiveness in terms of changes in acute healthcare service utilization (chiefly emergency room visits and inpatient admissions) among patients receiving DM program interventions (Mattke et al., 2007; Davidson et al., 2003). Much research has been done to evaluate cost effectiveness of DM, including whether DM programs produce greater savings than the costs of implementation (Mattke et al., 2007).

One of the most common evaluations of DM program effectiveness involves processes of care. Processes of care are standards of clinical care aimed at improving patients' outcomes, such as regular HbA_{1c} blood glucose testing and vision screenings for diabetics, or cholesterol and blood pressure monitoring for those with heart disease (Mattke et al., p.673, 2007; NCCDPHP, 2008; NCCDPHP, 2009; Hamman et al., 2006; Dijkstra et al., 2005; Stafford et al., 2003).

While most programs demonstrate improvements in processes of care and biomarkers, the findings on utilization and cost effectiveness vary among studies (Mattke et al., 2007). Some have shown reductions in costly inpatient and emergency department utilization (Mattke et al., p.674, 2007; Villagra & Ahmed, 2004; Sidorov et al., 2002). Most studies show improvements in patients' control of their diseases and intermediate-term outcomes (Mattke et al., p.674, 2007). However, most research on disease management programs has not followed participants beyond one year, and evidence for the direct relationship between the DM program itself and patients' long-term outcomes is limited (Mattke et al., p.674, 2007; Hebert et al., 2008).

Cost-effectiveness findings vary, and are dependent upon intensity of the interventions and length of time for which data are considered (Mattke et al., p.674, 2007; Hebert et al., 2008). A number of studies show that cost savings are possible, but success levels vary and results are often inconclusive (Mattke et al., p.674, 2007; Hebert et al., 2008; Dijkstra et al., 2005; Villagra & Ahmed, 2004; Sidorov et al., 2002).

A common limitation in the DM literature is that many studies are based on programs designed for higher-risk patients and implemented in university medical centers or other healthcare providers' local service areas (RAND press release, 2007; Mattke et al., p.675, 2007).

An example of a disease management program overcoming such limitations is the Utah Heart Disease and Stroke Prevention Program. The

program was coordinated by the state Department of Health in partnership with multiple MCOs. From 2004 to 2007, this CDC-funded heart disease management program improved the rate of blood pressure control (maintaining pressure lower than 140 systolic / 90 diastolic) by as much as 47% (CDC: Prevention programs making a difference, 2009). Lowering systolic blood pressure by even 12 points can result in a 21% reduction of risk of heart disease and 37% lower risk of stroke (CDC Heart disease and stroke prevention, 2009).

Disease management programs like these achieve results primarily through educational outreach. At the individual level, this means distributing healthy living or self-management educational materials to patients via their providers and MCOs, and with public service announcements in the media. Patients / health plan members are instructed in how to test HbA_{1c} blood glucose levels, how to self-administer insulin, and how to modify their diets to lose weight, avoid complications and live better quality lives (DPPOSRG, 2009; NCCDPHP, 2008; Dijkstra et al., 2005; Knowler et al., 2002; DPP Research Group, 2002). At the health care provider level, educational outreach entails continuing education seminars, providing the latest clinical research findings, and assessment and decision-making tools providers can use in the clinical setting (CDC: Prevention programs making a difference 2009; Dijkstra et al., 2005).

If Medicare Advantage managed care organizations are integrating these types of disease management programs into their operations, we should observe lower disease progression in areas of higher MA market penetration. In more mature MA markets, the differences between MA and FFS beneficiaries' chronic disease progression should narrow over time, as the spill-over effect increasingly diffuses disease management practice patterns throughout the physician community.

Chapter 3: Materials and Methods

Specific Aim

Analyze the relationships between respondents' chronic disease progression (diagnoses of diabetes, heart diseases and related comorbidities) and longitudinal changes in Medicare Advantage (MA) market penetration.

Hypothesis 1

Medicare beneficiaries in areas of the United States with elevated MA market penetration will experience slower rates of chronic disease progression than beneficiaries in areas of lower MA market penetration.

Hypothesis 2

The gap between the chronic disease progression rates of low and high MA market penetration areas will narrow over time. (this hypothesis is contingent upon rejecting the null hypothesis in Hypothesis 1).

Data Used

Medical Expenditure Panel Survey (MEPS)

The Medical Expenditure Panel Survey (MEPS) is a nationwide survey of families and individuals conducted annually since 1996 by the Agency for Healthcare Research and Quality (AHRQ). The goal of MEPS is to facilitate research on changes in health care service utilization, costs, and sources of payment. The sampling frame consists of households surveyed in the previous year's National Health Interview Survey (NHIS), which is conducted by the National Center for Health Statistics (MEPS website, 2010).

MEPS consists of multiple components. The components of focus in this research are the Household Component (HC) and the Medical Provider Component (MPC). The HC data includes detailed information on the respondent and all household members. The data include demographics, income, employment, insurance coverage information, disease diagnoses and other health conditions, self-reported health status, and details of health care service utilization and costs.

The MPC is used to supplement responses from the HC and impute missing values such as dates of medical appointments and related charges, diagnoses, procedures, and sources of payment (MEPS website, 2010). The data is collected directly from medical providers encountered by MEPS participant household members. The MPC was not designed to support

analysis independent of the HC (MEPS website, 2010). All MEPS data is self-reported, and provider responses to the MPC never override the data provided by the household's primary respondent (MEPS Survey Overview Workbook, p.4, 2010).

Sample Sizes and Response Rates

MEPS has a nationally representative, overlapping panel design. A new panel begins in the first quarter of each year. Over the course of each panel, individuals are surveyed every 6 months for 2 years for a total of 5 separate data points per individual (MEPS-HC Sample Design, 2010). There are 12 complete panels between 1996 and 2008. However, only four of them, Panels 9 -12 (2004-2008), are being used in this research due to lack of necessary variables in earlier panels. Diagnosis questions are only asked in Rounds 3 and 5 (the third and fifth data points). Due to this limitation, and that of the multilevel model approach used here, we will simplify to one outcome variable data point per respondent. This is accomplished using the change in Chronic Disease Severity Index as the outcome variable.

The Chronic Disease Severity Index (CDSI), a continuous scale, is a composite of the MEPS diagnoses identified in the survey. The CDSI change score is the difference between an individual's CDSI scores in the first and second (final) measurements of diagnoses (MEPS Rounds 3 and 5). This results in a more cross-sectional approach to the analysis, with each of the

panels (9 through 12) representing a single period on the four-panel, five-year time scale.

From 1996 through 2008, each panel has consisted of between 21,571 and 37,418 individuals (represented in 8,655 to 14,828 households). The sampling frame for this research consists only of those MEPS respondents who are Medicare-eligible. This restricts sample sizes used in this study to between 2,860 and 5,055 per year (4,191 to 4,653 in Panels 9-12) (Table 3).

Response rates for any given MEPS panel are a cumulative function of the NHIS response rate and the response rates for each round of the MEPS survey. Taken together, final cumulative response rates have ranged between 56.9% and 70.7% for each MEPS panel. The survey is conducted by MEPS contractors using a computer-assisted personal interviewing (CAPI) tool on laptop computers. The CAPI program makes the complex skip patterns and round-specific modules simpler to administer and less prone to human error. This reduces the total time required to interview each respondent, and increases cumulative response rates (MEPS-HC Sample Design, 2010).

Previous Analyses of MEPS in the Literature

MEPS data has been used by many other researchers to study chronic disease, and issues of access, utilization and cost. For example, Chen and Escarce (2008) used the office visit and medication data in MEPS-HC to

analyze the relationships between family structure, treatments, and outcomes for children with chronic asthma. To obtain all desired variables, the MEPS-HC Full-Year Consolidated Data Files were linked with the Medical Conditions and Event Files for 1996-2003 (Medical Conditions and Event Files are found within the Household Component). The Event Files contain information on the individual provider encounters, including prescription data. The Medical Conditions Files contain respondent-reported diagnoses, and the Full-Year Consolidated Files contain all the other variables used in the analysis, including demographics, insurance coverage data, and health status. Chen and Escarce (2008) obtained additional information on asthmatic children's diagnoses, and frequency and severity of asthmatic attacks by linking MEPS with cross-sectional data from the 2003 National Survey of Children's Health (NSCH).

In a separate analysis of NSCH data, Chen and Escarce (2008) used ordinal logistic regression to assess a 4-category scale of asthma severity ("inactive, mild, moderate, or severe health difficulties"). While MEPS does not measure conditions on a severity scale, the research presented here uses MEPS diagnosis and health status responses to develop a Chronic Disease Severity Index (CDSI) progression scale. This analysis is similar to that of Chen and Escarce (2008) in that it uses many of the same MEPS explanatory variables and a scale to characterize disease severity. A key difference is that this analysis is longitudinal in nature, and that a progression scale (the CDSI),

discussed in the Variables section of this chapter, is developed using MEPS diagnosis data.

Another study using MEPS data was that of Satchell and Pati (2005). Their goal was to assess the number of U.S. children with gaps in insurance coverage, and to test for disparities between such gaps for children in vulnerable groups and American children overall. The researchers defined subjects as uninsured for the full year, having experienced some gap in coverage, or insured for the full year. Multivariate ordinal logistic regression was then used to assess the likelihood of gaps in insurance coverage for children in vulnerable groups. The Satchell and Pati (2005) analysis can inform the methodology developed in this study, as it used many of the same covariates. Satchell and Pati's (2005) use of an ordinal dependent variable is also informative, though the Chronic Disease Severity Index (CDSI) progression scale will be more complex and changes in the CDSI will be analyzed over the five year time period covered by MEPS Panels 9-12.

MEPS has also been used to study cancer screening rates for patients in areas of varying levels of managed care organization (MCO) market penetration (Baker et al., 2004). Seeking to better understand the potential benefits of MCO spill-over effects, Baker et al. (2004) used 1996 MEPS-HC data to assess effects of market-level MCO penetration on four different cancer screenings. Health plans were categorized as either "managed" or "non-managed" according to health plan descriptions in MEPS. Baker et al.

(2004) did not limit their study to Medicare beneficiaries. For those respondents with Medicare, Baker et al. (2004) defined “managed” Medicare as equivalent to HMO plan type, and all other MA plans and traditional FFS were categorized as “un-managed.” MCO market penetration data came from Baker’s earlier work, and metropolitan statistical areas (MSAs) were categorized as areas of low (<10%), medium (between 10% and 25%), and high (>25%) managed care market penetration.

Using the weighting established by MEPS to ensure a nationally representative sample, Baker et al.’s (2004) logistic regression showed statistically higher odds of women receiving cancer screening in areas of high MCO market penetration. Interestingly, the screening rate differences were not statistically significant for MCO members versus non-members. This finding supports the hypothesis that public health benefits of managed care may accrue more at the local level than at the individual level. Baker et al. (2004) further posit that statistically significant differences may have existed between MCO members and non-members in the past, but that spill-over effects caused area level screening rates to converge for the two groups over time. This belief also influenced the development of the analysis presented in the current research, and is an important driver for the decision to conduct longitudinal analyses.

In addition to using some of the same covariates and analyzing MCO plans by type, the research by Baker et al. (2004) also analyzed differences

between MSAs of varying penetration levels. The research presented here builds from the foundation laid by Baker et al. (2004), and uses a multilevel approach to assessing the outcome variable at the county, state, and census region levels (MSA-level data was no longer readily available from MEPS at the time of this study).

In a study related to Baker et al. (2004), Tye et al. (2004) sought to understand the effect of managed care on cancer screening. Like Baker et al. (2004), Tye et al. (2004) drew their data from MEPS and used multivariate logistic regression in their analysis. The Tye et al. (2004) research differed in that it moved beyond the simple typologies of "managed care" and "non-managed care" and analyzed outcomes based on specific features of respondents' health plans. The authors found that the increased odds ratios of MCO plan members receiving breast cancer screenings were statistically significant if the MCO had a defined provider network and a gatekeeper design. Among Medicare Advantage plans, these are the primary differentiators between HMOs and the less restrictive PPO and PFFS designs.

CMS Market Penetration Data

In this research, CMS is the data source for MA market penetration data. CMS also provides the specific plan type composition of the MA market at the county, state, census region, and national levels. This data is published monthly by CMS, but for this research, only February data will be used for

each year in the study. February data most accurately reflected the enrollment changes occurring during Medicare's Annual Election Period (AEP), which historically began in November and ended December 31 (Goldstein et al., 2001).

Hypothesis 2 is contingent upon finding significance of Hypothesis 1, and tests whether the relationships between chronic disease progression and MA market penetration change as MA markets mature. For this test, markets that have not maintained at least 25% MA market penetration for the previous two years will be excluded from the analysis. If no significant association is found between MA market penetration and CDSI change in Hypothesis 1, then Hypothesis 2 will be null.

Data Analysis Methods

Hypothesis 1

Medicare beneficiaries in areas of the United States with elevated MA market penetration will experience slower rates of chronic disease progression than beneficiaries in areas of lower MA market penetration.

Hypothesis 2

The gap between the chronic disease progression rates of low and high MA market penetration areas will narrow over time. (this hypothesis is contingent upon rejecting the null hypothesis in Hypothesis 1).

Descriptive Analysis

Frequency distributions, cross-tabulations, and tables of means and standard deviations will be run for each variable in the analysis. In particular, this descriptive analysis will inform the choice of how the market penetration and age covariates will be treated. Depending upon the appearance of the frequency distributions, market penetration and age may be characterized as continuous variables, or their ranges grouped into quintiles or other meaningful groupings.

As introduced earlier, the outcome variable in this analysis is the change in Chronic Disease Severity Index (CDSI) score. The CDSI is a combined measure of the individual's overall chronic disease state. The CDSI, discussed in more detail in the Variables section of this chapter, will also be described with frequency and cross-tabulation tables.

For categorical variables, the tables will present the percentages of the sample falling into each category. Together, these exploratory analyses will enable assessment of normality/skewness of the data and will aid in identifying outliers.

Variable-specific cross tabulations will be presented. The crosstab of each covariate with CDSI will aid in the preliminary identification of variables that exhibit stronger relationships to chronic disease progression. Tests of association will be conducted between covariates to assess multicollinearity and assumptions of independence.

MEPS uses 'logical edits' and a weighted sequential hot-deck procedure to impute missing values, and little missingness is expected to remain. However, missingness will be assessed for each variable, and decisions made about the proper imputation approach.

Multi-Level Modeling

"The analysis of data sets that contain measurements from different levels of a hierarchy requires techniques matched to the hierarchical structure" (Duncan et al., 2002). The data for this dissertation research are clustered in a hierarchical structure: Individuals (1st level) are clustered within time (2nd level, represented by the series of MEPS panels, and clustered within geographical areas (3rd level). Our research questions necessitate analyzing the individual-level variables (CDSI scores, insurance and demographic information) in the context of the geographic-level variables within which they are clustered (county, state, census region). This approach has been used successfully by other researchers in the social sciences (Duncan et al., 2002; Yang and Land, 2008 & 2006).

MEPS respondents in each panel are randomly sampled from the U.S. non-institutionalized population, and it is unlikely for a given individual to be selected for more than one MEPS panel. The number of states and counties in the U.S. is constant, but because MEPS randomly samples individuals, not all states or counties are represented in each panel, though some may be represented in more than one MEPS panel (especially the more populous markets).

The methods employed in this dissertation follow the Hierarchical Age-Period-Cohort (HAPC) multilevel approach to analyzing repeated cross-sectional data, as outlined by Yang and Land (2008 & 2006). This model will facilitate answers to the research hypotheses, and estimate the proportions of variation in disease progression attributable to the individual, market, and time period levels. The Variables section below outlines the variables being used in the analysis, and is followed by the Equations section which explains the incorporation of each variable into the equations for each level of the model.

Variables

This study uses variables from two sources: CMS market share reports, and the MEPS survey. One of the most novel contributions of this dissertation research is the disease progression variable, the “Chronic Disease Severity Index” (CDSI), which is derived from MEPS diagnosis variables. This scale was developed by the author with significant contributions from clinical advisors, Daniel Barrett, MD, Brent Godek, MD, and Priscilla Latta, MD.

The CDSI is a continuous scale in which respondents accumulate points for each diagnosis. CDSI scores are constructed with MEPS subjects' self-reported diagnosis data. Subjects' progression scores include diagnoses for MEPS-recorded chronic conditions, including diabetes, various heart conditions, high cholesterol, hypertension, and associated comorbidities.

Typically, the outcome of interest is a disease diagnosis, achievement or failure to achieve the subject's program goals, or mortality (Venditti et al., 2008; Knowler et al., 2002; Hamman et al., 2006; Eriksson & Lindgarde, 1991; Landon et al., 2007). This dissertation research differs from earlier studies by examining the changes in respondents' overall chronic disease states and relating them to changes in MA market penetration rates. Figure 2 lists the diagnoses included in the CDSI composite score and the point value associated with each. Variables used in the analysis are summarized below:

CDSI outcome score	(continuous)	Age^2	(continuous)
CDSI change	(continuous)	Sex	(dichotomous)
MA High-Penetration	(dichotomous)	Marital status	(dichotomous)
MA Dominant Type	(categorical)	Income level % FPL	(dichotomous)
MSA-dweller	(dichotomous)	Races	(dichotomous)
Education levels	(dichotomous)	Hispanic	(dichotomous)
Age	(dichotomous)	Medicare-covered	(dichotomous)

Other Insurance	(dichotomous)	MEPS Panel #	(categorical)
Managed care plan	(dichotomous)	Market (geo-area)	(categorical)

The change in Chronic Disease Severity Index (CDSI) is the outcome variable of this study, and is represented on a continuous scale, as explained earlier. The CDSI change score is the difference between an individual's two CDSI scores. CDSI is computed using the diagnosis codes reported in Rounds 3 and 5 of the MEPS survey. Each diagnosis was given a unique weight by the author's clinical advisory team. Weights of 1 to 10 points are ascribed to each diagnosis, and are based upon the physicians' assessment of the medical severity of each condition. For example, a first-time diagnosis of high blood pressure has a 1-point weight, whereas a heart attack is 10 points. Respondents gain or lose points as they report more or fewer diagnoses at Round 5 compared to Round 3.

The explanatory covariate of greatest interest is MA Market Penetration level (HIPEN), a dichotomous dummy variable indicating whether a market's MA penetration rate is $\geq$ 25%.

The remaining explanatory covariates are individual-level variables. MSA is a dichotomous variable indicating whether the respondent lives in metropolitan statistical area, and delineates urban from rural residents. Education level is a set of four dichotomous dummy variables indicating whether the respondent has: (1) completed high school, (2) some college, (3)

completed college, or (4) greater than undergraduate education (the reference group is those with 'less than a high school education'). Age is a set of six dichotomous dummy variables indicating whether the respondent is: (1) 70-74, (2) 75-79, (3) 80-84, (4) 85 or older, (5) 50-64, or (6) under 50 (the reference group is those ages 65-69). The Age^2 quadratic term is included in the model to allow the effect of age to differ as respondents age. Sex is a dichotomous variable. Marital status is a set of 5 dichotomous variables indicating whether the respondent is: (1) married, (2) widowed, (3) divorced, (4) separated, or (5) never married. The Income variable is a set of four dichotomous dummy variables indicating whether the respondent's household income is: (1) 100% to 200% of federal poverty level (FPL), (2) 201% to 300% of FPL, (3) 301% to 400% of FPL, or (4) greater than 400% of FPL (the reference group is those with household incomes less than or equal to 100% of federal poverty level).

Race and ethnicity are represented by two separate variables in MEPS: 'race' and 'Hispanic.' This approach allows individuals to categorize themselves as any of the racial groups presented below, and at the same time identify themselves as Hispanic[2]. The Race variable is a set of five dichotomous variables indicating whether the respondent identifies him/herself as: (1) white, (2) black, (3) American Indian / Alaska Native, (4) Asian, (5) Native Hawaiian / Pacific Islander, or (6) multiple races. The Hispanic variable

[2] The Office of Management and Budget issued guidance in 1997 that Hispanic or Latino ethnicity should be reported separately from race (OMB, 1997).

is a single dichotomous variable identifying the individual as “Hispanic” or “non-Hispanic.”

Three dichotomous variables indicate whether the respondent is Medicare eligible, has any other health insurance plan, and whether s/he is a member of a managed care plan or HMO. Since only Medicare-eligibles are included in the sample, this variable is not needed in the equations. Though the Panel and Market variables are not used in the regression model, they facilitate a match for the merging of the market penetration data files.

More detailed variable tables are presented in the Tables section. Table 1 introduces each variable being used in the analysis, its source, and a description of each. Table 2 presents all variables being drawn from MEPS and CMS, including those used to construct variables in Table 1.

Table 3 and Table 4 demonstrate the temporal nature and overlapping design of the MEPS panel survey data. Table 3 shows the number of observations in the sampling frame, which is composed of those MEPS respondents who are Medicare-eligible. Table 4 presents the number of households surveyed by MEPS at each time period.

Equations for Hypotheses 1 and 2

As introduced and depicted earlier, the data are clustered in a hierarchical structure. The individual respondent’s attributes are at the 1st level, including CDSI progression scale change scores, insurance type, market

/ geographic identification (residency in a particular county, state and census region), and all demographic data.

Level 1 individual respondent observations are cross-clustered under both Levels 2 and 3. Level 2 is time, composed of the series of four MEPS panels from 2004 through 2008 (Panels 9-12). Level 3 is market / geographic area (county, state and census region). The only variable associated uniquely with Level 3 is the MA market penetration rate. This 3-level model is a cross-classified version of the Hierarchical Age-Period-Cohort (HAPC) approach for Repeated Cross-Sectional Surveys, as explained by Yang and Land (2008). The cross-classification enables levels 2 and 3 to be combined in one equation (Equation 2 below). The Multilevel equation set for the model is shown below. The subscripts *i*, *j*, and *k* represent individual, time, and market, respectively.

(Equation 1): Level 1 Model: The Individual

$$CDSI\Delta_{ijk} = \beta_{0jk} + \beta_1 AGE1_{ijk} + \beta_2 AGE2_{ijk} + \beta_3 AGE3_{ijk} + \beta_4 AGE4_{ijk} + \beta_5 AGE5_{ijk} + \beta_6 AGE6_{ijk} + \beta_7 (AGE)^2_{ijk} + \beta_8 EDUCATION1_{ijk} + \beta_9 EDUCATION2_{ijk} + \beta_{10} EDUCATION3_{ijk} + \beta_{11} EDUCATION4_{ijk} + \beta_{12} MSA_{ijk} + \beta_{13} MALE_{ijk} + \beta_{14} MARRIED2_{ijk} + \beta_{15} NEVERMARRIED3_{ijk} + \beta_{16} WIDOWED_{ijk} + \beta_{17} DIVORCED_{ijk} + \beta_{18} SEPARATED_{ijk} + \beta_{19} FPL1_{ijk} + \beta_{20} FPL2_{ijk} + \beta_{21} FPL3_{ijk} + \beta_{22} FPL4_{ijk} + \beta_{23} BLCK_{ijk} + \beta_{24} AIAN_{ijk} + \beta_{25} ASIA_{ijk} + \beta_{26} NHPI_{ijk} + \beta_{27} MULT_{ijk} + \beta_{28} HISP_{ijk} + \beta_{29} OTRINS_{ijk} + \beta_{30} MCO_{ijk} + e_{ijk}; \; e_{ijk} \sim N(0,\sigma^2)$$

(Equation 2): Level 2 Model: Market x Time Period (cross-classified)

$$\beta_{0jk} = \gamma_0 + \gamma_1 HIPEN_{jk} + u_{0j} + v_{0k}, \quad u_{0j} \sim N(0;\tau_u);\ v_{0k} \sim N(0;\tau_v)$$

(Equation 3): Combined Model [3]

$$CDSI\Delta_{ijk} = \gamma_0 + \gamma_1 HIPEN_{jk} + \beta_1 AGE1_{ijk} + \beta_2 AGE2_{ijk} + \beta_3 AGE3_{ijk} + \beta_4 AGE4_{ijk} + \beta_5 AGE5_{ijk} + \beta_6 AGE6_{ijk} + \beta_7 (AGE)^2_{ijk} + \beta_8 EDUCATION1_{ijk} + \beta_9 EDUCATION2_{ijk} + \beta_{10} EDUCATION3_{ijk} + \beta_{11} EDUCATION4_{ijk} + \beta_{12} MSA_{ijk} + \beta_{13} MALE_{ijk} + \beta_{14} MARRIED2_{ijk} + \beta_{15} NEVERMARRIED3_{ijk} + \beta_{16} WIDOWED_{ijk} + \beta_{17} DIVORCED_{ijk} + \beta_{18} SEPARATED_{ijk} + \beta_{19} FPL1_{ijk} + \beta_{20} FPL2_{ijk} + \beta_{21} FPL3_{ijk} + \beta_{22} FPL4_{ijk} + \beta_{23} BLACK_{ijk} + \beta_{24} AIAN_{ijk} + \beta_{25} ASIAN_{ijk} + \beta_{26} NHPI_{ijk} + \beta_{27} MULT_{ijk} + \beta_{28} HISP_{ijk} + \beta_{29} OTRINS_{ijk} + \beta_{30} MCO_{ijk} + u_{0j} + v_{0k} + e_{ijk};\quad e_{ijk} \sim N(0,\sigma^2)$$

In these equations, i represents the i^{th} individual in the sample (i = 1, – …, n_{jk}); j indicates the j^{th} Panel of the MEPS survey (1 = Panel 9, 2 = Panel 10, 3 = Panel 11, 4 = Panel 12); and k represents the specific market, or geographical area (county, state, or census region: k = 1, – …, n_k).

[3] HIPEN = dichotomous flag to indicate whether market has ≥25% MA market penetration; AGE1 = age 70-74; AGE2 = age 75-79; AGE3 = age 80-84; AGE4 = age ≥85; AGE5 = age 50-64; AGE6 = under age 50 (age 65-69 is reference group for all dummy variables for age); EDUCATION1 = high school completed; EDUCATION2 = some college completed; EDUCATION3 = 4-yrs college completed; EDUCATION4 = >4 yrs of college completed (less than high school is reference group for all dummy variables for education); MSA = urban resident; MALE = male gender; FPL1 = household income 101%-200% of Federal Poverty Level; FPL2 = 201%-300%; FPL3 = 301%-400%; FPL4 = >400% FPL (≤100% of FPL is reference group for all dummy variables for income); BLACK = black race; AIAN = American Indian / Alaska Native race; ASIAN = Asian race; NHPI = Native Hawaiian / Pacific Islander race; MULT = multiple races reported; HISP = Hispanic ethnicity; OTRINS = Other Private insurance coverage; MCO = coverage by a managed care organization.

Within each market area and panel, $CDSI\Delta_{ijk}$ is the individual's CDSI progression scale change score for the year, and is a function of that individual's attributes as shown in Equation 1. The β_{0jk} intercept for Equation 1 varies from market to market and over time, and is represented by Equation 2. The β_{0jk} coefficient represents the mean CDSI change score for all individuals residing in market *k* during the j^{th} MEPS survey panel. The γ_0 term in Equation 2 is the overall model intercept for all individuals (across all markets and panels).

β_1 through β_{30} are the slope coefficients for each of the individual-level covariates, and are fixed effects. The γ_1 term in Equation 2 is the market-level slope coefficient for MA market penetration level, and the primary covariate of interest in this research. The γ_1 term indicates the change in CDSI score attributable to a shift from low-penetration to high-penetration. This variable is critical for evaluating the research hypotheses.

The individual-level random effect is e_{ijk} and represents the deviation from the mean (β_{0jk}) of the individual's CDSI change score (within market *k* and time *j*). It is assumed to be normally distributed with mean of 0 and variance of σ^2. The residual random effects in the model are represented by u_{0j} and v_{0k}, where u_{0j} is the random effect for market across all panels, and v_{0k} is the random effect of time (MEPS Panel number) across all markets. Both residual random effects are assumed to be normally distributed with means of 0 and variances of τ_v, as shown in Equation 2. The u_{0j} is of particular interest,

as it represents the degree of unexplained variance that is attributable to the effects of the market level of the model.

Power Analysis

The statistical power of a model is the probability that it leads us to correctly reject the null hypothesis (Gauvreau, p.59, 2001; Rosner, p.214, 2000). Statistical power for multilevel models is a somewhat more complex calculation than that for simpler regression techniques. The sample size required to achieve statistical power in multilevel models depends upon the total sample size, but even more so on the number of clusters (Hox, p.233-234, 2010).

As a general rule of thumb, at least 30 clusters with 30 observations in each are preferred in order to obtain the desired statistical power and the ability to make inferences to the population from which the sample is drawn (Hox, p.235, 2010). If full maximum likelihood estimation (full MLE) is used, it is preferable to have 48 clusters or more to achieve the most accurate estimates of variances (Hox, p.234, 2010; Browne & Draper, p.402, 409, 2000). Kreft & Bokhee (p.13, 1994) have proposed that power as high as 0.90 can be obtained with only 30 clusters containing 150 individuals each, or with 150 clusters each containing 5 individuals.

In the current dissertation research, this supports the use of full MLE when the market level is defined as the state or county level, as there are

between 50 and 56 “states” in the data (sampled from 50 states, plus Washington D.C. and territories), and between 109 and 124 counties represented in each of Panels 9-12. When running the model at the census region level, there are only 4 clusters. After running the models at all three levels, the output and Wald test statistics from the census region-level model were compared to the output from state and county-level models. There was no significant improvement to the census region-level model by using state or county levels of analysis, despite the larger numbers of clusters.

As a nationally representative survey, MEPS includes large numbers of observations, ranging from a low of 21,571 individuals in 1996 to a high of 37,418 in 2002 (MEPS-HC Sample Sizes, 2009). Between 1,637 and 2,237 individuals from the MEPS sample were Medicare beneficiaries in Panels 9-12 and were alive from beginning to completion of their Panels, and thereby included in the data for this analysis. According to Hox (2010), Browne and Draper (2000), and Kreft and Bokhee (1994), sample size should not prove to be a barrier to statistical power for the overall model, particularly at the state or county levels. Care will be taken to ensure that inferences made to the broader population are both statistically and substantively meaningful.

Chapter 4: Results and Analysis

The objective of this research is to analyze the relationships between the market penetration of Medicare Advantage (MA) plans and the progression of chronic diseases among Medicare beneficiaries. The Descriptive Analyses and results of the multilevel model introduced in Chapter 3 are presented here.

Descriptive Analyses

The sections below and associated tables and figures describe the CDSI outcome variable and the primary independent variables used in the analysis.

Chronic Disease Severity Index (CDSI)

The outcome variable in this study is the Chronic Disease Severity Index, a scale developed by the author in consultation with a team of physician advisors. Each of the MEPS diagnoses considered in this study (Figure 2) has been assigned a point value. Higher points are associated with worse conditions. As MEPS respondents report diagnoses, points accumulate and sum to the individual's CDSI score at times 1 and 2 (end of years 1 and 2 of each MEPS panel). Table 5 presents the mean CDSI score and standard deviation for each year of MEPS Panels 9-12. For Panels 9 through 11, respondents entered the two-year survey period with approximately 7.75 CDSI points on average, and exited after gaining an average of 1.4 to 1.5 additional points. Panel 12 respondents entered with more than 9 CDSI points on

average and accumulated, on average, an additional 2 by the end of their panel. It is unclear why this difference is not more gradual or distributed more evenly across time, but it may be due to increased documentation of chronic conditions following Medicare's risk adjustment policy expansion through the Medicare Modernization Act (MMA). Figure 3 depicts the distributions of CDSI variables in each panel. The data are clustered to the left with a right skewness in Year 1 and Year 2, as respondents' conditions are most likely to remain unchanged. Any change is more likely to indicate worsening of conditions rather than improvement.

Independent Variables

Market Level Independent Variables

The primary market-level explanatory variable of interest is Market Penetration of Medicare Advantage (MA). The HiPen variables are dummy variables signifying that a market area's MA penetration rate is $\geq$ 25% (Baker et al., 2004). There is one HiPen variable for each market level of the model (Census Region, State, and County-levels), and the model is run once for each level. Table 6 shows the number of markets (census region, state, or county levels) with at least 25% market penetration in each panel. At the census region level, no region changed HiPen status. However, the state and county-level data provide some insight into the growth of MA market penetration after the passage, and during implementation of the MMA.

While the number of counties with at least 25% MA market penetration grew strongly from 2004 to 2005, more explosive growth occurred in 2006, the year more of the MMA's changes took effect, including the Part D drug benefit. This 2005-2006 county-level growth caused the number of high-penetration states to increase from 7 to 9 (adding Pennsylvania and Puerto Rico).

The number of high-penetration counties grew by approximately 34% from 2006-2007, yielding one new high-penetration state (Minnesota). The pattern of rapid growth increased from 2007-2008 as Florida, New York, Ohio, and Utah became high-penetration states, driven by a 70% growth in high-penetration counties.

Individual Level Independent Variables

All individuals in this study had Medicare coverage. Approximately 94% to 95% were Medicare-covered in year 1 of the panel, and the remaining 5% to 6% had become eligible during their second year of the panel.

Fewer than half of these Medicare-eligible individuals report having some sort of other insurance coverage (40%-46%), and this varies little across panels. Only 4% to 6% report having obtained or dropped their other insurance coverage during the survey period.

The proportion of individuals reporting coverage through an HMO was only 15% to 16% in 2004 and 2005. However, this figure grew rapidly and

coincides with the passage of the MMA, which began to have substantive effects on MA enrollment in 2006. In the years 2006 to 2008, 33% to 35% of beneficiaries in the MEPS survey reported coverage through an HMO or other managed care organization (MCO), including Medicaid HMOs, Medicare MCOs, and other private HMOs. This increase coincides with the addition of a question in the MEPS survey asking specifically about Medicare managed care coverage in 2006 (the MCRPHO variable). Prior to 2006, MEPS asked about private HMO and Medicaid HMO coverage, but not specifically about Medicare managed care plan coverage.

This impacts the MCO variable in the regression equation, which is a composite of the aforementioned managed care coverage variables. The addition of the MCRPHO variable in MEPS, and its subsequent inclusion in the MCO variable of this regression analysis, means that respondents have greater opportunity to self-identify as having managed care coverage. When MCRPHO is omitted, the percentage of respondents reporting MCO coverage falls to its 2004-2005 levels, 15% to 16%. This may limit the ability to make comparisons between Panel 9 and Panels 10-12, but did not appear to have a consistent impact on the regression coefficients. The addition of MCRPHO as an underlying component of the MCO variable in 2006 may have contributed to the increased magnitude and significance of MCO in the regression model for Panel 10 (2005-2006), and to a lesser extent in Panel 11 (2006-2007).

However, if there was an effect, it does not appear to have continued into Panel 12 (2007-2008).

Beneficiaries may change their MA enrollment annually, but only a small percentage chooses to do so. Of beneficiaries in the MEPS survey, only 5% to 6% report obtaining new HMO/MCO coverage or dropping their HMO/MCO coverage between years 1 and 2 of the survey period. This effect was not deemed sufficiently substantive to warrant inclusion of both the year 1 and year 2 MCO variables. Because the year 1 MCO coverage has more time to impact CDSI outcomes, it was selected for inclusion in the regression model, and year 2 MCO coverage was omitted.

Weighted demographic data were also analyzed and are described in Table 8. The weighted descriptive statistics are representative of the overall Medicare-eligible population in the United States. In most respects, they differ very little from the unweighted statistics, however, MEPS over-samples individuals who are African-American or Hispanic, those with less than a high school education, those with incomes lower than 200% of the federal poverty level, and individuals not living in a metropolitan statistical area (MSA).

Over the five-year period represented by MEPS panels 9 through 12, the proportion of Medicare eligibles under age 65 and over 85 increased, as did the proportion of Hispanics. Previous studies have shown that Hispanics, on average, report better health measures, including lower rates of cardiovascular disease and longer life expectancy (Braveman et al, 2010; Vega et al, 2009).

Therefore, the increase in the Hispanic proportion of the Medicare-eligible population may have an impact on the CDSI outcome scores of the MEPS sample and the general Medicare population over time[4].

Cross-Tabs

Market Level Cross-Tabulations with CDSI Change

Two-way tables were run between all explanatory variables shown in the equations in Chapter 3 and the CDSI Change categorical variable. Tables 9a – 9c summarize the output for the market-level Medicare Advantage market penetration variable and the CDSI Change categorical variable. At the census region and state levels, the correlations between high market penetration status and CDSI change were only statistically significant in Panel 10. At the county level, the correlation is significant in Panels 10 and 12.

In Panels 9 and 11, at Census Region, State, and County levels, there do not appear to be substantial differences between the CDSI changes of low and high-penetration markets.

During Panel 10, at all three market levels, MEPS respondents in high-MA market penetration markets were more likely to have no change in CDSI score and less likely to worsen compared to respondents in low-penetration

[4] The Office of Management and Budget issued guidance in 1997 that Hispanic or Latino ethnicity should be reported separately from race (OMB, 1997).

markets (No change was defined as a CDSI change of less than or equal to 1 CDSI point. Worsening was defined as gaining more than 1 CDSI point).

At the county level in Panel 12, a different relationship exists. Respondents in high-penetration counties appear less likely to have no change and more likely to have worsened, a relationship opposite of what was observed in Panel 10. It may be that the rapid enrollment growth in non-managed or less-managed MA plan types (particularly PFFS plans) from 2006-2008 had begun to dilute any previously existing protective health effects. This would be consistent with concern expressed in the literature (Baker et al., 2008, Nicholas, 2009), and the hypotheses of the authors, that growth in PFFS and PPO enrollment could reduce potentially beneficial spill-over effects of HMOs.

Individual Level Key Variable Correlations with CDSI Change

The output from the correlations between individual level variables and CDSI (including CDSI in years 1 and 2, as well as CDSI change) is summarized in Table 10. The individual's insurance-related variables are shown first, followed by demographic variables. Interesting associations between CDSI scores and individual insurance-related variables include:

- Negative correlations between individual HMO coverage and CDSI scores, suggesting a protective effect (statistically significant in Panel 9, but not Panels 10 and 11).
- Positive correlations between individual HMO coverage and CDSI scores in Panel 12, suggesting a worsening effect of HMO coverage. As posited earlier, this change from Panel 9 through 12 may reflect the change in the MA market composition and growth of non-managed plan types.
- Other Private Insurance and CDSI scores are also negatively correlated in Panels 9 through 11, suggesting a protective effect (statistically significant in Panels 10 and 11).
- Positive correlations (but near-zero magnitude and not significant) between individual Other Private Insurance and CDSI scores in Panel 12. It may be that respondents are recording their HMO coverage as their Other Private Insurance. As speculated in the Panel 12 HMO-CDSI correlation, the change over time may reflect the change in the plan type composition of the MA market from 2004 through 2008.

Next, the table shows the relationships between the other individual-level variables (from the equations shown in Chapter 3) and their relationships to the interval CDSI variable (including CDSI in years 1 and 2, as well as CDSI change). Interesting observations include:

- Strong correlations between increasing CDSI (worsening) and ages 75 and older, as well as for ages 50 to 64 (those qualifying through disability).

Perhaps not surprising, those under age 50, who have had fewer years in which to develop chronic conditions, have negative correlations with CDSI, indicating better health for those younger beneficiaries.

- While not significant at all education levels or all panels, the education category dummy variables were consistently negatively correlated with CDSI scores, suggesting that high school graduation and higher levels of education are related to better health.
- Higher income levels (greater than 400% of FPL) have a consistently negative, statistically significant correlation with lower (better) CDSI scores. However, for income levels below 400%, correlations with CDSI were consistently positive (worse health), though this was only significant for those earning 201% to 300% of FPL in Panels 10-12.
- Although previous research has found correlations between Hispanic ethnicity and some measures of improved health, no such statistically significant relationship was observed in this data. Perhaps this is due to the small number of Hispanics in the MEPS sample, or perhaps related to acculturation into mainstream American lifestyles.
- While being married was not significantly correlated with CDSI scores, being widowed or never married was consistently related to CDSI, though in opposite directions. The statistically significant correlation between being a widow and higher CDSI may be directly related to the relationships between being a widow and age, income, and education. Being a widow is

positively correlated with age and negatively correlated with income (FPL group) and education. Never having been married has a statistically significant correlation with lower (better) CDSI scores, though this is likely due to younger Medicare beneficiaries who are eligible due to disability. Never having been married is negatively correlated with income, education, and age. Both marital statuses are negatively correlated with having Other Private Insurance. Being divorced is not significantly related to CDSI scores, except in Panel 11 where it appears to be correlated with lower CDSI. Being separated is generally correlated with somewhat higher CDSI scores, though the relationship is only statistically significant in Panel 9.

- Asian race was correlated with lower CDSI scores, though this relationship was not statistically significant in Panel 9, year 1 of Panel 11, or year 2 of Panel 12. No other racial groups had statistically significant correlations with CDSI score, except for American Indian / Alaska Native (AIAN) in Panel 11, which was associated with higher (worse) CDSI.
- Male gender is consistently correlated with higher CDSI scores in each year of each panel. This is intuitive, and suggests that men on Medicare will tend to have larger CDSI scores (more chronic conditions and related comorbidities) than women on Medicare.
- Residence in an urban, metropolitan statistical area (MSA) is correlated with higher (worse) CDSI scores, and the relationship is statistically significant in at least one year of each panel. We must be cautious not to

infer a causal relationship in this association. It is possible that urban environmental effects could contribute to ill health for beneficiaries. However, it is more probable that this association reflects the migration of sicker beneficiaries (with higher CDSI scores) into urban areas in order to live closer to hospitals and specialists.

Independence and Multicollinearity

Tests for correlation among covariates were run and matrices of the correlation coefficients are presented in Tables 11a-11d (Panels 9-12). There is a positive, statistically significant correlation between MCO and Other Private Insurance coverage. This was expected since MCO coverage is a type of private insurance, and some beneficiaries with MCO plan types also respond affirmatively to the MEPS “Other Private Insurance” question.

Having Other Insurance is significantly negatively correlated with lower age in all panels, and with ages over 85 in Panel 11. This is not surprising, since non-MA types of insurance, particularly Medigap Supplements, are costly and become more costly with age. The under-65 and oldest ages have significant negative correlations with the highest incomes, and it is intuitive that they would be less likely to afford Other Insurance. Some other interesting correlations with Other Private Insurance include:

- Education levels beyond high school diploma are correlated with having Other Insurance.

- Male gender has positive, significant correlation with Other Insurance in one or both years of Panels 9-11 (not significant in Panel 12).

These associations were expected for this generation, particularly due to the linkage between insurance and employment, and the historical role of the man as the household's primary wage earner (and often more educated).

Other Private Insurance coverage has statistically significant negative correlations with Hispanic ethnicity and Black race. This inverse relationship may reflect the lower average income and education status of these groups.

Other Private Insurance coverage is positively correlated with being married, and negatively correlated with being widowed, divorced, separated, or never having been married. Non-married marital statuses are consistently associated with lower incomes, limiting individuals' abilities to afford insurance. For many women, loss of a husband often means loss of not only Social Security and/or other pension income, but also loss of employer-sponsored retiree supplemental health insurance.

Those reporting membership in Managed Care (MCO), however, differ from those with the more overarching Other Insurance coverage. MCO coverage is significantly positively correlated with lower age in all panels. Beneficiaries under age 65, who qualify through disability, are frequently dual eligible and their MCO coverage may be coming through state-contracted Medicaid MCOs. Older beneficiaries were significantly negatively correlated

with MCO membership in Panels 9-11. As suggested earlier, it is possible that older beneficiaries are no longer able to afford managed care plans, even though premiums are typically lower than Other Private Insurance such as Medigap Medicare Supplements. Other interesting correlations with MCO membership include:

- Negative correlations between higher income and MCO membership, though the strength of this correlation weakened in Panel 12. This change in Panel 12 compared to previous years may be indicative of the broader market appeal gained by MA plans after the Medicare Modernization Act (MMA).
- Significant positive correlations between MCO membership and never having been married (in turn, never having been married is correlated with younger ages, a population that typically gains Medicare eligibility through developmental or other disability).
- MCO membership's positive correlation with being male. As with Other Insurance, this may be related to men's historic role as primary wage earner, and the legacy of receiving insurance through employment.
- MCO coverage has a statistically significant negative correlation with being widowed. Widows are predominantly female, and as suggested for the widow-Other Insurance association, losing a husband often means losing employer-sponsored retiree supplemental health insurance. In many cases, this may equate to losing MCO coverage.

- MCO membership has statistically significant positive correlations with Hispanic ethnicity, and Black or Asian race. This may be largely attributable to those groups' greater concentration in metro areas.
- MCO membership is also significantly positively correlated with living in an urban, metropolitan statistical area (MSA). Because MCO plans require provider networks, they are more readily available in urban areas. Non-MCO insurers (including PFFS plans) may not need contracted provider networks, making them more attractive to beneficiaries residing outside MSAs.

Multilevel Model Results

A multi-level regression model was specified with CDSI change (number of points change between first and second measurements) as the outcome variable. Independent variables included residence in a Medicare Advantage (MA) high-penetration census region, individual-level coverage by managed care (HMO) or Other Private Insurance, and the respondents' demographic variables. The model was run for each panel independently, and a summary of the resulting coefficients and p-values is presented in Tables 12 a-c.

Results at Census Region Clustering Level

At the census region level (Table 12a), there was no consistent effect of high MA market penetration on CDSI score change. This finding does not support the hypothesis that high levels of MA market penetration result in beneficiaries experiencing slower rates of chronic disease progression. Coefficients for this key covariate ranged from approximately -0.2 in Panels 10 and 11, to approximately 0.5 in Panel 12 (only statistically significant in Panel 12). Although not significant, the Panel 10 and 11 coefficients indicate a reduction in beneficiaries' CDSI scores of 0.2 points (protective effect) when they live in high-penetration markets, compared to those living in low-penetration areas (<25% MA market penetration). Conversely, the Panel 9 and 12 coefficients (Panel 12 was significant), indicate that residence in a high-penetration market is associated with increases of about 0.5 CDSI points (a worsening health effect). From these results, we cannot conclude that high market penetration of Medicare Advantage has any consistent significant effect on progression of chronic disease (as measured by the CDSI scale).

The effect of individual beneficiaries' coverage by an HMO, however, had a different relationship with their changes in CDSI scores (Table 12a). Although not statistically significant at the 0.10 level, the negative (protective) relationship between HMO coverage and CDSI change was consistent across all panels. The coefficients indicate a reduction in CDSI scores of approximately 0.1 to 0.5 points when beneficiaries are members of an HMO.

Although the primary hypothesis of this research is that high penetration MA markets positively impact beneficiary health, this finding is supportive of the underlying belief that managed care can make a beneficial impact on health.

Coverage by Other Private Insurance also had a more consistent impact on beneficiaries' CDSI scores than market-level MA penetration (Table 12a). However, the effect is the opposite of the impact of HMO coverage. The model indicates increases in CDSI scores (worsening) of between 0.1 and 0.6 points when beneficiaries have Other Private Insurance coverage. This effect was only statistically significant in Panel 10, when the coefficient was largest (0.55). While on the face of it this finding may be counterintuitive, it is not inconsistent with the hypothesis of this study. The Other Private Insurance variable includes coverage by the less-managed forms of MA plans, such as PFFS and PPOs. Since these plan types are less able to conduct active disease management, it is not surprising that their members experience greater progression of chronic disease than their peers in HMOs.

Beyond these key covariates of interest, demographic control variables were included in the model, few of which had statistical significance. Coefficients expected to increase CDSI change (worsening) included:

- Older age
- Male gender
- Lower education
- Lower income
- Hispanic ethnicity
- Racial minority status
- Non-married marital status
- Urban residence

While few of these demographic covariates were consistently statistically significant in the model at the census region level, the directions of their effects on CDSI change were generally as expected. As reported in Table 12a, being age 80-84 adds approximately 0.1 to 0.5 points to beneficiary CDSI change scores, relative to the age 65-69 comparator group. Being age 85 or higher contributes approximately 0.3 to 1.0 additional CDSI change points relative to the age 65-69 group.

Another expected finding was the protective effect of higher income. Relative to beneficiaries living in poverty (≤100% of FPL), higher income levels (>300% of FPL) experience as much as a 0.9-CDSI-point decline in CDSI change (protective effect).

Likewise, the effects of Hispanic ethnicity or racial minority status were as expected. For those coefficients that were significant or near-significant (<0.15), we see Hispanic ethnicity increasing CDSI scores (worsening) by nearly one point, Black race raising scores by a half point, and American Indian / Alaska Native and Multiple Race statuses driving CDSI change increases by 1.7 to 2.4 points. While the effect of Asian race was mixed over time, when it was statistically significant, it had a protective effect of lowering CDSI changes scores by 1.2 points.

There were some unexpected findings, however. Higher education was consistently associated with increasing CDSI (worsening). The impact of having some college education, a full four years of college, or more than four

years (compared with having not completed high school) ranged between a near-zero effect to greater than one additional CDSI point. This finding was counterintuitive, since greater education is generally believed to have a protective health effect.

There are multiple potential explanations for the worsening effect detected in this regression for those with higher education. First, the outcome variable was CDSI change, not absolute CDSI score. Better-educated beneficiaries may have lower CDSI scores overall and simply experience greater CDSI-point increases later in life. It is also possible, since the CDSI is composed of chronic condition diagnoses and related complications, that this finding reflects the long-term impacts of the more sedentary workplaces of the more highly educated Medicare beneficiaries.

Other unexpected findings were with respect to marital status, sex and urban residence. None had consistent impacts on CDSI change over time. None of the marital status variables were statistically significant. A protective effect of being married and worsening effect from being widowed were expected. There is some collinearity between marital status and age, and it may be that this is impacting the statistical significance of the marital status coefficients in the model.

Male gender was expected to be a consistent and statistically significant influence on higher CDSI change scores, but this was not observed. When significant, the impact was to increase CDSI change by 0.4 points. As with the

Education variables, it may be that using CDSI change as the outcome variable (rather than raw CDSI score) is affecting the consistency of direction, magnitude and significance. Males consistently have higher CDSI scores overall, but the increases in CDSI change over the one-year period in each panel are not statistically significant.

Urban residence was also expected to be associated with higher CDSI change (worsening), as those with more complex medical needs commonly prefer to live nearer to healthcare services. Like male gender, the association between urban residence and CDSI change was of mixed direction and impact. When significant, it was related to a nearly 0.8 CDSI-point increase in scores (worsening). As with the sex and education variables, it may be that using CDSI change as the outcome variable affects the association. Urban beneficiaries consistently have higher raw CDSI scores, but their increases in CDSI change within each panel are not significant.

Results at the State Clustering Level

At the state level (Table 12b), the direction, magnitude and statistical significance of the covariates were equivalent to those observed at the census region level (Table 12a). Again, there was no consistent effect of high MA market penetration at the state level on beneficiaries' CDSI score changes.

As at the census region level, we cannot conclude that high market penetration of MA at the state level has any consistent significant effect on progression of chronic disease (as measured by the CDSI scale).

This finding was surprising. The lack of consistency with the hypothesis at the census region level was not unexpected, as states within a census region (Figure 4) can be quite different on a number of factors, including their MA market penetration (Figure 5). However, the impact of high market penetration, with market defined as a state, was anticipated to be a more significant influence on CDSI change.

The associations of individual beneficiaries' HMO and Other Private Insurance coverage at the state level were similar to those previously described at the census region level. The state level results continue to indicate reductions in CDSI scores of approximately 0.1 to 0.5 points when beneficiaries are members of an HMO, and increases (worsening) between 0.1 and 0.6 points when beneficiaries have Other Private Insurance coverage. These state level findings continue to support the underlying beliefs that managed care can make a beneficial impact, and that coverage by less-managed plan types is less associated with improvements in chronic disease state.

Results at the County Clustering Level

At the county level (Table 12c) in Panels 9-11, we begin to observe some small differences in the direction of the high-penetration variable, compared to those described earlier, though none that are significant. The direction, magnitude and significance of the high-penetration coefficient at the county level in Panel 12 are consistent with those observed at the other levels. At the county level, just as at the census region and state levels, we cannot conclude any consistently significant effect of high MA market penetration on progression of chronic disease (as measured by the CDSI scale).

Relevance of Hypothesis 2

As introduced in Chapter 3, Hypothesis 2 was that the gap between the chronic disease progression rates of low and high MA market penetration areas will narrow over time. However, this hypothesis was contingent upon rejecting the null hypothesis in Hypothesis 1. The model results presented in Chapter 4 and discussed in Chapters 4 and 5 demonstrated that there was no consistent statistically significant effect of high MA market penetration on CDSI score change. Since Hypothesis 1 was not supported, the threshold for investigating Hypothesis 2 has not been met.

Sensitivity Analysis

As a measure of validation for the CDSI scale, the same correlation matrices and regression models were run again using change in self-reported relative health (SRH) as the outcome variable. The same multi-level mixed model was used (Stata's xtmixed command) in the same process as was followed with CDSI-change as the outcome variable. The CDSI, measured in MEPS rounds 3 and 5, and CDSI change scores are continuous scales and not bounded on the upper or lower ends. SRH change was defined as the difference in SRH scores between MEPS rounds 1 and 5, and is confined to a five-point scale, where 1 is excellent and 5 is poor health. Therefore, like the CDSI and CDSI change scores, smaller numbers and negative changes indicate relatively better health status.

While the ordinal nature of SRH presents a limitation when using a multilevel mixed model (Stata's xtmixed), ordinal scales with 5 or more categories and normal distributions have been shown to produce similar results as continuous scales. Because SRH change is normally distributed and has 5 categories on its scale, and to be most consistent with the regression procedures performed on CDSI change, this sensitivity analysis uses the same multilevel mixed model as used in the main analysis.

The Self-Reported Relative Health Regression Models

Table 13a-c presents the census region, state, and county level regression coefficients and p-values for the SRH-change model in comparison to the same statistics for the CDSI-change model. For the high-penetration variables, there were a few differences between the SRH-change and CDSI-change models. In Panel 12 at census region and county levels, the coefficients changed from positive and significant in the CDSI model to negative and non-significant in the SRH model. The Panel 12 state level coefficient remained positive, as in the CDSI model, but also became non-significant. Panels 10 and 11 saw no substantive differences between the two models. In Panel 9, the SRH coefficient was positive and significant, as compared to the negative, non-significant coefficient for the CDSI version of the model.

The magnitude of the coefficients differs between the models. This is to be expected, given the differences in the CDSI and SRH scales (unbounded continuous CDSI scale vs. the 1-5 SRH scale). The most noteworthy difference between the models for the high-penetration variables was Panel 12. The SRH model shows a similar pattern of non-significant negative coefficients from Panel 10 through 12, indicating a potentially protective effect of high market penetration on SRH. The CDSI model's pattern changed in Panel 12, as high-penetration became positive and significant, indicating a potential worsening effect on health. It is possible the change in the CDSI

model coefficient for high-penetration is related to the rapid growth of non-managed PFFS MA plan type

The Other Private Insurance and Managed Care plan membership variables were of particular interest in this study. The managed care coefficients had been consistently negative (protective) in Panels 9 through 12 of the CDSI change model, though significance was only approached in Panel 10. In the SRH change model, the magnitudes of these coefficients were near zero (a mix of positive and negative signs), and no panels had statistical significance. There appear to be differences between diagnoses of chronic conditions (measured by CDSI) and individuals' self-reported relative health status (measured by SRH), and these differences may be related to whether beneficiaries are covered by managed care plans or other types of private insurance.

In the CDSI change model, Other Private Insurance had positive coefficients (worsening) and statistical significance in Panel 10. In the SRH change model, Other Private Insurance coefficients remained positive in Panels 10 through 12, but became smaller and lost significance in Panel 10. Their sign changed to negative in Panel 9, but the effect was not significant at any market level. The findings for Other Private Insurance are relatively consistent between the two models, lending support for the belief that non-managed insurance does not provide a protective health effect.

When assessing the patterns of significance of the demographic independent variables across panels and market levels, some noteworthy differences emerge. In the SRH models, age was the most consistently significant variable, followed by income and education. Among the race variables, the only noteworthy difference between the models was for Black race. The CDSI model indicated an association between worsening health and Black race more strongly and more consistently than the SRH model. For other races and for Hispanic ethnicity, coefficients in both models were inconsistent over time and presented no substantive differences between the models. Any small racial differences that exist between the models may be related to differences between group members' general perceptions about their health or differences in their willingness to report it as 'poor' or 'excellent.'

The Age variable was fairly consistent between the SRH and CDSI models. Both models indicated higher (worse) scores for those in older age than the age 65-69 comparator group. Both models had negative coefficients (better health) for the 50-64 and under age 50 groups in comparison to those aged 65-69, though none were significant.

For the education level variables, there were no consistent, substantive differences between the CDSI and SRH models, though statistical significance varied. Both models reflected worse health (higher SRH and CDSI scores) with higher levels of education. As discussed earlier, one would expect higher education levels to be related to better health status, but neither model

consistently makes this association. This is an area for future investigation and an opportunity to refine the way the model assesses education.

In the CDSI model, coefficients for the income variables (percentages of poverty level) were generally negative, an indication of higher incomes relating to better health, though the relationship was seldom statistically significant. In the SRH model, coefficients were also generally negative or near-zero, though less consistently than in the CDSI model, particularly at the higher income levels. There may be differences in self-perceived health status between higher and lower income groups, even for those with similar chronic condition diagnoses.

On the marital status variables, CDSI change is more often negative (protective) for non-married beneficiaries than is SRH change. There appears to be a pattern of widowed, divorced or never-married beneficiaries having a lower chronic disease burden compared to how they self-report their health status.

The SRH model more frequently associated male gender with protective health effects than did the CDSI model. The difference between the models may be related to men minimizing their reported relative health problems. This is more difficult to bias when being asked about specific diagnoses of chronic health conditions.

Urban residence was generally non-significant in the CDSI change model, except in Panel 9 when it was positive (related to worsening CDSI) and significant. MSA coefficients in the SRH model were near-zero and non-significant in all panels and at all market levels. Beneficiaries in urban and rural areas appear not to differ significantly in how they report their relative health, though there is some evidence to suggest a higher chronic disease burden for those living in urban areas. This is likely due to those with more complex medical needs moving to urban areas to be close to medical treatment.

Summary of Differences between CDSI and SRH Regression Models

In the CDSI model, the impacts of most of the covariates are somewhat more consistent with the current body of public health knowledge: increasing age, low income, racial minority status (other than Asian), and male gender are associated with poorer health among beneficiaries. The associations between individual insurance type and the health outcome variable are also more consistent in the CDSI model. An unexpected association discovered in the model was the consistent relationship between higher education and worse health (higher CDSI scores). A similar association between SRH and education emerged (Table 13a-c), and potential explanations were presented earlier in this chapter.

Statistical Significance of the Overall CDSI and SRH Models

The Wald tests of significance for the CDSI change model at each market level in Panels 9, 10, and 12 suggest statistical significance at the 0.10 level (the Wald statistic in Panel 11 does not approach significance at any market level). The Wald chi-square statistics ranged from 42 to 45, and associated p-values from approximately 0.03 to 0.065. The likelihood ratio tests for the model did not approach significance at any market level or in any panel. From these test statistics, we can conclude that the census region-level model is reasonably useful for explaining the variation in the changes in beneficiary CDSI scores. However, we can also conclude that the addition of market level clustering at census region, state, and county levels did not contribute significant predictive power to the model.

Except in Panel 10, the Relative Health change (SRH) versions of the model also presented Wald statistics with p-values less than 0.10 (the Wald statistic in Panel 10 does not approach significance at any market level). At some market levels, in some panels, the SRH model had somewhat greater statistical significance than the CDSI model. As in the CDSI models, the addition of the market level random effects did not improve upon a simpler, linear regression version of either model.

There were no inconsistencies that were so great between the models as to clearly invalidate the CDSI model. Furthermore, the CDSI model's apparent advantages on the insurance, age, income, race, and sex covariates warrant

further investigation of the CDSI scale's usefulness in health services and health policy research. Judging from these significance statistics, we cannot conclude that analysis at the state or county levels improves the model. Further, it is not clear that the SRH greatly improves upon or invalidates the CDSI model. Nor is SRH any more accurate in representing Medicare beneficiary health overall than the CDSI scale.

Chapter 5: Discussion and Conclusions

The objective of this research has been to analyze the relationships between the market penetration of Medicare Advantage (MA) plans and the progression of chronic diseases among Medicare beneficiaries. The Chronic Disease Severity Index scale (CDSI) was constructed to represent beneficiaries' overall chronic disease states for survey or claims-based data, when more direct clinical measures of disease progression are not available. Using the CDSI on the MEPS dataset from AHRQ, we sought to assess the impacts of MA market penetration and other potentially causal covariates on the overall chronic disease state of Medicare beneficiaries from 2004 through 2008.

Though the model explains much of the variation in CDSI change, the author expected the multilevel model would show that market-level MA penetration explains a significant level of variation in CDSI change. However, this hypothesis was not substantiated, and the findings suggest that unmeasured factors may be contributing to additional unexplained heterogeneity.

The estimates from the model do not consistently suggest that residence in an area of high MA market penetration has a protective effect on the health of Medicare beneficiaries (as represented through the CDSI scale). Although there were some indications of a protective effect in Panel 10, the results were not significant in the following and previous panels, and appear to change in

Panel 12 to indicate a worsening health effect. Given the changes occurring in Panel 12, it would be informative to extend the time to subsequent panels as they become available.

These inconsistent estimates between Panel 12 and earlier panels could be related to the changing trends in MA plan type enrollment since passage and implementation of the MMA. They may also be affected by administration of the MEPS survey and coding of responses. Both of these questions will be explored in subsequent research.

There are other limitations and potential explanations for inconsistent or otherwise unanticipated findings of this study. MA market penetration was represented as a dichotomous variable with ≥25% penetration defined as 'high' (Baker et al., 2004). In the future, investigations should consider alternative thresholds, multiple categories of market penetration levels, and maintenance of high-penetration over time (market maturation).

The MEPS data presents other limitations. Respondents are followed for only two years, and the diagnosis questions necessary for the CDSI scale are only asked at the end of each year. More longitudinal data with a more comprehensive record of diagnoses and complications would improve the methodology and should produce more accurate CDSI scores.

Underlying the author's first hypothesis was the anticipation that risk-adjustment provisions of the MMA could contribute to improved health for beneficiaries, particularly for MA HMO enrollees. However, there was little

statistical significance for such an effect, and we cannot make conclusive inferences about the effects of MA HMO membership on individual Medicare beneficiary health (as represented through the CDSI scale). If there were any risk-adjustment benefits to HMO enrollees after the passage of the MMA, they had either not yet manifested by 2008, or they were outweighed by growth in non-managed plan types.

The findings also suggest the need for better means of representing individual types of insurance coverage. HMO coverage was related to improving health, and Other Private Insurance was associated with worsening health. However, as used in MEPS, these variables are not mutually exclusive, and the author believes refinement of these variables may result in clearer and more consistent outcomes from the model when used on other datasets in the future. Previous research has also proposed that MA plan types be analyzed separately, though this is not possible with currently available MEPS data. For future MA studies, it will be important to differentiate between HMO, PPO, and PFFS plan types, particularly as more data becomes available post-MMA.

Limitations

There are a number of limitations to this study's methodology and statistical model. First, the Chronic Disease Severity Index scale (CDSI) is new and not yet tested elsewhere. It has been vetted by multiple physicians

specializing in Family and Internal Medicine, and is believed to be valid from a clinical perspective (Barrett, 2011; Godek, 2011; Latta, 2011). The CDSI change score also presents a limitation, as it accounts solely for the differences between respondents' two CDSI scores over a relatively short 12-15 month period.

The MEPS survey data has important limitations that must be considered in this analysis. Ideally, it would have been possible to directly use CMS data for MA enrollees' plan type information, diagnosis data and demographic variables. However, CMS only makes Traditional FFS data available to researchers, and does not provide information on MA enrollees. As a result, we have had to rely upon self-reported data for diagnoses, insurance, and the other covariates used in the model.

Individuals' chronic disease diagnosis data is self-reported in MEPS and subject to recall error and the honesty of participants' responses to surveyors. MEPS has little problem with missingness on diagnosis-related variables, as most missing data has been imputed using the provider surveys of the MEPS-Provider Component. MEPS has limitations with respect to respondent age. The MEPS procedures for data entry top-code the respondent's age at 90, limiting the ability to analyze the disease progression of the eldest Medicare beneficiaries.

The MEPS insurance variables also have limitations. MEPS has collected and verified plan type information in the past. The detailed managed

care plan data used by Tye et al (2004) was available in the 1996 survey year, but discontinued by MEPS thereafter. This means the only method for differentiating individual Medicare Traditional FFS beneficiaries from members of MA plans is through the use of the three dichotomous insurance variables: Medicare, Other Insurance, and Member of Managed Care Plan / HMO.

Differentiating between beneficiaries with solely Traditional FFS and those beneficiaries with some additional coverage is less prone to error (only the Other Insurance variable is needed). However, the ability to differentiate between beneficiaries enrolled in MA HMOs and those with other forms of supplemental Medicare insurance (such as Medigap plans, MA PPOs and MA PFFS plans) is more limited. The primary concern is the degree to which respondents understand which type of plans they have, and the clarity of communication between the surveyor and respondent.

Health care providers' diagnosis practice patterns are also a limitation. The accuracy of the CDSI depends upon respondent recall of the diagnoses given to them by their providers. Therefore CDSI is affected not only by respondent recall, but also by the variations in physician practice patterns of diagnosis and patient communication.

Consistency with Previous Research

The results of this study were somewhat consistent with the mixed findings of previous research. The meta-analysis by Miller and Luft (2002)

found mixed results in more than half the studies they reviewed. Of the studies specifically addressing managed care market penetration, most showed direct relationships between high-penetration and increased levels of screening, but none assessed patient-level health outcomes. Finding great variation around the country, with better results in mature managed care markets like California, Miller and Luft (2002) speculated that disparate disease management practices could be contributing to lack of consistent outcomes, even among similar plan types. This may persist as an important contributor to the unmeasured heterogeneity among CDSI outcomes across different markets and across individuals.

Like some of the literature reviewed by Miller and Luft (2002), Baker et al. (2004) found high market penetration of HMOs to be associated with more screenings, but less so for high penetration by PPO plans. Baker et al. (2004) also found market-level penetration rates to be more important than individuals' plan types. This was not readily evident in the current analysis, as the impacts of market-level penetration were inconsistent in direction, and when they were statistically significant (in Panel 12), they indicated a worsening effect on individuals' CDSI outcomes.

The study by Scanlon et al. (2006) associated managed care market penetration with health plan-level outcomes. This study had mixed findings for measures of processes of care, but more conclusive improvements for biometric outcome measures. Scanlon et al. (2006) used each individual

health plan performance measure as the outcome variable in multiple iterations of their model. They concluded that results could be different if all were incorporated into one model. The current research affirms that assertion. The CDSI combines multiple outcome measures into one composite dependent variable, as Scanlon et al. (2006) recommended. However, when taken together in one composite score (CDSI), statistical significance is lost. As in the current research, Scanlon et al. (2006) and Baker et al. (2004) concluded that better measures of health plan type could also have improved the methods and provided results more actionable for policymakers.

The two-phased study by Escarce et al. (2006) and Rogowski et al. (2007) also found mixed outcomes (post-hospitalization mortality) with increases in overall managed care market penetration. Like the Scanlon et al. (2006) study, the individual dependent variables used in the model were mortality rates related to specific diseases / conditions. The researchers studied post-hospitalization mortality in California, Wisconsin, and New York, and speculated in their conclusions that benefits might only accrue after a market became mature. The current research used one composite outcome variable (CDSI) and studied specifically Medicare managed care markets on a nationwide scale during a time of rapid growth. These differences in methodology may have contributed to differences in the findings.

While Chernew et al. (2008) and Nicholas (2009) focused on the economics of spill-over effects rather than health-related outcomes, both were

concerned about post-Medicare Modernization Act growth in non-managed types of plans. Both researchers expressed concern that growth in the less-managed / non-managed PPO and Private-fee-for-Service (PFFS) plans would dilute any spill-over effects that might be realized through market penetration of the more medically managed HMO plans. This continues to be a research concern, as the majority of the Medicare Advantage growth since 2004 has been in PPO and PFFS plan types. The MEPS data is not ideal for making this differentiation, and there is room for future study to more clearly investigate the differences in beneficiary health outcomes between members of different types of plans.

Future Research

There are multiple avenues of future research under consideration by the authors. The current research included MEPS data from 2004-2008, from only the first few years of Medicare Modernization Act (MMA) implementation. A future analysis will extend the data through Panel 13 (2008-2009), and later to Panel 14 (2009-1010). This will provide additional years of MMA-influenced data. The CDSI instrument will be further refined to improve its clinical validity, and compared against models using single-diagnosis outcome variables, as done by Scanlon et al. (2006). Future revisions of the CDSI will also be tested on other datasets to better assess statistical reliability.

A need continues to exist in the literature for comparative studies of health plan types. The ability of MEPS data to differentiate accurately between types of health plans is limited. Other datasets are under consideration to address this shortcoming without sacrificing the nationally representative scope of study. The authors' future research will improve the ability to compare the differences between plan types.

As proposed by Baker et al. (2004) and Escarce et al. (2006), the maturity of a managed care market should be expected to impact practice patterns and, potentially, health outcomes. In addition to better differentiating between plan types, future research must incorporate better means of assessing managed care market maturity. These proposed future research directions are currently under investigation by the primary investigator, in conjunction with other researchers at Oregon State and Saint Louis Universities, and the Saint Louis University Center for Outcomes Research.

This research found unexpected associations between higher education and worsening health. This finding should be explored and better understood. Additionally, given the differences between genders, marital statuses, and races, it would be valuable to further investigate the discrepancies between the perceptions of health (SRH) and more clinical measures (like the CDSI).

Policy Implications and Recommendations

Despite the lack of support for the initial hypotheses, the results have important implications for policymakers. The federal government's cost to have beneficiaries in Medicare Advantage (MA) was recently approximately 13% greater than for the traditional Fee For Service (FFS) program (McDowell & Sheingold, p.29, 2009; Berenson, p.w156, 2008). Proponents advocate that the MA program is a means to provide beneficiaries with greater choice than in the FFS program. Indeed, MA organizations have the flexibility to provide extra benefits and better financial protections. However, if Medicare Advantage is intended to produce better health outcomes than FFS, the current analyses, and the research that preceded it, have not shown compelling evidence for such a comparative advantage. If policymakers and taxpayers expect more than improved choice for the 13% "over-payments" made to MA organizations, they may not be receiving as much benefit as they expect.

Given the findings of this research, there may be reasons to question the CMS risk adjustment program. Since the MMA, CMS has provided MA organizations with additional funds when they enroll beneficiaries with health conditions. If health outcomes are not significantly different between those individuals in the FFS and MA programs, CMS should question whether anything other than beneficiary choice is being gained through this program.

As presented in Chapter 1, the Patient Protection and Affordable Care Act (ACA) contains provisions for expansion of Patient-Centered Medical Home models, accountable care organizations, healthcare information technology, and Pay-for-Performance initiatives. The effectiveness of any of these ACA initiatives must be monitored, both for impacts on health outcomes and for economic effects. This research can inform future approaches to outcomes assessment using the CDSI, and multilevel modeling methodologies similar to those employed here.

In 2011, members of the U.S. House of Representatives proposed Medicare reforms that begin transitioning Medicare from a defined-benefit, primarily government-administered program to a more defined-contribution voucher-based model (though such changes would only affect Americans more than ten years from Medicare eligibility). With their vouchers, beneficiaries would purchase their own insurance in the free market; the descriptions of which sound remarkably similar to Medicare Advantage (NPR, 2011).

The belief underlying these types of reform proposals is that the free market should be able to stem the rising tide of healthcare cost inflation and ensure higher quality of care as insurers compete for beneficiaries' business. The fallacy, at least as we know the MA program today, is that the 'bid' process between CMS and MA organizations is not reflective of a truly 'free market' in the way that advocates may envision. For this process to have a

chance for success, CMS would have to stop setting the capitation benchmark at levels in excess of Traditional FFS costs. Advocates of this approach believe it will "give seniors the power" (NPR, 2011). The risk, however, is that individuals will not have sufficient purchasing power in the market to command lower premiums from insurers. It is also unlikely they would gain the power to demand higher quality from healthcare service providers. In such a voucher scenario, it is likely that costs would continue to increase as they have been. Then, absent significant voucher increases from the federal government, the burden of inflation would fall solely on the beneficiaries themselves.

Given the results of the research, and the investigator's experience in the MA industry, there are three specific recommendations:

- CMS should explore the initiation of a disease management / care management program for FFS beneficiaries, thereby eliminating this major difference between the programs. Controlling for this difference, researchers could better assess the real differences between the government-run and privately-contracted versions of Medicare.
- CMS should investigate the feasibility of restructuring MA organizations' capitation arrangements so that payment is less than or equal to FFS costs when beneficiary outcomes are not significantly better than FFS comparison groups.
- MA plans would be prudent to proactively demonstrate their value to beneficiaries and taxpayers. Using their claims data (or preferably

clinical data) and epidemiological methods, they should better monitor and report the longitudinal outcomes of their enrolled beneficiaries. Demonstrating that they can bring value in terms of improved health outcomes, not solely improved choices, will help insure their long-term survival, regardless of which political party is in power.

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Appendices

Figures

Figure 1a: 2008 Diabetes Prevalence Rates, BRFSS

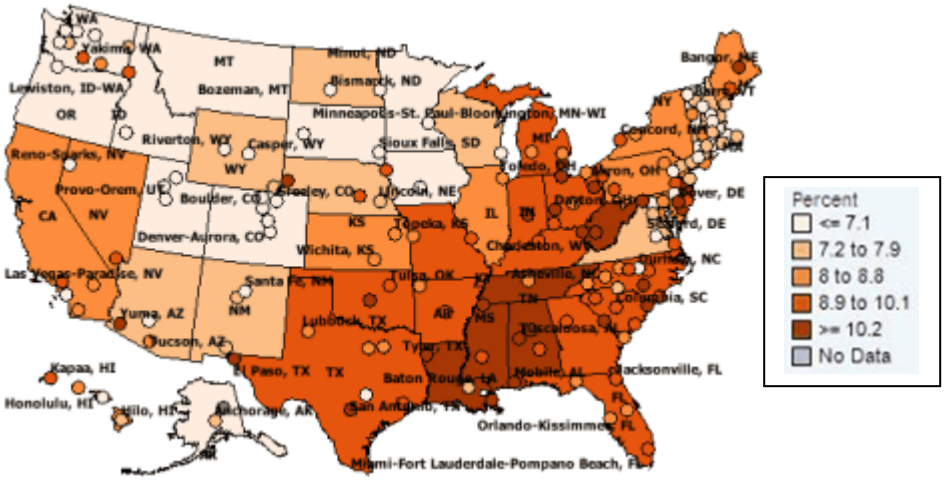


Figure 1b: 2007 Hypertension Prevalence Rates, BRFSS

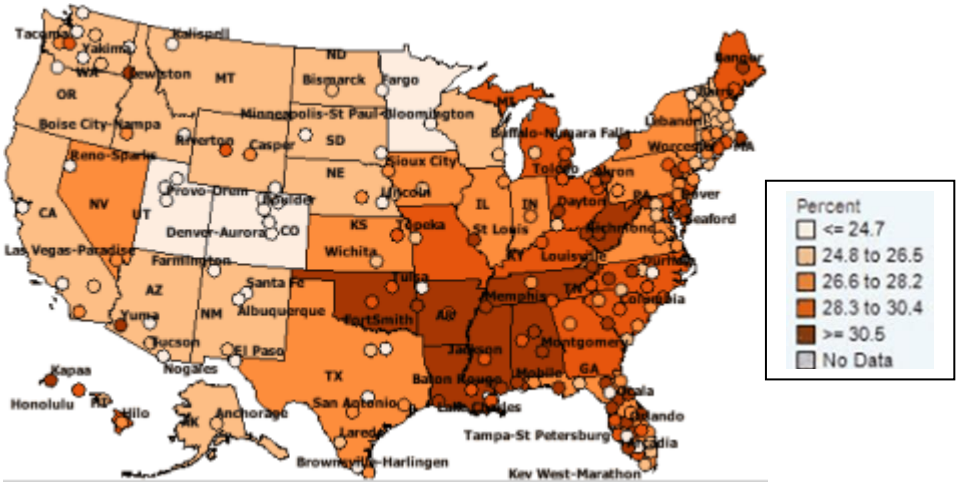


Figure 1c: 2008 Myocardial Infarction (MI) Prevalence Rates, BRFSS

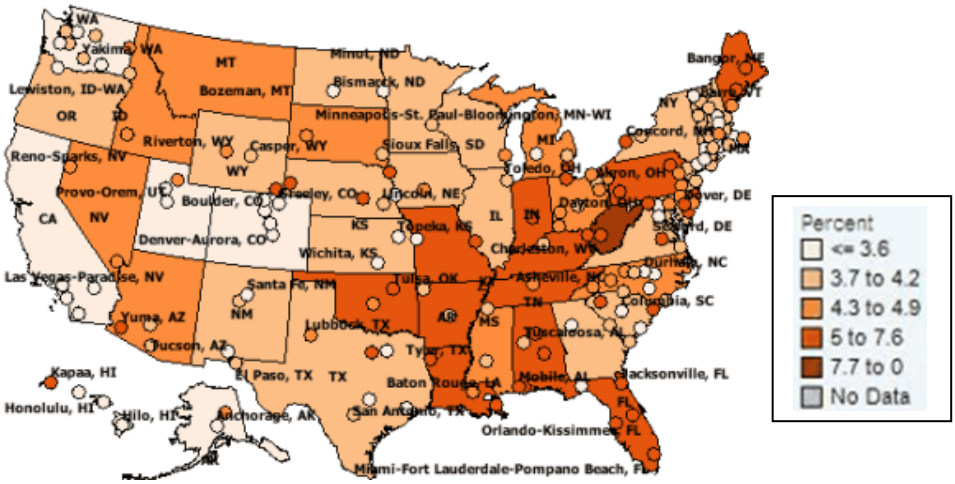
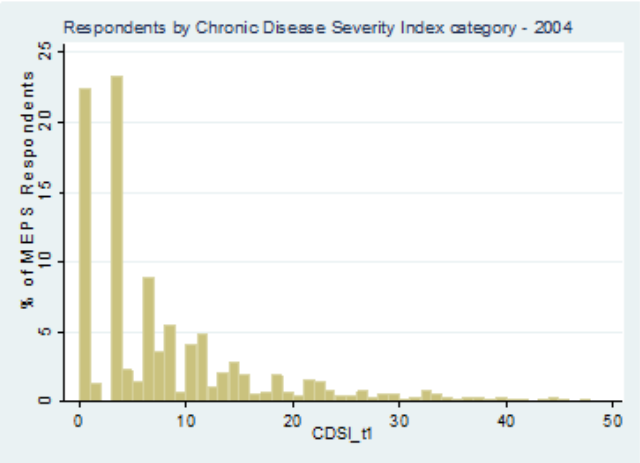


Figure 2: Components of the CDSI Progression Scale

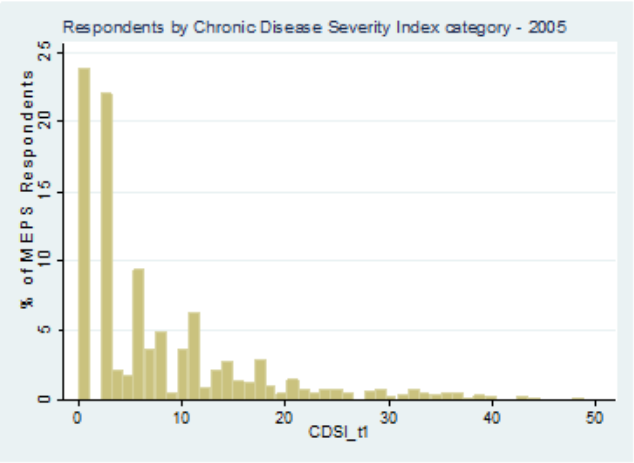
Diagnosis	CDSI Point-Value
myocardial infarction (heart attack)	10
coronary heart disease	8
angina	8
stroke / TIA	7
diabetes (type 2 only)	5
other heart problem	4
“walk-limit” physical limitation	3
diabetes-related eye or kidney problem	3
multiple diagnoses of high-blood pressure	2
high cholesterol	2
high blood pressure (first time diagnosis)	1

Figure 3: Histograms of CDSI_t1, t2, and Change: Panels 9-12 (1 of 3)

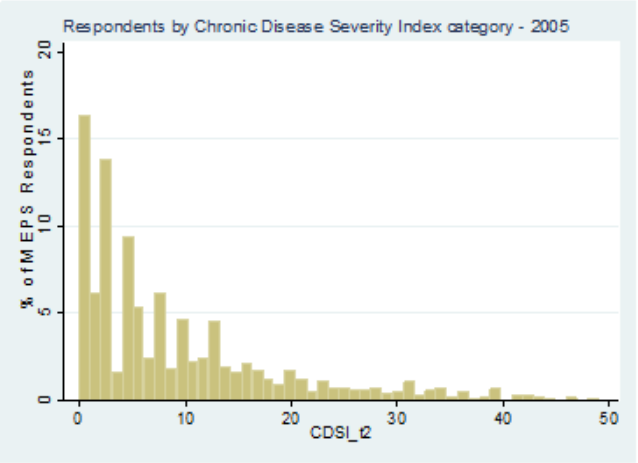
Panel 9, year 1



Panel 10, year 1



Panel 9, year 2



Panel 10, year 2

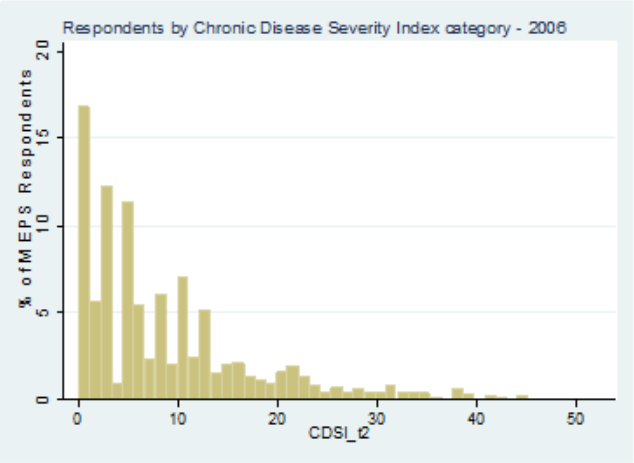
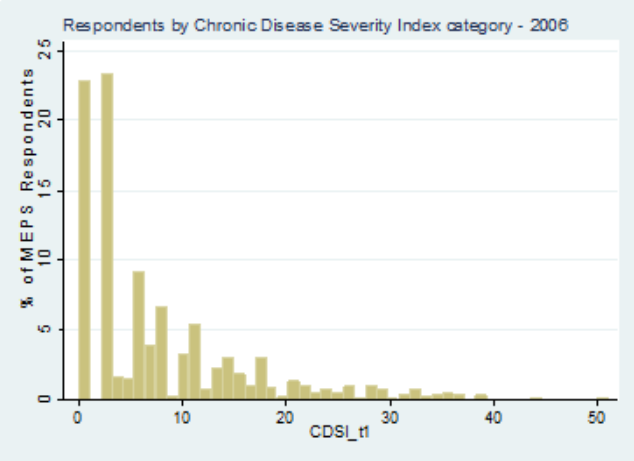
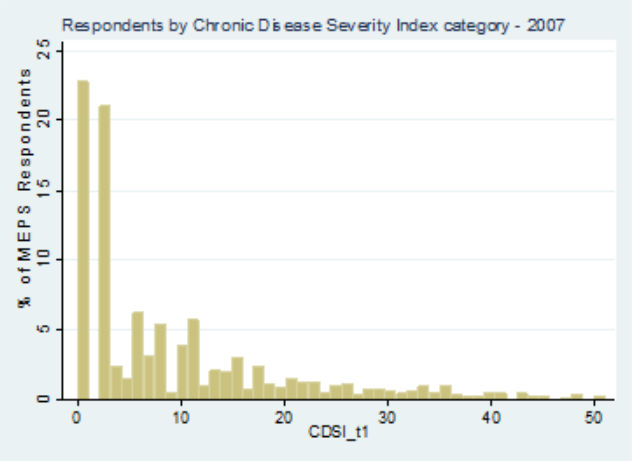


Figure 3: Histograms of CDSI_t1, t2, and Change: Panels 9-12 (2 of 3)

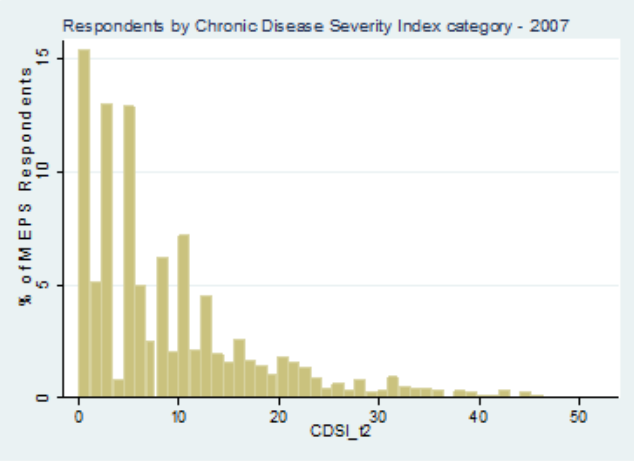
Panel 11, year 1



Panel 12, year 1



Panel 11, year 2



Panel 12, year 2

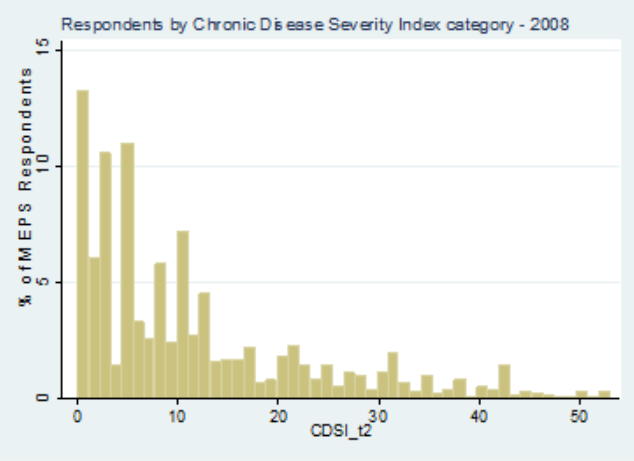
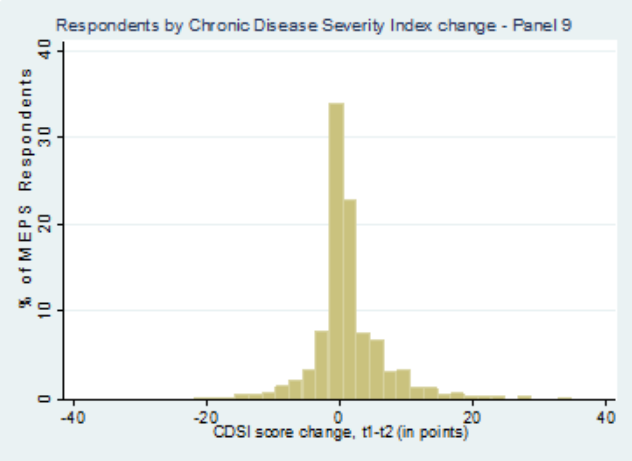
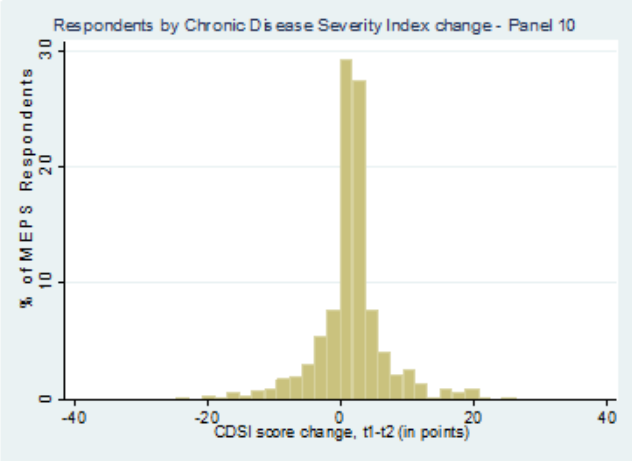


Figure 3: Histograms of CDSI_t1, t2, and Change: Panels 9-12 (3 of 3)

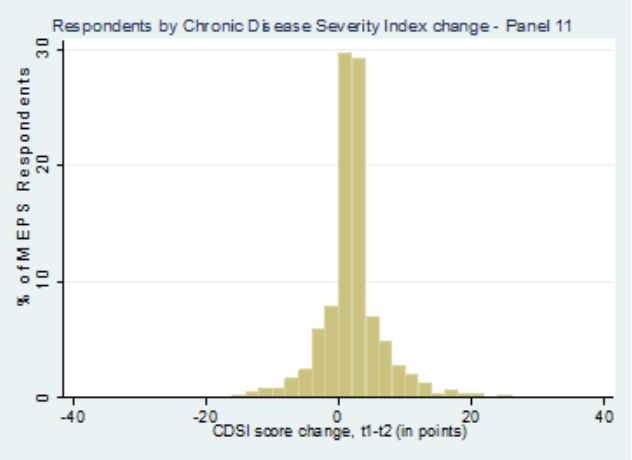
Panel 9, Change (yr2-yr1)



Panel 10, Change (yr2-yr1)



Panel 11, Change (yr2-yr1)



Panel 12, Change (yr2-yr1)

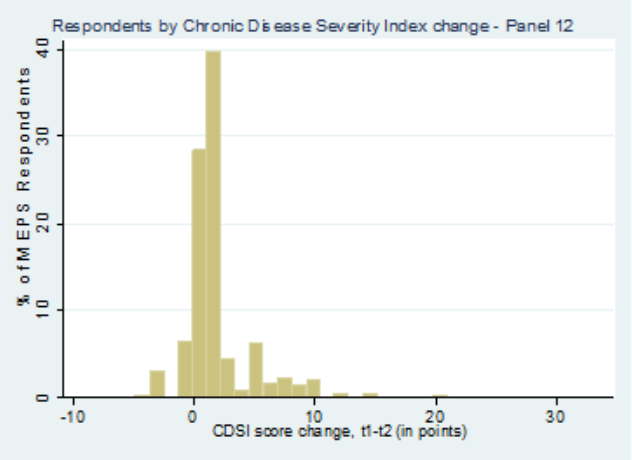


Figure 4: Census Regions of the United States

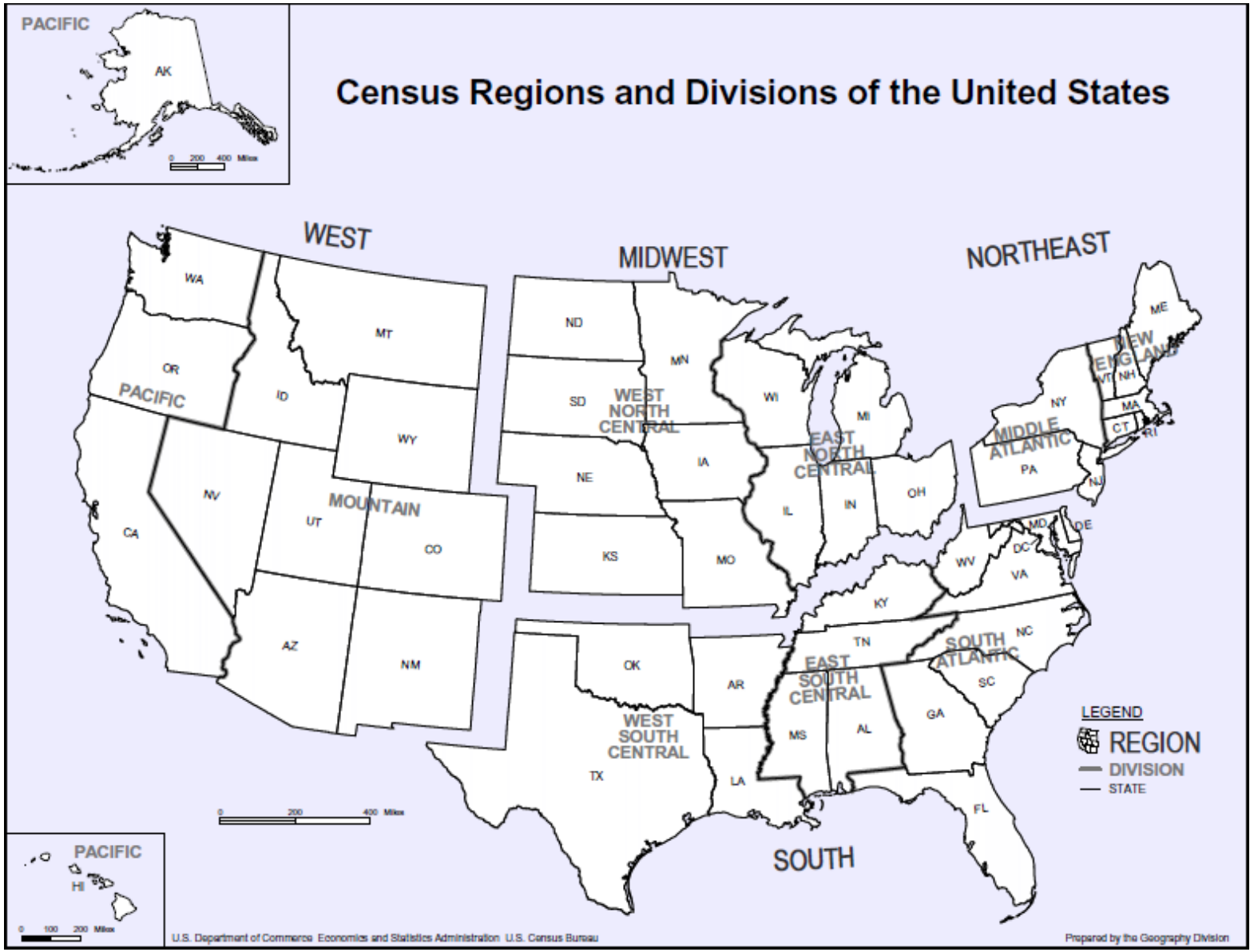
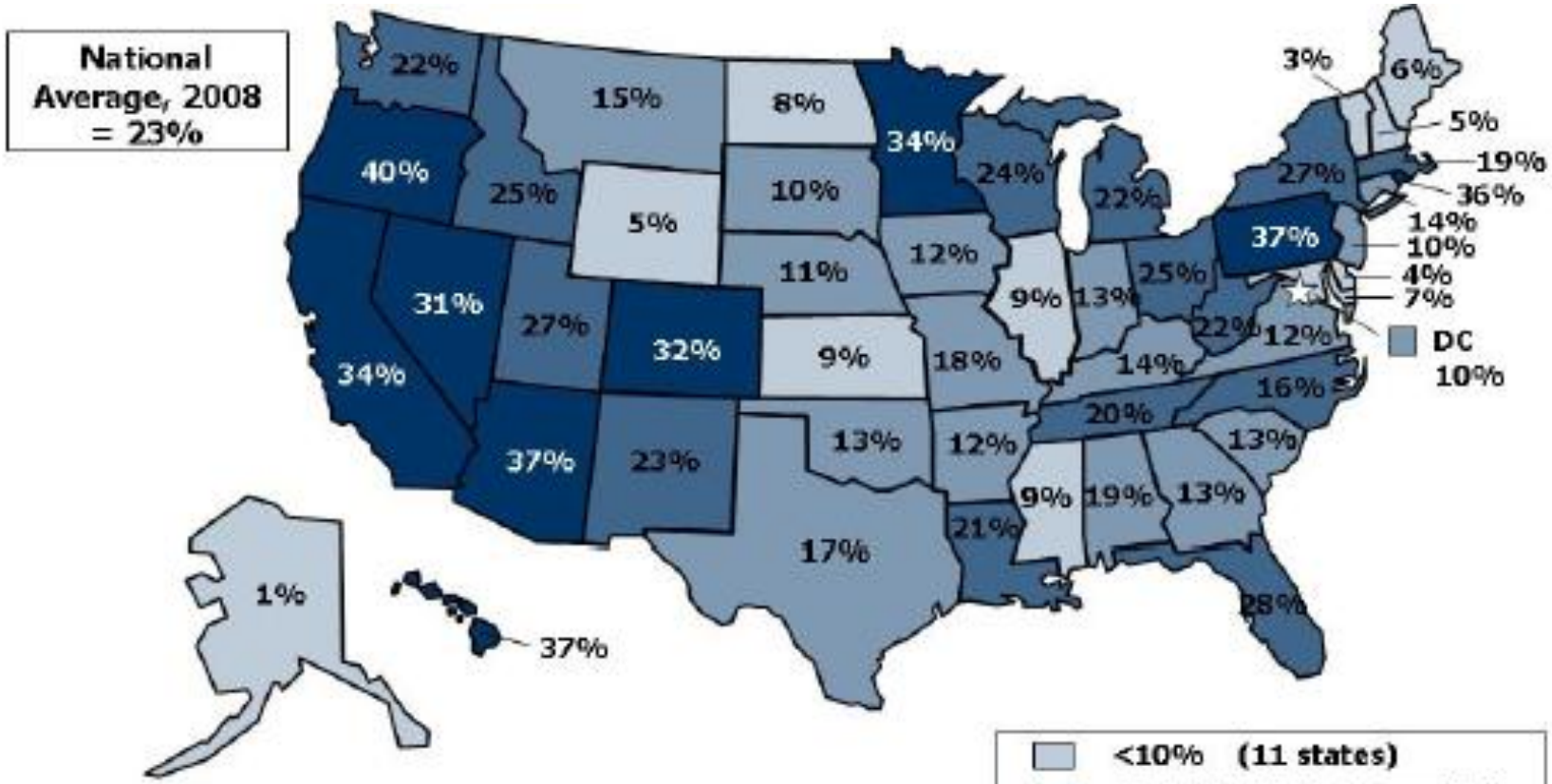


Figure 5: 2008 Medicare Advantage Market Penetration by State



Note: Share of Medicare Advantage enrollees includes beneficiaries in Medicare HMOs, PPOs, PSOs, MSAs, PFFS, demonstrations, PACE, employer direct PFFS, and cost plans.
SOURCE: Kaiser Family Foundation analysis of Centers for Medicare and Medicaid Services State/County Market Penetration Files, July 2008.

Tables

Table 1: Variables Used Directly in the Analysis

Variable Name	Variable Code	Source	Variable Type	Data Description
Dependent Variable				
Chronic Disease Severity Index	CDSI change	constructed from component MEPS-HC diagnosis variables (see Table 2)	continuous (outcome variable)	continuous scale; CDSI_t2 - CDSI_y1
Independent Variables				
MA high market penetration (dummy var)	hipenregion_t1/2, highpenstate_t1/2, hipencty1/2	constructed from CMS PENRATE variables	dichotomous covariate	1= lives in a HIPEN market (county, state, or region)
Metropolitan Statistical Area	MSA2, 4	MEPS HC, Longitudinal File	dichotomous covariate	1= lives in an MSA
County	cntyx2, x4	MEPS (non-public use)	categorical covariate	1-3262 (incl. territories)
State	state2, 4	MEPS (non-public use)	categorical covariate	1-56 (incl. territories)
Census Region	REGION2, 4	MEPS HC, Longitudinal File	categorical covariate	1=NE, 2=Midwest, 3=South, 4=West
degree of education	HIDEG	MEPS HC, Longitudinal File	multiple dichotomous covariates	1= no degree, 2= high school, 3= some college, 4= bachelors, 5= >bachelors
age	AGEy1x	MEPS HC, Longitudinal File	multiple dichotomous covariates	computed from Date of Birth and Survey Administration dates
age^2	AGEy1_sqrd	computed from AGE in MEPS HC	continuous covariate	
Household Income (as % of Federal Poverty Level)	POVCATy1, 2	MEPS HC, Longitudinal File	multiple dichotomous covariates	1= 100% or less, 2= 101% - 200% FPL, 3= 201% - 300% FPL, 4= 301% - 400% FPL, 5= above 400% FPL
race	RACEX	MEPS HC, Longitudinal File	multiple dichotomous covariates	1= white, no other; 2= black, no other; 3= American Indian/Alaska Native, no other; 4= Asian, no other; 5= Native Hawaiian/Pacific Islander, no other; 6= multiple races reported
Hispanic	HISPANX	MEPS HC, Longitudinal File	dichotomous covariate	1 = Hispanic
sex	SEX	MEPS HC, Longitudinal File	dichotomous covariate	1= male
marital status	MARRY2x	MEPS HC, Longitudinal File	multiple dichotomous covariates	"married2," "nvrmry2," "widowed2," "divorced2," and "separated2" dummary variables created from original "marry2x" MEPS variable

Table 2: All Variables Drawn from MEPS and CMS (page 1 of 4)

Variable Name	Variable Code	Source	Variable Type	Data Description
Dependent Variable (and its components)				
Chronic Disease Severity Index	CDSI	constructed from component dependent variables below	continuous (outcome variable)	continuous scale
Diagnosed w/ High Blood Pressure	HIBPDX	MEPS Household Component (HC), Longitudinal File	dichotomous (component of outcome var)	1= Yes, has the condition
Multiple Diagnoses of High Blood Pressure	BPMLDX	MEPS HC, Longitudinal File	dichotomous (component of outcome var)	1= Yes, has the condition
Diagnosed with Coronary Heart Disease	CHDDX	MEPS HC, Longitudinal File	dichotomous (component of outcome var)	1= Yes, has the condition
Diagnosed with Angina / severe chest pain	ANGIDX	MEPS HC, Longitudinal File	dichotomous (component of outcome var)	1= Yes, has the condition
Diagnosed with heart attack / myocardial infarction (MI)	MIDX	MEPS HC, Longitudinal File	dichotomous (component of outcome var)	1= Yes, has the condition
Diagnosed with other heart disease	OHRTDX	MEPS HC, Longitudinal File	dichotomous (component of outcome var)	1= Yes, has the condition
Diagnosed with stroke or transischemic attack (TIA)	STRKDX	MEPS HC, Longitudinal File	dichotomous (component of outcome var)	1= Yes, has the condition
Diagnosed with high cholesterol / hyperlipidemia	CHOLDX	MEPS HC, Longitudinal File	dichotomous (component of outcome var)	1= Yes, has the condition
Diagnosed with diabetes	DIABDX	MEPS HC, Longitudinal File	dichotomous (component of outcome var)	1= Yes, has the condition (excl. gestational diabetes)
Kidney problems caused by diabetes	DSKIDN53	MEPS HC, Longitudinal File	dichotomous (component of outcome var)	1= Yes, has the condition
Eye problems caused by diabetes	DSEYPR53	MEPS HC, Longitudinal File	dichotomous (component of outcome var)	1= Yes, has the condition
Limitation in physical functioning	WLKLIM31, 53	MEPS HC, Longitudinal File	dichotomous (component of outcome var)	1= Yes, has the condition
Perceived Health Status	RTHLTH1, 5 (and difference)	MEPS HC, Longitudinal File	ordinal (used as substitute for outcome var in sensitivity analysis)	5-point scale ("Excellent" to "Poor")

Table 2: All Variables Drawn from MEPS and CMS continued (page 2 of 4)

Variable Name	Variable Code	Source	Variable Type	Data Description
Dependent Variable (and its components)				
Total # ER visits in the year	ERTOTy1, 2	MEPS HC, Longitudinal File	continuous (component of outcome var)	0, 1 to 14
Total # in-patient discharges in the year	IPDISy1, 2	MEPS HC, Longitudinal File	continuous (component of outcome var)	0, 1 to 283
Total # in-patient nights in the year	IPNGTy1, 2	MEPS HC, Longitudinal File	continuous (component of outcome var)	0, 1 to 283
Independent Variables				
MA market penetration	region_penrate_t1/2, state_penrate_t1/2, cty_penrate_t1/2	CMS	continuous covariate	MA market penetration %
MA high market penetration (dummy var)	hipenregion_t1/2, highpenstate_t1/2, hipencty1/2	constructed from CMS PENRATE variables	dichotomous covariate	1= lives in a HIPEN market (county, state, or region)
Metropolitan Statistical Area	MSA2, 4	MEPS HC, Longitudinal File	dichotomous covariate	1= lives in an MSA
County	cntyx2, x4	MEPS (non-public use)	categorical covariate	1-3262 (incl. territories)
State	state2, 4	MEPS (non-public use)	categorical covariate	1-56 (incl. territories)
Census Region	REGION2, 4	MEPS HC, Longitudinal File	categorical covariate	1=NE, 2=Midwest, 3=South, 4=West
degree of education	HIDEG	MEPS HC, Longitudinal File	multiple dichotomous covariates	1= no degree, 2= high school, 3= some college, 4= bachelors, 5= >bachelors
age	AGEy1x	MEPS HC, Longitudinal File	multiple dichotomous covariates	computed from Date of Birth and Survey Administration dates
age^2	AGEy1_sqrd	computed from AGE in MEPS HC	continuous covariate	
Household Income (as % of Federal Poverty Level)	POVCATy1, 2	MEPS HC, Longitudinal File	multiple dichotomous covariates	1= 100% or less, 2= 101% - 200% FPL, 3= 201% - 300% FPL, 4= 301% - 400% FPL, 5= above 400% FPL
race	RACEX	MEPS HC, Longitudinal File	multiple dichotomous covariates	1= white, no other; 2= black, no other; 3= American Indian/Alaska Native, no other; 4= Asian, no other; 5= Native Hawaiian/Pacific Islander, no other; 6= multiple races reported
Hispanic	HISPANX	MEPS HC, Longitudinal File	dichotomous covariate	1 = Hispanic

Table 2: All Variables Drawn from MEPS and CMS continued (page 3 of 4)

Variable Name	Variable Code	Source	Variable Type	Data Description
Independent Variables				
sex	SEX	MEPS HC, Longitudinal File	dichotomous covariate	1= male
marital status	MARRY2x	MEPS HC, Longitudinal File	multiple dichotomous covariates	"married2," "nvrmry2," "widowed2," "divorced2," and "separated2" dummary variables created from original "marry2x" MEPS variable
person disposition status	pstats1, 2, 3, 4, 5	MEPS HC, Longitudinal File	categorical covariate	PSTATS values of -1, 1-5, 12, 21, 23-24, 31, 34 & 51 to exclude deceased, military, or otherwise out of scope
Covered by Medicare	MCAREy1x, 2x	MEPS HC, Longitudinal File	dichotomous covariate	1= yes
Covered by Medicare Part D	MCRPDy1x, 2x	MEPS HC, Longitudinal File	categorical covariate	1= yes, 2= Medicare, but not Part D, 3= no Medicare
Covered by Medicare MCO	MCRPHOy1, 2	MEPS HC, Longitudinal File	categorical covariate	1= yes, 2= Medicare, but not MCO, 3= no Medicare
Covered by Medicaid/SCHIP HMO at any time during year 1, 2	MCDATy1x, 2x	MEPS HC, Longitudinal File	categorical covariate	1= yes
Covered by Medicaid/SCHIP HMO	MCDHMOy1, 2	MEPS HC, Longitudinal File	categorical covariate	1= yes, 2= Medicaid/SCHIP, but not HMO, 3= no Medicaid/SCHIP
Covered by Medicaid/SCHIP gatekeeper plan	MCDMCy1, 2	MEPS HC, Longitudinal File	categorical covariate	2= yes, 2= Medicaid/SCHIP, but not gatekeeper plan, 3= no Medicaid/SCHIP
Covered by private at any time during year 1 / 2	PRIVATy1, 2	MEPS HC, Longitudinal File	dichotomous covariate	1= yes
Ever had Private Insurance during the year	PRVEVyy	MEPS HC, Longitudinal File	dichotomous covariate	1= yes
Ever had Medicare during the year	MCREVy1, 2	MEPS HC, Longitudinal File	dichotomous covariate	1= yes
Covered by a private HMO as of end of year 1 / 2	PRVHMOy1, 2	MEPS HC, Longitudinal File	dichotomous	1= yes, 2= covered by insurance, but not HMO, 3= not covered by private insurance
Covered by Private Plan w/ Dr. list	PRVDRLy1, 2	MEPS HC, Longitudinal File	dichotomous	1= yes, 2= no Dr. list, 3= no private insurance
Covered by HMO that pays for out-of-network care	PHMONPy1, 2	MEPS HC, Longitudinal File	dichotomous	1= non-plan Drs covered, 2= not covered
Covered by private gatekeeper plan as of end of year 1 / 2	PRVMNCy1, 2	MEPS HC, Longitudinal File	categorical	1= yes, 2= covered by insurance, but not gatekeeper, 3= not covered by private insurance

Table 2: All Variables Drawn from MEPS and CMS continued (page 4 of 4)

Variable Name	Variable Code	Source	Variable Type	Data Description
Independent Variables				
Covered by Gatekeeper plan that pays for out-of-network care	PMNCNPy1, 2	MEPS HC, Longitudinal File	dichotomous	1= non-plan Drs covered, 2= not covered
Covered by Doctor-List plan that pays for out-of-network care	PRDRNPy1, 2	MEPS HC, Longitudinal File	dichotomous	1= non-plan Drs covered, 2= not covered
Identifiers & Weights				
Individual ID Number	DUPERSID	MEPS HC, Longitudinal File	categorical	8-digit ID number
Longitudinal Weight	LONGWT	MEPS HC, Longitudinal File	continuous	weighting factor
Person ID	PID	MEPS HC, Longitudinal File	categorical	3-digit person number
Dwelling Unit ID number	DUID	MEPS HC, Longitudinal File	categorical	5-digit household number
Panel number	PANEL	MEPS HC, Longitudinal File	categorical	2-digit number
Year	yr20yy	MEPS HC, Longitudinal File	dichotomous	dummy variable for each yearin the panel

Table 3: Medicare-eligible MEPS Respondents

	Two-way Cross-Classified Data Structure: Number of Medicare Eligibles in Each Cohort(Market)-by-Period Cell													
					Year									
Market	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008*	Total
Northeast	614	970	591	609	628	779	836	676	731	728	779	727	769	9,437
Midwest	683	1034	695	689	723	1012	1064	896	917	920	967	917	926	11,443
South	986	1624	1,258	1,198	1,238	1684	2057	1868	1849	1807	1887	1652	1667	20,775
West	577	920	648	633	705	927	1098	1006	958	960	1020	895	904	11,251
U.S. Total	2,860	4,548	3,192	3,129	3,294	4,402	5,055	4,446	4,455	4,415	4,653	4,191	4,266	52,906

* Estimated. At the time of publication, 2008 data was not available in the MEPSnet-HC Query tool.

Table 4: Number of MEPS Households per Data Collection Period

January-June 1996	10,799		July-December 1996	9,485
Panel 1 Round 1	10,799		Panel 1 Round 2	9,485
January-June 1997	15,689		July-December 1997	14,657
Panel 1 Round 3	9,228		Panel 1 Round 4	9,019
Panel 2 round 1	6,461		Panel 2 Round 2	5,638
January-June 1998	19,269		July-December 1998	9,871
Panel 1 round 5	8,477		Panel 2 Round 4	5,290
Panel 2 Roudn 3	5,382		Panel 3 Round 2	4,581
Panel 3 Round 1	5,410			
January-June 1999	17,612		July-December 1999	10,161
Panel 2 Round 5	5,127		Panel 3 Round 4	4,243
Panel 3 round 3	5,382		Panel 4 Round 2	5,918
Panel 4 Round 1	7,103			
January-June 2000	15,447		July-December 2000	10,222
Panel 3 Round 5	4,183		Panel 4 Round 4	5,567
Panel 4 Round 3	5,731		Panel 5 Round 2	4,655
Panel 5 Round 1	5,533			
January-June 2001	21,069		July-December 2001	13,777
Panel 4 Round 5	5,547		Panel 5 Round 4	4,426
Panel 5 Round 3	4,496		Panel 6 Round 2	9,351
Panel 6 Round 1	11,026			
January-June 2002	21,915		July-December 2002	15,968
Panel 5 Round 5	4,393		Panel 6 Round 4	8,977
Panel 6 Round 3	9,183		Panel 7 Round 2	6,991
Panel 7 Round 1	8,339			

January-June 2003	24,315		July-December 2003	13,814
Panel 6 Round 5	8,830		Panel 7 Round 4	6,655
Panel 7 Round 3	6,779		Panel 8 Round 2	7,159
Panel 8 Round 1	8,706			
January-June 2004	22,552		July-December 2004	14,068
Panel 7 Round 5	6,578		Panel 8 Round 4	6,878
Panel 8 Round 3	7,035		Panel 9 Round 2	7,190
Panel 9 round 1	8,939			
January-June 2005	22,548		July-December 2005	13,991
Panel 8 Round 5	6,795		Panel 9 Round 4	6,843
Panel 9 Round 3	7,005		Panel 10 Round 2	7,148
Panel 10 Round 1	8,748			
January-June 2006	23,278		July-December 2006	14,280
Panel 9 Round 5	6,703		Panel 10 Round 4	6,708
Panel 10 Round 3	6,921		Panel 11 Round 2	7,572
Panel 11 Round 1	9,654			
January-June 2007	21,326		July-December 2007	12,906
Panel 10 Round 5	6,596		Panel 11 round 4	7,005
Panel 11 round 3	7,263		Panel 12 Round 2	5,901
Panel 12 Rond 1	7,467			
January-June 2008	22,414		July-December 2008	13,384
Panel 11 round 5	6,895		Panel 12 Round 4	5,376
Panel 12 Round 3	5,580		Panel 13 Round 2	8,008
Panel 13 Round 1	9,939			

TABLE 5 Number, Mean and Standard Deviation of CDSI Scores

	2004-2005 Panel 9	*2005-2006* Panel 10	*2006-2007* Panel 11	*2007-2008* Panel 12
CDSI year 1				
N	2017	2115	2283	1674
mean	7.75	7.87	7.74	9.35
std.dev.	8.70	8.74	8.37	10.40
CDSI year 2				
N	2017	2115	2283	1674
mean	9.24	9.12	9.16	11.47
std.dev.	9.36	9.13	9.08	11.38
CDSI change				
N	2017	2115	2283	1674
mean	1.49	1.25	1.42	2.12
std.dev.	5.59	5.50	5.23	3.42

TABLE 6 Number of High-Penetration Markets*

	2004-2005		2005-2006		2006-2007		2007-2008	
	Panel 9		Panel 10		Panel 11		Panel 12	
	Yr1	Yr2	Yr1	Yr2	Yr1	Yr2	Yr1	Yr2
Regions								
Penetration >25%	1	1	1	1	1	1	1	1
	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%
Penetration < 25%	3	3	3	3	3	3	3	3
	75.0%	75.0%	75.0%	75.0%	75.0%	75.0%	75.0%	75.0%
States								
Penetration >25%	7	7	7	9	9	10	10	14
	13.2%	13.2%	13.2%	17.0%	17.0%	18.9%	18.9%	26.4%
Penetration < 25%	46	46	46	44	44	43	43	39
	86.8%	86.8%	86.8%	83.0%	83.0%	81.1%	81.1%	73.6%
Counties								
Penetration >25%	129	153	153	233	233	313	313	534
	4.0%	4.7%	4.7%	7.2%	7.2%	9.7%	9.7%	16.5%
Penetration < 25%	3113	3089	3089	3009	3009	2929	2929	2708
	96.0%	95.3%	95.3%	92.8%	92.8%	90.4%	90.4%	83.5%

* excludes markets not represented by MEPS respondents in any given Panel

** percentage of all markets shown below number of markets

*** District of Columbia, Puerto Rico and U.S. Virgin Islands included in States

TABLE 7 Medicare, Other Insurance and Managed Care Coverage (1 of 2)

	2004-2005 Panel 9	*2005-2006* Panel 10	*2006-2007* Panel 11	*2007-2008* Panel 12
gained Medicare between yr1 & yr2				
N	96	102	135	97
%	4.8%	4.8%	5.9%	5.8%
Other Insurance (yr 1)				
N	932	950	953	739
%	46.2%	44.9%	41.7%	44.1%
Other Insurance (yr 2)				
N	935	934	916	740
%	46.4%	44.2%	40.1%	44.2%
added Other coverage between yr1 & yr2				
N	45	44	34	52
%	2.2%	2.1%	1.5%	3.1%
dropped Other coverage between yr1 & yr2				
N	42	60	71	51
%	2.1%	2.8%	3.1%	3.0%

TABLE 7 Medicare, Other Insurance and Managed Care Coverage (2 of 2)

	2004-2005 Panel 9	*2005-2006* Panel 10	*2006-2007* Panel 11	*2007-2008* Panel 12
Managed Care* (yr 1)				
N	316	343	806	547
%	15.7%	16.2%	35.3%	32.7%
Managed Care* (yr 2)				
N	314	703	797	567
%	15.6%	33.2%	34.9%	33.9%
added Managed Care coverage between yr1 & yr2				
N	57	38	66	38
%	2.8%	1.8%	2.9%	2.3%
dropped Managed Care coverage between yr1 & yr2				
N	59	70	70	51
%	2.9%	3.3%	3.1%	3.0%

* Managed Care (MCO) variable = yes if respondent indicated year-end coverage by "Medicare managed care," a "Medicaid or SCHIP HMO," a "Private HMO," or "an HMO that pays non-plan doctors."

TABLE 8 Summary of Demographic Variables (1 of 2)

	2004-2005 Panel 9	*2005-2006* Panel 10	*2006-2007* Panel 11	*2007-2008* Panel 12
age*				
N	2013	2115	2282	1674
mean	68.60	69.1	68.9	69.4
std.dev.	14.20	13.7	13.8	13.3
age group*				
<50	7.0%	5.2%	7.1%	6.6%
50-64	10.8%	12.0%	13.0%	13.7%
65-69	24.6%	24.6%	24.2%	23.3%
70-74	19.9%	20.0%	18.7%	18.5%
75-79	17.4%	17.7%	16.5%	16.7%
80-84	13.0%	12.4%	11.7%	12.5%
>85	7.3%	8.0%	8.8%	8.7%
male	42.6%	43.4%	43.9%	43.7%
education				
<high school	26.2%	26.8%	26.3%	22.8%
high school	34.7%	34.8%	35.3%	35.0%
some college	18.2%	17.2%	17.1%	20.0%
4-yr college	11.2%	11.6%	10.5%	11.7%
>4-yrs college	8.2%	8.4%	9.5%	8.8%
missing	1.4%	1.3%	1.4%	1.7%
metro-residents*	78.3%	79.2%	78.8%	79.9%

* Year 1 data presented.
All descriptive statistics are weighted and representative of the population.

TABLE 8 Summary of Demographic Variables (2 of 2)

	2004-2005 Panel 9	*2005-2006* Panel 10	*2006-2007* Panel 11	*2007-2008* Panel 12
race				
white	84.0%	85.2%	84.6%	85.2%
black	10.4%	10.1%	10.2%	9.8%
American Indian / Alaska Native	0.5%	0.7%	0.7%	0.6%
Asian	3.0%	3.0%	3.1%	3.4%
Native Hawaiian / Pacific Islander	0.3%	0.3%	0.2%	0.2%
multiple	1.7%	0.7%	1.2%	1.0%
hispanic	6.7%	7.7%	7.2%	7.3%
% of poverty level*				
<100% FPL	14.8%	11.8%	16.4%	11.2%
101%-200%	5.4%	7.2%	6.6%	8.1%
201%-300%	19.6%	17.8%	16.6%	15.2%
301%-400%	28.9%	27.2%	27.2%	32.6%
>400% FPL	31.3%	35.9%	33.2%	32.9%
marital status*				
married	51.7%	54.9%	51.5%	53.3%
widowed	27.7%	26.2%	24.5%	24.4%
divorced	11.4%	10.7%	13.1%	12.2%
separated	1.5%	1.9%	1.5%	1.3%
never married	7.5%	6.2%	9.1%	8.6%
missing	0.2%	0.2%	0.4%	0.3%
marital status*				
married	51.7%	54.9%	51.5%	53.3%
not married	48.1%	44.9%	48.2%	46.4%
missing	0.2%	0.2%	0.4%	0.3%

* Year 1 data presented

TABLE 9a CDSI Change and Market Penetration Level - Region level

(% of respondents experiencing each CDSI outcome)

	2004-2005 Panel 9	*2005-2006* Panel 10 *	*2006-2007* Panel 11	*2007-2008* Panel 12
High-Penetration Regions				
no CDSI change	35.3%	40.4%	33.8%	31.1%
CDSI worsened	47.5%	43.3%	48.3%	66.1%
CDSI improved	17.2%	16.3%	17.9%	2.8%
Low-Penetration Regions				
no CDSI change	35.9%	31.8%	34.8%	36.0%
CDSI worsened	47.1%	49.5%	49.7%	60.4%
CDSI improved	17.0%	18.7%	15.5%	3.6%

Market penetration status as of end of year 1 of each panel

*** p-value <0.001 ** p-value <0.01 * p-value <0.05

TABLE 9b CDSI Change and Market Penetration Level - State level

(% of respondents experiencing each CDSI outcome)

	2004-2005 Panel 9	*2005-2006* Panel 10 *	*2006-2007* Panel 11	*2007-2008* Panel 12
High-Penetration States				
no CDSI change	34.6%	41.5%	32.4%	32.1%
CDSI worsened	48.4%	42.5%	49.8%	65.2%
CDSI improved	17.0%	16.0%	17.8%	2.7%
Low-Penetration States				
no CDSI change	36.0%	32.0%	35.1%	35.8%
CDSI worsened	46.9%	49.3%	49.4%	60.5%
CDSI improved	17.1%	18.7%	15.5%	3.7%

Market penetration status as of end of year 1 of each panel

*** p-value <0.001 ** p-value <0.01 * p-value <0.05

TABLE 9c CDSI Change and Market Penetration Level - County level

(% of respondents experiencing each CDSI outcome)

	2004-2005 Panel 9	*2005-2006* Panel 10 *	*2006-2007* Panel 11	*2007-2008* Panel 12 *
High-Penetration Counties				
no CDSI change	34.8%	38.9%	35.1%	29.6%
CDSI worsened	47.3%	44.7%	49.5%	66.7%
CDSI improved	17.9%	16.4%	15.4%	3.7%
Low-Penetration Counties				
no CDSI change	36.1%	32.0%	34.4%	37.0%
CDSI worsened	47.1%	49.2%	49.4%	59.6%
CDSI improved	16.8%	18.8%	16.2%	3.4%

Market penetration status as of end of year 1 of each panel

*** p-value <0.001 ** p-value <0.01 * p-value <0.05

TABLE 10 Summary of Key Variable Correlations with CDSI (p-values) (1 of 2)

	Panel 9[a]			Panel 10[a]			Panel 11[a]			Panel 12[a]		
	CDSI 2004 (yr1)	*CDSI 2005 (yr2)*	*CDSI change*	*CDSI 2005 (yr1)*	*CDSI 2006 (yr2)*	*CDSI change*	*CDSI 2006 (yr1)*	*CDSI 2007 (yr2)*	*CDSI change*	*CDSI 2007 (yr1)*	*CDSI 2008 (yr2)*	*CDSI change*
HMO coverage[b]	-0.050*	-0.057*	-0.018	-0.021	-0.040	-0.034	0.006	-0.012	-0.031	0.025	0.024	0.005
	(0.024)	(0.010)	(0.409)	(0.335)	(0.068)	(0.119)	(0.782)	(0.574)	(0.140)	(0.311)	(0.324)	(0.824)
Other Private Insurance[b]	-0.037	-0.020	0.024	-0.058**	-0.012	0.074***	-0.044*	-0.043*	-0.002	0.006	0.008	0.010
	(0.093)	(0.379)	(0.274)	(0.008)	(0.592)	(0.001)	(0.034)	(0.043)	(0.917)	(0.817)	(0.741)	(0.690)
Age [b]	0.136***	0.166***	0.068**	0.098***	0.142***	0.085***	0.145***	0.156***	0.039	0.171***	0.191***	0.116***
	(0.000)	(0.000)	(0.002)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.061)	(0.000)	(0.000)	(0.000)
Education Level[c]	-0.0485*	-0.016	0.048*	-0.111***	-0.093***	0.021	-0.077***	-0.056**	0.028	-0.073**	-0.056*	0.034
	(0.031)	(0.484)	(0.033)	(0.000)	(0.000)	(0.339)	(0.000)	(0.008)	(0.193)	(0.003)	(0.023)	(0.173)
Federal Poverty Level Category[b]	-0.059**	-0.057*	-0.004	-0.057**	-0.045*	0.015	-0.011	-0.010	-0.001	-0.062*	-0.064**	-0.025
	(0.008)	(0.011)	(0.875)	(0.009)	(0.037)	(0.480)	(0.617)	(0.634)	(0.982)	(0.011)	(0.009)	(0.301)
Marital Status[b+]												
married	-0.035	-0.003	0.0485*	-0.015	-0.031	-0.029	-0.005	-0.008	-0.007	-0.033	-0.042	-0.042
	(0.112)	(0.891)	(0.029)	(0.505)	(0.155)	(0.177)	(0.814)	(0.697)	(0.757)	(0.182)	(0.084)	(0.089)
never married	-0.106***	-0.117***	-0.031	-0.083***	-0.087***	-0.013	-0.117***	-0.116***	-0.015	-0.104***	-0.102***	-0.026
	(0.000)	(0.000)	(0.162)	(0.000)	(0.000)	(0.544)	(0.000)	(0.000)	(0.490)	(0.000)	(0.000)	(0.287)
widowed	0.077***	0.067**	-0.008	0.032	0.056*	0.044*	0.122***	0.120***	0.012	0.090**	0.111***	0.096***
	(0.001)	(0.003)	(0.730)	(0.147)	(0.010)	(0.041)	(0.000)	(0.000)	(0.580)	(0.002)	(0.000)	(0.000)
divorced	0.015	-0.015	-0.047*	0.033	0.031	0.000	-0.045*	-0.044*	-0.005	0.020	0.006	-0.040
	(0.509)	(0.496)	(0.034)	(0.135)	(0.154)	(0.995)	(0.033)	(0.035)	(0.817)	(0.425)	(0.817)	(0.105)
separated	0.066**	0.075**	0.023	0.029	0.026	-0.003	-0.004	0.009	0.023	0.022	0.017	-0.010
	(0.003)	(0.001)	(0.297)	(0.177)	(0.225)	(0.904)	(0.863)	(0.659)	(0.272)	(0.376)	(0.496)	(0.687)

a. Statistics for panels 9 - 12 presented here to demonstrate the changes from 2004 and the beginnings of Medicare Modernization Act passage to 2008.

b. HMO, Other Private Insurance Coverage, Age, Poverty Level, Marital Status, and Urban/Rural reflect individual's status at end of the first year of each panel.

c. Education level, Hispanic ethnicity, Race, and Sex assessed at beginning of each panel and assumed not to change.

+ Urban/Rural and marital status relationships to CDSI are considered more important in this study than change in status, which was not addressed.

All descriptive statistics are weighted and representative of the population.

Increasing CDSI scores are indicative of a worsening in the respondent's health.

*** p-value <0.001 ** p-value <0.01 * p-value <0.05

TABLE 10 Summary of Key Variable Correlations with CDSI (p-values) (2 of 2)

	Panel 9[a]			Panel 10[a]			Panel 11[a]			Panel 12[a]		
	CDSI 2004 (yr1)	*CDSI 2005 (yr2)*	*CDSI change*	*CDSI 2005 (yr1)*	*CDSI 2006 (yr2)*	*CDSI change*	*CDSI 2006 (yr1)*	*CDSI 2007 (yr2)*	*CDSI change*	*CDSI 2007 (yr1)*	*CDSI 2008 (yr2)*	*CDSI change*
Hispanic Ethnicity[c]	-0.016	-0.024	-0.015	-0.019	0.003	0.036	-0.018	0.001	0.032	0.016	0.011	-0.013
	(0.476)	(0.282)	(0.489)	(0.394)	(0.890)	(0.103)	(0.382)	(0.980)	(0.132)	(0.503)	(0.651)	(0.609)
Race[c]												
Black	0.027	0.011	-0.024	0.004	0.000	-0.006	-0.012	-0.004	0.013	0.029	0.030	0.013
	(0.224)	(0.635)	(0.290)	(0.841)	(0.984)	(0.769)	(0.580)	(0.868)	(0.531)	(0.244)	(0.223)	(0.597)
American Indian /	0.033	0.029	-0.002	-0.004	-0.014	-0.017	0.055**	0.051*	0.000	-0.014	-0.001	0.039
Alaska Native	(0.134)	(0.189)	(0.915)	(0.852)	(0.528)	(0.436)	(0.009)	(0.015)	(1.000)	(0.558)	(0.958)	(0.114)
Asian	-0.031	-0.008	0.034	-0.071**	-0.064**	0.005	-0.030	-0.057**	-0.053*	-0.054*	-0.043	0.019
	(0.169)	(0.738)	(0.125)	(0.001)	(0.003)	(0.805)	(0.154)	(0.006)	(0.011)	(0.029)	(0.079)	(0.449)
Native Hawaiian /	0.028	0.023	-0.005	-0.011	-0.020	-0.016	-0.027	-0.018	0.013	-0.009	-0.003	0.017
Pacific Islander	(0.212)	(0.307)	(0.839)	(0.625)	(0.367)	(0.452)	(0.198)	(0.399)	(0.526)	(0.710)	(0.899)	(0.486)
Multiple	0.026	-0.005	-0.048	0.021	0.031	0.019	0.016	0.002	-0.023	0.022	0.021	0.005
	(0.238)	(0.819)	(0.031)	(0.341)	(0.158)	(0.385)	(0.456)	(0.928)	0.279	(0.377)	(0.387)	(0.833)
Sex[c]	0.052*	0.035	-0.021	0.106***	0.086***	-0.026	0.045*	0.047*	0.009	0.045	0.044	0.008
	(0.019)	(0.113)	(0.346)	(0.000)	(0.000)	(0.238)	(0.032)	(0.026)	(0.671)	(0.063)	(0.075)	(0.745)
Urban / Rural[b+]	0.016	0.049*	0.057	-0.032	-0.043	-0.020	-0.044*	-0.029	0.021	0.053*	0.055*	0.023
	(0.469)	(0.027)	(0.011)	(0.137)	(0.050)	(0.348)	(0.038)	(0.167)	(0.325)	(0.031)	(0.025)	(0.351)

a. Statistics for panels 9 - 12 presented here to demonstrate the changes from 2004 and the beginnings of Medicare Modernization Act passage to 2008.

b. HMO, Other Private Insurance Coverage, Age, Poverty Level, Marital Status, and Urban/Rural reflect individual's status at end of the first year of each panel.

c. Education level, Hispanic ethnicity, Race, and Sex assessed at beginning of each panel and assumed not to change.

+ Urban/Rural and marital status relationships to CDSI are considered more important in this study than change in status, which was not addressed.

All descriptive statistics are weighted and representative of the population.

Increasing CDSI scores are indicative of a worsening in the respondent's health.

*** p-value <0.001 ** p-value <0.01 * p-value <0.05

Table 11a: Panel 9 Key Covariate Intercorrelations, Census Region Level

	Managed Care	Other Insurance	Age 70-74	Age 75-79	Age 80-84	Age 85+	Age 60-64	Age < 50
Managed Care	1.00	0.08***	-0.06*	-0.05*	-0.06**	-0.04	0.08***	0.21***
Other Insurance	0.08***	1.00	0.04	0.01	-0.05*	0.01	-0.02	0.21***
High School	0.03	0.04	0.01	-0.05*	0.04	-0.03	0.00	0.03
Some College	0.00	0.07**	0.01	0.01	-0.04	0.01	-0.01	-0.01
4 Years College	-0.06**	0.08***	-0.05*	0.02	-0.05*	-0.02	0.01	-0.02
> 4 Years College	0.01	0.07**	0.06**	-0.04	0.01	0.00	0.01	-0.07**
101-200% FPL	0.02	-0.14***	0.00	-0.02	0.02	0.00	0.02	0.04
201-300% FPL	0.02	-0.06**	-0.05*	-0.01	0.08***	0.03	-0.05*	0.12***
301-400% FPL	-0.01	0.07**	-0.02	0.05*	0.01	0.01	0.00	-0.08***
> 400% FPL	-0.05*	0.21***	0.06**	-0.02	-0.06**	-0.03	-0.03	-0.16***
Hispanic	0.07**	-0.13***	-0.03	-0.01	-0.04	-0.03	0.02	0.04
Black	0.04	-0.15***	-0.02	-0.03	-0.07***	-0.01	0.06**	0.14***
American Indian/ Alaska Native	0.00	-0.06*	-0.01	0.03	0.01	-0.02	0.01	0.00
Asian	0.13***	-0.13***	0.00	0.00	-0.02	0.01	-0.05*	-0.03
Native Hawaiian and Pacific Islander	-0.02	-0.03	0.01	0.02	0.00	-0.02	-0.01	-0.02
Multiple Races	0.05*	-0.04	0.00	-0.02	-0.02	-0.03	0.02	0.11***
Married	-0.03	0.26***	0.08***	-0.03	-0.07**	-0.15***	0.00	-0.14***
Never Married	0.16***	-0.16***	-0.10***	-0.07**	-0.05*	-0.02	0.07**	0.46***
Widowed	-0.07**	-0.09***	-0.05*	0.14***	0.18***	0.24***	-0.12***	-0.16***
Divorced	0.01	-0.10***	0.02	-0.09***	-0.09***	-0.08***	0.09	0.06**
Separated	0.00	-0.09***	0.03	-0.03	-0.03	-0.04	0.05*	0.00
Male	0.01	0.06*	0.01	-0.06**	-0.02	-0.06**	0.02	0.02
Urban/MSA Resident	0.09***	0.03	-0.02	0.02	-0.01	0.02	-0.01	-0.04

*** p-value <0.001 ** p-value <0.01 * p-value <0.05

HMO coverage, Other Private Insurance Coverage, Age, Poverty Level,
Marital Status, and Urban/Rural reflect individual's status at end of the first year of each panel.

Table 11b: Panel 10 Key Covariate Intercorrelations, Census Region Level

	Managed Care	Other Insurance	Age 70-74	Age 75-79	Age 80-84	Age 85+	Age 60-64	Age < 50
Managed Care	1.00	0.12***	-0.03	-0.05*	-0.07**	-0.06**	0.06**	0.14***
Other Insurance	0.12***	1.00	0.03	0.02	-0.05*	-0.01	-0.06**	-0.15***
High School	-0.03	0.01	0.00	0.02	0.00	-0.06*	0.00	0.03
Some College	-0.03	0.05*	-0.02	-0.02	-0.03	-0.01	0.04*	-0.01
4 Years College	0.00	0.13***	0.05*	-0.03	0.02	0.00	-0.02	-0.04*
> 4 Years College	0.02	0.12***	0.04	-0.05*	-0.02	0.01	-0.03	-0.06**
101-200% FPL	0.03	-0.10***	-0.03	-0.04	0.00	0.03	0.05*	0.05*
201-300% FPL	-0.06**	-0.10***	-0.06**	0.06*	0.00	0.13***	-0.02	0.02
301-400% FPL	-0.01	0.03	-0.01	0.07**	0.04*	-0.02	-0.04	0.05*
> 400% FPL	0.03	0.28***	0.09***	-0.07***	-0.02	-0.09***	-0.05*	-0.14***
Hispanic	0.10***	-0.15***	0.01	-0.02	-0.04	-0.04	0.05*	0.09***
Black	0.03	-0.14***	-0.05*	-0.05*	-0.03	0.01	0.05*	0.13***
American Indian/ Alaska Native	0.00	-0.02	-0.04	0.00	-0.02	-0.02	0.06**	-0.01
Asian	0.10***	-0.09***	0.03	0.00	0.04	-0.03	-0.04	0.02
Native Hawaiian and Pacific Islander	-0.01	-0.03	-0.01	-0.03	-0.02	-0.02	0.01	0.09***
Multiple Races	0.00	-0.03	0.00	0.02	-0.01	-0.02	0.02	-0.01
Married	-0.03	0.19***	0.11***	0.06**	-0.11***	-0.23***	-0.03	-0.13***
Never Married	0.13***	-0.13***	-0.04	-0.07***	-0.04	-0.03	0.09***	0.38***
Widowed	-0.09***	-0.06**	-0.06**	0.04	0.21***	0.33***	-0.14***	-0.14***
Divorced	0.05*	-0.08***	-0.06**	-0.09***	-0.06**	-0.06**	0.14***	0.07***
Separated	0.03	-0.07**	-0.02	-0.01	-0.05*	-0.04	0.07***	0.05*
Male	0.05*	0.07**	0.00	-0.01	-0.03	-0.11***	0.03	0.00
Urban/MSA Resident	0.10***	-0.01	-0.03	0.01	0.06**	0.01	-0.02	0.00

*** p-value <0.001 ** p-value <0.01 * p-value <0.05

HMO coverage, Other Private Insurance Coverage, Age, Poverty Level,
Marital Status, and Urban/Rural reflect individual's status at end of the first year of each panel.

Table 11c: Panel 11 Key Covariate Intercorrelations, Census Region Level

	Managed Care	Other Insurance	Age 70-74	Age 75-79	Age 80-84	Age 85+	Age 60-64	Age < 50
Managed Care	1.00	0.13***	-0.04	-0.01	-0.07**	-0.07***	0.06**	0.15***
Other Insurance	0.13***	1.00	0.00	0.02	0.01	-0.08***	0.02	-0.15***
High School	0.00	0.04*	-0.01	0.01	0.00	-0.04	0.01	0.02
Some College	-0.05*	0.06**	0.00	0.00	0.00	-0.04*	0.04*	-0.01
4 Years College	0.01	0.08***	0.03	-0.01	-0.04	0.00	0.01	-0.07***
> 4 Years College	-0.02	0.13***	0.05*	0.02	-0.05*	-0.03	-0.02	-0.07**
101-200% FPL	0.01	-0.10***	0.02	-0.05**	0.01	0.01	0.01	-0.03
201-300% FPL	-0.05*	-0.09***	0.00	0.03	0.04	0.06**	0.00	-0.02
301-400% FPL	-0.02	0.01	0.00	0.05*	0.05*	-0.02	-0.03	-0.03
> 400% FPL	0.00	0.26***	0.01	0.00	-0.08***	-0.01	-0.02	-0.12***
Hispanic	0.11***	-0.18***	-0.01	-0.03	0.00	-0.02	0.00	0.07**
Black	0.07***	-0.10***	0.00	-0.05*	-0.02	-0.05*	0.08***	0.12***
American Indian/ Alaska Native	-0.01	-0.03	-0.01	0.00	-0.03	-0.02	0.02	-0.02
Asian	0.05*	-0.03	0.07***	-0.02	-0.01	0.00	-0.01	-0.03
Native Hawaiian and Pacific Islander	0.00	0.00	-0.01	0.00	-0.01	-0.01	0.04	-0.01
Multiple Races	-0.03	-0.01	-0.01	-0.01	-0.03	-0.02	0.04	0.05*
Married	-0.05*	0.22***	0.09***	-0.02	-0.05**	-0.16***	0.04	-0.18***
Never Married	0.13***	-0.14***	-0.06**	-0.07**	-0.05*	-0.05*	0.03	0.50***
Widowed	-0.06**	-0.09***	-0.04*	0.13***	0.14***	0.28***	-0.17***	-0.15***
Divorced	0.04	-0.07***	-0.03	-0.07***	-0.04*	-0.07***	0.11***	-0.01
Separated	0.00	-0.05*	0.01	-0.01	-0.02	-0.04	0.07**	0.03
Male	0.03	0.03	0.00	-0.01	-0.04	-0.10***	0.07**	0.00
Urban/MSA Resident	0.07***	0.03	0.04	0.01	0.04*	-0.01	-0.03	-0.09***

*** p-value <0.001 ** p-value <0.01 * p-value <0.05

HMO coverage, Other Private Insurance Coverage, Age, Poverty Level,

Marital Status, and Urban/Rural reflect individual's status at end of the first year of each panel.

Table 11d: Panel 12 Key Covariate Intercorrelations, Census Region Level

	Managed Care	Other Insurance	Age 70-74	Age 75-79	Age 80-84	Age 85+	Age 60-64	Age < 50
Managed Care	1.00	0.19***	0.00	-0.06**	-0.04	-0.05	0.11***	0.03
Other Insurance	0.19***	1.00	0.02	0.02	-0.02	0.00	0.01	-0.21***
High School	-0.02	-0.01	0.01	0.03	0.00	-0.02	-0.02	0.03
Some College	0.01	0.06	-0.01	0.00	-0.02	0.01	0.05	-0.03
4 Years College	0.00	0.09***	0.02	0.02	0.00	-0.05*	0.00	-0.08***
> 4 Years College	0.01	0.17***	0.00	0.02	-0.02	-0.03	-0.02	-0.08**
101-200% FPL	-0.05	-0.13***	-0.04	0.04	0.01	0.00	-0.06*	0.08
201-300% FPL	-0.05	-0.11***	-0.05*	0.00	0.08**	0.06*	-0.01	0.01
301-400% FPL	-0.01	0.00	-0.01	-0.05	0.04	0.00	-0.01	0.00
> 400% FPL	0.03	0.31***	0.10***	0.03	-0.09***	-0.05*	-0.04	-0.15***
Hispanic	0.06**	-0.12***	0.01	0.01	-0.01	-0.02	-0.01	0.01
Black	0.05*	-0.11***	0.01	-0.02	-0.03	-0.03	0.07**	0.07**
American Indian/ Alaska Native	0.01	-0.04	-0.01	0.01	-0.03	-0.02	0.03	0.00
Asian	0.07**	-0.03	0.01	0.02	-0.01	0.00	-0.03	0.03
Native Hawaiian and Pacific Islander	0.05	0.02	0.04	-0.02	0.02	-0.01	-0.02	-0.01
Multiple Races	-0.01	-0.04	-0.01	0.01	-0.04	-0.03	-0.03	0.07**
Married	-0.01	0.19***	0.11***	0.03	-0.06*	-0.21***	0.00	-0.16***
Never Married	0.06**	-0.16***	-0.07**	-0.11***	-0.05*	-0.03	0.03	0.47***
Widowed	-0.05	-0.07**	-0.05*	0.08***	0.16***	0.30***	-0.14***	-0.13***
Divorced	0.01	-0.04	-0.03	-0.07**	-0.06*	-0.05*	0.14***	-0.01
Separated	0.00	-0.05*	-0.02	0.01	-0.04	0.01	0.03	0.06*
Male	0.06*	0.04	0.00	0.01	-0.05*	-0.07**	0.04	0.02
Urban/MSA Resident	0.1***	0.08***	-0.02	0.01	0.07**	0.02	-0.02	-0.05

*** p-value <0.001 ** p-value <0.01 * p-value <0.05

HMO coverage, Other Private Insurance Coverage, Age, Poverty Level,

Marital Status, and Urban/Rural reflect individual's status at end of the first year of each panel.

TABLE 12a Census Region-Level Regression Model: Resulting Coefficients (p-values)

	2004-2005 Panel 9 [1]	*2005-2006* Panel 10 [1]	*2006-2007* Panel 11 [1]	*2007-2008* Panel 12 [1]
High-Penetration:				
Region [2]	0.463	-0.230	-0.211	0.538
	(0.167)	(0.453)	(0.574)	(0.015)*
HMO coverage [2]	-0.270	-0.531	-0.374	-0.097
	(0.459)	(0.122)	(0.238)	(0.698)
Other Private				
Insurance Coverage [2]	0.073	0.550	0.148	0.188
	(0.799)	(0.046)	(0.564)	(0.330)
Age Groups [2]				
age 70-74	-0.149	0.207	0.080	0.145
	(0.695)	(0.573)	(0.813)	(0.569)
age 75-80	0.066	0.094	0.032	0.281
	(0.871)	(0.808)	(0.929)	(0.308)
age 80-84	0.092	0.355	-0.161	0.457
	(0.845)	(0.421)	(0.691)	(0.129)
age 85+	0.619	1.033	-0.063	0.275
	(0.269)	(0.053)	(0.891)	(0.447)
age 50-64	-0.317	-0.209	-0.374	-0.147
	(0.467)	(0.614)	(0.313)	(0.606)
age < 50	-0.794	-0.621	-0.553	-0.746
	(0.176)	(0.290)	(0.297)	(0.066)
Education Level [3]				
high school degree	-0.586	0.409	-0.303	0.200
	(0.071)	(0.191)	(0.289)	(0.376)
some college	-0.184	0.080	0.231	0.275
	(0.649)	(0.838)	(0.525)	(0.301)
4-yrs college	0.260	1.110	0.104	0.491
	(0.609)	(0.019)*	(0.814)	(0.127)
> 4-yrs college	0.385	0.595	0.763	-0.114
	(0.496)	(0.269)	(0.113)	(0.755)

*** p-value <0.001 ** p-value <0.01 * p-value <0.05

[1] Statistics for panels 9 - 12 presented here to demonstrate the changes from 2004 and the beginnings of Medicare Modernization Act passage to 2008.

[2] High-penetration status, HMO coverage, Other Private Insurance Coverage, Age, Poverty Level, Marital Status, and Urban/Rural reflect individual's status at end of the first year of each panel.

[3] Education level, Hispanic ethnicity, Race, and Sex assessed at beginning of each panel and assumed not to change.

TABLE 12a (continued) Census Region-Level Regression: Resulting Coefficients (p-values)

	2004-2005 Panel 9	*2005-2006* Panel 10	*2006-2007* Panel 11	*2007-2008* Panel 12
Federal Poverty Level Category [2]				
101%-200% FPL	0.660	-0.669	-0.228	-0.460
	(0.219)	(0.167)	(0.614)	(0.200)
201%-300% FPL	-0.317	0.594	0.516	-0.237
	(0.423)	(0.142)	(0.150)	(0.444)
301%-400% FPL	-0.852	-0.156	-0.009	-0.302
	(0.027)*	(0.689)	(0.977)	(0.288)
> 400% FPL	-0.345	-0.063	0.149	-0.534
	(0.424)	(0.884)	(0.688)	(0.090)
Hispanic Ethnicity [3]	-0.417	0.976	0.505	-0.297
	(0.325)	(0.013)*	(0.175)	(0.304)
Race [3]				
black	-0.093	0.510	0.507	0.156
	(0.806)	(0.138)	(0.108)	(0.536)
American Indian or Alaska Native	0.115	-0.218	-0.084	1.706
	(0.939)	(0.871)	(0.952)	(0.085)
Asian	0.278	0.851	-1.211	-0.066
	(0.752)	(0.266)	(0.047)	(0.862)
Native Hawaiian or Pacific Islander	-1.008	-0.300	2.865	0.669
	(0.611)	(0.871)	(0.221)	(0.696)
Multiple races	-1.263	2.421	-0.884	0.882
	(0.208)	(0.045)*	(0.345)	(0.263)
Marital Status [2]				
widowed	0.068	0.592	-0.404	0.168
	(0.938)	(0.442)	(0.628)	(0.796)
divorced	-0.296	0.370	-0.432	-0.260
	(0.742)	(0.638)	(0.610)	(0.697)
married	0.571	0.339	-0.711	-0.258
	(0.506)	(0.648)	(0.382)	(0.686)
never married	-0.181	0.599	-0.465	-0.254
	(0.847)	(0.472)	(0.597)	(0.712)
Male [3]	-0.235	-0.111	0.030	0.405
	(0.382)	(0.664)	(0.898)	(0.021)*
Urban [2]	0.774	-0.292	0.235	-0.143
	(0.011)*	(0.323)	(0.380)	(0.514)

*** p-value <0.001 ** p-value <0.01 * p-value <0.05

[2] High-penetration status, HMO coverage, Other Private Insurance Coverage, Age, Poverty Level, Marital Status, and Urban/Rural reflect individual's status at end of the first year of each panel.

[3] Education level, Hispanic ethnicity, Race, and Sex assessed at beginning of each panel and assumed not to change.

TABLE 12b State-Level Regression Model: Resulting Coefficients (p-values)

	2004-2005 Panel 9 [1]	*2005-2006* Panel 10 [1]	*2006-2007* Panel 11 [1]	*2007-2008* Panel 12 [1]
High-Penetration:				
State [2]	0.245	-0.134	-0.030	0.508
	(0.494)	(0.685)	(0.917)	(0.029)*
HMO coverage [2]	-0.236	-0.535	-0.384	-0.120
	(0.515)	(0.119)	(0.226)	(0.630)
Other Private				
Insurance Coverage [2]	0.057	0.560	0.145	0.208
	(0.841)	(0.043)*	(0.571)	(0.281)
Age Groups [2]				
age 70-74	-0.138	0.224	0.057	0.123
	(0.717)	(0.540)	(0.866)	(0.629)
age 75-80	0.078	0.102	0.000	0.277
	(0.849)	(0.791)	(0.999)	(0.313)
age 80-84	0.111	0.370	-0.191	0.423
	(0.813)	(0.400)	(0.638)	(0.160)
age 85+	0.626	1.035	-0.110	0.240
	(0.263)	(0.052)	(0.811)	(0.506)
age 50-64	-0.308	-0.187	-0.400	-0.152
	(0.479)	(0.650)	(0.280)	(0.595)
age < 50	-0.784	-0.552	-0.646	-0.775
	(0.180)	(0.345)	(0.220)	(0.055)
Education Level [3]				
high school degree	-0.586	0.389	-0.336	0.204
	(0.071)	(0.213)	(0.240)	(0.366)
some college	-0.159	0.066	0.191	0.287
	(0.694)	(0.866)	(0.599)	(0.278)
4-yrs college	0.290	1.099	0.066	0.527
	(0.567)	(0.020)*	(0.883)	(0.100)
> 4-yrs college	0.389	0.575	0.720	-0.082
	(0.492)	(0.285)	(0.135)	(0.823)

*** p-value <0.001 ** p-value <0.01 * p-value <0.05

[1] Statistics for panels 9 - 12 presented here to demonstrate the changes from 2004 and the beginnings of Medicare Modernization Act passage to 2008.

[2] High-penetration status, HMO coverage, Other Private Insurance Coverage, Age, Poverty Level, Marital Status, and Urban/Rural reflect individual's status at end of the first year of each panel.

[3] Education level, Hispanic ethnicity, Race, and Sex assessed at beginning of each panel and assumed not to change.

TABLE 12b (continued) State-Level Regression: Resulting Coefficients (p-values)

	2004-2005 Panel 9	*2005-2006* Panel 10	*2006-2007* Panel 11	*2007-2008* Panel 12
Federal Poverty Level Category [2]				
101%-200% FPL	0.659	-0.678	-0.251	-0.487
	(0.218)	(0.161)	(0.578)	(0.174)
201%-300% FPL	-0.318	0.588	0.491	-0.263
	(0.422)	(0.145)	(0.170)	(0.395)
301%-400% FPL	-0.857	-0.183	-0.054	-0.334
	(0.026)*	(0.637)	(0.872)	(0.239)
> 400% FPL	-0.326	-0.081	0.083	-0.588
	(0.450)	(0.850)	(0.821)	(0.062)
Hispanic Ethnicity [3]	-0.353	0.927	0.468	-0.317
	(0.402)	(0.018)*	(0.202)	(0.278)
Race [3]				
black	-0.122	0.534	0.552	0.150
	(0.744)	(0.118)	(0.078)	(0.552)
American Indian	0.130	-0.207	-0.081	1.746
or Alaska Native	(0.931)	(0.877)	(0.954)	(0.077)*
Asian	0.374	0.790	-1.311	-0.079
	(0.670)	(0.301)	(0.031)*	(0.836)
Native Hawaiian	-0.889	-0.376	2.758	0.719
or Pacific Islander	(0.654)	(0.838)	(0.238)	(0.674)
Multiple races	-1.217	2.411	-0.903	0.960
	(0.219)	(0.045)*	(0.335)	(0.223)
Marital Status [2]				
widowed	-0.664	3.294	-0.212	-0.714
	(0.798)	(0.196)	(0.919)	(0.655)
divorced	-1.018	3.065	-0.283	-1.155
	(0.696)	(0.230)	(0.892)	(0.472)
married	-0.160	3.046	-0.520	-1.139
	(0.951)	(0.231)	(0.801)	(0.472)
never married	-0.913	3.265	-0.264	-1.137
	(0.724)	(0.200)	(0.898)	(0.481)
Male [3]	-0.236	-0.115	0.026	0.401
	(0.379)	(0.653)	(0.911)	(0.022)*
Urban [2]	0.799	-0.291	0.216	-0.128
	(0.009)**	(0.325)	(0.422)	(0.560)

*** p-value <0.001 ** p-value <0.01 * p-value <0.05

[2] High-penetration status, HMO coverage, Other Private Insurance Coverage, Age, Poverty Level, Marital Status, and Urban/Rural reflect individual's status at end of the first year of each panel.

[3] Education level, Hispanic ethnicity, Race, and Sex assessed at beginning of each panel and assumed not to change.

TABLE 12c County-Level Regression Model: Resulting Coefficients (p-values)

	2004-2005 Panel 9 [1]	*2005-2006* Panel 10 [1]	*2006-2007* Panel 11 [1]	*2007-2008* Panel 12 [1]
High-Penetration:				
County [2]	-0.210	0.196	0.122	0.450
	(0.504)	(0.513)	(0.648)	(0.025)*
HMO coverage [2]	-0.176	-0.590	-0.397	-0.117
	(0.628)	(0.088)	(0.209)	(0.641)
Other Private				
Insurance Coverage [2]	0.022	0.592	0.162	0.201
	(0.938)	(0.033)*	(0.527)	(0.297)
Age [2]				
age 70-74	-0.131	0.223	0.052	0.130
	(0.730)	(0.542)	(0.879)	(0.609)
age 75-80	0.106	0.091	-0.009	0.286
	(0.796)	(0.814)	(0.980)	(0.298)
age 80-84	0.152	0.367	-0.198	0.433
	(0.748)	(0.405)	(0.627)	(0.150)
age 85+	0.634	1.032	-0.125	0.278
	(0.257)	(0.053)	(0.786)	(0.442)
age 50-64	-0.297	-0.188	-0.397	-0.141
	(0.494)	(0.649)	(0.285)	(0.622)
age < 50	-0.785	-0.555	-0.641	-0.784
	(0.180)	(0.341)	(0.223)	(0.052)
Education Level [3]				
high school degree	-0.571	0.386	-0.346	0.215
	(0.079)	(0.216)	(0.226)	(0.339)
some college	-0.118	0.052	0.187	0.316
	(0.770)	(0.894)	(0.606)	(0.231)
4-yrs college	0.315	1.076	0.058	0.554
	(0.535)	(0.023)*	(0.896)	(0.083)
> 4-yrs college	0.414	0.532	0.715	-0.089
	(0.464)	(0.322)	(0.137)	(0.808)

*** p-value <0.001 ** p-value <0.01 * p-value <0.05

[1] Statistics for panels 9 - 12 presented here to demonstrate the changes from 2004 and the beginnings of Medicare Modernization Act passage to 2008.

[2] High-penetration status, HMO coverage, Other Private Insurance Coverage, Age, Poverty Level, Marital Status, and Urban/Rural reflect individual's status at end of the first year of each panel.

[3] Education level, Hispanic ethnicity, Race, and Sex assessed at beginning of each panel and assumed not to change.

TABLE 12c (continued) County-Level Regression: Resulting Coefficients (p-values)

	2004-2005	*2005-2006*	*2006-2007*	*2007-2008*
	Panel 9	Panel 10	Panel 11	Panel 12
Federal Poverty Level Category [2]				
101%-200% FPL	0.660	-0.681	-0.245	-0.491
	(0.217)	(0.159)	(0.588)	(0.171)
201%-300% FPL	-0.310	0.576	0.489	-0.277
	(0.433)	(0.154)	(0.171)	(0.372)
301%-400% FPL	-0.849	-0.204	-0.058	-0.297
	(0.027)*	(0.601)	(0.864)	(0.294)
> 400% FPL	-0.300	-0.106	0.076	-0.545
	(0.486)	(0.804)	(0.837)	(0.082)
Hispanic Ethnicity [3]	-0.259	0.861	0.436	-0.322
	(0.535)	(0.028)*	(0.237)	(0.268)
Race [3]				
black	-0.158	0.564	0.558	0.103
	(0.673)	(0.099)	(0.075)	(0.682)
American Indian or Alaska Native	0.122	-0.211	-0.072	1.702
	(0.935)	(0.875)	(0.959)	(0.085)
Asian	0.506	0.654	-1.383	0.027
	(0.562)	(0.388)	(0.022)*	(0.943)
Native Hawaiian or Pacific Islander	-0.600	-0.502	2.729	0.781
	(0.762)	(0.784)	(0.243)	(0.647)
Multiple races	-1.163	2.368	-0.888	0.885
	(0.240)	(0.049)*	(0.343)	(0.261)
Marital Status [2]				
widowed	-0.673	3.282	-0.221	-0.540
	(0.795)	(0.198)	(0.915)	(0.734)
divorced	-1.029	3.058	-0.295	-0.947
	(0.692)	(0.231)	(0.888)	(0.554)
married	-0.166	3.047	-0.525	-0.955
	(0.949)	(0.231)	(0.799)	(0.545)
never married	-0.926	3.222	-0.282	-0.913
	(0.720)	(0.205)	(0.891)	(0.570)
Male [3]	-0.231	-0.118	0.025	0.391
	(0.390)	(0.644)	(0.916)	(0.026)*
Urban [2]	0.864	-0.348	0.180	-0.195
	(0.005)**	(0.251)	(0.516)	(0.382)

*** p-value <0.001 ** p-value <0.01 * p-value <0.05

[2] High-penetration status, HMO coverage, Other Private Insurance Coverage, Age, Poverty Level, Marital Status, and Urban/Rural reflect individual's status at end of the first year of each panel.

[3] Education level, Hispanic ethnicity, Race, and Sex assessed at beginning of each panel and assumed not to change.

TABLE 13a Census Region-Level Regression Model: Resulting Coefficients (p-values)

	2004-2005		*2005-2006*		*2006-2007*		*2007-2008*	
	Panel 9 [1]		Panel 10 [1]		Panel 11 [1]		Panel 12 [1]	
	CDSI	SRH	CDSI	SRH	CDSI	SRH	CDSI	SRH
High-Penetration:								
Region [2]	0.463	0.022	-0.230	-0.027	-0.211	-0.038	0.538	-0.031
	(0.167)	(0.720)	(0.453)	(0.646)	(0.574)	(0.514)	(0.015)*	(0.634)
HMO coverage [2]	-0.270	0.075	-0.531	0.048	-0.374	-0.007	-0.097	0.015
	(0.459)	(0.267)	(0.122)	(0.467)	(0.238)	(0.912)	(0.698)	(0.843)
Other Private								
Insurance Coverage [2]	0.073	-0.027	0.550	0.043	0.148	0.023	0.188	0.087
	(0.799)	(0.614)	(0.046)	(0.414)	(0.564)	(0.649)	(0.330)	(0.125)
Age Groups [2]								
age 70-74	-0.149	-0.005	0.207	-0.003	0.080	-0.001	0.145	0.033
	(0.695)	(0.941)	(0.573)	(0.962)	(0.813)	(0.992)	(0.569)	(0.655)
age 75-80	0.066	0.031	0.094	0.039	0.032	0.055	0.281	0.248
	(0.871)	(0.682)	(0.808)	(0.599)	(0.929)	(0.449)	(0.308)	(0.002)**
age 80-84	0.092	0.285	0.355	0.008	-0.161	0.072	0.457	0.142
	(0.845)	(0.001)**	(0.421)	(0.920)	(0.691)	(0.376)	(0.129)	(0.108)
age 85+	0.619	0.109	1.033	0.262	-0.063	0.216	0.275	0.212
	(0.269)	(0.294)	(0.053)	(0.010)*	(0.891)	(0.019)*	(0.447)	(0.046)*
age 50-64	-0.317	-0.133	-0.209	-0.136	-0.374	-0.127	-0.147	-0.121
	(0.467)	(0.101)	(0.614)	(0.083)	(0.313)	(0.086)	(0.606)	(0.148)
age < 50	-0.794	-0.091	-0.621	-0.024	-0.553	-0.149	-0.746	-0.026
	(0.176)	(0.405)	(0.290)	(0.831)	(0.297)	(0.162)	(0.066)	(0.829)

*** p-value <0.001 ** p-value <0.01 * p-value <0.05

[1] Statistics for panels 9 - 12 presented here to demonstrate the changes from 2004 and the beginnings of Medicare Modernization Act passage to 2008.

[2] High-penetration status, HMO coverage, Other Private Insurance Coverage, Age, Poverty Level, Marital Status, and Urban/Rural reflect individual's status at end of the first year of each panel.

TABLE 13a (continued) Census Region-Level Regression Model: Resulting Coefficients (p-values)

	2004-2005		*2005-2006*		*2006-2007*		*2007-2008*	
	Panel 9 [1]		Panel 10 [1]		Panel 11 [1]		Panel 12 [1]	
	CDSI	SRH	CDSI	SRH	CDSI	SRH	CDSI	SRH
Education Level [3]								
high school degree	-0.586	0.141	0.409	0.117	-0.303	-0.040	0.200	0.062
	(0.071)	(0.020)*	(0.191)	(0.051)	(0.289)	(0.481)	(0.376)	(0.350)
some college	-0.184	0.073	0.080	0.091	0.231	0.099	0.275	0.089
	(0.649)	(0.330)	(0.838)	(0.217)	(0.525)	(0.175)	(0.301)	(0.252)
4-yrs college	0.260	-0.006	1.110	0.054	0.104	0.100	0.491	0.078
	(0.609)	(0.952)	(0.019)*	(0.552)	(0.814)	(0.263)	(0.127)	(0.412)
> 4-yrs college	0.385	0.056	0.595	0.046	0.763	0.074	-0.114	0.128
	(0.496)	(0.597)	(0.269)	(0.652)	(0.113)	(0.443)	(0.755)	(0.231)
Federal Poverty Level Category [2]								
101%-200% FPL	0.660	-0.184	-0.669	-0.124	-0.228	-0.109	-0.460	0.096
	(0.219)	(0.065)	(0.167)	(0.177)	(0.614)	(0.231)	(0.200)	(0.362)
201%-300% FPL	-0.317	-0.034	0.594	-0.007	0.516	-0.030	-0.237	0.118
	(0.423)	(0.648)	(0.142)	(0.929)	(0.150)	(0.679)	(0.444)	(0.196)
301%-400% FPL	-0.852	-0.065	-0.156	0.035	-0.009	0.020	-0.302	0.103
	(0.027)*	(0.365)	(0.689)	(0.639)	(0.977)	(0.774)	(0.288)	(0.215)
> 400% FPL	-0.345	0.206	-0.063	0.073	0.149	0.027	-0.534	0.136
	(0.424)	(0.010)*	(0.884)	(0.372)	(0.688)	(0.721)	(0.090)	(0.143)
Hispanic Ethnicity [3]	-0.417	0.013	0.976	0.026	0.505	0.045	-0.297	-0.054
	(0.325)	(0.866)	(0.013)*	(0.730)	(0.175)	(0.547)	(0.304)	(0.527)

*** p-value <0.001 ** p-value <0.01 * p-value <0.05

[2] High-penetration status, HMO coverage, Other Private Insurance Coverage, Age, Poverty Level, Marital Status, and Urban/Rural reflect individual's status at end of the first year of each panel.

[3] Education level, Hispanic ethnicity, Race, and Sex assessed at beginning of each panel and assumed not to change.

TABLE 13a (continued) Census Region-Level Regression: Resulting Coefficients (p-values)

	2004-2005		*2005-2006*		*2006-2007*		*2007-2008*	
	Panel 9 [1]		Panel 10 [1]		Panel 11 [1]		Panel 12 [1]	
	CDSI	SRH	CDSI	SRH	CDSI	SRH	CDSI	SRH
Race [3]								
black	-0.093	-0.004	0.510	0.003	0.507	-0.054	0.156	-0.006
	(0.806)	(0.951)	(0.138)	(0.962)	(0.108)	(0.391)	(0.536)	(0.931)
American Indian	0.115	0.478	-0.218	-0.139	-0.084	0.212	1.706	-0.119
or Alaska Native	(0.939)	(0.086)	(0.871)	(0.585)	(0.952)	(0.451)	(0.085)	(0.682)
Asian	0.278	-0.166	0.851	-0.101	-1.211	0.144	-0.066	0.246
	(0.752)	(0.309)	(0.266)	(0.493)	(0.047)*	(0.239)	(0.862)	(0.029)*
Native Hawaiian	-1.008	-0.260	-0.300	0.303	2.865	0.053	0.669	-0.529
or Pacific Islander	(0.611)	(0.480)	(0.871)	(0.387)	(0.221)	(0.910)	(0.696)	(0.292)
Multiple races	-1.263	-0.324	2.421	-0.317	-0.884	0.143	0.882	0.452
	(0.208)	(0.082)	(0.045)*	(0.167)	(0.345)	(0.447)	(0.263)	(0.050)*
Marital Status [2]								
widowed	0.068	0.002	0.592	0.009	-0.404	0.123	0.168	-0.172
	(0.938)	(0.992)	(0.442)	(0.949)	(0.628)	(0.462)	(0.796)	(0.369)
divorced	-0.296	0.083	0.370	0.021	-0.432	0.074	-0.260	-0.034
	(0.742)	(0.622)	(0.638)	(0.890)	(0.610)	(0.664)	(0.697)	(0.862)
married	0.571	0.073	0.339	0.034	-0.711	0.107	-0.258	-0.039
	(0.506)	(0.649)	(0.648)	(0.809)	(0.382)	(0.512)	(0.686)	(0.835)
never married	-0.181	0.180	0.599	0.108	-0.465	0.070	-0.254	0.010
	(0.847)	(0.303)	(0.472)	(0.494)	(0.597)	(0.693)	(0.712)	(0.959)
Male [3]	-0.235	-0.033	-0.111	-0.046	0.030	-0.002	0.405	0.023
	(0.382)	(0.511)	(0.664)	(0.346)	(0.898)	(0.968)	(0.021)*	(0.654)
Urban [2]	0.774	0.011	-0.292	-0.022	0.235	0.002	-0.143	-0.022
	(0.011)*	(0.844)	(0.323)	(0.693)	(0.380)	(0.965)	(0.514)	(0.732)

*** p-value <0.001 ** p-value <0.01 * p-value <0.05

[2] High-penetration status, HMO coverage, Other Private Insurance Coverage, Age, Poverty Level, Marital Status, and Urban/Rural reflect individual's status at end of the first year of each panel.

[3] Education level, Hispanic ethnicity, Race, and Sex assessed at beginning of each panel and assumed not to change.

TABLE 13b State-Level Regression Model: Resulting Coefficients (p-values)

	2004-2005		*2005-2006*		*2006-2007*		*2007-2008*	
	Panel 9 [1]		Panel 10 [1]		Panel 11 [1]		Panel 12 [1]	
	CDSI	SRH	CDSI	SRH	CDSI	SRH	CDSI	SRH
High-Penetration:								
State [2]	0.245	0.093	-0.134	-0.066	-0.030	-0.066	0.508	0.043
	(0.494)	(0.165)	(0.685)	(0.292)	(0.917)	(0.253)	(0.029)*	(0.495)
HMO coverage [2]	-0.236	0.067	-0.535	0.053	-0.384	-0.001	-0.120	0.007
	(0.515)	(0.325)	(0.119)	(0.418)	(0.226)	(0.991)	(0.630)	(0.924)
Other Private								
Insurance Coverage [2]	0.057	-0.022	0.560	0.039	0.145	0.021	0.208	0.091
	(0.841)	(0.682)	(0.043)*	(0.460)	(0.571)	(0.686)	(0.281)	(0.107)
Age Groups [2]								
age 70-74	-0.138	-0.008	0.224	-0.003	0.057	-0.002	0.123	0.034
	(0.717)	(0.912)	(0.540)	(0.962)	(0.866)	(0.971)	(0.629)	(0.650)
age 75-80	0.078	0.027	0.102	0.039	0.000	0.055	0.277	0.246
	(0.849)	(0.721)	(0.791)	(0.593)	(0.999)	(0.453)	(0.313)	(0.002)**
age 80-84	0.111	0.280	0.370	0.008	-0.191	0.069	0.423	0.142
	(0.813)	(0.001)**	(0.400)	(0.920)	(0.638)	(0.397)	(0.160)	(0.108)
age 85+	0.626	0.108	1.035	0.262	-0.110	0.216	0.240	0.209
	(0.263)	(0.298)	(0.052)	(0.010)*	(0.811)	(0.019)*	(0.506)	(0.049)*
age 50-64	-0.308	-0.135	-0.187	-0.137	-0.400	-0.129	-0.152	-0.119
	(0.479)	(0.096)	(0.650)	(0.083)	(0.280)	(0.084)	(0.595)	(0.154)
age < 50	-0.784	-0.093	-0.552	-0.024	-0.646	-0.152	-0.775	-0.018
	(0.180)	(0.397)	(0.345)	(0.832)	(0.220)	(0.154)	(0.055)	(0.880)

*** p-value <0.001 ** p-value <0.01 * p-value <0.05

[1] Statistics for panels 9 - 12 presented here to demonstrate the changes from 2004 and the beginnings of Medicare Modernization Act passage to 2008.

[2] High-penetration status, HMO coverage, Other Private Insurance Coverage, Age, Poverty Level, Marital Status, and Urban/Rural reflect individual's status at end of the first year of each panel.

TABLE 13b (continued) State-Level Regression Model: Resulting Coefficients (p-values)

	2004-2005 Panel 9 [1]		*2005-2006* Panel 10 [1]		*2006-2007* Panel 11 [1]		*2007-2008* Panel 12 [1]	
	CDSI	SRH	CDSI	SRH	CDSI	SRH	CDSI	SRH
Education Level [3]								
high school degree	-0.586	0.139	0.389	0.117	-0.336	-0.040	0.204	0.059
	(0.071)	(0.021)*	(0.213)	(0.049)*	(0.240)	(0.488)	(0.366)	(0.371)
some college	-0.159	0.067	0.066	0.094	0.191	0.098	0.287	0.082
	(0.694)	(0.369)	(0.866)	(0.206)	(0.599)	(0.178)	(0.278)	(0.292)
4-yrs college	0.290	-0.009	1.099	0.057	0.066	0.101	0.527	0.073
	(0.567)	(0.926)	(0.020)*	(0.529)	(0.883)	(0.258)	(0.100)	(0.443)
> 4-yrs college	0.389	0.050	0.575	0.051	0.720	0.076	-0.082	0.130
	(0.492)	(0.632)	(0.285)	(0.615)	(0.135)	(0.432)	(0.823)	(0.225)
Federal Poverty Level Category [2]								
101%-200% FPL	0.659	-0.186	-0.678	-0.124	-0.251	-0.112	-0.487	0.096
	(0.218)	(0.062)	(0.161)	(0.177)	(0.578)	(0.218)	(0.174)	(0.363)
201%-300% FPL	-0.318	-0.035	0.588	-0.007	0.491	-0.031	-0.263	0.117
	(0.422)	(0.632)	(0.145)	(0.931)	(0.170)	(0.670)	(0.395)	(0.201)
301%-400% FPL	-0.857	-0.065	-0.183	0.036	-0.054	0.018	-0.334	0.097
	(0.026)*	(0.361)	(0.637)	(0.631)	(0.872)	(0.795)	(0.239)	(0.245)
> 400% FPL	-0.326	0.202	-0.081	0.075	0.083	0.026	-0.588	0.127
	(0.450)	(0.012)*	(0.850)	(0.355)	(0.821)	(0.722)	(0.062)	(0.170)
Hispanic Ethnicity [3]	-0.353	-0.001	0.927	0.034	0.468	0.047	-0.317	-0.060
	(0.402)	(0.987)	(0.018)*	(0.655)	(0.202)	(0.528)	(0.278)	(0.481)

*** p-value <0.001 ** p-value <0.01 * p-value <0.05

[2] High-penetration status, HMO coverage, Other Private Insurance Coverage, Age, Poverty Level, Marital Status, and Urban/Rural reflect individual's status at end of the first year of each panel.

[3] Education level, Hispanic ethnicity, Race, and Sex assessed at beginning of each panel and assumed not to change.

TABLE 13b (continued) State-Level Regression: Resulting Coefficients (p-values)

	2004-2005 Panel 9 [1]		*2005-2006* Panel 10 [1]		*2006-2007* Panel 11 [1]		*2007-2008* Panel 12 [1]	
	CDSI	SRH	CDSI	SRH	CDSI	SRH	CDSI	SRH
Race [3]								
black	-0.122	0.001	0.534	0.000	0.552	-0.056	0.150	0.002
	(0.744)	(0.992)	(0.118)	(0.996)	(0.078)	(0.375)	(0.552)	(0.980)
American Indian	0.130	0.480	-0.207	-0.138	-0.081	0.209	1.746	-0.120
or Alaska Native	(0.931)	(0.084)	(0.877)	(0.588)	(0.954)	(0.457)	(0.077)*	(0.679)
Asian	0.374	-0.188	0.790	-0.084	-1.311	0.155	-0.079	0.211
	(0.670)	(0.249)	(0.301)	(0.564)	(0.031)*	(0.204)	(0.836)	(0.059)
Native Hawaiian	-0.889	-0.303	-0.376	0.324	2.758	0.052	0.719	0.475
or Pacific Islander	(0.654)	(0.410)	(0.838)	(0.355)	(0.238)	(0.911)	(0.674)	(0.344)
Multiple races	-1.217	-0.336	2.411	-0.311	-0.903	0.140	0.960	0.455
	(0.219)	(0.072)	(0.045)*	(0.175)	(0.335)	(0.455)	(0.223)	(0.049)*
Marital Status [2]								
widowed	-0.664	0.008	3.294	0.010	-0.212	0.128	-0.714	-0.160
	(0.798)	(0.960)	(0.196)	(0.943)	(0.919)	(0.445)	(0.655)	(0.404)
divorced	-1.018	0.090	3.065	0.021	-0.283	0.077	-1.155	-0.025
	(0.696)	(0.592)	(0.230)	(0.887)	(0.892)	(0.652)	(0.472)	(0.898)
married	-0.160	0.079	3.046	0.034	-0.520	0.108	-1.139	-0.028
	(0.951)	(0.621)	(0.231)	(0.812)	(0.801)	(0.506)	(0.472)	(0.880)
never married	-0.913	0.188	3.265	0.112	-0.264	0.075	-1.137	0.017
	(0.724)	(0.282)	(0.200)	(0.480)	(0.898)	(0.671)	(0.481)	(0.932)
Male [3]	-0.236	-0.033	-0.115	-0.045	0.026	-0.001	0.401	0.024
	(0.379)	(0.504)	(0.653)	(0.357)	(0.911)	(0.979)	(0.022)*	(0.643)
Urban [2]	0.799	0.004	-0.291	-0.018	0.216	0.009	-0.128	-0.026
	(0.009)**	(0.945)	(0.325)	(0.746)	(0.422)	(0.865)	(0.560)	(0.680)

*** p-value <0.001 ** p-value <0.01 * p-value <0.05

[2] High-penetration status, HMO coverage, Other Private Insurance Coverage, Age, Poverty Level, Marital Status, and Urban/Rural reflect individual's status at end of the first year of each panel.

[3] Education level, Hispanic ethnicity, Race, and Sex assessed at beginning of each panel and assumed not to change.

TABLE 13c County-Level Regression Model: Resulting Coefficients (p-values)

	2004-2005 Panel 9 [1]		*2005-2006* Panel 10 [1]		*2006-2007* Panel 11 [1]		*2007-2008* Panel 12 [1]	
	CDSI	SRH	CDSI	SRH	CDSI	SRH	CDSI	SRH
High-Penetration:								
County [2]	-0.210	0.141	0.196	-0.013	0.122	-0.052	0.450	-0.023
	(0.504)	(0.016)*	(0.513)	(0.818)	(0.648)	(0.331)	(0.025)*	(0.699)
HMO coverage [2]	-0.176	0.058	-0.590	0.046	-0.397	-0.004	-0.117	0.015
	(0.628)	(0.391)	(0.088)	(0.480)	(0.209)	(0.944)	(0.641)	(0.842)
Other Private								
Insurance Coverage [2]	0.022	-0.017	0.592	0.043	0.162	0.022	0.201	0.086
	(0.938)	(0.755)	(0.033)*	(0.412)	(0.527)	(0.663)	(0.297)	(0.129)
Age [2]								
age 70-74	-0.131	-0.002	0.223	-0.003	0.052	0.001	0.130	0.034
	(0.730)	(0.975)	(0.542)	(0.968)	(0.879)	(0.991)	(0.609)	(0.653)
age 75-80	0.106	0.023	0.091	0.038	-0.009	0.055	0.286	0.248
	(0.796)	(0.761)	(0.814)	(0.604)	(0.980)	(0.452)	(0.298)	(0.002)**
age 80-84	0.152	0.274	0.367	0.009	-0.198	0.074	0.433	0.143
	(0.748)	(0.002)**	(0.405)	(0.916)	(0.627)	(0.363)	(0.150)	(0.105)
age 85+	0.634	0.107	1.032	0.261	-0.125	0.220	0.278	0.212
	(0.257)	(0.302)	(0.053)	(0.010)*	(0.786)	(0.017)*	(0.442)	(0.046)*
age 50-64	-0.297	-0.135	-0.188	-0.136	-0.397	-0.130	-0.141	-0.121
	(0.494)	(0.096)	(0.649)	(0.085)	(0.285)	(0.080)	(0.622)	(0.149)
age < 50	-0.785	-0.083	-0.555	-0.026	-0.641	-0.151	-0.784	-0.025
	(0.180)	(0.446)	(0.341)	(0.819)	(0.223)	(0.156)	(0.052)	(0.835)

*** p-value <0.001 ** p-value <0.01 * p-value <0.05

[1] Statistics for panels 9 - 12 presented here to demonstrate the changes from 2004 and the beginnings of Medicare Modernization Act passage to 2008.

[2] High-penetration status, HMO coverage, Other Private Insurance Coverage, Age, Poverty Level, Marital Status, and Urban/Rural reflect individual's status at end of the first year of each panel.

TABLE 13c (continued) County-Level Regression Model: Resulting Coefficients (p-values)

	2004-2005 Panel 9 [1]		*2005-2006* Panel 10 [1]		*2006-2007* Panel 11 [1]		*2007-2008* Panel 12 [1]	
	CDSI	SRH	CDSI	SRH	CDSI	SRH	CDSI	SRH
Education Level [3]								
high school degree	-0.571	0.134	0.386	0.116	-0.346	-0.038	0.215	0.062
	(0.079)	(0.027)*	(0.216)	(0.051)	(0.226)	(0.513)	(0.339)	(0.352)
some college	-0.118	0.062	0.052	0.091	0.187	0.098	0.316	0.087
	(0.770)	(0.408)	(0.894)	(0.221)	(0.606)	(0.177)	(0.231)	(0.264)
4-yrs college	0.315	-0.010	1.076	0.053	0.058	0.099	0.554	0.076
	(0.535)	(0.912)	(0.023)*	(0.554)	(0.896)	(0.267)	(0.083)	(0.423)
> 4-yrs college	0.414	0.051	0.532	0.045	0.715	0.073	-0.089	0.128
	(0.464)	(0.628)	(0.322)	(0.663)	(0.137)	(0.452)	(0.808)	(0.234)
Federal Poverty Level Category [2]								
101%-200% FPL	0.660	-0.183	-0.681	-0.124	-0.245	-0.112	-0.491	0.097
	(0.217)	(0.067)	(0.159)	(0.179)	(0.588)	(0.216)	(0.171)	(0.358)
201%-300% FPL	-0.310	-0.036	0.576	-0.007	0.489	-0.031	-0.277	0.119
	(0.433)	(0.625)	(0.154)	(0.929)	(0.171)	(0.668)	(0.372)	(0.192)
301%-400% FPL	-0.849	-0.070	-0.204	0.035	-0.058	0.017	-0.297	0.102
	(0.027)*	(0.329)	(0.601)	(0.639)	(0.864)	(0.798)	(0.294)	(0.221)
> 400% FPL	-0.300	0.202	-0.106	0.071	0.076	0.025	-0.545	0.135
	(0.486)	(0.012)*	(0.804)	(0.382)	(0.837)	(0.739)	(0.082)	(0.145)
Hispanic Ethnicity [3]	-0.259	-0.007	0.861	0.022	0.436	0.046	-0.322	-0.053
	(0.535)	(0.933)	(0.028)*	(0.767)	(0.237)	(0.535)	(0.268)	(0.537)

*** p-value <0.001 ** p-value <0.01 * p-value <0.05

[2] High-penetration status, HMO coverage, Other Private Insurance Coverage, Age, Poverty Level, Marital Status, and Urban/Rural reflect individual's status at end of the first year of each panel.

[3] Education level, Hispanic ethnicity, Race, and Sex assessed at beginning of each panel and assumed not to change.

TABLE 13c (continued) County-Level Regression: Resulting Coefficients (p-values)

	2004-2005 Panel 9 [1]		*2005-2006* Panel 10 [1]		*2006-2007* Panel 11 [1]		*2007-2008* Panel 12 [1]	
	CDSI	SRH	CDSI	SRH	CDSI	SRH	CDSI	SRH
Race [3]								
black	-0.158	0.005	0.564	0.006	0.558	-0.054	0.103	-0.003
	(0.673)	(0.938)	(0.099)	(0.931)	(0.075)	(0.394)	(0.682)	(0.965)
American Indian	0.122	0.481	-0.211	-0.138	-0.072	0.222	1.702	-0.119
or Alaska Native	(0.935)	(0.084)	(0.875)	(0.588)	(0.959)	(0.430)	(0.085)	(0.681)
Asian	0.506	-0.194	0.654	-0.110	-1.383	0.146	0.027	0.240
	(0.562)	(0.233)	(0.388)	(0.450)	(0.022)*	(0.227)	(0.943)	(0.030)*
Native Hawaiian	-0.600	-0.341	-0.502	0.290	2.729	0.034	0.781	0.521
or Pacific Islander	(0.762)	(0.354)	(0.784)	(0.406)	(0.243)	(0.942)	(0.647)	(0.299)
Multiple races	-1.163	-0.333	2.368	-0.320	-0.888	0.140	0.885	0.452
	(0.240)	(0.074)	(0.049)*	(0.163)	(0.343)	(0.455)	(0.261)	(0.051)
Marital Status [2]								
widowed	-0.673	0.007	3.282	0.009	-0.221	0.117	-0.540	-0.169
	(0.795)	(0.966)	(0.198)	(0.953)	(0.915)	(0.484)	(0.734)	(0.376)
divorced	-1.029	0.091	3.058	0.020	-0.295	0.070	-0.947	-0.033
	(0.692)	(0.588)	(0.231)	(0.895)	(0.888)	(0.679)	(0.554)	(0.868)
married	-0.166	0.077	3.047	0.034	-0.525	0.102	-0.955	-0.037
	(0.949)	(0.627)	(0.231)	(0.811)	(0.799)	(0.532)	(0.545)	(0.844)
never married	-0.926	0.184	3.222	0.107	-0.282	0.068	-0.913	0.011
	(0.720)	(0.291)	(0.205)	(0.501)	(0.891)	(0.701)	(0.570)	(0.956)
Male [3]	-0.231	-0.036	-0.118	-0.046	0.025	-0.002	0.391	0.023
	(0.390)	(0.474)	(0.644)	(0.340)	(0.916)	(0.973)	(0.026)*	(0.649)
Urban [2]	0.864	-0.013	-0.348	-0.021	0.180	0.014	-0.195	-0.020
	(0.005)**	(0.820)	(0.251)	(0.722)	(0.516)	(0.796)	(0.382)	(0.763)

*** p-value <0.001 ** p-value <0.01 * p-value <0.05

[2] High-penetration status, HMO coverage, Other Private Insurance Coverage, Age, Poverty Level, Marital Status, and Urban/Rural reflect individual's status at end of the first year of each panel.

[3] Education level, Hispanic ethnicity, Race, and Sex assessed at beginning of each panel and assumed not to change.

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