INTEGRATING MEDICARE AND MEDICAID HEALTHCARE DELIVERY AND REIMBURSEMENT POLICIES FOR DUAL ELIGIBLE BENEFICIARIES:

A Cost-Efficiency Analysis of Managed Care

Kan Zhang

Dr. Frank Sloan, Faculty Advisor
Dr. Kent Kimbrough, Seminar Professor

Honors thesis submitted in partial fulfillment of the requirement for Graduation with Distinction in Economics in Trinity College of Duke University

Duke University
Durham, North Carolina
2012

ACKNOWLEDGEMENTS

I would like to express my deepest gratitude to Dr. Frank Sloan, whose experience and expertise in health economics was invaluable in the creation of this thesis. He has offered instrumental advice and suggestions towards the analysis of patient data, and helped me greatly in understanding and interpreting my results. I would also like to thank Dr. Kent Kimbrough, who has offered weekly guidance on the thesis writing process for two semesters. In addition, I am very grateful for the countless hours that he has invested in reading numerous copies of my drafts in process, offering critical comments and suggestions for improvements; as well as for his patience in listening to my presentations regarding the findings and progress. Finally, I would like to express my appreciation for the California State Department of Health, and in particular, Mr. Terrence Nolan from the California Office of Statewide Health Planning and Development, for his generosity in waiving the fee for the data used in this thesis.

ABSTRACT

This paper examines the role of Managed Care in reducing inefficiencies in the provision of healthcare for Medicare-Medicaid dual eligible patients, and more generally, for elderly Medicare-only beneficiaries. The dataset used in the analyses of this study is the patient hospital discharge data from California between years 2006 and 2010 (inclusive). More specifically, only records for elderly patients (age 65+) whose payer categories are Medicare or Medicaid were utilized. A series of different regression models were run on this dataset, as well as subsets of this data, and all consistently showed managed care enrollment to reduce utilization rates as well as costs of inpatient hospital services. Using the regression results obtained, annual cost savings from inpatient services that can be achieved by enrolling all California non managed care dual eligibles and Medicare beneficiaries into such organizations is estimated to be approximately $1.42 billion. This is equivalent to 10.39% of total Medicare spending on hospitalizations in California each year.

JEL Classification: I10 I11 I12 I18 D61
Keywords: Dual Eligibles; Managed Care; Medicare

I. INTRODUCTION

The United States has long been deemed to have one of the most cost-inefficient healthcare systems among economically developed countries. The cost of healthcare in the United States has steadily grown at an average rate of 2.4 percent points faster than the growth of GDP for the past 40 years with no signs of slowing, and total health expenditures reached 16.2% of total GDP in 2007, the equivalent of $2.2 trillion. At this rate, health expenditures are expected to reach 25% of total GDP by 2025. Furthermore, the Medicare, Medicaid, and Children's Health Insurance Programs combined made up 21% of Federal expenditures in 2010, placing significant pressure on the Federal budget. Despite a per capita healthcare spending of almost $8000, 42% of chronically ill patients were unable to comply with recommended treatment, and over 45 million Americans remained uninsured as of 2007 (Kaiser, 2009).

Despite a positive global correlation between healthcare spending and GDP per capita, the US stands as a clear outlier, outspending other comparable western nations by $477 billion annually after adjusting for income (Angrisano et. al., 2007). However, this spending has not translated into superior health outcomes in the US: a Commonwealth Fund study found the U.S. in the middle of the pack in overall healthcare outcomes among the developed nations; while a 191 nation comprehensive quantitative study conducted by the WHO ranks the US at 37 in overall health outcome. Furthermore, based on studying the prevalence of 130 leading diseases including melanoma, hepatitis, obesity, and anxiety, McKinsey and Company concludes that the US population is *not* inherently sicker than that of other leading nations (Aggarwal, 2008). This suggests that there exists inefficiencies within the US healthcare system and that there is potential for reduced expenditures without compromising the quality of healthcare.

The most expensive population sector with regard to healthcare consumption is comprised of the 9.2 million Medicare-Medicaid dual eligible beneficiaries. Most Medicare enrollees become enrolled at age 65 given that they have worked for at least 40 quarters (exceptions include patients with end-stage renal disease and the permanently disabled, who are eligible to enroll independent of age). Of all Medicare enrollees, those whose incomes fall below their state Medicaid income limits may also enroll in Medicaid, which covers services excluded by Medicare and any cost-sharing requirements set by Medicare. While only 8% of the general Medicare population is below the Federal Poverty Line, over 60% of dual-eligibles fall in that category, and 43% of them suffer from at least one mental or cognitive impairment. Up to 60% of dual-eligibles battle multiple chronicle conditions and they are also three times more likely to be disabled than the general Medicare population (Medpac, 2004). When first conceived in 1965, the Medicaid and Medicare programs were designed as separate programs to cater to different sectors of the US population, but today, there are over nine million citizens who are eligible and have enrolled in the both. A total of $215 billion of state and federal spending was used to fund the healthcare costs of the dual eligible population in 2005, accounting for one quarter of all Medicare spending and 46% of total Medicaid spending (Rosenbaum et. al., 2009). While predisposed conditions of this group of enrollees do play a large factor into such high costs, there are a number of other inefficiencies in the system that are also driving up this expenditure.

Inefficiency often arises due to the lack of coordination between Medicare and Medicaid in the delivery and reimbursement policies of healthcare. More importantly, while Medicare is fully funded by the government, Medicaid is a jointly funded by the state and federal governments. This leads to much cost shifting at the expense of more inefficient, and oftentimes unnecessary health services, resulting in wasted resources and oftentimes poorer health outcomes

(Grabowski, 2007). Medicare is not a comprehensive benefit package and only covers the costs of services such as inpatient and outpatient hospital stays, physician fees, prescription drugs, and laboratory fees. It furthermore has premiums and co-payment policies so that overall, it covers just over half of an enrollee's total medical costs (Grabowski, 2007). It does not cover long-term care services in institutions or skilled nursing facilities (SNF's), limiting coverage in such care to 90 days of post-acute services following a hospitalization if approved by a utilization review committee (HAP, 2010). However, up to 22% of all dual-eligibles are long-term stays at SNF's, and are paid for by Medicaid, which in addition covers charges for dental/vision care, Medicare cost-sharing requirements, acute care services, and home health care (Grabowski, 2007).

There are a number of motivations behind the inefficient cost shifting practices between acute and long-term care settings that are oftentimes deleterious to patients. One significant cause of shifts from the State to Federal government is the lack of investments in SNF's and home- and community-based services (HCBS). Medicaid covers the full cost of long-stay dual eligible patients in SNF's and HCBS's when they are in the homes, but it is only required to pay the Medicare deductibles and copayments when they are hospitalized, so that it is cheaper for Medicaid to transfer its long-stay dual eligibles to the hospital when complications arise. One day of hospital treatment can cost up to $1000 for the equivalent care that can be provided for $425 by an Intensive Service Day (ISD) in a nursing home. It has been shown that a $10 increase in investment in clinical services and medical staff in homes can reduce hospitalizations by 9%. However, such investments would lead to higher nursing home costs, which would be paid for by Medicaid, hence states, which have significant control over nursing home, have no incentives to reduce hospitalizations by investing in better SNF care (Grabowski, 2007).

Providers of SNF care themselves furthermore face incentives to send long-stay patients to hospitals. The first incentive is the bed-hold policy, whereby nursing homes receive a daily rate from Medicaid to hold beds open for residents during their hospitalizations. Since the marginal profit for holding a bed is often higher than that of caring for a patient, nursing homes are incentivized to hospitalize their patients. The second source of financial incentive results from the fact that Medicare rates to nursing homes for post-acute care is higher than Medicaid rates for long-term care. Therefore, by hospitalizing their long-stay dual eligibles, nursing homes may expect a higher payment from Medicare upon their residents' return for up to 90 days. As many as one quarter of all long-stay nursing home dual eligible residents are hospitalized annually, a certain percentage of which are likely unnecessary. It is estimated that 23% of the 82,230 hospitalizations of long-stay dual eligibles (worth $250 million) in the state of New York in 2004 were avoidable. Furthermore, hospital stays can be traumatic and research has shown that patients to become more cognitively impaired after a hospitalization (Grabowski, 2007).

Under the current situation, neither program is incentivized to internalize the costs and risks of dual-eligible beneficiaries (Grabowski, 2007), and one possible method to correct for this is to fully align payment policies so that inefficiency can be eliminated. A particularly promising approach to this issue is to enroll all 9.2 million dual-eligible beneficiaries in managed care organizations (MCO's), which are systems composed of affiliated networks of physicians, hospitals, and other providers working under a coordinated system to deliver healthcare as efficiently as possible. The Federal government has taken some initiative by introducing the Program of All-Inclusive Care for the Elderly (PACE) that specifically combines care reimbursements by Medicare and Medicaid; as well as the Special Needs Plans (SNPs)[1] designed

[1] The 2003 Medicare Modernization Act introduced the Medicare Advantage special needs plans (SNPs) to offer states an additional vehicle through which Medicare and Medicaid services can be coordinated. However, it is up to each individual states' Medicaid agencies

especially for dual-eligibles, known as D-SNP's, which were made available in 2003 (Menges et. al., 2011). Furthermore, the passage of Obama's Affordable Care Act in March of 2010 also saw an attempt to align the financial reimbursement policies of Medicaid and Medicare programs for dual eligibles in all 50 states (HHS Press Office, 2011).

The efficacy of the programs that are currently in place, including PACE, SNP's and some state-initiated programs have been evaluated by various entities at different points in time in the past, and have all come to differing conclusions. Furthermore, the greater body of the existing research is not specifically focused on dual-eligibles, and instead evaluates the cost of general MCO enrollees. A direct comparison of the costs of managed care enrolled and non-enrolled dual eligibles using the most updated statistics is lacking, and this is what will be explored in this paper. I intend to add to this volume of research by conducting cost-efficiency analyses on hospitalizations of Californian elderly patients by dual-eligibility and MCO enrollment. A more current and comprehensive analysis is especially necessarily now given the Affordable Care Act's component targeted at managing dual-eligible patients. The outcomes of this empirical study may shed light on the extent to which managed care can reduce the costs of dual-eligibles, and the impact they may have if they were to be expanded to cover all 9.2 million enrollees.

II. LITERATURE REVIEW

The importance of reducing the annual national expenditure on healthcare services has prompted numerous papers and studies on the topic. The Harvard Medical School presented a paper offering an extensive overview of the underlying problems regarding dual-eligible beneficiaries, and then draws from a number of other studies on the subject matter to propose

---

to contract SNPs and establish single plans to offer both acute and long-term care services to their dual eligible patients. Uptake has been slow and few states have thus far taken advantage of this option (Milliagan, Jr. and Woodcock, 2008).

two policies. One is the pay-for-performance policy, which in theory should target the problem associated with unnecessary hospitalizations, and shift providers' focus from the quantity to the quality of care services. It offers evidence from a controlled experiment conducted by Rosenthal and Frank in 2006, which found that financial incentives are effective in reducing the intensity of care and dependency of nursing home residents. An alternative proposal that is offered is the possibility of federalizing the Medicaid costs for dual eligibles so that the cost of all care for this group is financed by one payer. Not only should this move improve efficiency, but it would also free up state Medicaid funds to be invested in its other 50-55 million beneficiaries. The costs that are saved by the state are more significant than the extra costs accrued by the Federal government due to its lower taxing and borrowing authority (Grabowski, 2007).

With regard to outcomes of current integration models, another report found that the first year of enrollment into the PACE program cost on average 9.7% higher per enrollee, but Medicare still managed to accrue savings of 42%, indicating that Medicaid spending rose by a much higher margin of 86%. An analysis of the Minnesota Senior Health Options (MSHO) model further found costs to have increased per enrollee in the initial stages. What is promising, however, is that quality of care showed statistically significant improvements for PACE enrollees in various different measures, from probability of receiving ambulatory to higher quality of life (Abt, 2000). MSHO enrollees, on the other hand, were not found to have experienced statistically significant improvements in any outcomes evaluated (Grabowski, 2007), and an additional study that evaluates the costs and outcomes of the MSHO program concludes that it is not a viable solution to the US healthcare cost problem (Kane et. al., 2005). The MSHO model differs from traditional CMO's and the PACE model in that it does not

require enrollees to seek health from a limited number of providers within a coordinated network.

Despite a 9.2% increase in costs per enrollee for first year enrollment in PACE (Abt, 2000), a separate study published by the Lewin Group offers some explanations to this and furthermore projects long-run savings despite higher initial costs. The report draws data from the Centers for Medicare and Medicaid Services (CMS) and figures from 2005 show that across the US, only 6% of all Medicaid spending on dual eligibles is capitation spending, compared to 25.8% of spending on non dual eligible Medicaid beneficiaries. The remaining 94% of Medicaid spending on dual eligibles were fee-for services expenses. The report then uses baseline FFS costs of different healthcare service categories including, among others, "Inpatient Services", "Nursing Facility Care", and "Home Health Services" across the 50 states to trend forward their future costs. Calculations were based on Medicare and Medicaid per capita costs trended forward at an annual rate of 7%, as well as the assumption that the number of dual eligibles grows at an annual rate of 1.5%. Based on these forward trending methods, the total expenditure on dual eligibles is estimated to reach $7 trillion (47% accrued by Medicaid, and 53% by Medicare) over a 15 year time period, between 2010 and 2024 (Lewin Group, 2008).

The same report then identifies the distinct sources of cost savings, and based on their analyses of existing capitated programs and the cost impacts of proposed changes, estimates the amount that each source can potentially save (Arizona and Minnesota were excluded from the model as more than half of their dual eligibles were already enrolled in capitated CMO's by 2005). Some services that were evaluated include: nursing home costs (savings beginning at 1.3% in 2010, and rising up to 13.5% by 2024); inpatient hospital costs (up to 20% annual savings); and other Medicaid services including outpatient hospital fees, physician services fees,

and diagnostic providers, among others (5% annual savings). Home health costs is the only source that is expected to rise, but by the same proportion as that of savings expected from lower nursing home costs. Taking all of these figures into account, national combined Medicaid and Medicare savings are predicted to begin at 2.7% by 2010, and increase to 4.7% by the 2024. Over the full 15-year period, the capitated MCO system is estimated to reduce dual eligible healthcare costs by 4.2%, or $301 billion compared to the current system (Lewin Group, 2008).

An interesting observation, however, is that savings by Medicare by far outweigh savings by Medicaid, and that Medicaid costs in fact rise in the first years (equivalent to negative savings) until 2015 (Lewin Group, 2008). Additionally, maximum savings to Medicaid is estimated to reach a maximum of just 0.9%, compared to Medicare's 7.9%, which falls in line with Abt's findings from evaluating PACE's first year of operation. This is because there exist greater barriers to improving long-term care services so most initial savings would come from more efficient acute care utilization. Since Medicare is the primary payer for acute services, it is logical that savings from such a model primarily benefits Medicare, or the Federal government.

A more current study on the efficacy of MCO enrollment of dual eligibles was able to evaluate recent implementations of integrated programs. This paper focuses particularly on Medicaid agencies that have contracted the SNP's in Minnesota, New Mexico and New York. Minnesota's MSHO has a long history dating back to 1983, which then expanded to integrate the two programs together in 1997. Since SNP's were introduced, MSHO has taken advantage of the opportunity and as of the time that this report was created, nine integrated SNP plans were covering all but four of the State's counties, covering almost 37 thousand dual eligibles. New York's experience with integrated care began with the introduction of SNP's in 2003 and enrollment began in 2005. By the end of 2009, 27 New York counties had access to Medicaid

contracts with one of 11 SNP's, but enrollment remained low compared to Minnesota, with just under 5,500 enrollees in the metro area. Finally, New Mexico entered the scene most recently in August 2008, and estimated enrollments reach up to 38 thousand (Edwards et. al., 2009).

On this note, it has been found that following the increase of enrollees that transitioned into the SNP model, general healthcare outcomes improved in that fewer preventable hospitalizations and fewer emergency services were used. However, costs to Medicaid have also risen slightly in the early years of implementation, though the study recognizes that this may change as the program matures. Furthermore, the Minnesota Medicaid agency states that the objective of its program was only to improve healthcare outcomes, and never to reduce costs, hence without further analysis, it is premature to rule out the entire model in question. Similarly, New York's program also saw positive feedback from enrollees regarding the level of care, but due to low levels of enrollment, this report was unable to offer any further detailed analysis of the costs and outcomes of healthcare. Unfortunately, New Mexico's program was too new to undergo similar evaluations at the time of this report. However, the main expectations of the SNP's to offer "seamless access" to care, to reduce dependency on institutional care, and to improve the quality of life, fall in line with that of the other two programs (PACE and MCO's); and given the similarities in the way that the plans are designed and implemented, positive outcomes of New Mexico's program can be reasonably expected (Kane et. al., 2004).

Given the context of the existing publications, which have all employed different types of data and methods of analysis to evaluate Medicare/Medicaid integration programs to arrive at mixed conclusions, this paper aims to build upon the findings and undertake a more uniform approach in evaluating the cost-efficiency of managed care. California hospital discharge data

(2006-2010) for dual-eligibles enrolled in managed care will be analyzed against those who are not enrolled to determine the potential impact of such programs nationwide.

III. ECONOMIC THEORY

The economic theory outlined below, which suggests a fee-for-service policy to be cost-inefficient in the health market, is based on Peter Zweifel and Breyer Friedrich's book, *Health Economics*. While this section focuses on a qualitative explanation of the theoretical framework, a full mathematical derivation can be found in appendix A.

Within the healthcare market, the consumers of healthcare (patients) know less about their own needs for the good, and ultimately rely on the suppliers (doctors) to determine their own demand curve for healthcare. What makes dual-eligibles distinct is that they are essentially fully insured at no cost[2], so that the consumption of healthcare is no longer checked by the consumers' willingness to pay. As a result, "supplier-induced-demand" dictates the amount of healthcare that dual-eligibles consume, and healthcare providers are incentivized to induce as much demand as they need to maximize their revenue, even when additional services they offer may produce minimal, if any, benefits. The assumptions listed below can then be made based on this theory.

1. A patient's consumption of healthcare increases with the physician's induced demand.
2. The demand for each physician's time in supplying healthcare as a fraction of his/her total time available is only determined by the number of patients that the physician has and the amount of health services each patient consumes.
3. A physician's income is a direct function of the number of hours s/he works.

[2] While Medicare itself is not free (premiums, co-payments and deductibles apply), the Medicaid program helps dual eligibles cover these costs in addition to its own services such as long-term care.

4. A physician's utility is positively correlated with income, negatively correlated with the number of hours worked, and inherently, negatively correlated with the amount of induced demand s/he creates.
5. The success of treatment is a function of the services offered, each of which is produced by physician working hours and some other factor of production.
6. The physician's income is determined by revenue minus costs, where the factor cost for each service is the same.

Following these assumptions, a physician's utility model based on income, time worked, and amount of healthcare demand induced in his/her patients can be deduced. The first order derivative of this function then demonstrates that the amount of healthcare induced by a physician is determined by the unit where the marginal benefit of consumption equals the sum of the marginal loss and marginal "bad conscience" associated with each additional unit of induced healthcare demand.

Moving forward, the factors of production can then be incorporated into the success rate of the treatment (assumptions 5 and 6), allowing for the physician's income to be expressed as a function of revenues and factor prices. Similarly, the amount of services induced can be written as a function of the success of treatment, which in turn is a function of the production factors that go into each. Finally, by incorporating the above new functions into the original utility model, and differentiating with respect to time and other production factor respectively, it can be shown that under these assumptions, the marginal rate of substitution between time and other production factor is equal to the ratio of their respective prices. This therefore implies that the most efficient way to achieve a certain outcome is by using the least number of procedures possible. This

would only occur when an additional unit of each procedure produced requires the equal amount of marginal inputs, which is less than likely to be the case.

On the other hand, when this utility function is applied to the case where provider reimbursement is under a capitated policy (as is mostly the case with Managed Care), rather than the fee-for-service policy assumed above, revenue merely becomes a function of the number of patients that a provider has. Meanwhile, the average amount of services that each patient receives is simply determined by the total amount of services produced by each provider, divided by the number of patients s/he sees. Following this simplification, the utility function of the physician is once again revised, and the derivative of this implies that at the optimum, any marginal utility that is lost to an extra unit of time providing health services must be offset by any marginal gains in income. Since this income is inherently a function of the success of a service, any overutilization or inefficient use of healthcare can potentially be eliminated.

Based on the above analysis, providers of healthcare are incentivized to induce more demand in the consumers of healthcare under a fee-for-service policy, creating inefficiency and excess costs. This incentive appears to be eliminated, however, under a capitation policy since the utility of leisure time lost to providing more healthcare must be offset by the utility gained by the success of treatment, and consequently income. As mentioned earlier, the provision of healthcare services to dual-eligibles may be even more prone to provider induced demand, since the willingness-to-pay check that helps limit the amount of healthcare demanded by other consumers does not exist in this case.

IV. EMPIRICAL DATA

There are a number of different types of managed care plans that have been implemented in different states in which dual eligibles have enrolled in. For example, there is the Primary Care Management Provider (PCCM), whereby physicians contract directly with the State to coordinate and cover all primary care for their enrollees. Prepaid Inpatient Health Plans (PIHP) provide limited inpatient or institutional services, while Prepaid Ambulatory Health Plans (PAHP) cover limited services in ambulatory health. Though these three types of plans have been implemented in a number of states across the country, all of which have dual eligible enrollees, they will not be taken into consideration in this study. Instead, only patients under Managed Care Organizations (MCO's) and PACE, both of which cover pre-paid, capitated, comprehensive Medicare and Medicaid services will be evaluated. This decision was made based on the fact that the other plans do not offer as full or extensive of a range of the services that dual-eligibles are covered for, which would impact costs significantly.

The original study design included patient discharge data from 2006 to 2010 (inclusive) from Arizona, New Mexico, and New York, due to their relative high rates of MCO enrollment among their dual eligible populations. Unfortunately, the data from Arizona and New York were both too expensive to purchase, and the New Mexico State Department of Health was unresponsive despite continued attempts to contact them. Other states such as Tennessee, Texas, Massachusetts, Minnesota, Oregon, and Pennsylvania, which also have relatively high numbers of dual eligible enrollees in managed care were also considered as replacements, but were ultimately rejected as well due to similar difficulties in locating data. After reaching out to the State Departments of Health from a number of states to inquire about the availability and cost of

patient hospital discharge data, California was ultimately chosen, since it was able to waive the cost of the data.

Despite California's low percentage of dual eligibles enrolled in any form of managed care system, the fact that it is such a large state ensures that the absolute number of dual eligible enrollees in MCO's and PACE is among the highest. As of 2009, 82,215 dual eligibles were enrolled in MCO's, ranking fourth among the fifty states, and 2,068 were enrolled in PACE, ranking second (Kaiser, 2011). In fact, the nation's first PACE program was developed in California by On Lok Senior Health Services in the early 1970's, and was then adopted on a larger scale as a demonstration in the 1980's (Grabowski, 2007). By 1997, the Balanced Budget Act officially established PACE as a permanent Medicare provider and voluntary option under Medicaid, and there are five PACE programs in operation today (Grabowski, 2997). Furthermore, the largest health management organization (HMO) demonstration began in the Los Angeles, Riverside, and San Bernardino counties and continued through 2007, at which time the state made a decision to continue this program in the three counties (Douglas, 2011). These HMO's provide preventative, primary, acute, as well as long-term care services.

The population group of interest is the elderly population (defined as age 65 and older), who are automatically enrolled into Medicare. Hence, only discharges of patients that fall in this age group will be used. In addition, hospital stays that were paid for by any other category other than Medicare or Medicaid will not be considered, since payment rates to hospitals by private insurance or out-of-pocket payers vary for the same services. After the data from across the five years had been aggregated and cleaned, the number of observations totaled. 2,915,139. The breakdown into non dual eligibles and dual eligibles by managed care enrollment and non dual eligibles is presented in table 1.

Table 1. Number of Dual-Eligible and non Dual-Eligible discharges (by Managed Care Enrollment)

Patient Type	Number of Discharges
Non Dual-Eligibles	**2,785,128**
Managed Care Enrollees	*2,195,138*
Non Managed Care Enrollees	*589,990*
Dual-Eligibles	**130,011**
Managed Care Enrollees	*11,862*
Non Managed Care Enrollees	*118,149*

In addition, the average charges (in 2006 dollars) per stay by patient-type are listed below in table 2.

Table 2. Average charge per hospital stay – by Dual-Eligibility status

Patient Type	Average charge
All patients	$56,846
Non Dual-Eligibles	$56,674
Dual-Eligible	$60,519

V. METHODOLOGY

In order to analyze the cost-saving effect of managed care enrollment for dual eligible patients, a number of regressions will be run on the data described above. The dependent variables used in the various regressions are listed below in table 3.

Table 3. List of Dependent Variables used in the analysis

Dependent Variables	Description
Charge	Total charge for stay adjusted for inflation (in 2006 dollars)
AdjCharge	Total charge for stay adjusted for inflation (in 2006 dollars), and further adjusted for hospital discount rate (cost-charge ratio)
LOS	Total length of stay at the hospital (measured in days)
Totdiag	Total number of diagnoses (max. 26) for each admission
Totproc	Total number of procedures (max. 21) performed at each patient's admission

The variable *Charge* is simply the charge given by the hospital discharge data adjusted for yearly inflation so that all values are in 2006 dollars[3]. The variable *AdjCharge*, on the other hand, requires some background knowledge on how hospitals are reimbursed for the services they provide. In the realm of hospital care, the concepts of **charge** and **payment** are different, in that while each hospital *charges* all its patients the same amount for a given service, the actual amount that each hospital *receives* in payment for a given service varies by the patient's payer type. Across the U.S., Medicare on average only pays hospitals 43% of the charges specified for their services to beneficiaries, which make up approximately 40% of patients. Medicaid on average pays a slightly lower rate than Medicare for the same services, and in some states, the Medicaid program pays hospitals as little as 27% of predetermined charges for services to its beneficiaries, who on average make up 13% of all hospital patients. Similarly, private insurance companies also have the power to negotiate the actual payments that they make to hospitals for different services provided (larger companies usually pay lower rates), and on average make payments at a rate of 52% of hospital charges. Even though the charges that hospitals set for each service are grossly inflated relative to the amount that these services cost to hospitals to provide them, the payment rates that Medicare and Medicaid make are so low that hospitals are unable to break even when they cater to this population. In fact, the 43% of hospital charges that Medicare pays is only sufficient to reimburse hospitals 98 cents for every dollar that it costs hospitals to provide a service, while Medicaid's payments on average only cover 96 cents for every dollar that hospitals bear for providing a service (AHA, 2003).

Therefore, regressions with *Charge* as the dependent variable would only serve as a measure of how managed care enrollment affects a patient's level of **utilization** of hospital

[3] CPI table downloaded from the California Department of Finance – *Financial and Economics Data.* http://www.dof.ca.gov/HTML/FS_DATA/LatestEconData/FS_Price.htm

services since *Charge* only reflects the value that a hospital places on a particular service. In order to obtain a better understanding of how the actual **costs** to the Medicare and Medicaid programs are affected, it is necessary to run regressions using a variable that reflects the **payment** that hospitals receive for the hospitalizations in the dataset, hence the charge variable provided by the data must be adjusted. The adjustment used will be each hospital's cost-to-charge ratio, which is calculated by $\frac{Total\ Costs\ of\ Operation}{Gross\ Patient\ Revenue}$. The values for both of these variables are obtained from publicly released annual hospital financial reports, and the ratio is calculated for each California hospital, and then assigned to each patient contained in the dataset according to the hospital from which s/he was admitted into. The *Charge* variable for each patient is then adjusted by this cost-to-charge ratio in order to obtain a more accurate view of each hospitalization's actual cost to the government. However, it is important to remember that this ratio is a function of each hospital's percentage of Medicare patients, percentage of Medicaid patients, percentage of patients under other public programs, percentage of privately insured patients, and percentage of uninsured patients. Since the patients in the dataset that will be used in the analysis consist of only elderly patients in the Medicare program or elderly dual eligible patients, the *AdjCharge* values obtained are only an approximate of the actual payments made out to hospitals for these discharges. Hospitals that had a cost-to-charge ratio higher than 1 were omitted, and the summary statistics of the remaining ratios are presented in table 4 on the following page. It is worthwhile to note the last line of table 4, which reports that the correlation between the cost-to-charge ratio and percentage of elderly Medicare/dual eligible patients enrolled in managed care in each hospital is negative. As expected, this implies that the higher the percentage of managed care patients there are, the lower the cost-to-charge ratio of a hospital is.

Table 4. Cost-to-Charge ratios of hospitals in the dataset

Cost-to-Charge Ratio	
Mean	0.25815
Std. Dev.	0.081
Minimum	0.0991
Maximum	1.00
Correlation with % Managed Care	***-0.12844***
	<.0001

The third dependent variable (listed in table 3) that will be explored is *LOS,* which is the length of stay of each patient, and is provided by the dataset. The next dependent variable is *totdiag*, which is the total number of conditions a patient was diagnosed with during a given hospital stay. The dataset provides the code for the main diagnosis, and up to 25 other diagnoses for each observation. Finally, the last dependent variable is *totproc*, which is the total number of procedures that were performed on each individual during their hospital stay. Again, the dataset provides the procedure code for the main procedures, and up to 20 other procedures.

Table 5, on page 22, lists the descriptions of each independent variable that will be used in the various regressions. The variables *anyManaged, Dual,* and *DualManaged* are self-explanatory. The variable *Weights* is a measure of the severity of the main diagnosis for which each patient was admitted for, and by including it in the regression, the severity of patients' medical conditions can be significantly controlled for. The weights are obtained through the DRG (Diagnosis Related Group) Code that is included in the patient discharge data. Each DRG Code corresponds to a different diagnosis, which in turn corresponds to a different "weight" or severity of the diagnosis, as determined each year by the Centers for Medicare and Medicaid

(CMS)[4]. DRG weights tables for each year are downloaded from the CMS website and the severity of each patient that was discharged is determined by the DRG code assigned to their admission using the table from their respective year of discharge. For example, in 2006, a DRG code of 001 denoted "Heart Transplant or Implant of Heart Assist System" and had a weight of 24.8548. On the other end of the spectrum, a code of 894 denoted "Alcohol/Drug Abuse or Dependence" only had a weight of 0.4021. The variable *IntDualWeights* is simply an interaction variable for *Dual* and *Weights*, which has been included in an attempt to better capture and control for the effect of *Weights* on dual-eligible patients.

Independent variables 6 – 13 were created to capture the nature of the elderly patient mix of each California hospital from which data was received from on a macro scale. The values for these variables are simply presented in percentage form and the corresponding percentages are assigned to each patient according to the hospital that s/he was discharged from. It is worthy to note that the independent variable 9, *ODualM,* is slightly different in that captures the percentage of managed care enrollees among each **hospital's elderly dual-eligible patients only,** rather than all elderly patients. These variables are important to capture and control for in the regressions since hospitals that cater heavily to managed care patients or hospitals that cater heavily to dual-eligible patients will operate very differently and likely to have different payment rates. Similarly, the ethnic and racial breakdown of patients in hospitals may, to a certain degree, reflect the socioeconomic class of patients admitted into each hospital, which in turn also affects operations and costs.

[4] Prior to 2008, there were 559 DRG's in use. From 2008 and onwards, the CMS updated this classification to include 746 different groups.

Table 5. List of Independent Variables used in the analysis

Independent Variables	Description
1. anyManaged	Binary variable = 1 for managed care enrollee, 0 for non managed care enrollee
2. Dual	Binary variable = 1 for dual-eligible, 0 for non dual-eligible
3. DualManaged	Interaction between anyManaged and Dual, 1 for dual-eligibles enrolled in managed care
4. Weights	The weight, or severity of the medical condition that patient was admitted for, as determined by CMS (see below)
5. intDualWeights	Interaction between the variables Dual and Weights
6. HospDual	% of elderly patients who are dual-eligibles admitted into the hospital between 2006 and 2010
7. HospManaged	% of elderly patients who are in managed care admitted into the hospital between 2006 and 2010
8. HospDualManaged	% of elderly patients who are in managed-care dual-eligibles admitted into the hospital between 2006 and 2010
9. HospOnlyDual Managed	% of ***dual-eligible*** patients who are in managed care admitted into the hospital between 2006 and 2010
10. HospHisp	% of elderly patients who are Hispanic admitted into the hospital between 2006 and 2010
11. HospBlack	% of elderly patients who are Black admitted into the hospital between 2006 and 2010
12. HospAsian	% of elderly patients who are Asian admitted into the hospital between 2006 and 2010
13. HospOtherRace	% of elderly patients who are another Race (Native American, Hawaiian, Alaskan, Unidentified) admitted into the hospital between 2006 and 2010
14. Dementia	Binary Variable = 1 if at least one of the patient's top 5 diagnoses falls under the category of dementia, as defined by the ICD-9
15. Psychosis	Binary Variable = 1 if at least one of the patient's top 5 diagnoses falls under the category of psychosis, as defined by the ICD-9
16. Neutoric	Binary Variable = 1 if at least one of the patient's top 5 diagnoses falls under the category of neurotic disorder, as defined by the ICD-9
17. Retardation	Binary Variable = 1 if at least one of the patient's top 5 diagnoses falls under the category of mental retardation, as defined by the ICD-9
18. Age at Admission	% of elderly patients who are Black admitted into the hospital between 2006 and 2010
19 - 25. Other Demographic Variables	Binary variables to control for the demographic factors of patients, including: Gender (1 for Male) Ethnicity (1 for Hispanic), Race (binary variables set for Black, White, Native American, Asian or Pacific Islander, and Other Race).

Variables 14 – 17, namely *Dementia, Psychosis, Neurotic,* and *Retardation*, were created to further control for patient conditions. It is common practice for hospitals and other care providers to invest less resources and efforts into the care of patients with the above mental conditions, simply because such conditions have such a detrimental effect that the quality of life of patients is reduced to such a low level where aggressive health care efforts become unjustified. Hence, controlling for all other factors, the charge (or payment) for patients suffering from these conditions should be much lower than those who do not. Only the first five out of the total 26 diagnoses provided by the dataset were analyzed to determine whether any of these conditions were present in each patient. This as achieved by matching the principal diagnosis code and the first four other diagnosis codes, when available, provided for each admission with the ICD-9 codes (Dementia = 290, Psychosis = 291-299, Neurotic Disorders = 300-316, Mental Retardation = 317-319). Four binary variables were consequently created for wherever any of the above conditions were present in a patient.

Independent variable 18, *Age_yrs,* is simply the age of each patient at the time of admission, which is provided in the dataset. Unfortunately however, one shortcoming of this variable is that all patients over the age of 85 were attributed age = 85 without further specification. Finally, variables 19 – 25 are simply demographic factors that control for gender, ethnicity, and race, which have been shown to have some effect on health condition as well as health services received.

Two different regression models with different combinations of the independent variables from table 5 are then run against the dependent variables presented in table 3. Datasets including all elderly patients, only dual eligible patients, as well as only non dual eligible patients are used. This first regression is run for all five dependent variables using a dataset including all elderly

patients to determine the general effect of managed care enrollment on the cost of a hospital stay, regardless of dual eligibility.

$$Dependent\ Variables\ 1-5 = \alpha + \gamma_1 anyManaged + \gamma_2 Dual + \gamma_3 DualManaged + \gamma_4 Weights + \gamma_5 IntDualWeights + \gamma_6 HospDual + \gamma_7 Managed + \gamma_8 DualM + \gamma_9 ODualM + \gamma_{10} Hisp + \gamma_{11} Black + \gamma_{12} Asian + \gamma_{13} OotherR + \gamma_{14} Dementia + \gamma_{15} Psychosis + \gamma_{16} Neurotic + \gamma_{17} Retardation + \gamma_{18} Age\_yrs + \gamma_{19-25} OtherDemographicVariables + \varepsilon$$

The key hypothesis of this paper, which is that the enrollment in managed care should lower the cost and utilization of health care services, would suggest that for dependent variables *Charge, AdjCharge, LOS,* and *totproc,* the sign for the resulting γ_1 should be negative. In addition, the sign for the resulting γ_2 is expected to be positive, which would suggest the existence of the higher costs and service utilization rates of dual-eligibles due to the inefficiencies discussed earlier. Since the condition of the patients are controlled for by variable *Weights,* as well as by the mental condition and demographic variables, γ_2 should not reflect significant differences between dual-eligibles and non dual-eligibles resulting from underlying health and medical conditions. However, for the dependent variable *totdiag,* it is difficult to predict the signs for the resulting γ_1 and γ_2. While the first four dependent variables directly reflect the level of utilization, *totdiag* is technically more indicative of a patient's condition, whereby a higher number for *totdiag* would suggest a worse state of health. However, since the total number of diagnosis does affect the number of procedures or services that a patient receives during a hospitalization, *totdiag* is likely to indirectly reflect some level of utilization.

While the first regression model is run on a dataset that pools all elderly patients together, this next regression will instead be run on two separate datasets so that dual-eligibles and non dual eligibles can be analyzed separately. By isolating the two different patient types, the independent variables *Dual, DualManaged, IntDualWeights* become unnecessary and are thus omitted:

$$Independent\ Variables\ 1-2$$
$$= \alpha + \gamma_1 anyManaged + \gamma_2 Weights + \gamma_3 HospDual + \gamma_4 Managed + \gamma_5 DualM$$
$$+ \gamma_6 ODualM + \gamma_7 Hisp + \gamma_8 Black + \gamma_9 Asian + \gamma_{10} OotherR + \gamma_{11} Dementia$$
$$+ \gamma_{12} Psychosis + \gamma_{13} Neurotic + \gamma_{14} Retardation + \gamma_{15} Age\_yrs$$
$$+ \gamma_{16-22} OtherDemographicVariables + \varepsilon$$

While it is useful to gauge how the level of service utilization and patient health status differs between managed care and non manage care patients by running regressions against the variables *LOS, totproc,* and *totdiag,* the ultimate purpose of this paper is to determine the level of savings that manage care may potentially obtain. Hence, it is unnecessary to run the second regression model on these three dependent variables again, and will instead only be run against *Charge* and *AdjCharge.* The interpretation of the regression results of model 1 for *LOS, totproc*, and *totdiag* can be used again to aid the interpretation and understanding of the regression results of model 2. Similar to model 1, the sign for γ_1 is expected to be positive for both datasets.

VI. RESULTS

Before the regression results are presented, it is first instructive to examine the difference in the means of certain variables between different patient types, as presented in table 6.

Table 6. All elderly patients – by Dual-Eligibility

Variable	NONDUAL (2,785,110*)	DUAL (130,011*)	Difference (NonDual - Dual)	t Value	Pr > |t|
Charge	56552.83	60414.50	-3861.67	-17.93	<.0001
AdjCharge (N = 2,741,994 and 127,704 respectively)	13748.34	15131.95	-1383.61	-26.23	<.0001
Weight	1.4711	1.4658	0.0053	1.50	0.1324
LOS	5.7292	9.0502	-3.3211	-104.08	<.0001
totdiag	11.2143	10.6913	0.5230	34.21	<.0001
totproc	2.2810	2.3387	-0.0577	-8.48	<.0001
% Patients with Dementia	0.89%	0.74%	0.1560%	5.89	<.0001
% Patients with Psychosis	7.67%	6.40%	1.2700%	16.88	<.0001
% Patients with Neurotic Disorder	4.65%	4.31%	0.3400%	5.73	<.0001
% Patients with Mental Retardation	0.04%	0.08%	-0.0428%	-7.62	<.0001

**The number in parenthesis is the total number of observations in each patient group that is applicable for all variables except for* AjdCharge*. Discount rates were not available for some hospitals and patients from those hospitals do not have an adjusted charge. The number of observations with a valid adjusted charge available for non-duals and duals are reflected in the same paragraph.*

From table 6, it can be seen that the mean of all variables, with the exception of *Weights*, are statistically different between dual eligibles and non dual eligibles. In particular, *Charge*, and *AdjCharge* are respectively 7% and 10% higher for dual eligibles, which is in alignment with past findings. Furthermore, dual eligibles on average stay at the hospital up to 60% longer than non dual eligibles do, and undergo 3% more procedures, which is a good indicator of unnecessary healthcare services caused by the inefficiencies that were explained in the introduction. On the other hand, the means for variables *Weights,* and *% Patients with Dementia, Psychosis, and Neurotic Disorders,* are higher for non dual eligibles, albeit the difference is small. This appears to be a contradiction to the general literature, which suggest that dual eligibles are overall sicker and more likely to suffer from a mental illness than non dual eligibles. However, this observation, coupled

with the lower costs and shorter lengths of hospital stays of non dual eligibles, does provide further proof of inefficiencies in the provision of healthcare for duals.

Table 7. All elderly patients – by Managed Care Enrollment

Variable	Non-Managed (2,313,287*)	Managed (601,852*)	Difference (NonManaged - Managed)	t Value	Pr > |t|
Charge	58756.20	48917.90	9838.30	89.70	<.0001
AdjCharge (N = 2,741,994 and 127,704 respectively)	14357.40	11700.00	2657.40	98.98	<.0001
Weight	1.4784	1.4420	0.0364	20.15	<.0001
LOS	6.2271	4.5327	1.6944	20.15	<.0001
totdiag	11.4378	10.2424	1.1954	153.91	<.0001
totproc	2.2966	2.2337	0.0629	18.13	<.0001
% Patients with Dementia	0.91%	0.79%	0.1160%	8.57	<.0001
% Patients with Psychosis	7.71%	7.21%	0.5000%	13.19	<.0001
% Patients with Neurotic Disorder	4.55%	4.97%	-0.4200%	-13.81	<.0001
% Patients with Mental Retardation	0.05%	0.01%	0.0361%	12.62	<.0001

**The number in parenthesis is the total number of observations in each patient group that is applicable for all variables except for* AdjCharge*. Discount rates were not available for some hospitals and patients from those hospitals do not have an adjusted charge. The number of observations with a valid adjusted charge available for non-duals and duals are reflected in the same paragraph.*

The values presented in table 7 also provide support for the hypothesis, in that managed care patients have a lower hospital utilization rate and cost. More specifically, the *Charge* and *AdjCharge* variables are, respectively, 20% and 23% lower for Managed Care enrollees, and the length of stay is 37% lower. Furthermore, slightly fewer procedures were performed on Managed Care patients. While it is also true that the *Weights* and prevalence of *Dementia, Psychosis* and *Mental Retardation* are also lower for Managed Care enrollees, these differences are very small, and are unlikely to account for the entirety of savings in costs and utilization.

Table 8. ***Dual Eligible*** *patients only – by Managed Care Enrollment*

Variable	Non-Managed (118,149*)	Managed (11,862*)	Difference (NonManaged - Managed)	t Value	Pr > |t|
Charge	60271.60	61837.80	-1566.20	-1.79	0.0733
Charge (N = 2,741,994 and 127,704 respectively)	15123.40	15216.20	-92.80	-0.42	0.6727
Weight	1.4617	1.5069	-0.0452	-3.37	0.0007
LOS	9.2891	6.6712	2.6179	7.86	<.0001
totdiag	10.7313	10.2930	0.4383	8.40	<.0001
totproc	2.3334	2.3914	-0.0580	-2.42	0.0155
% Patients with Dementia	0.77%	0.44%	0.3290%	3.99	<.0001
% Patients with Psychosis	6.56%	4.79%	1.7700%	7.51	<.0001
% Patients with Neurotic Disorder	4.28%	4.62%	-0.3400%	-1.74	0.081
% Patients with Mental Retardation	0.08%	0.11%	-0.0330%	-1.20	0.2316

**The number in parenthesis is the total number of observations in each patient group that is applicable for all variables except for* AdjCharge*. Discount rates were not available for some hospitals and patients from those hospitals do not have an adjusted charge. The number of observations with a valid adjusted charge available for non-duals and duals are reflected in the same paragraph.*

The results presented in table 8 are much less telling and many of the differences in the means of variables between managed care enrollees and non enrollees are not statistically significant. Firstly, managed care dual-eligibles appear to be more costly than non managed care enrollees, by approximately 3% in charge and 0.6% in adjusted charge, both of which are small differences and not statistically significant. However, this does not imply that managed care is a more costly option for dual eligibles because in the case of the dual eligible population (unlike the general elderly population), the *Weights* variable is 3% higher for those enrolled in managed care, and this difference is in fact statistically significant. The mean length of stay at a hospital by managed care enrollees is also 40%

shorter than it is for non enrollees despite their higher values for *Weights*, which suggests more efficient utilization of hospital services.

Table 9. ***Non Dual Eligible*** *patients only – by Managed Care Enrollment*

Variable	Non-Managed (2,195,138*)	Managed (589,990*)	Difference (NonManaged - Managed)	t Value	Pr > |t|
Charge	58674.70	48658.20	10016.50	91.04	<.0001
AdjCharge (N = 2,741,994 and 127,704 respectively)	14316.40	11628.70	2687.70	100.00	<.0001
Weight	1.4793	1.4407	0.0386	21.21	<.0001
LOS	6.0623	4.4897	1.5726	122.86	<.0001
totdiag	11.4758	10.2414	1.2344	156.97	<.0001
totproc	2.2946	2.2305	0.0641	18.26	<.0001
% Patients with Dementia	0.92%	0.80%	0.1170%	8.46	<.0001
% Patients with Psychosis	7.78%	7.26%	0.5200%	13.32	<.0001
% Patients with Neurotic Disorder	4.56%	4.98%	-0.4200%	-13.36	<.0001
% Patients with Mental Retardation	0.05%	0.01%	0.0365%	12.90	<.0001

**The number in parenthesis is the total number of observations in each patient group that is applicable for all variables except for* AdjCharge*. Discount rates were not available for some hospitals and patients from those hospitals do not have an adjusted charge. The number of observations with a valid adjusted charge available for non-duals and duals are reflected in the same paragraph.*

Table 9, which analyzes the differences in means among the non dual eligible population by managed care enrollment is much more straightforward than table 8. As hypothesized, managed care patients cost much less than non managed care patients. Even though managed care enrollees do have a lower mean value for *Weights*, by approximately 2.6%, the mean *Charge* and Adj*Charge* are 17%, and 19% lower respectively, while *LOS* is as much as 26% lower. Furthermore, patients who are not enrolled in any form of managed care have a higher prevalence of *Dementia, Psychosis, and Mental Retardation* patients, and since these patients generally utilize less health services, they should also

have the effect of bringing the average cost down. At the same time however, it is important to keep in mind that these patients represent such a small percentage of the total population that the effect of their cost on the average is also likely to be minimal.

After having reviewed these basic statistics, it is now be useful to begin running regressions using the two models described in the methodology section. In all the results tables presented, the resulting coefficients for all the patient demographic variables (*age_yrs, Male, Hispanic, Black, White, Native American, Asian or Pacific Islander, and Other Race*) have been omitted. This is because for each regression, some of these coefficients are not statistically significant and the signs of the coefficients do not contribute any indicative information for the purposes of this thesis. However, these variables were not dropped from the regression because the F-tests that were run on each regression to test the joint significance of these eight independent variables yielded a p-value of <0.0001 each time, indicating that it is indeed necessary to control for these variables. Please see Appendix B for complete regression results.

Table 10 on the next page summarizes the results of the regression using model 1 and *Charge* as the dependent variable, run on the dataset containing all elderly patients under Medicare or Medicaid. The results in this table mostly provide support for the hypothesis that controlling for various medical and demographic factors, patients in managed care face lower charges for inpatient stays. The coefficient for *Managed Care Enrollment* of -5534.86 suggests that enrolling in managed care lowers hospital charge by just under 10% of the average charge of $56,846.

Table 10. Regression Results – Dependent Variable: Charge; Dataset – all Elderly

Variable	Parameter Estimate	Std. Error	t Value	Pr >|t|
Intercept	20167.00	782.84	25.76	<.0001
Managed Care Enrollment	-5534.86	93.54	-59.17	<.0001
Dual Eligible	2245.87	257.29	8.73	<.0001
Dual Eligible x Managed Care (Interaction)	433.36	580.35	0.75	0.4552
Weights	38241.00	28.56	1339.04	<.0001
Dual Eligible x Weights (Interaction)	1134.85	119.94	9.46	<.0001
Dementia	-6032.87	369.41	-16.33	<.0001
Psychosis	-3207.54	131.16	-24.46	<.0001
Neurotic Disorder	-6256.61	165.55	-37.79	<.0001
Mental Retardation	-7677.84	1743.80	-4.4	<.0001
Age at Admission	-155.77	5.44	-28.63	<.0001

Summary Statistics	
Number of observations used	2,875,871
Mean Charge (Dep. Var)	56,846
F Value	80,263.60
Pr > F	<.0001
Adjusted R-square	0.411

Meanwhile, the positive coefficient for *Dual Eligible* indicates that a dual eligible patient accrues a higher charge than a non dual-eligible with the same conditions and demographic indicators in the same hospital by approximately 4% of the mean charge. The coefficient for *Weights* is very large, and suggests that an increase in the weight value by 1 increases charges by 67%, while being diagnosed with one of the four mental conditions lowers hospital charges by between 6% and 14%. The two interaction variables also provide valuable information. Firstly, the statistically significant and positive coefficient for the *Dual x Weights* interaction variable suggests that the cost-increasing effect of the

Weights variable of a patient is approximately 3% ($= \frac{1143.85}{38241.00}$) greater for dual eligibles than for non dual eligibles. Meanwhile, the coefficient for the *Dual x Managed Care* interaction variable is also positive, which suggests that being enrolled in Managed Care has an approximately 8% ($= \frac{433.36}{5534.86}$), smaller cost-saving effect in the case of dual-eligibles, although this coefficient is not statistically insignificant, given its p-value of 0.46. Thus, without taking the coefficient of the *Dual x Managed Care* variable into consideration, a dual-eligible patient can save $3289 (= -$5535 + $2246) worth of hospital services utilization, or approximately 6% of the mean, by enrolling in managed care.

Table 11 below shows the same effect of managed care enrollment when the regression is run on the dataset including all elderly patients using *AdjCharge* as the dependent variable. According to the coefficient of -1186.24 for *Managed Care Enrollment,* actual payments made out to the hospitals by the government can be reduced by almost 9% of the mean adjusted charge of $13,799 per average hospital admission if patients were to enroll in managed care. Meanwhile, the coefficient of 1286.13 for *Dual Eligible* indicates that holding all other factors constant, a hospitalization of a dual-eligible patient costs the government over 9% of the mean adjusted charge. In line with the results from table 10, the coefficient for *Weights* indicates that a higher weight by 1 again constitutes to a 67% higher adjusted charge, which is suggestive that the method used to obtain the values for *AdjCharge* to approximate actual payments to hospitals is accountable. Meanwhile, being diagnosed with one of the four mental conditions appears to lower costs by between 4% and 17%. Again, the coefficient for the *Dual x Managed Care* interaction variable is not statistically significant and is also much smaller at -1.48 in this case. Hence, discarding this coefficient, a dual eligible beneficiary who is enrolled in managed care costs the

government approximately $100 (= -1186.24 + 1286.13), or equivalent to 0.7% of the mean adjusted charge more than a non dual-eligible. In comparison, a dual eligible who is not enrolled in managed care would instead cost the government $1286.13, or almost 10% more of the mean adjusted charge than a non dual eligible. Again, these results suggest that managed care is a good cost-saving option for dual eligible beneficiaries.

Table 11. Regression Results – Dependent Variable: AdjCharge; Dataset – all Elderly

Variable	Parameter Estimate	Std. Error	t Value	Pr >|t|
Intercept	5963.91	191.23	31.19	<.0001
Managed Care Enrollment	-1186.24	22.83	-51.96	<.0001
Dual Eligible	1286.13	62.79	20.48	<.0001
Managed Care * Dual Eligible (Interaction)	-1.48	141.19	-0.01	0.9916
Weights	9228.48	6.97	1324.91	<.0001
Dual Eligible * Weights (Interaction)	-162.66	29.28	-5.56	<.0001
Dementia	-980.16	89.87	-10.91	<.0001
Psychosis	-543.14	31.97	-16.99	<.0001
Neurotic Disorder	-1396.86	40.32	-34.64	<.0001
Mental Retardation	-2357.21	425.63	-5.54	<.0001
Age at Admission	-53.27	1.33	-40.19	<.0001

Summary Statistics	
Number of observations used	2,846,984
Mean Adjusted Charge (Dep. Var)	13,799
F Value	78,316.10
Pr > F	<.0001
Adjusted R-square	0.4075

Next, dual eligibles and non dual eligibles are separated into two different datasets and regressions using *Charge* and *AdjCharge* are run on each dataset respectively. The regression results are presented in tables 12 through 15.

Table 12. Regression Results – Dependent Variable: Charge;
Dataset – ***Dual Eligibles only***

Variable	Parameter Estimate	Std. Error	t Value	Pr >|t|
Intercept	3364.64	3626.27	0.93	0.3535
Managed Care Enrollment	-4642.51	885.41	-5.24	<.0001
Weights	39330	144.13	272.88	<.0001
Dementia	-3498.31	2343.05	-1.49	0.1354
Psychosis	-4054.65	825.94	-4.91	<.0001
Neurotic Disorder	-8263.45	995.91	-8.3	<.0001
Mental Retardation	-5679.49	7092.82	-0.8	0.4233
Age at Admission	85.87	29.08	2.95	0.0031

Summary Statistics	
Number of observations used	128,699
Mean Charge (Dep. Var)	60,519
F Value	3,588.04
Pr > F	<.0001
Adjusted R-square	0.3801

The regression presented in table 12 does a much better job of isolating the effect of enrolling in managed care among the dual eligible population by analyzing solely patients who fall under this category. Essentially, the results of this regression provide even stronger support for the hypothesis of this paper in that enrolling in managed care can more efficiently provide health services to the very costly dual eligible population. First, by looking at the mean of the dependent variable, the value in table 12 is 60,519, while the value is 56,846 in table 10. Hence, it becomes evident that dual eligibles constitute the more costly population, as the mean charge is higher when they are isolated from the general elderly population. Second, the coefficient for *Managed Care Enrollment* is statistically significant at -4642.51, which indicates that among the dual eligible population,

enrolling in managed care on average lowers the utilization of hospital services by almost 8% of the average level of utilization worth $60,519. The coefficients for the other variables are also logical, with that of the *Weights* variable indicating that a 1 point increase in weight causes hospital charges to rise by 65%, while having one of the four mental illnesses identified among the first five diagnoses tends to discourage hospitals from using the most aggressive treatments and thus lower charges by between 7% and 14% of the average charge for this population.

In table 13 presented below, the results from same regression model run on the same dataset composed of only dual eligible hospitalizations, but this time using *AdjCharge* as the dependent variable, depicts the effects of managed care enrollment in actual cost savings. Again in line with the hypothesis, the coefficient of -871.80 obtained for *Managed Care Enrollment* suggests that enrollment in an MCO would, on average, lead to a saving of almost 6% of the mean payment of $15,108 to hospitals per dual eligible admission. Observing the other variables, the coefficient for *Weights* indicates that a higher weight by 1 tends to cause the adjusted charge to increase by 61% of the average value. The coefficients for *Neurotic Disorder* and *Mental Retardation* also follow the theory and suggest lower hospital costs. It is interesting to note, however, that there are two variables with coefficients in this regression that are contrary to previous results, namely *Dementia* and *Psychosis*, the two more costly and aggressive mental conditions. Looking back at table 11, the coefficients for these two variables remain negative when the dependent variable used is *Charge*, which suggests a lower utilization rate of hospital services by such patients. However, when the *Charge* is adjusted by the hospital cost-to-charge ratio, the signs are reversed for these coefficients, and suggests that dual eligibles with dementia and

psychosis cost, respectively, 18% and 7% of the average adjusted charge more than dual eligibles without such disorders when they are admitted into the hospital. Despite this contradiction, this regression remains consistent with all previous regressions in showing that managed care plays a role in saving costs in hospitalizations.

Table 13. Regression Results – Dependent Variable: AdjCharge; Dataset – ***Dual Eligibles only***

Variable	Parameter Estimate	Std. Error	t Value	Pr >|t|
Intercept	4073.21	945.36	4.31	<.0001
Managed Care Enrollment	-871.80	230.50	-3.78	0.0002
Weights	9140.43	37.60	243.11	<.0001
Dementia	2766.22	611.89	4.52	<.0001
Psychosis	1111.97	215.88	5.15	<.0001
Neurotic Disorder	-1986.12	259.90	-7.64	<.0001
Mental Retardation	-158.42	1846.64	-0.09	0.9316
Age at Admission	-21.32	7.58	-2.81	0.0049

Summary Statistics	
Number of observations used	127,109
Mean Adjusted Charge (Dep. Var)	15,108
F Value	2,827.43
Pr > F	<.0001
Adjusted R-square	0.3285

Finally, the same two regressions are run using the dataset containing only the non dual eligible elderly population, and the results obtained are presented in the following tables.

Table 14. Regression Results – Dependent Variable: Charge;
Dataset – ***Non Dual Eligibles only***

Variable	Parameter Estimate	Std. Error	t Value	Pr >|t|
Intercept	21175	803.06	26.37	<.0001
Managed Care Enrollment	-5447.58	92.69	-58.77	<.0001
Weights	38237	28.22	1354.75	<.0001
Dementia	-6157.20	371.97	-16.55	<.0001
Psychosis	-3200.33	132.14	-24.22	<.0001
Neurotic Disorder	-6197.00	167.08	-37.09	<.0001
Mental Retardation	-8068.60	1806.95	-4.47	<.0001
Age at Admission	-167.58	5.53	-30.32	<.0001

Summary Statistics	
Number of observations used	2,747,172
Mean Charge (Dep. Var)	56,674
F Value	87,945.70
Pr > F	<.0001
Adjusted R-square	0.4132

Both tables 14 (above) and 15 (below) further reaffirm the cost and utilization saving effect of enrolling in managed care, this time among the elderly non dual eligible population. It is clear from these tables that the both regressions resulted in statistically significant coefficients carrying the expected sign for all of the variables presented. In particular, the coefficients for the *Managed Care Enrollment* variable, the variable which this paper is most concerned with, indicates that on average, a non dual eligible elderly resident of California can save almost 10% of the average *Charge* of $56,674, or approximately 9% of the average *AdjCharge* of $13,738 per hospitalization by enrolling in a managed care organization. The magnitudes for *Weights* and the four variables for mental

disorders are also commensurate with those obtained from regressing the dataset containing all observations (tables 10 and 11).

Table 15. Regression Results – Dependent Variable: AdjCharge; Dataset – ***Non Dual Eligibles only***

Variable	Parameter Estimate	Std. Error	t Value	Pr >|t|
Intercept	6237.42	195.12	31.97	<.0001
Managed Care Enrollment	-1186.98	22.50	-52.76	<.0001
Weights	9225.27	6.85	1347.5	<.0001
Dementia	-1120.32	89.99	-12.45	<.0001
Psychosis	-593.17	32.02	-18.52	<.0001
Neurotic Disorder	-1377.98	40.47	-34.05	<.0001
Mental Retardation	-2541.11	438.71	-5.79	<.0001
Age at Admission	-55.22	1.34	-41.24	<.0001

Summary Statistics	
Number of observations used	2,719,875
Mean Adjusted Charge (Dep. Var)	13,738
F Value	87,246.60
Pr > F	<.0001
Adjusted R-square	0.4137

Having examined the above regressions with the dependent variables being either *Charge* or *Adjusted Charge*, it is also worth analyzing the same regressions on the full dataset including all elderly patients, regardless of dual eligibility, using *LOS, totproc, and totdiag* as the dependent variables. The results from regressions against *LOS* and *totproc* can potentially offer some form of indication as to where the cost-savings may be occurring, while the results from the regression using *totdiag* as the dependent variable

could potentially contain more information regarding patient medical conditions and indirectly, a measure of the level of service utilization, by patient type.

Table 16. Regression Results – Dependent Variable: LOS (length of Stay); Dataset – All elderly

Variable	Parameter Estimate	Std. Error	t Value	Pr >|t|
Intercept	1.60	0.13	12	<.0001
Managed Care Enrollment	-1.18	0.02	-73.69	<.0001
Dual Eligible	2.24	0.04	51.1	<.0001
Dual Eligible x Managed Care (Interaction)	-0.58	0.10	-5.88	<.0001
Weights	1.78	0.00	365.72	<.0001
Dual Eligible x Weights (Interaction)	0.15	0.02	7.39	<.0001
Dementia	1.30	0.06	20.64	<.0001
Psychosis	0.92	0.02	41.14	<.0001
Neurotic Disorder	-0.53	0.03	-18.65	<.0001
Mental Retardation	0.41	0.30	1.38	0.1675
Age at Admission	0.04	0.00	48.19	<.0001

Summary Statistics	
Number of observations used	2,875,871
Mean LOS (Dep. Var)	5.83
F Value	7,285.47
Pr > F	<.0001
Adjusted R-square	0.0596

Most of the results depicted in table 16 are as expected and all coefficients, with the exception of that for the binary variable *Mental Retardation,* are statistically significant. As already seen in tables 7 – 9, managed care enrolled patients tend to have shorter hospital stays, and this regression further validates this point, since medical, demographic, and

hospital characteristic variables are significantly controlled for. The coefficient of -1.18 for *Managed Care Enrollment* indicates a shortened hospital stay by approximately 20% of the average length of stay of 5.83 days, and this is likely to be one of the sources of savings. The coefficient for the variable *Dual Eligible* presented in the next line of table 16 implies that holding all other variables constant, dual eligible patients on average stay in the hospital by 2.24 days longer, which is equivalent to approximately 39% of the average length of stay. This is not surprising, and supports the hypothesis that there exists inefficiency in the use of health services while caring for this demographic group. The coefficient for the *Dual x Managed Care* interaction variable is also informative, and its negative sign suggests that the effect of shortening hospital stays by enrolling in managed care is approximately 50% $(= \frac{0.58}{1.18})$ greater for dual eligibles than it is for non dual eligibles. However, this effect is offset by the greater lengthening effect on the *LOS* that is attributed to being a dual eligible patient, as discussed. Finally, for three of the mental conditions, namely *Dementia, Psychosis,* and *Mental Retardation*, the coefficients are positive, which indicate that patients with such conditions tend to have longer hospital stays, but having already established from tables 10 and 11 that their charges and costs are lower, this appears to suggest that their per diem cost is much lower than it is for patients without mental disorders. In other words, even though mentally ill patients stay in hospitals for longer, the treatments and services they receive on a daily basis are much less costly and aggressive.

The above interpretations of the results presented in table 16 help to partially explain the reason why costs for dual eligibles are higher than they are for non dual eligibles. Furthermore, the fact that holding all else constant, dual eligibles have longer hospital stays, provides support for the claim that there are inefficiencies in the provision

of healthcare services when it comes to caring for dual eligible beneficiaries. Finally, this regression suggests that one significant source of savings from managed care enrollment, particularly for dual eligibles, is the shortened length of stays per hospitalization. The next table presents the results for the same regression using the total number of procedures as the dependent variable.

Table 17. Regression Results – Dependent Variable: Total no. of procedures; Dataset – All elderly

	Parameter Estimate	Std. Error	t Value	Pr >|t|
Intercept	2.61	0.03	97.66	<.0001
Managed Care Enrollment	-0.04	0.00	-11.53	<.0001
Dual Eligible	0.10	0.01	11.65	<.0001
Dual Eligible x Managed Care (Interaction)	0.06	0.02	2.92	0.0035
Weights	1.04	0.00	1069.72	<.0001
Dual Eligible x Weights (Interaction)	-0.09	0.00	-22.51	<.0001
Dementia	-0.33	0.01	-26.54	<.0001
Psychosis	-0.33	0.00	-72.88	<.0001
Neurotic Disorder	-0.26	0.01	-45.63	<.0001
Mental Retardation	-0.55	0.06	-9.25	<.0001
Age at Admission	-0.02	0.00	-132.79	<.0001

Summary Statistics	
Number of observations used	2,875,871
Mean Total Procedures (Dep. Var)	2.29
F Value	52,172.80
Pr > F	<.0001
Adjusted R-square	0.312

The regression results presented in table 17 suggests that enrollment in managed care, holding all other factors constant, also lowers healthcare utilization in terms of procedures performed per admission, though the difference of 0.04, which is only 1.7% of

the average number of procedures performed, is not great. Again, dual eligibles tend to consume more in healthcare, with a positive coefficient of 0.10 (equivalent to 4.4% of the average) for the variable *Dual Eligible*. The positive coefficient of 0.06 for the *Dual Eligible x Managed Care* interaction variable also provides insightful information – it indicates that while holding all else constant, a dual eligible who enrolls in managed care receives a higher number of procedures per average hospitalization by 0.02 (= -0.04 + 0.06). Even though this is a very small number, and at first appears to contradict the hypothesis, it is important to consider this value in conjunction with the other findings of this paper. Tables 10 – 13 all indicate that for dual eligibles (as well as the general elderly population), hospital service utilization rates and costs to the government are lowered by enrolling in managed care, and furthermore, as just seen in table 16, the length of stay per hospitalization is also shortened by managed care enrollment. Hence, the lower costs and lengths of stay, coupled with the slightly higher number of procedures that dual eligibles enrolled in managed care receive, provide support for the claim that managed care enrollment eliminates some of the inefficiencies associated with providing health care services to dual eligibles. Finally, as hypothesized, the coefficient for *Weights* is positive, while the coefficients for all four *mental conditions* are negative.

Table 18, on the following page, presents the regression results using the total number of diagnoses as the dependent variable. As mentioned previously, it is likely to be a better measure of patients' health conditions, which in turn, affects the rate of medical utilization that patients receive.

Table 18. Regression Results – Dependent Variable: Total no. of diagnoses; Dataset – All elderly

Variable	Parameter Estimate	Std. Error	t Value	Pr >|t|
Intercept	4.50	0.07	64.9	<.0001
Managed Care Enrollment	-1.08	0.01	-130.6	<.0001
Dual Eligible	-0.83	0.02	-36.42	<.0001
Dual Eligible x Managed Care (Interaction)	0.45	0.05	8.73	<.0001
Weights	0.96	0.00	378.12	<.0001
Dual Eligible x Weights (Interaction)	0.26	0.01	24.72	<.0001
Dementia	-1.28	0.03	-39.22	<.0001
Psychosis	-0.76	0.01	-65.86	<.0001
Neurotic Disorder	-2.21	0.01	-150.89	<.0001
Mental Retardation	-1.52	0.15	-9.87	<.0001
Age at Admission	0.08	0.00	163.82	<.0001

Summary Statistics	
Number of observations used	2,875,871
Mean no. Diagnoses (Dep. Var)	11.20
F Value	10,729.60
Pr > F	<.0001
Adjusted R-square	0.0853

The first coefficients to examine are those for variables concerned with managed care and dual eligibility: the coefficient for *Managed Care Enrollment* is -1.08, or almost 10% less than the average number of diagnoses for this dataset, suggesting that patients who enroll in managed care in general suffer from a fewer number of conditions. The coefficient for *Dual Eligible* is also negative at -0.83 (or approximately 7% of the average number), and this appears to be contrary to the general literature regarding dual eligibles, which conclude that dual eligibles are overall more sick than non dual eligible elderly.

While it is important to note this observation, it is not particularly concerning given that the regression already controls for other variables, such as *Weights,* which are indicative of patients' health statuses.

Finally, the *Dual Eligible x Managed Care* interaction variable offers the most important information, as this positive value of 0.45 indicates that among the dual eligible population (unlike the general population), those who enroll in managed care are in a poorer state of health since they are, on average, diagnosed with more conditions upon hospitalizations. This result is in line with the findings in tables 8 and 9, where it had been noted that managed care patients appear to be healthier among the general elderly population, but sicker among the dual eligible population. By interpreting this result in conjunction with those results from tables 16 and 17, there is support for the hypothesis that managed care can eliminate inefficiencies in treating dual eligible beneficiaries: even though the dual eligibles enrolled in managed care generally suffer from a poorer state of health than those who are not enrolled in managed care, the costs and service utilization rates per hospitalization for managed care enrollees are lower. Most importantly, the positive coefficient for the *Dual Eligible x Managed Care* interaction variable from table 17 indicating that dual eligibles enrolled in managed care receive, on average, a greater number of procedures suggests that necessary services are not compromised, and that savings are therefore accrued from reducing inefficiencies.

VII. DISCUSSION

The regression results using hospital discharge patient profile data from California between the years 2006 and 2010 provide support for the hypothesis and indicate that enrollment

in managed care can result in savings in the utilization rate of hospital services, as well as in the actual the costs of hospitalizations. The results from the nine regressions that were run to examine the effect of managed care enrollment from different angles are largely consistent and indicate that the cost-saving effect holds true for all elderly, regardless of dual eligibility. More specifically, however, it appears that managed care has a greater cost-saving effect for non dual eligibles than it does for dual eligibles, but it is important to keep in mind that among dual eligibles, it is those with more severe medical conditions who tend to enroll in managed care, while among the non dual eligibles, it is the healthier who generally enroll in managed care. Given that the severity of patients, most accurately captured by the variable *Weights*, has an immense effect on cost, the situation needs to be further investigated before a conclusion can be made regarding how cost-saving effects of managed care enrollment differ between dual eligibles and non dual eligibles. One significant concern associated with such a finding is the possibility that the cost and utilization saving effect of managed care comes at the expense of poorer or insufficient care, thus leading to lower health outcomes. While the dataset used for this paper did not include any variables that could serve as a measure of care outcomes, and hence could not be analyzed with respect to managed care enrollment, there have been extensive studies conducted to analyze health outcomes and patient satisfaction under managed care. For example, the AARP Public Policy Institute finds that managed care in the form of SNPs for dual eligibles has resulted in higher levels of patient satisfaction and improved outcomes in all three states studied, namely Minnesota, New York, and New Mexico (Edwards et al., 2009). In a CRS Report for Congress assessing several Medicare-Medicaid managed care integration programs across the country, most quality indicators were similar for managed care and non managed care enrollees. However, the burden on family caregivers was found to be significantly lower for

patients in managed care, and findings on mortality were mixed, as they were lower in some programs and higher in others (Stone and Tritz, 2007). Finally, a comprehensive review of numerous managed care studies finds patient health to be comparable between managed care enrollees and non enrollees and no systematic disparities in the quality of healthcare services provided by managed care organizations compared to traditional FFS providers (Simonet, 2003). Furthermore, a number of studies have found outcomes under managed care to be superior and that the lower utilization rates had no deteriorating effect on the health of enrollees (Simonet, 2003). Given the findings of these reports, among other similar ones, it is compelling to conclude that the decrease in costs and utilization of managed care enrollees found in this paper minimally, if at all, lowered the quality or outcome of care.

With regard to the findings presented in table 8, there appears to be a contradiction in that while dual eligibles who are enrolled in managed care on average have a shorter length of stay than non enrollees by approximately 40%, they face a higher cost and have a higher average weight. One possible reason behind this seeming contradiction is that managed care enrollees, once they are admitted into the hospital, receive more services and higher intensity or quality care each day, so that they are able to be discharged within a shorter period of time, but face a much higher daily cost. The regression results with *totproc* as the dependent variable, presented in table 17, provide support for this explanation by showing that dual eligibles enrolled in managed care in general receive more procedures per hospitalization. Finally, it is important to note that the figures presented in table 8 are simply the variable means of the dataset without controlling for any confounding factors, while the regression results in tables 11 and 12, which control for a host of variables that affect hospital costs, provide compelling evidence that

managed care enrollment does have a cost and utilization lowering effect on the care for dual eligible beneficiaries.

A potential shortcoming in the methodology used for the analysis concerns the way in which dual eligible patients were identified in the hospital data. Since the data does not indicate whether the dual eligibility status of a patient, dual eligibles had to be otherwise identified using a method which relied on observing the expected payer category. While assuming that all elderly patients are enrolled in Medicare, those whose expected payer categories were deemed Medicaid were identified as dual eligibles for the purposes of this paper. Since Medicare and Medicaid cover different healthcare services, there is a possibility that some of the elderly patients whose expected payer were indicated to be Medicare in the data were in fact dual eligibles, but mistakenly categorized as Medicare-only beneficiaries in the analyses. In other words, those dual eligibles who were admitted for a service covered by Medicare instead of Medicaid in the dataset were mistakenly identified as non dual eligibles.

In addition, although the variables included in the regressions have controlled for a significant amount of variance in both patient and hospital characteristics to produce robust results, there are still many confounding factors that exist, which could further improve results if they were included. However, this is a shared problem among all economic analyses of healthcare systems and policies, as it is highly unlikely to be able to control for every factor that affects utilization and cost. In this particular case, it could potentially also be useful to include the average income of the areas in which each hospital is situated in using hospital Zip Codes.

Finally, although patients' mental conditions are controlled for to a certain extent in the analyses, the methodology is not perfect because it only takes into account the principal diagnosis and the first four of the other 25 diagnoses provided in the dataset. This essentially

fails to recognize any patients who may have been diagnosed with a mental condition in one of the other 21 diagnoses given on this particular admission, or any patients who may have the a condition but were simply not identified by the hospital during this particular admission. I am particularly skeptical of this methodology because the dual eligibles in the sample have a lower occurrence of mental disorders than non dual eligibles, while existing studies and literature have found dual eligibles to be much more susceptible to such conditions. In addition, further understanding of the treatment of patients with such conditions needs to be obtained so that the results can be better interpreted and methodology can be improved. This is especially true concerning the results in table 11, which show higher costs for dual eligible patients with dementia and psychosis, despite lower the lower charges in table 10.

Despite the above shortcomings in the methodology, the regressions are still robust enough so that it is reasonable to estimate potential savings that could be accrued if all dual eligibles, and even all elderly patients, were enrolled in an all-comprehensive managed care plan. Furthermore, I am confident in using the coefficients for *Managed Care Enrollment* produced by the regressions using *AdjCharge* as the dependent variable to project actual savings. According to a study conducted by the AHIP Center for Policy and Research, the average Net Inpatient Revenue per Discharge for California Hospitals from Medicare was $11,493 in 2006, and rose to $14,168 in 2009 (AHIP, 2010). The average cost (or *AdjCharge* variable calculated by adjusting *Charge* by each hospital's cost-to-charge ratio) obtained in this dataset is $13,799 (in 2006 dollars) for all elderly patients with expected payers deemed Medicare or Medicaid discharged between 2006 and 2010. The mean *AdjCharge* for only the elderly patients whose expected payer is Medicare is $13,738 (in 2006 dollars) across the five years. Since both means fall within

the range reported by AHIP, albeit on the higher end of the spectrum, it is safe to say that these approximated costs obtained using the calculated cost-to-charge ratios are accurate.

First, looking at California alone, over 85% of its 1.1 million dual eligible beneficiaries are not in any form of managed care (HMA, 2011). Second, given that the inpatient hospitalizations rate for dual eligible beneficiaries is 574 per 1000 person years (Segal, 2011), it can be calculated that the total number of non managed care dual eligible hospitalizations in California is:

$$1{,}100{,}000 \times 0.85 \times \frac{574}{1000} = \mathbf{536{,}690}$$

Using the coefficient for the variable *Managed Care Enrollment* from the results of running regression model 2 with *AdjCharge* as the dependent variable (as presented in table 13), potential savings from inpatient hospitalizations obtained by enrolling the 85% of dual eligibles into managed care is estimated:

$$536{,}690 \times \$871.80 = \$\mathbf{467{,}886{,}342}$$

Furthermore, using the regression results presented in tables 11 and 15, inpatient hospital savings that can be obtained by enrolling those Medicare-only beneficiaries who still remain under the traditional fee-for-service system into managed care can be estimated. The total number of Medicare beneficiary hospital discharges **excluding** discharges for managed care enrollees in 2010 was 934,155 (State Health Facts, 2011). Within California, 86% of its Medicare beneficiaries are elderly (State Health Facts, 2011), and making the assumption that Medicare patients have the same rate of hospitalizations across ages, the total number of elderly Medicare patient discharges excluding those of managed care enrollees in 2010 was hence

803,373 (=934,155 x 0.86). The coefficient for the variable *Managed Care Enrollment* in the results of the regression run using *AdjCharge* as the dependent variable and the dataset containing only non dual eligibles (as presented in table 15) is 1,186.98. Using this figure, cost savings is estimated to amount to:

$$803{,}373 \times \$1{,}186.98 = \$\mathbf{953,588,040}$$

Based on these calculations, the total estimated savings in inpatient hospital services that the state of California would obtain by enrolling all of their dual eligibles and elderly Medicare-only beneficiaries who are not currently in managed care into some form of MCO is thus $467,886,342 + 4953,588,040 = **$1,421,474,382**, or approximately **$1.42 billion**. In 2009, total Medicare spending in California was $50.60 billion (State Health Facts, 2011), of which approximately 27% was for inpatient hospital services (State Health Facts, 2011). To place the $1.42 billion in savings in context:

$$\frac{1{,}421{,}474{,}382}{50{,}604{,}000{,}000 \times 0.27} = 0.1039$$

In effect, **10.39%** of total Medicare expenditures on California inpatient services could potentially be saved by enrolling these beneficiaries into managed care. Furthermore, these calculations do not take into consideration the fact that managed care organizations have proven to be effective in reducing the number of potentially avoidable hospitalizations, which are especially a problem in caring for dual eligibles for reasons explained in the introduction of this paper. It is estimated that the rate of such avoidable hospitalizations in California is 96 per 1,000 person-years (Segal, 2011). This major cause of inefficiency is also present among general Medicare and Medicaid patients, and a longitudinal analysis of California's hospitalizations

between 1990 and 1997 has shown managed care organizations to reduce the number of avoidable hospitalizations (Backus et. al., 2002). More recent evaluations of managed care programs in other states have also displayed a similar trend, in that managed care enrollees have a lower rate of potentially avoidable hospitalizations than traditional fee-for-service patients (Basu et. al., 2004, Edwards et. al., 2009). Hence, while it is possible that the magnitude of savings obtained above is an overestimation given the implicit generalizations and assumptions made in the calculation process, it is also possible that this is a modest prediction given these other effects of MCO's have on reducing inefficiencies.

These results can be extrapolated further to predict the cost-saving effect of enrolling non managed care dual eligibles and Medicare beneficiaries into MCO's across the US using two different methods. Working first with the nation's 9.2 million dual eligibles: up to 80% continue to receive care under the traditional fee-for-service system (Verdier et. al., 2011), and the nationwide average hospitalization rate of dual eligibles is 574 per 1000 person years (Segal, 2011). Hence, the annual number of non managed care dual eligible hospitalizations in the U.S. is:

$$9{,}200{,}000 \times 0.8 \times \frac{574}{1000} = \mathbf{4{,}224{,}640}$$

Then, using the coefficient of *Managed Care Enrollment* of the regression run on the dataset containing only dual eligibles, annual savings in adjusted charge is estimated to be:

$$4{,}224{,}642 \times 871.80 = \$\mathbf{3{,}683{,}041{,}152}$$

A second approach is also considered to estimate annual nationwide savings. In 2006, 28.5% of all dual eligible beneficiaries used hospital inpatient services, and the average inpatient

cost per dual eligible beneficiary was $5,269 (Medpac, 2010). Hence, the average cost **per dual eligible discharge** in 2006 was:

$$\frac{5{,}269}{0.285} = \$\mathbf{18{,}487.72}$$

Using regression results presented in table 13, enrollment in managed care for dual eligibles reduces the cost by $\frac{871.80}{15{,}108} = \mathbf{5.77\%}$ of the average adjusted charge of this population. Applying this percentage to the average cost per dual eligible discharge results in a per discharge saving of:

$$18{,}487.72 \times 0.0577 = \$\mathbf{1{,}066.83}$$

Finally, using the total annual number of non managed care dual eligible hospital discharges obtained above in the first method, total savings each year is approximately:

$$4{,}224{,}642 \times 1{,}066.83 = \$\mathbf{4{,}506{,}974{,}852}$$

Continuing on, the same two methods outlined above can then be applied to estimate potential savings if all non managed care Medicare-only beneficiaries across the country were enrolled in MCO's. Of all Medicare beneficiaries, 84% are above the age of 65; and in 2010, the total number of Medicare beneficiary inpatient discharges **excluding** managed care enrollees was 12,284,510 (State Health Facts, 2011). Again, under the assumption that hospitalization rates are equivalent across age, the total number of hospital discharges of non managed care elderly Medicare beneficiaries is 10,318,988. Multiplying this number by the coefficient of 1186.98 for the variable *Managed Care Enrollment* from table 15 (regression using the dataset with non dual eligibles only) results in estimated savings of $12,248,432,581, or approximately **$12.25 billion**.

Using method 2, and given that in 2006, the average inpatient cost per Medicare was $2,611 and that 18.5% of non dual eligible Medicare beneficiaries used inpatient services, the average cost **per Medicare discharge** in 2006 was thus $14,113.51. Using the average of the dependent variable *AdjCharge* of 13,738 and the coefficient of 1,186.98 for the variable *Managed Care* from the regression results presented in table 15, average managed care enrollment savings is 8.64%. Finally, applying this to the average cost per Medicare discharge, and the total number of annual non managed care elderly Medicare beneficiary discharges of 10,318,988 results in estimated savings of $12,583,048,883, or approximately **$12.58 billion**.

Using the lower and upper projections given by both methods, the estimated total amount saved nationally by enrolling both non managed care dual eligibles and Medicare beneficiaries into MCO's ranges from **$15,931,473,733** (= $3,683,041,152 + $12,248,432,581) to **$17,090,023,735** (= $4,506,974,852 + $12,583,048,883). In context, this $15.93 to $17.09 billion accounts for **11.53% to 12.37%** of the $138.11 billion that Medicare spent on inpatient services in 2010 (CMS, 2012). It is important to consider these values with discretion, given that the analysis in this paper only used patient discharge data from hospitals in the state of California. Healthcare costs, health utilization rates, Medicare payment rates, and dual eligible populations vary significantly from state to state, and estimations of country-wide cost saving effects of managed care enrollment using the regression results in this paper are therefore subject to great uncertainty. Finally, similar to the estimations of cost savings in California, these values also fail to take into account the lower rate of preventable hospitalizations associated with managed care enrollees compared to commercial fee-for-service patients (Basu et. al.,2004, Edwards et. al., 2009, Backus et. al. 2002).

In conclusion, the analysis performed on California's hospital discharge data of elderly Medicare and dual eligible patients from years 2006-2010 provide strong support for the this paper's hypothesis, in that managed care enrollment has the effect of eliminating inefficiencies and waste in providing healthcare for such patients. The effect of managed care enrollment was explored using different regression models performed on datasets including different patient types (dual eligibles, non dual eligibles, and all elderly), and despite some variations in the sign of coefficients of a few variables, all regressions were consistent in showing that managed care enrollment decreases cost and utilization rates. Those regressions with the same dependent variable furthermore exhibited coefficients for *Managed Care Enrollment* within the same magnitude. Finally, using the results obtained, projections for potential savings by enrolling dual eligibles and Medicare beneficiaries into managed care were calculated to account for approximately 10.39% of total annual Medicare spending on inpatient hospital services in California. These trends were further extrapolated to make similar estimations on a nation-wide scale, and a saving ranging from 11.53% to 12.37% of the country's Medicare spending on inpatient services is obtained. However, it is vital that these figures, especially the savings projected on a nation-wide scale, are considered with caution and with the knowledge that they were obtained under a number of assumptions and generalizations.

REFERENCES

AHIP Center for Policy and Research, 2010. "Recent Trends in Hospital Prices in California and Oregon." *America's Health Insurance Plans.*

American Hospital Association, 2003. "Hospital Charges Explained." *Passavant Hospital data files.* http://www.passavanthospital.com/_data/files/HospitalChargesExplained12803.pdf

Aggarwal, Ajay K. 2008. "Some Issues in US Healthcare." *International Management Review* 4(1): 101 – 109.

Backus, L et. al. 2002. "Effect of Managed Care on Preventable Hospitalization Rates in California." *Medical Care.* 40 (4)

Basu, Jayasree et. al. 2004. "Managed Care and Preventable Hospitalizations among Medicaid Adults." *Health Services research*. 39 (3).

Baumrucker, Evelyne P. 2010. "Medicaid: The Federal Medical Assistance Percentage (FMAP)." *Congressional Research Service.*

Bruen, Brian and Holahan, John. "Shifting the Cost of Dual Eligibles: Implications for States and the Federal Government." *Kaiser Commission Issue Paper.* http://www.kff.org/medicaid/upload/Shifting-the-Cost-of-Dual-Eligibles-Implications-for-States-and-the-Federal-Government-Issue-Paper.pdf

Centers for Medicare & Medicaid Services (CMS). 2009. Medicaid Coverage of Medicare Beneficiaries (Dual Eligibles) at a Glance. *Department of Health and Human Services, USA.*

Centers for Medicare & Medicaid Services (CMS). 2012. Data Compendium, 2010 Edition. Table II.1. *Centers for Medicare and Medicaid Services.*

Douglas, Toby, 2011. "California Department of Health Services Response to Request for Proposal: State Demonstrations to Integrate Care for Dual Eligibles." *California Department of Health Care Services.*

Edwards, Barbara C. et. al. 2009. "Integrating Medicare and Medicaid: State Experience with Dual Eligible Medicare Advantage Special needs Plans." *AARP Public Policy Institute.*

Eljay, LLC. 2006. "The Implications Of Medicaid Managed Care for Long-Term Care on Nursing Facility Providers." *Report Prepared for the American Health Care Association.* *http://www.ahcancal.org/research_data/funding/Documents/Medicaid_Managed_Care_Report.pdf*

Ettner, Susan L. 1996. "Adverse selection and purchase of Medigap insurance by the elderly." *Journal of Health Economics* 16: 543-562

Grabowski, David C. 2006. "The Cost-Effectiveness of Noninstitutional Long-Term Care Services: Review and Synthesis of the Most Recent Evidence." *Medical Care Research and Review* 63(3)

Grabowski, David C. 2007. "Medicare and Medicaid: Conflicting Incentives for Long-Term Care." *The Milbank Quarterly* 85(4): 579-610

Health Assistance Partnership (HAP). 2010. "SHIP Resources Guide: Medicare Basics." *Health Assistance Partnership.*

Health Management Associates (HMA). 2011. "HMA Investment Services Weekly Roundup; Trends in State Health Policy." *Health Management Associates.*

HHS Press Office. 2011. "New Flexibility for States to Improve Medicaid and Implement Innovative Practices." *U.S. Department of Health & Human Services.*

Kaiser Commission on Medicaid and the Uninsured, 2011. "Proposed Models to Integrate Medicare and Medicaid Benefits for Dual Eligibles: A Look at the 15 State Design Contracts Funded by CMS." *The Henry J. Kaiser Family Foundation.*

Kaiser Family Foundation. 2009. "Healthcare Costs: A Primer." *The Henry J. Kaiser Family Foundation*

Kane, Robert L. et. al. 2004. "Multistate Evaluation of Dual Eligibles Demonstration: Final Report." *Division of Health Services Research and Policy, University of Minnesota School of Public Health*. https://www.cms.gov/reports/downloads/Kane2_2004_1.pdf

Kane, Robert L. et. al. 2005. "The Quality of Care under a Managed-Care Program for Dual Eligibles." *The Gerontologist* 45(4): 496-504.

Liu, Korbin et. al. 1998. "Does Health Status Explain Higher Medicare Costs of Medicaid Enrollees?" *Health Care Financing Review* 20(2)

Medpac. 2004. "Dual Eligible Beneficiaries: An overview." *Report to Congress: New Approaches in Medicare:* 71-92

Medpac. 2010. "A Data Book: Healthcare Spending and the Medicare Program." *Medicare Payment Advisory Commission.*

Menges, Joel, Batt, Jeremy, Beronja, Kaleigh and Wiecezak, Jessica. 2011. "Achieving Optimal Care Coordination for Medicaid/Medicare Dual Eligibles." *Special Needs Consulting Services.*

Milligan Jr., Charles J. and Woodcock, Cynthia H. 2008. "Medicare Advantage Special Needs Plans for Dual Eligibles. A Primer." *University of Maryland, Baltimore County.*

Ng, Terence et. al. 2010. "Medicare and Medicaid in Long-Term Care." *Health Affairs* 29(1): 22-28.

Rosenbaum, Sara, Thorpe, Jane H., and Schroth, Sara. 2009. "Supporting Alternative Integrated Models for Dual Eligibles: A Legal Analysis of Current and Future Options." *Center for Health Care Strategies, Inc. Policy Brief.*

Segal, Misha. 2011. "Dual Eligible Beneficiaries and Potentially Avoidable Hospitalizations." *Center for Medicare and Medicaid Services Policy Insight Brief.*

Simonet, Daniel. 2003. "Managed Care and Traditional Insurance: Comparing Quality of Care." *International Social Security Review.* 56 (1).

State Health Facts. 2011. "California: Discharges and Total Days of Care for Medicare Beneficiaries Discharged from Short-Stay Hospitals, 2010." *The Henry J. Kaiser Family Foundation.*

Stone, Julia and Tritz, Karen. 2007. "CRS Report for Congress: Integrating Medicare and Medicaid Services Through Managed Care." *Congressional Research Service, The Library of Congress.*

The Lewin Group. 2008. "Increasing Use of the Capitated Model for Dual Eligibles: Cost Savings Estimates and public Policy Opportunities." *Association for Community Affiliated Plans*

Verdier, James M. et al. 2011. "Managing the Care of Dual Eligible Beneficiaries: A Review of Selected Programs and Special Needs Plans." *Mathematica Policy Research Inc.*

White, Alan J. et. al. 2000. "Evaluation of the Program of All-Inclusive Care for the Elderly Demonstration: A Comparison of the PACE Capitation Rates to Projected Costs in the First Year of Enrollment." *Abt Associates. Report Prepared for the Health Care Financing Administration.* https://www.cms.gov/pace/downloads/abtreport.pdf

Zhang, Hui. 2008. "Selection Bias and Utilization of the Dual Eligibles in Medicare and Medicaid HMOs." *Health Services Research* 43(5): 1598 – 1618.

Zweifel, Peter and Friedrich, Breyer. *Health Economics*. New York: Oxford University Press, 1997.

APPENDIX A

Zweifel and Friedrich's mathematical derivations of physician utility maximization:

Assumptions:

1. a patient's consumption of healthcare, M, increases monotonically with the physician's induced demand, s.
2. the demand for each physician's time in supplying healthcare as a fraction of his/her total time available, h, (0<h<1), is only determined by the number of patients that the physician has, R, and the amount of health services each patient consumes, M.
3. a physician's income, Y, is a direct function of the number of hours he works, t.
4. a physician's utility, u, is positively correlated with income, Y, and negatively with the number of hours worked and induced demand he/she creates.

From the above, the following functions are derived:

$$M = M(s), \qquad where\ M'(s) > 0 \tag{1}$$

$$h(s) = RM(s), \qquad where\ h'(s) = RM'(s) \tag{2}$$

$$Y = Y(t), \qquad where\ Y'(t) > 0 \tag{3}$$

$$u = u(Y, t, s), \qquad where\ u_Y > 0, u_t < 0, u_s < 0 \tag{4}$$

Adding the restriction that the number of hours worked cannot exceed the induced demand, $t \leq h(s) = RM(s)$, a physician's utility function can further be expressed by incorporating equations (1)-(3) into equation(6):

$$u = u\{Y[h(s)]\}, h(s), s\} \tag{5}$$

Hence, in order the find the optimum level induced demand that maximizes utility, the first derivative of the utility function with respect to amount of induced demand gives:

$$\frac{du}{ds} = Y'(t)RM'(s)u_Y + RM'(s)u_t + u_s = 0 \qquad (6)$$

From this, it is then clear that the amount induced is determined by the unit the marginal benefit of another unit of consumption is the same as the sum of the marginal loss and marginal bad conscience" created by an additional unit of healthcare demanded.

Taking this model to the next level, Zweifel and Breyer incorporate the factors of production of healthcare as well as the success of treatment. The following assumption is made:

5. the success of treatment, H, is a function of two services offered by the provider, M_1 and M_2, each of which is produced by working time t_1 and t_2 (where total working time $t = t_1 + t_2$), and another factor of production x_1 and x_2
6. the physician's income is the sum of the revenue, E, minus the costs, where the factor cost, w, is constant for all f_1's and f_2's.

giving rise to the following equations:

$$M_i = f_i(t_i, x_i), \qquad where \frac{df_i}{dt_i} > 0, \frac{df_i}{dx_i} > 0, i = 1,2 \qquad (7)$$

$$H = H(M_1, M_2) \qquad (8)$$

$$Y = E(.) - w(x_1 + x_2) \qquad (9)$$

$$H = H(M_1, M_2) = H\{f_1(t_1, x_1), f_2(t_2, x_2)\} \qquad (10)$$

By assuming that the success of treatment, H, is also positively correlated with a physician's utility, the utility function becomes:

$$u = u(Y, t, s) = u(E(.) - w(x_1 + x_2); t_1 + t_2; H\{f_1(t_1, x_1), f_2(t_2, x_2)\}) \qquad (11)$$

With a fee-for-service payment policy, revenue $E = p_1M_1 + p_2M_2 = p_1(t_1, x_1) + p_2(t_2, x_2)$.

By substituting *E* into equation (11), and differentiating with respect to *t* and *x* to obtain the conditions for maximum utility, the following are obtained:

$$\frac{du}{dt_i} = \left(u_Y p_i + u_H \frac{dH}{dM_i}\right)\frac{df_i}{dt_i} + u_t = 0, \quad where\ i = 1,2 \tag{12}$$

$$\frac{du}{dx_i} = \left(u_Y p_i + u_H \frac{dH}{dM_i}\right)\frac{df_i}{dx_i} + u_Y w = 0, \quad where\ i = 1,2 \tag{13}$$

Dividing $\frac{du}{dt_i}$ by $\frac{du}{dx_i}$ results in $\frac{du/dt_i}{du/dx_i} = \frac{-u_t/u_Y}{w}$, showing that the MRS between *t* and *x* is equal to the ratio of their prices. This implies that the most efficient way of meeting a level of H with the minimum M possible must then occur under the condition that M_1 and M_2 increase the quantity of x used by the same amount, or $\frac{(dH/dM_1)(df_1/dx_1)}{(dH/dM_2)(df_2/dx_2)} = 1$.

However, using equations (12) and (13) gives: $\frac{(dH/dM_1)(df_1/dx_1)}{(dH/dM_2)(df_2/dx_2)} = \frac{(p_2 u_Y + u_H dH/dM_2)(dH/dM_1)}{(p_2 u_Y + u_H dH/dM_1)(dH/dM_2)}$

Further simplification implies that only when $\frac{p_1}{p_2} = \frac{dH/dM_1}{dH/dM_2}$ (which is unlikely) does the above equation meets the condition of ensuring that a level H is delivered most efficiently. Hence Zweifel and Breyer conclude that it is highly likely that providers offer an inefficient health service plan under this payment policy.

On the other hand, under a capitated payment plan, revenue $E = qP(H)$, where *P'(H)>0*; q is the fee paid to the insurer per patient, and P is the total of number of patients that providers see and attempt to maintain their health level at H. As a result, the production function simply becomes *M = M(t)* where *M'(t) > 0* and *t* is the time dedicated to each patient; and success, $H = (\frac{M(t)}{P(H)})$ since the total amount of services produced by each provider must be divided up between the number of patients that must be seen.

By substituting the above deductions into equation (11), the provider's utility function under a capitated payment policy is obtained:

$$u = u(qP(H), t, H[M(t)/P(H)])$$

and differentiating with respect to *t* to obtain utility-maximizing hours gives:

$$\frac{du}{dt} = \{u_Y qP'(H) + u_H\}H'(t) + u_t = 0$$

Since $u_t < 0$, the above differential implies that at the optimum, any marginal utility that is lost to an extra unit of time providing health services must be offset by any marginal gains in income, which is inherently a function of the success level, eliminating any overutilization or inefficiencies of healthcare.

APPENDIX B

NOTE: Please refer to table 5 in the body of this paper for a description of the independent variables.

Full Regression Results – Dependent Variable: Charge;
Dataset – all Elderly

Variable	Parameter Estimate	Std. Error	t Value	Pr >|t|
Intercept	20167.00	782.84	25.76	<.0001
Managed Care Enrollment	-5534.86	93.54	-59.17	<.0001
Dual Eligible	2245.87	257.29	8.73	<.0001
Dual x Managed (Interaction)	433.36	580.35	0.75	0.4552
Weights	38241.00	28.56	1339.04	<.0001
Dual x Weights (Interaction)	1134.85	119.94	9.46	<.0001
HospDual	-274.19	7.89	-34.77	<.0001
HospManaged	-146.70	2.45	-59.79	<.0001
HospDualManaged	1891.36	47.19	40.08	<.0001
HospOnlyDualManaged	-26.85	1.76	-15.29	<.0001
HospHisp	-205.74	3.27	-62.98	<.0001
HospBlack	166.92	3.95	42.22	<.0001
HospAsian	209.09	3.30	63.41	<.0001
HospOtherRace	129.79	3.69	35.13	<.0001
Dementia	-6032.87	369.41	-16.33	<.0001
Psychosis	-3207.54	131.16	-24.46	<.0001
Neurotic Disorder	-6256.61	165.55	-37.79	<.0001
Mental Retardation	-7677.84	1743.80	-4.40	<.0001
Age at Admission	-155.77	5.44	-28.63	<.0001
Male	1018.25	70.67	14.41	<.0001
Hispanic	-327.30	134.37	-2.44	0.0149
White	-3124.35	646.67	-4.83	<.0001
Black	-852.38	668.97	-1.27	0.2026
Native American	-6804.18	1232.64	-5.52	<.0001
Asian Pacific	-2095.98	659.72	-3.18	0.0015
Other Race	-2092.36	665.08	-3.15	0.0017

F-test for Joint Significance of Demographic Variables	
Degrees of Freedom	8.00
F-Value	172.97
Pr > F	<.0001

Full Regression Results – Dependent Variable: AdjCharge; Dataset – all Elderly

Variable	Parameter Estimate	Std. Error	t Value	Pr >|t|
Intercept	5963.91	191.23	31.19	<.0001
Managed Care Enrollment	-1186.24	22.83	-51.96	<.0001
Dual Eligible	1286.13	62.79	20.48	<.0001
Dual x Managed (Interaction)	-1.48	141.19	-0.01	0.9916
Weights	9228.48	6.97	1324.91	<.0001
Dual x Weights (Interaction)	-162.66	29.28	-5.56	<.0001
HospDual	50.16	1.93	26.00	<.0001
HospManaged	-68.57	0.60	-114.92	<.0001
HospDualManaged	2.63	11.45	0.23	0.8186
HospOnlyDualManaged	24.76	0.43	58.08	<.0001
HospHisp	-45.93	0.80	-57.48	<.0001
HospBlack	-16.98	0.96	-17.61	<.0001
HospAsian	26.74	0.80	33.37	<.0001
HospOtherRace	13.06	0.90	14.51	<.0001
Dementia	-980.16	89.87	-10.91	<.0001
Psychosis	-543.14	31.97	-16.99	<.0001
Neurotic Disorder	-1396.86	40.32	-34.64	<.0001
Mental Retardation	-2357.21	425.63	-5.54	<.0001
Age at Admission	-53.27	1.33	-40.19	<.0001
Male	293.88	17.22	17.07	<.0001
Hispanic	-186.35	32.89	-5.67	<.0001
White	-228.32	158.19	-1.44	0.1489
Black	244.39	163.65	1.49	0.1354
Native American	580.49	301.11	1.93	0.0539
Asian Pacific	-4.26	161.35	-0.03	0.9789
Other Race	65.66348	162.65569	0.4	0.6864

F-test for Joint Significance of Demographic Variables	
Degrees of Freedom	8
F-Value	285.96
Pr > F	<.0001

Full Regression Results – Dependent Variable: Charge;
Dataset – ***Dual Eligibles only***

Variable	Parameter Estimate	Std. Error	t Value	Pr >|t|
Intercept	3364.64	3626.27	0.93	0.3535
Managed Care Enrollment	-4642.51	885.41	-5.24	<.0001
Weights	39330.00	144.13	272.88	<.0001
HospDual	-190.45	21.99	-8.66	<.0001
HospManaged	-41.05	16.75	-2.45	0.0143
HospDualManaged	34.52	193.05	0.18	0.8581
HospOnlyDualManaged	55.68	18.37	3.03	0.0024
HospHisp	-211.54	13.12	-16.12	<.0001
HospBlack	-19.69	16.21	-1.21	0.2246
HospAsian	162.12	13.35	12.14	<.0001
HospOtherRace	165.65	14.01	11.82	<.0001
Dementia	-3498.31	2343.05	-1.49	0.1354
Psychosis	-4054.65	825.94	-4.91	<.0001
Neurotic Disorder	-8263.45	995.91	-8.30	<.0001
Mental Retardation	-5679.49	7092.82	-0.80	0.4233
Age at Admission	85.87	29.08	2.95	0.0031
Male	1742.27	425.80	4.09	<.0001
Hispanic	-6507.46	567.26	-11.47	<.0001
White	785.62	2799.06	0.28	0.779
Black	3701.02	2939.02	1.26	0.2079
Native American	10678.00	5289.33	2.02	0.0435
Asian Pacific	-3734.03	2818.53	-1.32	0.1852
Other Race	850.94	2823.67	0.30	0.7631

F-test for Joint Significance of Demographic Variables	
Degrees of Freedom	8.00
F-Value	289.16
Pr > F	<.0001

Full Regression Results – Dependent Variable: AdjCharge;
Dataset – ***Dual Eligibles only***

Variable	Parameter Estimate	Std. Error	t Value	Pr >|t|
Intercept	4073.21	945.36	4.31	<.0001
Managed Care Enrollment	-871.80	230.49	-3.78	0.0002
Weights	9140.43	37.60	243.11	<.0001
HospDual	217.64	5.80	37.52	<.0001
HospManaged	-45.34	4.36	-10.40	<.0001
HospDualManaged	-64.95	50.08	-1.30	0.1946
HospOnlyDualManaged	38.25	4.77	8.02	<.0001
HospHisp	-70.79	3.43	-20.66	<.0001
HospBlack	-46.64	4.21	-11.07	<.0001
HospAsian	-31.65	3.47	-9.11	<.0001
HospOtherRace	14.53	3.64	3.99	<.0001
Dementia	2766.22	611.89	4.52	<.0001
Psychosis	1111.97	215.88	5.15	<.0001
Neurotic Disorder	-1986.12	259.90	-7.64	<.0001
Mental Retardation	-158.42	1846.64	-0.09	0.9316
Age at Admission	-21.32	7.58	-2.81	0.0049
Male	489.64	110.93	4.41	<.0001
Hispanic	-894.14	147.92	-6.04	<.0001
White	-445.74	730.16	-0.61	0.5416
Black	385.13	766.44	0.50	0.6153
Native American	3749.26	1410.29	2.66	0.0079
Asian Pacific	-577.07	735.11	-0.79	0.4325
Other Race	-367.97	736.46	-0.50	0.6173

F-test for Joint Significance of Demographic Variables	
Degrees of Freedom	8.00
F-Value	15.29
Pr > F	<.0001

Full Regression Results – Dependent Variable: Charge;
*Dataset – **Non Dual Eligibles only***

Variable	Parameter Estimate	Std. Error	t Value	Pr >|t|
Intercept	21175.00	803.06	26.37	<.0001
Managed Care Enrollment	-5447.58	92.69	-58.77	<.0001
Weights	38237.00	28.22	1354.75	<.0001
HospDual	-273.53	9.01	-30.37	<.0001
HospManaged	-150.09	2.47	-60.82	<.0001
HospDualManaged	2053.27	49.71	41.31	<.0001
HospOnlyDualManaged	-28.31	1.77	-15.96	<.0001
HospHisp	-206.60	3.41	-60.56	<.0001
HospBlack	185.90	4.11	45.22	<.0001
HospAsian	212.00	3.45	61.38	<.0001
HospOtherRace	125.08	3.86	32.38	<.0001
Dementia	-6157.20	371.97	-16.55	<.0001
Psychosis	-3200.33	132.14	-24.22	<.0001
Neurotic Disorder	-6197.00	167.08	-37.09	<.0001
Mental Retardation	-8068.60	1806.95	-4.47	<.0001
Age at Admission	-167.58	5.53	-30.32	<.0001
Male	979.79	71.32	13.74	<.0001
Hispanic	121.51	140.16	0.87	0.386
White	-3280.14	666.32	-4.92	<.0001
Black	-1369.10	688.68	-1.99	0.0468
Native American	-8337.76	1270.85	-6.56	<.0001
Asian Pacific	-2061.77	680.86	-3.03	0.0025
Other Race	-2378.85	687.22	-3.46	0.0005

F-test for Joint Significance of Demographic Variables	
Degrees of Freedom	8.00
F-Value	179.85
Pr > F	<.0001

Full Regression Results – Dependent Variable: AdjCharge;
*Dataset – **Non Dual Eligibles only***

Variable	Parameter Estimate	Std. Error	t Value	Pr >|t|
Intercept	6237.42	195.12	31.97	<.0001
Managed Care Enrollment	-1186.98	22.50	-52.76	<.0001
Weights	9225.27	6.85	1347.50	<.0001
HospDual	-1.04	2.19	-0.48	0.6346
HospManaged	-68.59	0.60	-114.94	<.0001
HospDualManaged	35.08	11.99	2.92	0.0034
HospOnlyDualManaged	23.04	0.43	53.83	<.0001
HospHisp	-40.29	0.83	-48.56	<.0001
HospBlack	-11.30	1.00	-11.32	<.0001
HospAsian	36.89	0.83	44.20	<.0001
HospOtherRace	12.41	0.94	13.25	<.0001
Dementia	-1120.32	89.99	-12.45	<.0001
Psychosis	-593.17	32.02	-18.52	<.0001
Neurotic Disorder	-1377.98	40.47	-34.05	<.0001
Mental Retardation	-2541.11	438.71	-5.79	<.0001
Age at Admission	-55.22	1.34	-41.24	<.0001
Male	280.45	17.28	16.23	<.0001
Hispanic	-106.95	34.12	-3.13	0.0017
White	-283.35	162.14	-1.75	0.0805
Black	179.47	167.59	1.07	0.2842
Native American	234.98	308.19	0.76	0.4458
Asian Pacific	-33.97	165.64	-0.21	0.8375
Other Race	-21.29	167.18	-0.13	0.8987

F-test for Joint Significance of Demographic Variables	
Degrees of Freedom	8.00
F-Value	289.16
Pr > F	<.0001

Regression Results – Dependent Variable: LOS (length of Stay); Dataset – All elderly

Variable	Parameter Estimate	Std. Error	t Value	Pr >|t|
Intercept	1.60	0.13	12.00	<.0001
Managed Care Enrollment	-1.18	0.02	-73.69	<.0001
Dual Eligible	2.24	0.04	51.10	<.0001
Dual x Managed (Interaction)	-0.58	0.10	-5.88	<.0001
Weights	1.78	0.00	365.72	<.0001
Dual x Weights (Interaction)	0.15	0.02	7.39	<.0001
HospDual	0.11	0.00	84.33	<.0001
HospManaged	-0.01	0.00	-33.31	<.0001
HospDualManaged	-0.04	0.01	-5.07	<.0001
HospOnlyDualManaged	0.00	0.00	-7.93	<.0001
HospHisp	-0.02	0.00	-38.94	<.0001
HospBlack	-0.02	0.00	-26.13	<.0001
HospAsian	0.00	0.00	4.45	<.0001
HospOtherRace	0.00	0.00	5.97	<.0001
Dementia	1.30	0.06	20.64	<.0001
Psychosis	0.92	0.02	41.14	<.0001
Neurotic Disorder	-0.53	0.03	-18.65	<.0001
Mental Retardation	0.41	0.30	1.38	0.1675
Age at Admission	0.04	0.00	48.19	<.0001
Male	-0.17	0.01	-13.80	<.0001
Hispanic	-0.08	0.02	-3.45	0.0006
White	-1.65	0.11	-14.95	<.0001
Black	-0.99	0.11	-8.67	<.0001
Native American	-0.98	0.21	-4.68	<.0001
Asian Pacific	-1.64	0.11	-14.52	<.0001
Other Race	-1.66	0.11	-14.58	<.0001

F-test for Joint Significance of Demographic Variables	
Degrees of Freedom	8.00
F-Value	411.76
Pr > F	<.0001

Regression Results – Dependent Variable: Total no. of procedures; Dataset – All elderly

Variable	Parameter Estimate	Std. Error	t Value	Pr >|t|
Intercept	2.61	0.03	97.66	<.0001
Managed Care Enrollment	-0.04	0.00	-11.53	<.0001
Dual Eligible	0.10	0.01	11.65	<.0001
Dual x Managed (Interaction)	0.06	0.02	2.92	0.0035
Weights	1.04	0.00	1069.72	<.0001
Dual x Weights (Interaction)	-0.09	0.00	-22.51	<.0001
HospDual	0.01	0.00	42.80	<.0001
HospManaged	0.00	0.00	11.26	<.0001
HospDualManaged	-0.09	0.00	-53.51	<.0001
HospOnlyDualManaged	0.00	0.00	64.66	<.0001
HospHisp	0.00	0.00	-25.72	<.0001
HospBlack	0.00	0.00	-26.20	<.0001
HospAsian	0.00	0.00	-1.36	0.1743
HospOtherRace	0.00	0.00	19.81	<.0001
Dementia	-0.33	0.01	-26.54	<.0001
Psychosis	-0.33	0.00	-72.88	<.0001
Neurotic Disorder	-0.26	0.01	-45.63	<.0001
Mental Retardation	-0.55	0.06	-9.25	<.0001
Age at Admission	-0.02	0.00	-132.79	<.0001
Male	0.10	0.00	43.39	<.0001
Hispanic	0.01	0.00	2.26	0.0241
White	0.02	0.02	0.99	0.3226
Black	0.00	0.02	0.15	0.8801
Native American	0.11	0.04	2.71	0.0066
Asian Pacific	0.08	0.02	3.42	0.0006
Other Race	0.06	0.02	2.55	0.0109

F-test for Joint Significance of Demographic Variables	
Degrees of Freedom	8.00
F-Value	2633.14
Pr > F	<.0001

Regression Results – Dependent Variable: Total no. of diagnoses; Dataset – All elderly

Variable	Parameter Estimate	Std. Error	t Value	Pr >|t|
Intercept	4.50	0.07	64.90	<.0001
Managed Care Enrollment	-1.08	0.01	-130.60	<.0001
Dual Eligible	-0.83	0.02	-36.42	<.0001
Dual x Managed (Interaction)	0.45	0.05	8.73	<.0001
Weights	0.96	0.00	378.12	<.0001
Dual x Weights (Interaction)	0.26	0.01	24.72	<.0001
HospDual	-0.01	0.00	-19.22	<.0001
HospManaged	-0.01	0.00	-52.16	<.0001
HospDualManaged	0.03	0.00	7.80	<.0001
HospOnlyDualManaged	0.00	0.00	31.24	<.0001
HospHisp	0.00	0.00	-6.16	<.0001
HospBlack	-0.01	0.00	-19.38	<.0001
HospAsian	0.00	0.00	-8.22	<.0001
HospOtherRace	0.01	0.00	23.29	<.0001
Dementia	-1.28	0.03	-39.22	<.0001
Psychosis	-0.76	0.01	-65.86	<.0001
Neurotic Disorder	-2.21	0.01	-150.89	<.0001
Mental Retardation	-1.52	0.15	-9.87	<.0001
Age at Admission	0.08	0.00	163.82	<.0001
Male	0.44	0.01	71.00	<.0001
Hispanic	0.14	0.01	11.71	<.0001
White	-0.52	0.06	-9.10	<.0001
Black	0.54	0.06	9.17	<.0001
Native American	0.10	0.11	0.95	0.3425
Asian Pacific	-0.57	0.06	-9.74	<.0001
Other Race	-0.45	0.06	-7.64	<.0001

F-test for Joint Significance of Demographic Variables	
Degrees of Freedom	8.00
F-Value	4122.31
Pr > F	<.0001