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THE EFFECTS OF STAND-ALONE PRESCRIPTION DRUG PLANS ON HEALTH CARE UTILIZATIONS, EXPENDITURES AND MEDICATION ADHERENCE AMONG ELDERLY MEDICARE BENEFICIARIES

by

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DEDICATION

This dissertation is dedicated to my parents and my son, for all their love, kindness and support.

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This dissertation could not have been finished without the great support that I have received from so many people over the years. At the forefront, I would like to thank my advisor, Dr. Kevin Z. Lu, for continuous support and guidance throughout my graduate study. He has given his support, patience, and guidance that allowed me to pursue research on topics which I am truly passionate about.

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ABSTRACT

Since the implementation of Medicare Part D in 2006, a growing body of evidence has shown that Medicare Part D might offset the total healthcare spending by improving the use of prescription drugs. However, little is known about the impact of different types of Part D plans – Stand-alone Prescription Drug Plan (PDPs) and Medicare Advantage Prescription Drug Plan (MA-PDs) – on health care utilizations and expenditures. This dissertation examined the association between the effect in PDPs on health care utilizations as well as expenditures, and medication adherence among elderly Medicare beneficiaries, compared to MA-PDs. Data was pooled from 2006-2010 Medicare Current Beneficiary Survey (MCBS) providing information on independent variable (type of Part D plans), primary outcomes of interest (health services use, costs and medication adherence) and covariates at the individual level. The study sample includes community-dwelling beneficiaries aged 66 years and older, who enrolled in Part D plans for the entire study year. Beneficiaries enrolled in employer sponsored insurance were excluded from the analysis. Cost-related nonadherence was evaluated based on beneficiaries' self-reports. Proportion of Days Covered (PDC) was used as a quantitative measure of Medication adherence for beneficiaries who were diagnosed with type 2 diabetes. Univariate and bivariate analyses were carried out to describe sample baseline characteristics. Naïve generalized linear models and two-stage residual inclusion (2SRI) methods were performed to examine the relationship between types of part D plans and outcomes of interest. This study included 6,596 PDP enrollees and 5,430 MA-PD

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enrollees. The study showed PDP enrollees generally had lower socioeconomic status, were more likely to have additional prescription drug coverage other than Part D, had more comorbidities and, were less likely to visit physicians when they felt sick than MA-PD enrollees. PDP enrollees tended to use more health services and had higher costs of total healthcare and prescription drugs, while had higher cost-related nonadherence and difficulties in affording prescription drugs, compared to those enrolled in MA-PDs. In the generalized lineal models, PDPs were associated with increased use and costs of health services. In the 2SRI, there was substantial evidence to support the selection bias into PDP plans. After controlling selection bias, PDPs was still associated with higher use and costs of all medical care (only expect hospitalizations) and prescription drugs. In addition, among diabetic beneficiaries, PDP group was associated with lower medication adherence to antihypertensive drugs, but had similar adherence to anti-diabetic drugs and antihyperlipimic drugs, compared to MA-PD group.

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LIST OF ABBREVIATIONS

2SLS.....Two-Stage Least Squares

2SRI .....Two-Stage Residual Inclusion

ADLs..... Activities of daily living

AHRF.....Area Health Resources Files

BMI ..... Body Mass Index

CCI.....Charlson Comorbidity Index

CMS .....The Centers for Medicare & Medicaid Services

CPI .....Consumer Price Index

CRN .....Cost-Related Nonadherence

DME.....Durable medical equipment

ESRD .....End-Stage Renal Disease

ESI.....Employer-Sponsored Insurance

FFS .....Fee for Service

GLM..... Generalized Linear Model

HCC .....Hierarchical Condition Categories

HMO ..... Health Maintenance Organization

HRSA.....Health Resources and Services Administration

IADLs .....Instrumental Activities of Daily Living

IV .....Instrumental Variable

LIS..... Low Income Subsidy

MA .....Medicare Advantage

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MA-PD..... Medicare Advantage Prescription Drug Plan

MCBS ..... Medicare Current Beneficiary Survey

MSA..... Medical Savings Account

NB ..... Negative Binomial

OLS .....Ordinary Least Squares

OOP.....Out-of-Pocket

PDP .....Stand-alone Prescription Drug Plan

POS .....Point of Service

PPO .....Preferred Provider Organization

PSO .....Provider Sponsored Organization

SE.....Standard Error

SNP .....Special Needs Plan

U.S. ..... United States

ZINB .....Zero-Inflated Negative Binomial

ZIP.....Zero-Inflated Poisson

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CHAPTER 1

INTRODUCTION

To date, the elderly are the most intensive users of health care services in the United States (U.S.). It estimated that elderly Americans only accounted for 13% of the total population, but consumed 36% of healthcare services.[1] It is widely believed that providing individuals with prescription drug coverage may lead to cost-saving by reducing other medical services that are related to suboptimal care.[2] As the U.S. President mentioned when he signed the Medicare Modernization Act (MMA) into law in 2003, "Drug coverage under Medicare will allow seniors to replace more expensive surgeries and hospitalizations with less expensive prescription medicine."[3] The Medicare program is the main insurance program for the elderly in the U.S. Prior to 2006, Medicare only covered prescription drugs that were administered during a hospital stay (under Medicare Part A) or a physician's office (under Medicare Part B), but did not cover outpatient prescription drugs until the implementation of Medicare Part D, which was part of Medicare Prescription Drug, Improvement, and Modernization Act of 2003. Before the introduction of Part D, Medicare beneficiaries can pay the total costs for outpatient prescription drugs, or obtain their prescription drug benefits through Medicare Advantage (MA) plans with drug benefits, Employer-Sponsored Insurance (ESI), public insurance plans (e.g., Medicaid), or Medigap with prescription drug coverage. Unlike Medicare Part

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A and B, Medicare Part D is delivered entirely by private insurance plans: stand-alone prescription drug plans (PDPs) and Medicare Advantage-Prescription Drug plans (MA-PDs). In 2014, more than 37 million Medicare beneficiaries enrolled in Part D. Among them, approximately 62% beneficiaries were in PDPs, and the rest were in MA-PDs. The average monthly premiums were $29, but the monthly premiums were varied by individual, due to the plans enrolled, beneficiaries' levels of income and assets, and late enrollment for Part D.

This chapter presents background information about the overview of the Medicare program, significance, and study objectives and specific aims for this dissertation.

1.1 A Brief Overview of Medicare and Supplemental Insurance

Medicare is a national health insurance program administered by the United States (U.S.) federal government. Since its establishment in 1965,[4] Medicare provides millions of Americans – mainly Americans aged 65 and older – with substantial protection against catastrophic losses due to medical care. With the aging of the U.S. population and the emergence of new technologies, Medicare has grown rapidly with an increasing number of beneficiaries and rising health care cost. Over the past decades, the number of Medicare beneficiaries has been tripled from 19 million in 1965 to 55 million in 2013.[5] Medicare has also expanded its range of coverage, e.g., prescription drugs benefits. Consequently, spending for Medicare increased dramatically. In 2014, Medicare payments totaled $597 billion, accounting for 14% of the federal budget; 23% of Medicare benefits were for hospital care, 12% for physician services, 11% for the Part D drug benefits, and 26% for Medicare Advantage private plans.[6]

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1.1.1 Original Medicare

To be eligible for Medicare, an individual or his spouse must be aged 65 or over who would be eligible for the social security benefits, and be a U.S. citizen or permanent resident. For individuals under age 65, they must be permanently disabled and receive disability benefits for at least two years, or have End-Stage Renal Disease (ESRD) or Amyotrophic Lateral Sclerosis. In 2014, 84% of Medicare beneficiaries were elderly.[7,8]

The original Medicare has 2 parts: Part A Hospital Insurance, which covers hospital, skilled-nursing facility, hospice and some home health care, Part B Medical Insurance, which provides coverage on medically necessary services, such as physician and outpatient services, home health care and preventative services. In addition, Part B covers a limited number of outpatient prescription drugs under certain conditions. In general, prescription drugs covered under Part B are drugs administered at a doctor's office or hospital outpatient setting. All Medicare beneficiaries are automatically covered under Part A without paying a premium, while Part B requires a monthly premium from those who choose to enroll in the program (Table 1)

Table 1.1 Summary of Medicare Part A and Part B Benefits

Covered Services	Beneficiary pays	Medicare Pays
Medicare Part A		
Inpatient Hospital Stay		
Days 1-60	$1,260 deductible	Balance
Days 61-90	$315 coinsurance per day	Balance
Days 91-150 (lifetime reserve days)	$630 coinsurance per day	Balance
All additional days	All costs	None
Skilled Nursing Facility Care		
Days 1-20	None	All costs

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Covered Services	Beneficiary pays	Medicare Pays
Days 21-100	Up to $152 coinsurance per day	Balance
All additional days	All costs	None
Home Health Care Services		
Part-time or intermittent skilled care, home health aide services	$0 for up to 35 hours per week	All costs
Hospice Care		
Pain relief, symptom management and support services for the terminally ill	Small co-payments	Balance
Durable Medical Equipment and Supplies	20% coinsurance for approved payments	Balance
Medicare Part B		
Medical Expenses		
Doctor's services Inpatient and outpatient medical services and supplies Physical and speech therapy Diagnostic tests Ambulance services	$147 deductible 20% coinsurance for most covered services for providers accepting assignment.	80% of Medicare approved costs after $147 deductible has been met.
Clinical Lab Tests		
Blood tests, urinalysis, etc.	$0 if medically necessary	100% for approved care.
Home Health Care Services		
Part-time or intermittent skilled care, home health aide services	$0 for up to 35 hours per week	All costs
Durable Medical Equipment and Supplies	20% coinsurance for approved payments after $147 deductible	20% of approved payments after $147 deductible
Outpatient Hospital Treatment	20% coinsurance for approved payments after $147 deductible	Medicare payment to hospital based on fee schedule.

Source: Medicare and You, 2015. Centers for Medicare & Medicaid Services.
Link: https://www.medicare.gov/pubs/ebook/pdf/Medicare_and_You-2015.pdf

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1.1.2 Medicare Advantage plans

Since the 1970s, managed care program was offered as an option of the original Medicare program through private health insurance companies. Medicare's managed care program was named "Medicare+Choice" by the Balanced Budget Act (BBA) of 1997, and "Medicare Advantage" by the Medicare Modernization Act (MMA) of 2003. The enrollment in managed care is open to all Medicare beneficiaries without preexisting ESRD. In 2015, 16.8 million or 31% Medicare beneficiaries enrolled in MA plans.[9]

Medicare Advantage (MA) plans include Preferred Provider Organization (PPO) Plans, Health Maintenance Organization (HMO) Plans, Private FFS Plans, Medical Savings Account (MSA) Plans, Special Needs Plans (SNP), Point of Service (POS) Plans, and Provider Sponsored Organizations (PSOs) Plans. MA plans provide more comprehensive coverage than the original Medicare, for example, most of the MA plans cover outpatient prescription drugs, which are not normally covered by traditional Part B plans. MA plans are required to set a yearly limit on out-of-pocket costs for medical services. Once this limit has been reached, the plan will pay 100% for the covered services for the remainder of the calendar year. Medicare pays the private companies a fixed amount ("capitation") for each enrollee every month. Table 1.2 shows the differences in the original Medicare and Medicare Advantage plans.

Table 1.2 Comparison Between the Original Medicare and MA Plans

	Original Medicare	**MA plans**
Premiums	Medicare premiums	Medicare premiums plus MA plan's premium (if charge one)
Out-of-pocket costs	Deductibles and coinsurances	Deductibles and copays set by MA plans
Out-of-pocket limit	No	Yes

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	Original Medicare	MA plans
Enroll in Supplemental insurance (Medigap)	Yes	No
Additional services (e.g., vision, dental)	No	Yes
Prescription Drug coverage	No, but can buy a separate Part D plan	Most plans provide drug coverage

Source: Medicare and You, 2015. Centers for Medicare & Medicaid Services.
Link: https://www.medicare.gov/pubs/ebook/pdf/Medicare_and_You-2015.pdf

1.1.3 Medicare Part D

As part of the 2003 Medicare Prescription Drug Improvement and Modernization Act (MMA), Medicare's drug benefit (or referred as “Part D”) became effective in January 01 2006. Medicare Part D was introduced to provide Medicare beneficiaries with affordable outpatient prescription drug coverage. Unlike the existing Part A and Part B program, Part D plans are delivered entirely by private companies through two distinct health care delivery systems: stand-alone Prescription Drug Plans (PDPs) and Medicare Advantage Prescription Drug plans (MA-PDs). PDPs provide prescription drug plans to Medicare beneficiaries enrolled in traditional fee-for-service plans for Part A and Part B programs, while MA-PDs offer prescription medication coverage to Medicare beneficiaries who enrolled in the MA plans with prescription drug coverage. Medicare beneficiaries can choose one of these two coverage options during Medicare open enrollment period (October 15-December 7), or switch from MA-PDs to PDPs during MA Disenrollment Period (January 1-February 14) each year. In 2015, more than 37 million Medicare beneficiaries were enrolled in Part D plans, an increase of 15 million compared to 2006. Among all the Part D enrollees, 62% of them were enrolled in PDPs.

Medicare Part D plans offered by PDPs and MA-PDs must comply with model

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plan developed by CMS each year. All part D plans have the following four coverage phases: (1) Deductible phase: beneficiaries pay 100% for drug costs until they reach the deductible amount ($320 in 2015). (2) Initial coverage limit: after the deductible is met, beneficiaries will enter the initial coverage limit, where they will pay the plan's cost share for covered medications. Once beneficiaries have spent $2,960 for covered drugs, including the deductible amount, they have reached the initial coverage limit and have entered the coverage gap. (3) Coverage gap (or "donut hole"): while in the coverage gap, beneficiaries will pay 45% of the cost for brand-name drugs and 65% of the cost for generic drugs in 2015. Beneficiaries are out of the coverage gap once their yearly out-of-pocket drug costs reach $4,700 in 2015. (4) Catastrophic coverage phase: during the catastrophic coverage phase, beneficiaries pay whichever amount is greater, either 5% of the covered drug cost or $2.65 for generics and $6.60 for brand name drugs in 2015. Table 1.3 compares the plan parameters from 2006 to 2010.

Table 1.3 Medicare Part D Benefit Parameters 2006-2010

Part D Standard Benefit Design Parameters:	**2010**	**2009**	**2008**	**2007**	**2006**
Deductible - (after the Deductible is met, Beneficiary pays 25% of covered costs up to total prescription costs meeting the Initial Coverage Limit.	$310	$295	$275	$265	$250
Initial Coverage Limit - Coverage Gap (Donut Hole) begins at this point. (The Beneficiary pays 100% of their prescription costs up to the Out-of-Pocket Threshold)	$2,830	$2,700	$2,510	$2,400	$2,250

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Part D Standard Benefit Design Parameters:	2010	2009	2008	2007	2006
Out-of-Pocket Threshold - This is the Total Out-of-Pocket Costs including the Donut Hole.	$4,550	$4,350	$4,050	$3,850	$3,600
Total Covered Part D Drug Out-of-Pocket Spending including the Coverage Gap - Catastrophic Coverage starts after this point.	$6,440.00	$6,153.75	$5,726.25	$5,451.25	$5,100.00

Source: 2010 Medicare Part D Standard Benefit Model Plan Parameters.
link: https://q1medicare.com/PartD-The-MedicarePartDOutlookAllYears.php

The cost-sharing structure varies largely among different Part D plans. Generally, the prescription drug coverage offered by MA-PD plans is more generous than those provided by PDP plans, because MA-PD plans are able to use the payments for coverage of non-drug medical services to subsidize prescription drug coverage.[10,11] Since MA-PD plans cover all the medical services, it is highly possible that they have stronger incentives than PDPs to offer more generous coverage to forestall the adverse health and economic consequences due to the unavailability of prescription drugs.[10,11] In fact, lower cost-sharing of prescription drugs has been observed in MA-PD plans compared to PDP plans. In 2014, 53% PDPs and 14% MA-PD plans charged deductible,[12] consequently, 89% of MA-PD and 43% PDP enrollees were covered by an enhanced plan without deductible. [11 11 11] Furthermore, 22% of MA-PD plans covering 31% of MA-PD enrollees offered additional gap coverage gap, while 18% of PDPs covering 3% of PDP enrollees provided coverage during coverage gap.[11,12]

1.1.4 Supplemental plans and other insurance

In addition to the Medicare Part D plans, beneficiaries can also obtain prescription

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drug benefits through private insurance (e.g., ESI) and public insurance (e.g., Medicaid, VA).

Medicare Supplement Insurance plan (or Medigap policy). Although Medicare covers a great portion of health services, it doesn't cover all the costs. For example, Medicare beneficiaries with only Part A and Part B coverage are responsible for copayments, deductibles, and coinsurance, which may leave a large amount of OOP expenses. Since 1980, beneficiaries have been offered the option to enroll in Medicare Supplement Insurance plans or Medigap policies, which are the health insurance to fill the "gaps" in the Original Medicare Plan coverages. Medigap policies are sold by private companies, and offer certain benefits that are not covered under the original Medicare, e.g., emergency foreign travel expenses. However, Medigap policies don't cover the share of the costs under certain types of health coverage, including MA Plans, PDPs, employer/union group health coverage, Medicaid, Department of Veterans Affairs (VA) benefits, or TRICARE. In addition, beneficiaries enrolled in Medicaid or MA plans are not eligible to purchase Medigap policies.

Medicare Extra Help Program / Low Income Subsidy (LIS). Beneficiaries with limited income and financial resources (e.g., bank account, real estates, stocks, bonds) may qualify for Extra Help/LIS, which is a federal program that helps seniors to pay for their Part D monthly premium, annual deductible, coinsurance, and copayments. Seniors are eligible if their annual income is below 150% FPL and their assets are less than the eligibility limits. A beneficiary can be eligible for full or partial subsidy depending on his income and financial resources. Table 1.4 compares the premium, deductible, and copayments for beneficiaries with different levels of subsidy in 2010. Beneficiaries who

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are eligible for LIS can enroll in either PDPs or MA-PDs. CMS pay the subsidized premiums directly to PDPs/MA-PDs based on the regional benchmark premiums. For LIS eligible individuals who have not enrolled in Medicare drug plans (PDPs or MA-PDs), they will automatically be enrolled in PDPs by CMS.

Table 1.4 Medicare Part D Extra Help/LIS Program in 2010

Subsidy Level	Monthly Premium	Annual Deductible	Copayments
Level 1- Individual with full Medicaid benefits in a nursing home	$0	$0	$0
Level 2- Non-institutionalized individuals with full Medicaid	$0	$0	$1.1 or $2.50 for generic $3.30 or $6.30 for brand-name No copays after catastrophic coverage ($6,440)
Level 3 - Non-institutionalized individuals with income below135% of FPL and resources below $8,100 for individual or $12,910 for married couple	$0	$0	$2.50 for generic $6.30 for brand-name No copays after catastrophic coverage ($6,440)
Level 4 - Non-institutionalized individuals with income 135%-150% of PFL and resources <$12,510 for individual or $25,010 for married couple	up to $31.94	$63.00	Up to 15% copayment $2.50/generic; $6.30/brand-name after catastrophic coverage ($6,440)

Source: 2010 Medicare Part D Standard Benefit Model Plan Parameters,
Link: https://q1medicare.com/PartD-The-MedicarePartDOutlookAllYears.php

1.1.5 Medicare's plan choices

Medicare beneficiaries have two ways to get Medicare benefits. First, an eligible beneficiary can enroll in the original Medicare FFS Plan to get his/her coverage on

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medical services, e.g., hospitalizations (Part A), outpatient care (Part B). To get additional coverage on prescription drugs, he/she can also add a Medicare prescription drug plan. Second, an individual can join a MA Plan to get all the Medicare benefits, including both non-drug medical services and prescription drug benefits. MA Plans usually offer prescription drug coverage through the MA-PD plans. In certain types of MA Plans (PFFS or MSA plans) that don't offer drug benefits, an individual can join a PDP plan. If an individual join in a both PDP and MA Plan with prescription drug coverage, however, he/she will be dis-enrolled from MA Plan and returned to the Original Medicare. Therefore, a beneficiary cannot enroll in both PDP and MA-PD plan at the same time. Figure 1.1 demonstrates the choices of Medicare coverage.

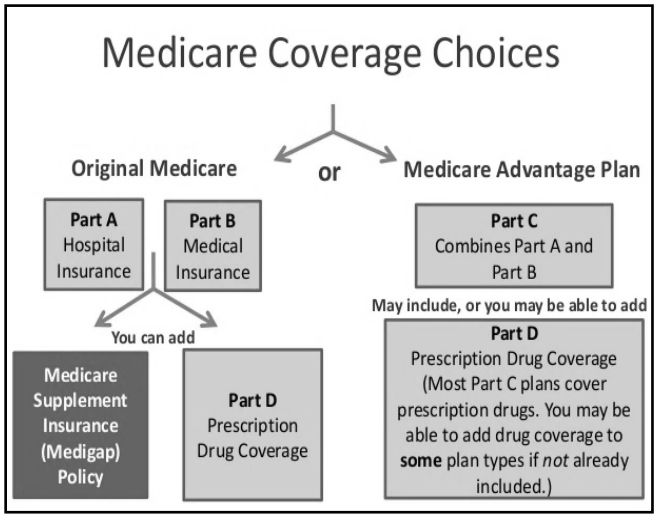

Figure 1.1 Choices of Medicare Coverage
Source: Medicare and You, 2015. Centers for Medicare & Medicaid Services.
Link: https://www.medicare.gov/pubs/ebook/pdf/Medicare_and_You-2015.pdf

1.1.6 Other plans in Medicare population

Employer-Sponsored Insurance (ESI). Many employers and unions provide group health insurance coverage to their current employees and retirees as a part of employees' compensation package. ESI has been considered the most reliable Medicare supplements,

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because ESI helps beneficiaries to pay for their medical expenses by meeting cost-sharing requirements (e.g., copay) and covering additional services that are not covered in the original Medicare.[2] Most ESI provides coverage for prescription drugs, which were not covered under Medicare prior to 2006. After the implementation of Part D, beneficiaries with ESI still have prescription drug benefits without paying Part D premiums, but they cannot enroll in the Part D plans, including both PDPs and MA-PDs.

Medicaid. Medicaid is the needs-based social welfare program that assists Americans of all ages with limited income and financial resources in paying for their health care. Unlike Medicare, Medicaid is jointly funded by both federal and state governments.[13] Medicaid provides a wider range of coverage, including prescription drugs, transportations, compared to Medicare. Prior to the introduction of Part D in 2006, Medicaid is the major source of prescription benefits for the elderly with low-income or permanent disabilities.[14] Since 2006, the prescription drug benefits for Medicare-Medicaid dual eligible beneficiaries were shifted from Medicaid to Medicare Part D because of the mandatory requirements under MMA. Therefore, dual eligible beneficiaries obtain prescription benefits through Medicare.

State Pharmaceutical Assistance Programs (SPAPs). State Pharmaceutical Assistance Programs (SPAPs) are state-run programs that provide prescription coverage for low-income seniors and adults with disabilities. Eligibility requirements are varied by states. For example, some states require applicants to be diagnosed with certain diseases, such as Human Immunodeficiency Virus infection and Acquired Immune Deficiency Syndrome (HIV/AIDS), while other states have no requirements on the conditions to be eligible for SPAPs. Some states also offer assistances to Medicare beneficiaries who are

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not qualified for Medicare Extra Help/LIS. In addition, SPAPs help beneficiaries to pay for drug costs that are not covered by Part D, such as premiums, deductible, and copayments. In 2010, a total of 14 states offered SPAPs for Medicare beneficiaries aged 65 or over, including Delaware, Indiana, Maine, Maryland, Massachusetts, Nevada, New Jersey, New York, Pennsylvania, Rhode Island, Vermont, Virgin Islands, and Wisconsin.[15]

Department of Veterans Affairs (VA). VA operates the nation's largest integrated health care delivery system to improve the health and well-beings of the U.S. veterans. Unlike Medicare, VA provides health care directly to veterans in the VA facilities with a wide range of medical services, including inpatient and outpatient care, emergency care, preventive care, rehabilitation, mental health and substance abuse treatment, home health, and hospice care. VA also covers the prescription drugs prescribed by a VA physician, but doesn't cover prescriptions prescribed by a non-VA physician unless certain criteria are met. Since the implementation of Part D in 2006, the drug benefits provided by VA were set to be same or better than those offered by the standard Medicare Part D plans. Veterans can join the Part D plans after the enrollment period without paying a penalty, and still be entitled all the VA health and prescription drug benefits.

1.2 Significance

As the elderly is the most intensive users of healthcare in the U.S., the Medicare program – the main insurance program for the elderly – is projected to exceed Social Security by 2024.[16] This rapid growth in Medicare expenditures was slow down after the implementation of Part D program. Medicare Part D is estimated to be associated with $1.5 billion in aggregate savings to Medicare yearly.[17] Medicare Part D is mainly

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delivered through two types of plans with considerable differences in their cost-sharing structures, which may lead to different impact on health resources use. MA plans were designed to better control healthcare costs than traditional FFS by reducing utilizations of hospitalizations and emergency care through comprehensive coverage. Since the implementation of Medicare Part D, limited studies have been published to compare FFS and MA plans on healthcare utilizations and expenditures. Additionally, there is no study to compare the health care utilizations and expenditures associated with the two specific types of Part D programs – PDPs and MA-PDs. Hence, real-world information comparing these two types of part D plans is necessary to better inform healthcare providers, patients, and stakeholders.

Furthermore, increasing evidence suggested the improvement in medication adherence since the implementation of Part D, while it is still unclear if there are any differences between MA-PD and PDP plans on medication adherence. Cost-relate nonadherence may arise, for example, if patients respond to higher cost sharing by reducing or discontinuing prescription drugs for chronic illness. Since MA-PD plans are more generous than PDP plans, MA-PD enrollees have lower out-of-pocket costs for prescription drugs than those enrolled in PDPs, and hence, are more likely to be adherent to their medication regimens. Since cost is considered the most modifiable factor for medication nonadherence, it is necessary to examine the role of PDPs on medication adherence among Medicare beneficiaries.

There are several challenges in conducting this project. First, there is the possibility of omitted variables related to both choice of Part D plans and study outcomes (utilizations, expenditures, and adherence). Selection of Part D plan may be determined

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by many factors, such as availability of plans, health conditions, and expected use of prescriptions, which in return influence the health care utilizations and expenditure. This reverse causality may lead to biased estimates of PDP effects on the clinical and economics outcomes. Even though a rich variety of potential confounders could be controlled in the analysis, it is still very reasonable to suspect the existence of omitted variables. To address this concern, I applied the innovative econometric method – instrumental variable approach – to obtain more consistent results by eliminating omitted variable bias.

In addition, it is always challenging to estimate the use of prescriptions solely based on pharmacy claims, because the filling of prescriptions may not be fully captured in the data. This challenge is becoming more salient with the emerging of generic drug discount programs, i.e., Walmart's' $4 generic prescription drug program,[18] as beneficiaries would pay cash directly to the pharmacies. For this case, the prescription fills cannot be fully captured by using the insurer's adjudication system. Therefore, using claims data alone may underestimate the prescription drug use. To account for this possibility, I used a combined source of information, self/proxy's reports and pharmacy claims, to estimate medication use, because using multiple data sources can generate more accurate estimates of drug use than a single source of information.

1.3 Study Objectives and Specific Aims

The main purpose of this project was to investigate the impact of stand-alone Prescription Drug Plans (PDPs) on health care utilizations, expenditures, and medication adherence among elderly beneficiaries, compared to Medicare Advantage Prescription Drug plans (MA-PDs).

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The specific aims are described as below.

Aim 1. To compare the characteristics of Medicare beneficiaries aged 65 years and older who enrolled in PDPs and MA-PD plans.

Hypothesis 1. Beneficiaries enrolled in PDPs had lower socioeconomic status, worse clinical conditions, and higher health care spending, compared to those enrolled in MA-PD plans.

- To compare demographic and socioeconomic characteristics of beneficiaries enrolled in PDP and MA-PD plans.
- To compare health conditions and healthy behaviors of beneficiaries enrolled in PDP and MA-PD plans.
- To compare contextual and environmental characteristics among beneficiaries enrolled in PDP and MA-PD plans.

Aim 2. To investigate the effect of the PDPs on utilizations and expenditures of medical care among Medicare beneficiaries compared to MA-PD plans.

Hypothesis 2. Beneficiaries enrolled in PDPs had higher utilizations and expenditures of medical care compared to those enrolled in MA-PD plans.

- To compare the annual healthcare utilizations and expenditures between beneficiaries enrolled in PDPs and MA-PD plans.
- To compare the annual healthcare expenditures between beneficiaries enrolled in PDPs and MA-PD plans.

Aim 3. To investigate the effect of the PDPs on medication adherence among Medicare beneficiaries compared to MA-PD plans.

Hypothesis 3. PDP enrollees had lower medication adherence compared to those

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enrolled in MA-PD plans.

- To compare cost-related non-adherence between beneficiaries enrolled in PDP and MA-PD plans.
- To compare adherence to oral anti-diabetic drugs among beneficiaries with type 2 diabetes who enrolled in PDPs and MA-PD plans.

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CHAPTER 2

CONCEPTUAL FRAMEWORK

The conceptual framework of this dissertation is based the Andersen's Behavioral Model (ABM) of Health Services nested with the economic theory of consumer demand for health insurance and health care services. This combined framework provides a theoretical basis for evaluating the role of part D plans on medication adherence, and health care utilizations and expenditures.

2.1 An Overview of Andersen's Behavioral Model of Health Services

Andersen's Behavioral Model (ABM) of Health Services was used as the conceptual framework for this dissertation.[19] Since the ABM model was initially developed by the U.S. health services researcher Ronald M. Andersen in 1968, the model has evolved over time,[20] and now there are 4 versions of ABM model that have been used for health services research. The initial model primarily focused on individual characteristics that influence the health services use.[21] In response to expert feedback and health services and policy research,[22] the ABM model was further modified by adding the external environment in the second revision,[23] and personal health practices in the third revision,[24] and the feedback loops in the fourth version.[25] The current model includes four domains: contextual characteristics, individual characteristics, health behavior, and outcomes, which are connected by feedback loops. As illustrated in figure 2.1, contextual domain can influence health behaviors and outcomes directly or through individual

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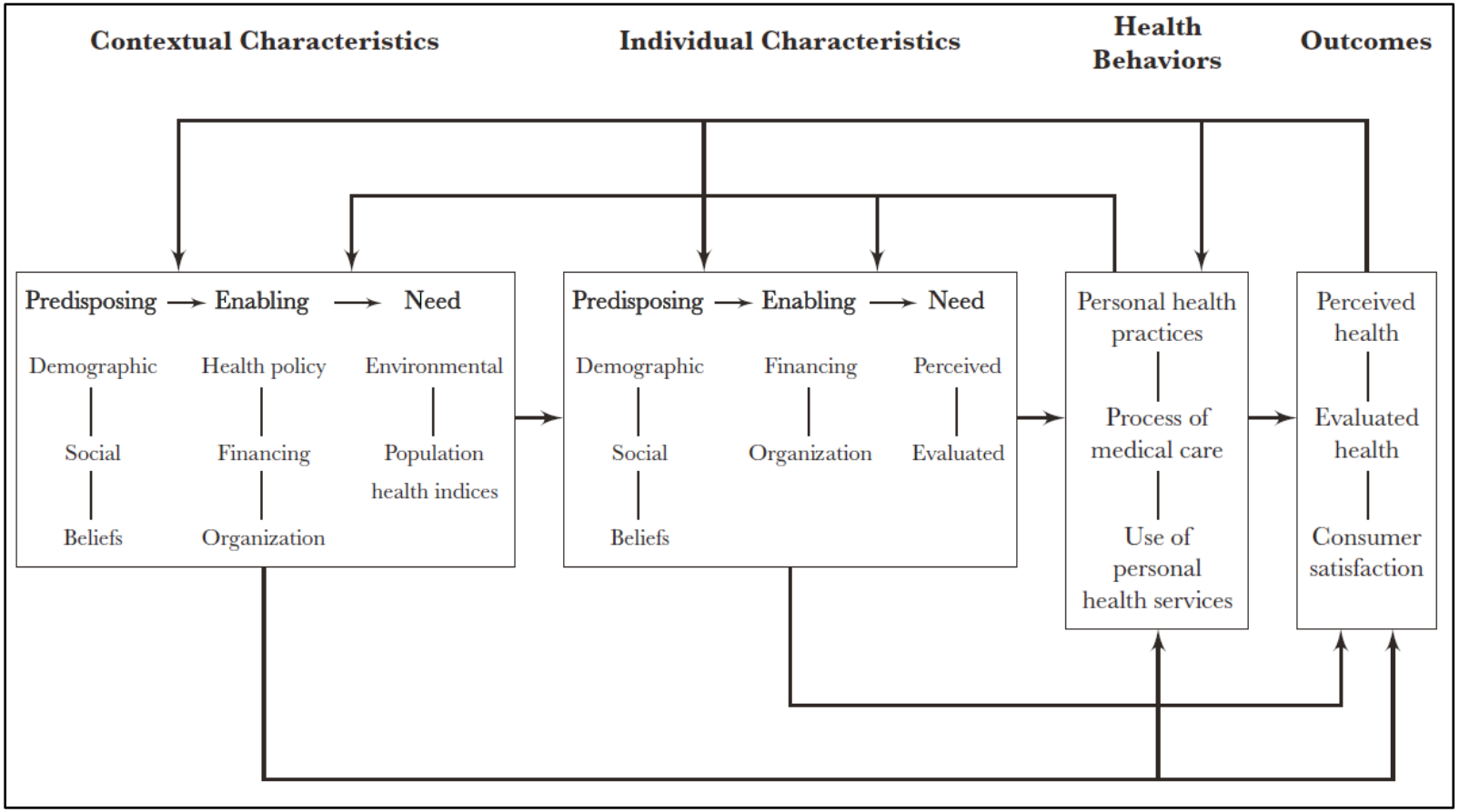

Figure 2.1 Andersen's Behavioral Model of Health Services

Sources: Andersen RM, Davidson PL. Improving access to care in America: individual and contextual indicators. In: Andersen RM, Rice TH, Kominski GF, eds. Changing the U.S. Health Care System: Key Issues in Health Services Policy and Management. San Francisco, CA: Jossey-Bass; 2007:3-31.

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characteristics. The arrows from outcomes to health behaviors, individual characteristics, and contextual characteristics is the feedback, depicting the possible ways to improve access to health services.[20]

2.1.1 Contextual characteristics domain

In the ABM model, the contextual characteristics refer to the environment, in which individuals live, work and socialize that influence their use of health services.[25] Contextual characteristics include aggregate-level characteristics of community and health care system. The contextual levels range from the households, counties, metropolitan statistical areas and even the nations. As shown in Figure 2.1, contextual characteristics domain includes predisposing characteristics, enabling characteristics, and need characteristics.

Predisposing contextual characteristics include three types of characteristics: demographic, social, and belief. Demographic contextual characteristics describe the community composition of age, gender, and marital status. A community with higher percentage of citizens may have different availabilities for health care facilities than a community with lower proportion of seniors. Social characteristics at a contextual level include the composition of a community on educational level, race/ethnicity, employment and crime rate. Contextual belief characteristics describe a community's values, cultural norms, and prevailing political perspectives that determine how the health care system should be organized, financed, and accessed to the population.[26-28]

Enabling contextual characteristics refer to the conditions that may influence the use of health service. Three types of enabling factors on the contextual level are specified: health policy, financing, and organization of resources. Health policy refers to

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authoritative decisions relating to health or influencing the use of health services. Health policy can range from the public policies made by any type of organization (e.g., government) at all levels from local to national, for example, policies made in the private sector by accrediting agencies (e.g., the Joint Commission on Accreditation of Health Care Organizations) or quality assessment organizations (the National Committee for Quality Assurance), or decision makers (e.g., executives of managed care organizations). Financing characteristics describe the financial resources on the contextual level that are potentially available to pay for health services, including per capita income, wealth, rate of health insurance coverage. Organization on the contextual level describes how the health services facilities and personnel are distributed and structured to provide the services to the population, such as per capita physicians and hospital beds.[29]

Contextual need characteristics can be described by environmental need characteristics and population health indices. Environmental contextual characteristics refer to the health-related measures of the physical environment, such as the quality of housing, water, and air. Population health indices include general and condition-specific mortality rates, morbidity rates, and disability rates.[30]

2.1.2 Individual characteristics domain

Similar to contextual characteristics, individual characteristics are also categorized into predisposing, enabling, and need characteristics. Individual characteristics demonstrate an individual's predisposition to use health services, ability to pay for health services, and need for healthcare.[22]

Individual predisposing characteristics describe an individual's propensity of using health services.[23] Similar to contextual characteristics, predisposing individual

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characteristics also include demographic, social, and belief factors. Individual demographic factors include age and gender, which may be considered as the biological imperatives suggesting the likelihood that an individual will need health services.[31] Social factors refer to the conditions that determine the status of a person in the community as well as his ability to cope with presenting problems. Social factors can be measured by education, occupation, race, ethnicity, social network, and social interactions.[32] Health beliefs describe attitudes, values, and knowledge that can affect their perception of need and use of health services.

Individual enabling characteristics include financing and organization of health services for the individual to pay for services. Financing of health services focuses on the income and wealth available to the individual to pay for the health services, and the out-of-pocket costs of health services as determined by applying cost-sharing of insurance plans.[23] Organization of health services refers the source of health services, the nature of that source of health care, means of transportation and travel time to healthcare facilities, and waiting time to receive services.[19]

Individual need characteristics refer to an individual's reason to seek or receive health care, which may be perceived by the individual and/or be evaluated by a health care professional. Hence, need is categorized as perceived need or evaluated need. Perceived need describes an individual's view of his own general health and functional status, his experiences and emotionally responds to illness, and their perceptions about the importance to seek health services. Anderson et al. indicated that perceived need is a social phenomenon that can be largely explainable by social characteristics (e.g., ethnicity, education) and health beliefs (e.g., health attitudes, knowledge). Evaluated

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individual need refers to the health care professional's judgment and objective measurement of a patient's physical status and need for health care, such as blood pressure, temperature, body mass index, laboratory test results, diagnoses and prognoses for diseases and conditions.[19]

2.1.3 Health behavior domain

Within the ABM, three types of health behavior are described, including personal health practices, the medical process, and utilization of personal health services.[20] Personal health practices refer to the individual's behavior or lifestyle that influence his health, including nutrition, physical activity, use of alcohol and tobacco, avoidance of drugs, adherence to medical regimens.[19] The process of medical care is the interaction between the health care providers and patients in the delivery of care, which might be related to counseling, writing prescriptions, quality of communication, and the patient-provider relationship.[33]

Actual use of health care is the essential component of health behavior domain in a comprehensive model that was originally developed to predict health services use. The use of health services can be measured as frequency, type, site, purpose, and coordination of health services received.[25] Anderson et al. hypothesized that individual characteristics, which include predisposing, enabling, and need factors, had different abilities to predict the use of health services, depending on the type of service examined (e.g., emergency department, inpatient, outpatient and dental care).[21]

2.1.4 Outcomes domain

Outcomes domain describes the results of contextual and individual characteristics as well as health behaviors, and can be measured as perceived health,

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evaluated health, and consumer satisfaction.[19] Perceived health status describes the extent to which an individual can live functionally and comfortably. Perceived health status can be measured by self-reports of general perceived health, independence for activities of daily living, and disability status. Evaluated health status mainly depends on the professional's judgment made based on the established clinical guidelines. Measures include the tests of physical and physiological functions, diagnosis and prognosis of condition the patient experienced. Outcome measures of perceived and evaluated health may be similar to the perceived and evaluated need measures, however, reducing an individual's needs has been considered as the ultimate outcomes of improved access to health services.

Consumer satisfaction is an individual's feel about the health services received. Measures include patient-reported waiting time, travel time, patient-provider communication, and technical care received. For a health plan perspective, patient satisfaction can also be measured by whether an individual chooses to switch health insurance plans.[34]

2.2 Demand of Health Insurance and Healthcare Services

The role of part D plans on the use of health services can be further explained using the economic theory of price elasticity of demand. This section illustrates the relationship between the cost-sharing of health insurance and demand for health services using both economic theory and empirical evidence.

Most Americans, particularly seniors, do not pay entirely for their health services. Instead, they enroll in health insurance plans to pay only a portion of healthcare expenses, which are of great uncertainty because the occurrences of many diseases are often

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unpredictable and associated with high costs for treating such conditions. This uncertainty may lead individuals to live in constant fear of losing their income. Health insurance is a form of risk management that allows risk-averse individuals to reduce the risks of uncertain loss associated with medical expenses. A large group of individuals make regular contributions (premiums) to an insurance provider to provide them financial assistance at the time of events. Hence, insurance reduces the risks of financial loss over a large group.

For singles good or services, the demand curve is downward sloping, indicating the inverse relationship between the price and quantity demanded. That is, the quantity demanded for given goods decreases as the price of that particular good increases, and vice versa. This relationship can be demonstrated using price elasticity of demand, which is defined as the ratio of percent change in quantity demanded to percent change in price of the service. The sign of the ratio indicates the direction of price and quantity demanded, and typically is negative because of the inverse relationship between price and quantity demanded. If the absolute value of the price elasticity of demand is less than 1, the percent change in demand is in a smaller level than percent change in price, then demand is inelastic. When the absolute value equals one, demand is unit elastic. If the absolute value is greater than one, the percent change in demand is greater than the percent change in price, then demand is elastic.

Figure 2.2 demonstrates a hypothetical example of the impact of health insurance on the demand of health care services. If Elizabeth is not insured, then the optimal choice of health care is Q_0 at the cost of care at P_0. When Elizabeth pays only 50% coinsurance, she only pays P_1 (or half of P_0), and her quantity demanded will increase, and the demand

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curve will rotate outward, and reaching to a new equilibrium quantity demanded Q_1. Having insurance will increase the demand of health services at any given market price, and hence, the presence of health insurance makes the demand less elastic. If Elizabeth pays 25% coinsurance, she only pays P_2 (or 25% of P_0), and her quantity demanded will be increased to Q_2. With decreasing coinsurance rates, quantity demanded will increase and the demand curve will rotate outwardly, therefore the demand for health services is less elastic.[35] In other words, lower coinsurance leads to greater use of health services.

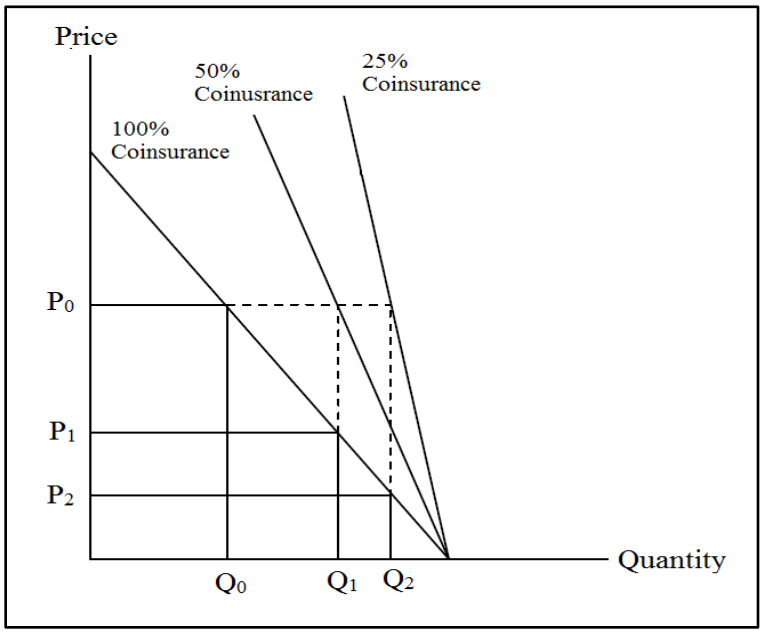

Figure 2.2 Health Insurance and Demand for Health Services
Source: Jacobs P, Rapoport J. The economics of health and medical care. Jones & Bartlett Learning; 2004

In addition, empirical evidence also supports the economic theory of health insurance and demand for health services including prescription drugs. The most remarkable study is the Health Insurance Experiment conducted by the Rand Corporation in 1985.[36] Individuals were randomly assigned to insurance plans of differing generosity with respect to coinsurance (0-95%), then tracked the health care utilizations and expenditures.[36] The results suggested that having insurance improves the use of health

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services.[37] The study also found that the quantity of health services (including prescription drugs) demanded increases with a decrease in coinsurance.[38] For example, the group with free care (0% coinsurance) had more prescription fills than those individuals assigned to the groups with 25% and 50% coinsurance. Finally, the results indicated that both physician office visits and prescription drug utilization were modestly price sensitive, suggesting the demand for prescriptions may be influenced by the price or the generosity of insurance plan.

However, the classic theory of demand for health services was developed for a particular single good, and may not hold for multiple goods or services which are either complements or substitutes. In the economic model developed by Goldman and Philipson,[39] the demand of a certain service is influenced by the change in the coinsurance of other services. This model implies that, the optimal copayment of prescription drugs increases with the level of substitutability of other services, such as emergency department visits and hospitalization.[39] For example, if the cost for physician's visits and prescription drugs is increased, inpatient care could be used as a substitute for these services, which is also called the "offset" effect. This "offset" effect was also observed among elderly Medicare beneficiaries in a recent study conducted by Chandra et al. In this study, the author found an increased use of inpatient care in response to increased copayments for physician's offices and prescription drugs.[40]

2.3 Adapted Model

ABM has been widely used to explain and predict health service use in health economic and policy research.[19] One remarkable application of the ABM on health policy research was the Health Insurance Experiment that was aimed to investigate the effect of

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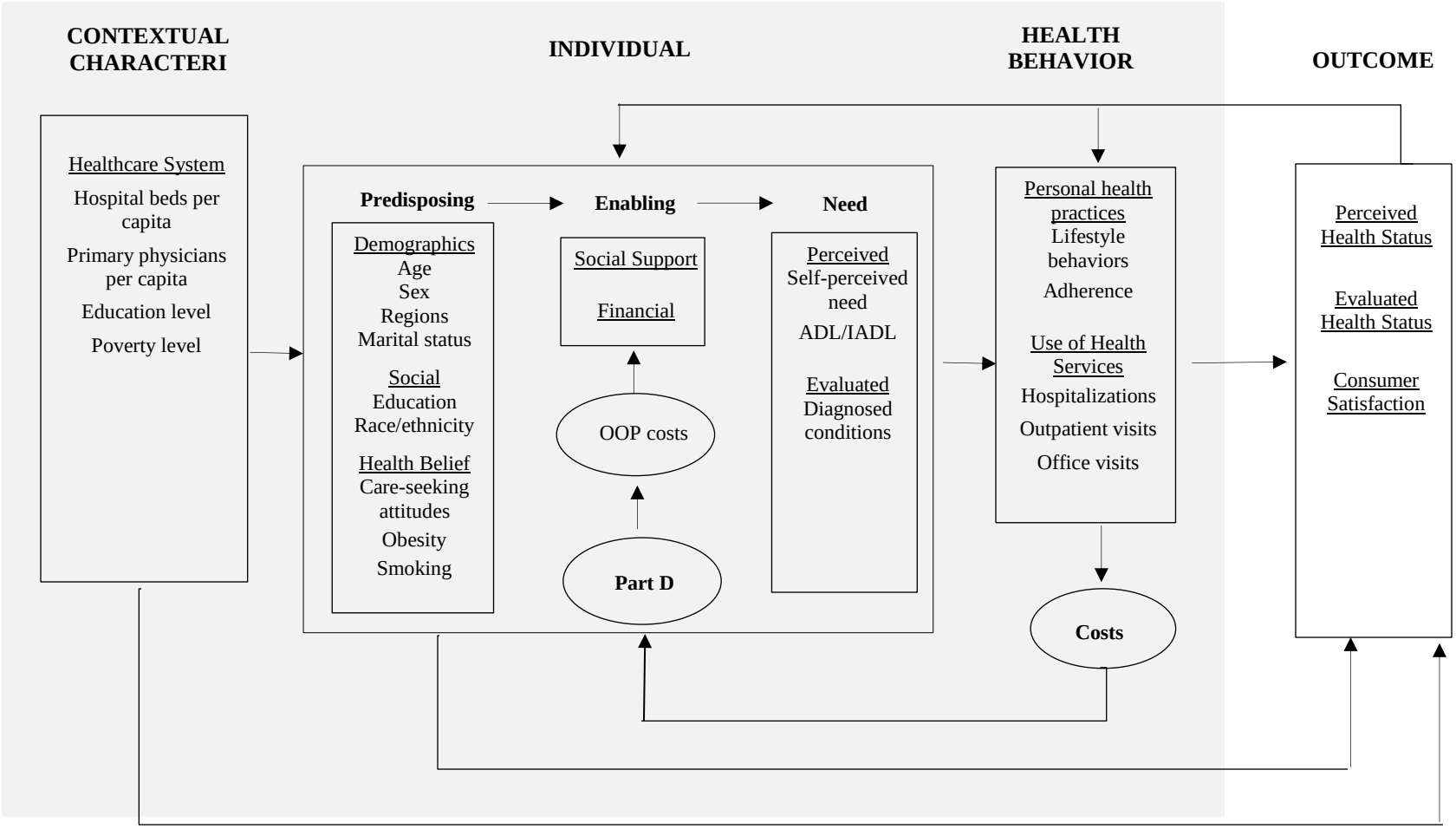

Figure 2.3 Adapted Andersen's Behavioral Model of Health Services

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co-insurance on demand for health services.[36,37,41,] Furthermore, ABM includes a wide variety of factors influencing healthcare use, such as, demographics, socioeconomics, health behaviors, which are critical in understanding the dynamic relationship between insurance plan and health outcomes. As mentioned previously the theory of price elasticity of demand can also be adapted to ABM to illustrate the relationship between drug price and demand for prescriptions and non-drug medical services. Therefore, ABM can be applied to this dissertation to explain the effect of Part D plans on the use and costs of health services.

Figure 2.3 demonstrates the adapted version of ABM for this dissertation. When applying the ABM to this study, the adapted model focused on three domains: contextual characteristics, individual characteristics, and health behavior. Health outcome domain was not included in the adapted model, because the outcome measures of this dissertation are the healthcare utilizations and medication adherence, which have been covered under the health behavior domain. The key independent variable – type of part D plans – was considered as one of the individual enabling factors that have direct effects on the health behaviors, e.g., medication adherence and use of health services. With lower levels of generosity of Part D plans (e.g., PDPs), the demand for prescription drugs will decrease as the effect price of prescription drugs increases. This decreased use of prescription drugs may lead to lower medication adherence and possibly result in increased use of non-drug medical services (e.g., hospitalizations).

2.3.1 Contextual characteristics

Several studies identify environmental or regional factors related to healthcare delivery and access. For each county code, we included 5 such factors reflecting

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predisposing and enabling characteristics. Contextual predisposing factors were reflected by the education level, income and employment rate in the area. Two variables were used to reflect health system capacity, including the number of primary care physicians and hospital beds available in an area. Primary care physicians included family physicians, non-specialist internal medicine physicians, general practitioners, and general practice obstetricians and gynecologists. These factors reflect how health services facilities and personnel distributed to provide the services within an area and may influence individual's access to care, e.g., the availability of physicians/hospitals.[29]

2.3.2 Individual characteristics

For the individual predisposing factors, demographic factors include age and gender, which may be associated with health care use. Social factors were reflected by education level, Race/ethnicity, living conditions, and geographic location. Higher levels of education may be associated with greater knowledge about care and more positive attitude in seeking care.[42] Race/ethnicity and geographic location have been shown to be linked to different treatment patterns for specific conditions. Individual's social connections can also influence the access to care, and were measured by the living conditions. Health beliefs can be reflected by the care-seeking attitudes that affect individual's perception of need and use of health services. The measures included how an individual seeks care when sick, such as, avoidance of going to see a doctor, keeping to himself, visiting a physician as soon as he can. Differences in the attitudes toward seeking professional health care have been documented in the published studies.

Individual enabling factors were measured by income and the effective price of health services determined by having health insurance and co-insurance. People with

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higher levels of income tend to use more health care, with all other factors being equal. As mentioned earlier, people purchase more health services as their prices decline. With lower percentage of coinsurance, people demand more health care as the effective price is lowered. The type of Part D plans, as the key independent variable of this dissertation, was included under this domain because it influences the effective price of prescriptions.

Individual need factors were reflected by both perceived and evaluated needs. Perceived needs were reflected by self-perceived health status, self-reported difficulties in Activities of Daily Living (ADLs) and Instrumental Activities of Daily Living (IADLs). An individual with higher self-perceived health and function status is associated with lower uses of health services. On the other hand, evaluated needs were reflected by the presence of chronic conditions diagnosed by health care professionals.

2.3.3 Health behavior

Personal health practices were measured as use of tobacco and presence of obesity, which are proxy measures of an individual's lifestyle. For example, an individual with normal weight is more likely to have healthy diet and exercise, compared to those with obesity.

This domain also included the primary outcome of interest of this dissertation – the actual use of health care (including prescriptions). I assumed that the contextual and individual characteristics mentioned above influence the use of health services. Since healthcare expenditures are highly correlated with health resource use, and healthcare costs were included under this domain.

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CHAPTER 3

LITERATURE REVIEWS

This chapter first reviews the published articles covering the effect of cost-sharing on prescription drug use and medication adherence. Later, this chapter reviews the literatures regarding the impact of Part D plans on prescription drug and medical services uses. In addition, this chapter compares the healthcare utilizations and expenditures associated with Medicare Advantage (MA) and Fee-For-Service (FFS) plans, because MA-PD and PDP enrollees are mainly enrolled in MA and FFS plans, respectively. Finally, this chapter describes the empirical evidence of selection bias in MA plans, which may also exist in the selection of MA-PDs vs. PDPs.

3.1 The Impact of Cost-Sharing on Prescription Drug Use and Medication Adherence

3.1.1 Prescription drug use

Based on the conceptual framework – Anderson's behavior model, prescription drug coverage is considered an enabling factor that helps individuals to pay for prescriptions.[43-45] Hence, patients may fill more prescriptions as the generosity of the drug plans improved, which has been demonstrated in the RAND Elderly Health Supplement study.[37,38] Prescription drug coverage reduced the economic barrier to prescription drugs, consequently, the likelihood of filling prescriptions increased with the improvement in the generosity of the drug plans.[46] Similarly, Huh et al. suggested that the

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probability of any prescription use was 4.5 percent higher among community-dwelling beneficiaries with prescription drug coverage, compared to those without any drug coverage.[47]

In addition, prior findings suggested that increased costs-sharing for prescription drugs was associated with reduced use of prescription drugs.[48-52] The RAND Health Insurance Experiment indicated that individuals reduced their health service use when they have increased cost-sharing regardless of the effectiveness of the services.[52] Artz et al. also found that improvement in drug coverage generosity leads to increased use of outpatient prescription drugs among elderly Medicare beneficiaries.[51] However, most of existing studies accessing the effect of cost-sharing on healthcare utilizations without adjusting selection bias into more generous insurance plans.[50,53] As a result, the differences between the two groups might be overestimated.[54-56] Based on conceptual framework and empirical evidence, unmeasured factors, such as, health-seeking attitudes, may be related to the choice of insurance plans (e.g., HMOs), but these factors cannot be easily measured in observational study. Even though the measurable confounders were adjusted in the analysis, it is still very difficult to rule out the possibility of selection bias in the observational studies.[57-61]

3.1.2 Medication adherence

For medication adherence, recent data demonstrated consistent evidence that increased drug costs was the major factor of medication nonadherence.[62] Among patients with chronic diseases, increased cost-sharing for prescription drugs is associated with decreased adherence.[63,64] These findings can be explained using the conceptual framework of this dissertation. With lower generosity of drug plans, patients may face

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higher drug costs and fill less prescriptions, and as a result, patients may have lower medication adherence. This under-desirable adherence, in turn, negatively affected health outcomes.[65]

Furthermore, Cost-Related Nonadherence (CRN) was reported higher among Medicare beneficiaries with higher out-of-pocket medication spending. Even though there was sufficient evidence supporting the link between CRN and drug costs, it is still unclear about the link between drug coverage benefits and medication adherence.[66] In a report based on an analysis of community pharmacy data in 2007, approximately 15% of Medicare beneficiaries experiencing a coverage gap stopped taking their medications[67]. Tseng et al. surveyed Medicare beneficiaries regarding their medication-taking behavior when reaching the coverage gap, and found that they were more likely to reduce the use of essential medications but unlikely to discontinue the medication treatment.[68] Interestingly, MA enrollees with coverage gap had 5% lower adherence for anti-diabetic and antihypertensive drugs, and 8% for antihyperlipidemic drugs.[69] These findings from published studies varied mainly because of the differences on study population, data sources, therapeutic drug classes examined, or adherence measures.[70] Despite the inconsistent findings on the CRN associated with prescription benefits, the start of Medicare Part D reduced the prevalence of CRN considerablely.[71] However, there is no study comparing the CRN between PDPs and MA-PDs.

3.2 The Impact of Medicare Part D on Medication Adherence, Healthcare Utilizations and Expenditures

3.2.1 The impact of introducing Medicare Part D

Medicare Part D was designed to improve the affordability and utilization of

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necessary prescription drugs. Before the implementation of Part D, Pauly et al. projected that Part D might be associated with a 20% increase in the use of prescription drugs for Medicare beneficiaries without previous coverage for prescriptions, and a 6% increase for those with some coverage.[72] These estimates have been supported in a growing body of studies since the implementation of Part D, with the drug use increasing from 7%-30%.[73-77] In addition to the improvement in utilizations, the Out-Of-Pocket (OOP) spending for prescription drugs was reduced by 8-35%.[74-77] By summarizing these findings, Polinski et al. concluded that the introduction of Part D contributed to 6-13% increase in the utilizations of prescription drugs and 13-18% decrease in OOP spending for prescriptions.[78] As the OOP costs for prescription lowered with the introduction of Medicare Part D, CRN has also been reduced among overall Medicare enrollees,[71] but it still remained a significant problem among the patients with certain conditions, such as stroke,[79] depression,[80] and disability[81]. Although increases in prescription drug use have been recorded after the implementing of Medicare Part D, it is still unclear about the impact of different type of Part D plans on the prescription use. Furthermore, several studies suggested that the start of Part D reduced the total healthcare utilizations and costs, but it is still unknown if these two types of part D plans have different impacts on use and costs of health services.

3.2.2 MA-PDs versus PDPs

Limited studies compared the PDPs and MA-PDs on healthcare utilizations and costs. To my knowledge, the current data focused on the impact of two Part D plans on medication adherence.[82,83] Jung et al. estimated the adherence to statins among Medicare beneficiaries enrolled in MA-PD plans and PDPs, using claim data from the Chronic

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Condition Warehouse 2007.[82] There were small differences in medication adherence observed in MA-PD and PDPs, which were unlikely to result in meaningful outcomes in clinical settings.[82] However, this study failed to use national representative samples and to control for unobserved confounders. Furthermore, this study only focused on one therapeutic drug class–statins–and therefore, the findings lacked generalizability to other drug classes or conditions, because beneficiaries taking other medications might experience different financial burdens and perceived need, compared to those using statins. Another study accessed guideline-recommended diabetes treatments among elderly Medicare beneficiaries. The findings indicated that PDPs and MA-PDs had similar use of anti-diabetic drugs.[83] However, individual-level factors influencing medication adherence were not controlled in this study.[83]

In summary, based on the prior review of the existing studies, Medicare Part D has increased the utilization of prescription medication and health care spending. The Part D plans –mainly MA-PD plans and PDPs– exhibit significant variations on their cost-sharing strategies (e.g., copayments), which pose a considerable influence on individuals' financial burden and medication adherence. Increasing findings from recent studies indicated the impact of Part D on reducing health care utilizations and expenditures, however, the impact of MA-PDs and PDPs remains unclear due to lack of published literature. Two recent published studies compared the medication adherence between MA-PDs and PDPs using Medicare claims, but reached different conclusions on the impact of PDPs on medication adherences. Hence, the effect of PDP on medication adherence compared to MA-PDs is still inconclusive. Furthermore, the evidence on CRN related to these two plans is still largely lacking. To our best knowledge, there is no study

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to compare CRN among these two specific types of Part D plans. Despite the inconclusive findings on medication adherence, little was known about the impact of these two types of part D plans on healthcare utilizations and costs.

3.3 Managed Care and Healthcare Utilizations and Expenditures

A large body of literature has examined the impact of managed care on health care utilizations and expenditures, access to medical services, quality and satisfaction with care received, compared to traditional FFS plans (the Part A and B).[84] These mixed results were observed consistently by Miller and Luft, in the systemic literature reviews of previous studies published in the past two decades.[85-87] Since health care utilizations and expenditures are the main focus of this dissertation, this section focuses on the published studies evaluating the impact of managed care on health care uses and costs.

In RAND Health Insurance Experiment (HIE), HMOs have shown significantly lower use of hospitals among the working-age population.[88] However, there were concerns that the findings generated from the RAND experiment might not be applicable to the elderly (e.g., Medicare enrollees), because the elderly are sicker and are more likely to have higher health care costs than their younger counterparts.[89,90] As expected, the empirical evidence on the healthcare use among elderly Medicare beneficiaries is not consistent in the existing literatures, particularly for studies comparing HMOs to FFS plans. In the early demonstration studies in the 1990s, HMOs have shown significant reductions in their healthcare utilizations and costs compared to FFS plans.[91-94] Recently, more data suggested that the health services use among HMOs and traditional FFS had converged. Previous studies showed that both FFS and group Model HMOs have been associated with the overuse of health services.[93,94] However, in a recently published

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literature review by Keyhani et al., Medicare HMOs and Medicare FFS had similar rates of inappropriate coronary angiography on the national level, and rates of carotid endarterectomy in New York State, while managed care plans had higher use of non-recommended antibiotics for the treatment of upper respiratory infection than FFS.[95] Therefore, there is not enough evidence supporting which of the health care systems is more effective in lowering the use of health services.

Despite the inconsistent results of the HMO's impact on the use of overall medical services, there was no clear pattern in the evidence for inpatient care.[87] HMO was associated with a lower rate of preventable hospitalizations and overall hospitalizations.[96-98] Fitch et.al. found that Medicare FFS beneficiaries with heart failure were associated with higher admission and readmission rates for hospitalizations and health care costs.[98] In a cross-sectional study using the data from Healthcare Cost and Utilization Project (HCUP-SID) databases, Basu et al. suggested that HMOs reduced the preventable hospitalizations for Medicare beneficiaries in four states with the highest HMO penetration rates.[96] Similarly, the evidence of the medical expenditures per capita was inconsistent. Total health care costs per enrollee were significantly lower for individuals enrolled in HMOs than those who didn't enroll in HMOs.[99] However, this cost-saving was not proved among patients with certain conditions, e.g., musculoskeletal conditions.[100]

In addition, there are a large body of studies comparing the quality of care related to HMOs and FFS plans. Several studies suggested that MA enrollees tended to receive more preventative care.[87,101-103] However, other studies indicated that MA enrollees were less likely to receive the appropriate care, i.e. coronary angioplasty following a heart

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attack,[104] and more likely to be readmitted to hospitals for preventable conditions,[105] and had lower patient satisfaction on medical care,[106] compared to FFS enrollees. Regarding the health outcomes, few studies have demonstrated no difference in survival or functional status for the elderly enrolled in HMOs and FFS plans,[101,107-110] while one study showed that HMO enrollees had a greater decline in functional status than FFS enrollees.[111] Furthermore, several studies have also found that HMO enrollees had poorer access to specialized services and physician specialist care than those enrolled in FFS plans.[112-114] However, MA plans demonstrated an reduction in racial and socioeconomic disparities in the access to care and quality of care. For example, Trivedi et al. reported the racial gap had been narrowed for seven Health Plan Employer Data and Information Set (HEDIS) measures among MA enrollees from 1997 to 2003.[115] MA plans also successfully reduced the racial and socioeconomic disparities among male Medicare beneficiaries,[116] and ameliorated racial/ethnic disparities in receiving health care.[117]

Overall, the data is outdated, with few studies included after 2006, providing a limited picture of managed care plans since the implementation of Medicare Part D.

3.4 Favorable Selection in Managed Care Plans

Since its implementation, the favorable selection of HMOs has been characterized in a number of studies, because HMOs have the incentive to reduce overall healthcare costs through enrollment of healthier individuals and disenrollment of sicker ones.[118] In the late 1980s and early 1990s, HMO enrollees had significantly lower health care utilizations prior to enrollment, and lower mortality rates but higher health and functional status after enrollment, compared to FFS stayers.[119-126] Recent data continuously showed the favorable selection of healthy and low-cost beneficiaries into HMOs.[127] Medicare

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HMO enrollees had significantly lower severity scores than those for Medicare FFS enrollees.[128] On the other hand, recent data suggested the beneficiaries who dis-enrolled from HMOs were sicker and had higher costs than those continuously enrolled in HMOs.[119,126,129-133] All these findings suggested a pattern of selecting healthy and low-cost beneficiaries into HMOs, resulting in high-cost individuals enrolling in the FFS plans. In contrast, some studies indicated that there is no substantial evidence to support the selection bias between HMOs and FFS plans. The Price Waterhouse, however, suggested that the differences in predicted costs between HMO and FFS were not statistically different, based on the analysis using 1992 Medicare Current Beneficiary Survey (MCBS) data.[134] Similarly, Dowd et al. found that HMO enrollees had a similar prevalence of various health conditions than non-enrollees, indicating that the favorable selection of healthy patients is not salient among adults aged over 65.

Given the design of Part D plans, there is an existing concern on potential adverse selection among Medicare beneficiaries with chronic diseases,[135] because heavy users of prescription drugs had a strong incentive to enroll in plans with more generous coverage. Part D programs have incorporated several features in eliminating this possibly adverse selection. First, early enrollment is encouraged to reduce the possibility that healthy beneficiaries postpone their enrollment until sick. Second, CMS pays plans by adjusting for the enrollee's characteristics, including diagnosis, age, and sex, and other subsidiary factors, such as low-income status and long-term institutionalized status. Despite these efforts in reducing the adverse selections of part D plans, published data still suggested MA-PD enrollees were healthier and had lower health care costs compared to those enrolled in PDPs, when Part D was implemented in 2006.[136,137] The characteristics of

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PDP and MA-PD enrollees might have been changed since the introduction of Part D. However, data comparing the characteristics between these two specific types of Part D plans is largely lacking in the current literature.

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CHAPTER 4

RESEARCH DESIGN AND METHODS

This chapter includes a description of study design, data sources, selection of study sample, measures of independent and dependent variables, statistical analysis, and sensitivity analysis.

4.1 Study Design

Retrospective cross-sectional study design was used for this dissertation. We explored the type of part D plans (PDPs vs. MA-PDs) on health services use as well as costs, and medication adherence among elderly Medicare beneficiaries. Since this study is a retrospective observational study without random assignment of insurance plans, self-selection of Part D plans may attribute to selection bias, leading to biased estimates of PDPs on outcomes. Instrumental variable analysis was performed to address this concern. Since this study is an observational study using administrative claims, and it received exemption from the University of South Carolina Institutional Review Board (IRB) review.

4.2 Data Sources

In this retrospective study, two data sources were used to test the hypotheses mentioned in Chapter 1: Medicare Current Beneficiaries Survey (MCBS; 2006-2010), and Area Health Resources Files (AHRF; 2006-2010). Based on the conceptual

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framework, both individual-level and contextual-level data is necessary for this project. MCBS provides the individual-level information on independent variable (type of Part D plans), primary outcomes of interest (health services use and costs and medication adherence) and covariates at the individual level (demographics, socioeconomics, health conditions and health status, and health-seeking attitudes). AHRF data provides the county-level covariates that are relevant to health services use (e.g., local availability of health care system) and instrumental variable (e.g., PDP penetration rate). The following sections describe the data files and linkage of these data files for further analyses.

4.2.1 Medicare Current Beneficiary Survey (MCBS)

Medicare Current Beneficiary Survey (MCBS) is a longitudinal and multi-purpose survey of nationally representative sample of Medicare beneficiaries, including both aged and disabled beneficiaries residing in the community or long-term care facilities in the U.S. and Puerto Rico.[138] MCBS is conducted continuously by Centers for Medicare & Medicaid Services (CMS), Department of Health and Human Services. MCBS has been previously used in evaluating the impact of HMOs on health care utilizations and expenditures compared to Fee-For-Service (FFS) plans.[139,140]

MCBS employs a multistage stratified random sampling design and a rotating panel design. The purpose of this multistage sampling design is to reduce the costs of traveling for interviews while maintaining the national representativeness of Medicare beneficiaries. In the first stage of sampling, 107 geographic primary sampling units (PSUs), which consist of counties or groups of counties, were selected to represent the nation. Within PSUs, samples were restricted to address (zip codes) within a total of 1,163 sub-PSU areas selected using systematic sampling. To better represent the areas of

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the nation, MCBS added or replaced several PSUs, primarily Western and Southwestern, which had experienced major growth in their elderly population, since the 1980 census. The survey sample was drawn by systematic random sampling within age strata from an enrollment list of Medicare beneficiaries residing in these areas. Approximately 16,000 Medicare beneficiaries were interviewed each round, and only 12,000 beneficiaries completed all four interviews each calendar year due to rotating panel design.[138,141] The response rate is around 80%. All personal identifying information was removed for confidentiality purposes.[142-144]

Initial interviews are conducted each fall, and collect information on demographics, socioeconomic characteristics and medical conditions. The follow interview is divided into rounds three times yearly, to collect information on the use of health care services and prescription drugs, health insurance coverage, and sources of payment. Data related to the health status is collected in the third round. The annual interview lasts around 1 hours, and covers a variety of demographic and behavioral questions such as income, assets, living arrangements, satisfactory to health care systems, and access to medical care. MCBS interviewed the sampled person directly, but if he/she was unable to answer the questions, he/she would be asked to designate a proxy respondent, usually a family member or close acquaintance who was familiar with his/her care. All interviewers are trained and retrained, particularly in analyzing insurance statements, apportioning payments, and dealing with the stresses of interviewing the patients who are chronically ill. Spanish translation is provided for Hispanic persons who cannot speak English.

To avoid the reporting errors in the surveys, survey reports were matched with

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Medicare claims, and filled in and corrected survey-reported payment amounts with more accurate information from bills submitted to and paid by Medicare. Hence, the final database consists of data from survey and administrative claims.[142-144]

MCBS contains two modules – the Cost and Use and the Access to Care modules. This study used data from these two modules of MCBS 2006-2010. The data files used for this study is presented in Table 5.1. In the Cost and Use module, RIC K file provides survey information for each beneficiary, RIC 1 and RIC 2 files provide self or proxy-reported demographics, socioeconomics, and clinical conditions, RIC 4 files provide self or proxy-reported insurance coverage for each beneficiary, RIC IPE, OPE, MPE, DUE, and FAE files provide self-reported medical records on an event level. RIC PME files provide pharmacy claims from both self-reports and claims. In the Access to Care module, RIC 3 files provide information on beneficiaries' CRN and care-seeking attitudes. The key variables used in this study are described in Appendix A.

Table 4.1 List of Data Files in MCBS

Module	Record Type	Contents
Access to Care	RIC 3	Access to Health care
Cost and Use	RIC K	Key information
	RIC A	Administrative identification
	RIC 1	Survey identification
	RIC 2	Survey health status and functioning
	RIC 4	Survey health insurance
	RIC 5	Living conditions
	RIC X	Survey cross-sectional weights
	RIC DUE	Dental Events
	RIC IPE	Inpatient hospital events
	RIC MPE	Medical provider events
	RIC OPE	Outpatient hospital events
	RIC PME	Prescribed medicine events

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Module	Record Type	Contents
	RIC IUE	Institutional Events
	RIC FAE	Facility Events

4.2.2 Area Health Resource File (AHRF)

Area Health Resource File (AHRF) is a comprehensive health resource database that is administered by Health Resources and Services Administration (HRSA). AHRF collects data for every county in the U.S., and covers more than 50 data sources, such as American Medical Association, U.S. Census Bureau. AHRF provides a broad range of information on health care providers and facilities, and population characteristics on the county level. AHRF is available for public use and released annually. Data from AHRF 2014-2015 was used for this dissertation to provide information on the contextual factors related to health services use, and the instrumental variables (e.g., PDP penetration, % white collar jobs). The following table presents the key variables extracted from AHRF files and their data sources.

Table 4.2 Variables and Data Sources in the AHRF

Variable	Data source	Year
Primary physicians	American Medical Association Physician Masterfile	2010
Hospital beds	American Hospital Association Annual Survey of Hospitals	2006-2010
Per capita income	U.S. Department of Commerce	2010
Number of population	U.S. Census Bureau	2010
Education	American Community Survey (ACS) Summary File, U.S. Census Bureau	2010
PDP penetration	Centers for Medicare & Medicaid Services (CMS)	2008-2010
% white collar worker	American Community Survey (ACS) Summary File, U.S. Census Bureau	2005

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4.2.3 Linkage of data

MCBS data files were linked with AHRFs using county codes for each beneficiary. The following figure demonstrates the steps involved in pooling the data files for sample selection.

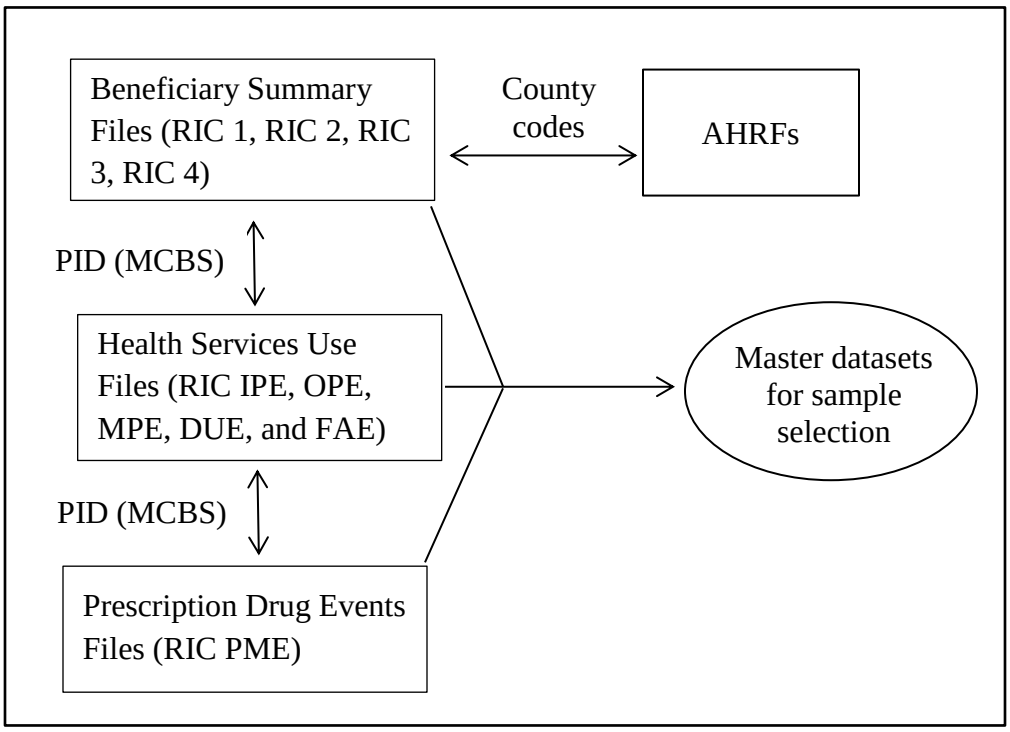

Figure 4.1 Flowchart of Database Preparation

4.3 Study Sample

4.3.1 Selection criteria

To assess the effect of PDPs on health care utilization and expenditures, and cost related non-adherence among elderly Medicare beneficiaries, the study sample included community-dwelling Medicare beneficiaries aged 66 and older who enrolled in part D plan in 2006-2010.

The selection criteria for full sample are summarized as follows:

Inclusion criteria included: (1) aged 66 years and older in each study year. We

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included beneficiaries who were aged at least 66 years, to ensure that elderly beneficiaries had at least one full-year of Medicare enrollment. Non-elderly beneficiaries generally have disabilities or ESRD, and are not representative of Medicare population because they have a much different characteristics and pattern of health care utilizations than elderly individuals.[145] (2) resided in the community in each study year. Facility-dwelling beneficiary were excluded because utilization data incurred in the facility is incomplete; and (3) enrolled in Part D plans–either PDPs or MA-PDs–from January 1 through December 31 in each study year.

Exclusion criteria included: (1) enrolled in Employer-Sponsored Insurance (ESI), because ESI enrollees cannot enroll in Part D plans at the same time; (2) entitled Medicare due to ESRD or disability; and/or (3) died or transferred to hospice services, because full-year data is necessary for estimating the annual medical care utilization and medication adherence.[146,147]

For Aim 3, I applied the same sample selection criteria for Aim 2, but limited the study sample to beneficiaries who were diagnosed with type 2 diabetes based on self/proxy-reports in the initial interview in more than one visits. Self-reported diagnosis of diabetes is considered as the gold standard of identifying diabetic patients when the clinical indicators are absent.[148,149]

4.4 Independent Variables

4.4.1 Key independent variable

Key independent variable was the enrollment in PDPs or MA-PDs, which was identified from administrative claims. The Part D enrollment status was defined using the monthly indicator for part D coverage for the full study year, and was measured as a

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binary variable equal to 1 if the beneficiary was enrolled in PDPs and 0 otherwise. The comparison group of interest was the enrollment in MA-PD plans.

4.4.2 Other covariates

Based on the conceptual framework, potential confounders were selected and adjusted in this study. The following section describes the measure of covariates.

Demographic characteristics. Demographic characteristics included age, gender, race/ethnicity, marital status, living situation, census region and metropolitan status of beneficiaries' residence. Age was categorized into three groups: 65-75 years, 75-85 years, and >85 years. Gender was defined as female and male. Race/ethnicity was defined based on self-reports, and was grouped as: non-Hispanic white, non-Hispanic blacks, Hispanics, and others. Marital status was categorized as: married, widowed, divorced/separated, and never married. Living situation was categorized as: living alone, living with spouse, living with children, and living with others or non-relatives. Census region was defined as Northeast, Midwest, South, and West. Metropolitan status was categorized as metropolitan area and non-metropolitan area.

Socioeconomic characteristics. Socioeconomic characteristics included education, Low Income Subsidy (LIS), and annual income. Education was categorized as: less than high school, high school graduate, and some college, bachelor's degree or more. Annual income was grouped as: <$25,000 and ≥$25,000.

Health conditions. Three measures were used to evaluate the health conditions, including self-perceived health status, Charlson Comorbidity Index (CCI), and functional limitations. For self-perceived health status, beneficiaries were asked to compare their general health to other people of the same age, and rate their health as excellent, very

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good, good, fair, and poor. To estimate CCI, a MCBS-adapted measure was estimated using self-reported comorbid conditions, include hypertension, coronary heart disease (CHD), congestive heart failure (CHF), stroke, peripheral vascular disease, diabetes, chronic obstructive pulmonary disease (COPD), any arthritis, osteoporosis, ulcers, liver disease, paralysis, dementia, Parkinson, depression, and any mental illness.[150-152] The CCI was categorized as 0, 1-2, 3+ for Aim 1-3.1. Since diabetes is used to calculate CCI, CCI was categorized as 1-2 and 3+ for Aim 3.2.

Beneficiaries were defined as having functional limitations if they responded "yes" to the questions about activities of daily living (ADLs) and instrumental activities of daily living (IADLs). The ADLs refer to activities that are related to daily self-care, include bathing or showering, dressing, eating, getting in or out of bed or a chair, walking, and toileting. The IADLs are the activities that support an independent life style, including using the telephone, doing light housework, doing heavy housework, preparing meals, shopping for personal items, and managing money. The number of ADLs and IADLs was categorized as 0, 1-2, 3+.

Lifestyle factors. Lifestyle factors included smoking status and Body Mass Index (BMI), which was measured using beneficiaries' self-reports. Smoking status was categorized as never, past, and current smoker. BMI was calculated from self-reported height and weight by using the following formula, and categorized as under or normal weight (<24.9 kg/m^2), overweight (25.0-29.9 kg/m^2), and obese (>30.0 kg/m^2).[153]

$$\text{BMI} = \frac{weight(\,lb)}{height^2\ (in^2)} \times 703$$

Care-seeking attitudes. Care-seeking attitudes were defined based on beneficiaries' responses to the questions: "You will do just about anything to avoid going

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to the doctor;" "When you are sick, you try to keep it to yourself;" and "Usually, you go to the doctor as soon as you start to feel bad." Other questions include: "During the past year, did you have any health problem or condition about which you think you should have seen a doctor or other medical person, but did not?"[154,155]

Other drug coverage. Other prescription drug coverage was defined based on both Medicare administrative records and self-reports. For beneficiaries with other prescription drug benefits, they were grouped as public, private, and other coverage.

Study year. Study years for measuring utilization and spending were classified as 2006, 2007, 2008, 2009, 2010 to capture changes in practice patterns or policies.

Contextual factors. Since the availability of health facilities as well as health care providers varies by communities, it is necessary to control for the control for environment or contextual factors that are related to the health services use. For each county code, we included five factors reflecting economic status, health status, and selected characteristics of the local health system. The number of primary physicians per 1,000 capita was used to reflect the local availability of primary care, including general family medicine, general practice, general internal medicine and general pediatrics. The number of hospital beds per 1,000 capita was used to reflect the resource of health care facility. The socioeconomic status of the community was reflected by the percent of people in poverty, education level and unemployment rate.

4.5 Dependent Variables

4.5.1 Health care utilization.

The annual number of health services use was estimated using self-reports. MCBS collect the use of healthcare services in both Medicare claims and surveys. Since it is

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optional for MA plans to report claims to CMS, using claims solely cannot fully capture the utilization data for MA-PD enrollees, leading to inaccurate results. To address this concern, self-reports were used to compare health care utilizations in PDPs and MA-PDs. The number of visits was counted for each beneficiary during the study year, and then categorized as inpatient, outpatient, medical provider (doctor's office), and other medical services (e.g., home health, hospice care).

4.5.2 Health care expenditures.

The annual costs were estimated for total health care spending for all types of medical events, including home health, inpatient, medical provider, outpatient, hospice care, and prescription drugs. Healthcare expenditures were categorized as (1) all medical expenditures; (2) medical expenditures paid by Medicare; (3) Non-Medicare expenditures made by public (i.e. Medicaid, VA) and private insurance (i.e. employer-paid coverage and Medicare supplement policies); (4) out-of-pocket, including copayments, deductibles. In addition, health care expenditures were analyzed separately by service category: inpatient, outpatient, medical provider (doctor's office), and other medical services (e.g., home health, hospice care).

There are substantial geographic variations on Medicare spending due to the differences in operating health care facilities in some areas than others (e.g., wages, rents). In addition, the geographic variations were found to be associated with the enrollment in Part D plans. For example, MA enrollees were more likely to reside in west census region compared to MA-PD enrollees. Failure to account for geographic differences in healthcare costs may lead to biased estimates. To adjust for such differences, we used the modification of the Geographic Practice Cost Index that was

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developed for the Dartmouth Atlas of Health Care.[156,157]

Furthermore, this dissertation pooled data from 2006 to 2010, and there were increased proportions of beneficiaries enrolled in MA-PDs during this study period. Considering the elevated rate of general inflation, costs incurred in the later study period (e.g., 2010) are higher than those in the earlier study period (e.g., 2006), with other factors being constant. Hence, the unadjusted healthcare costs between two groups are incomparable if the inflation rate is not adjusted. Medical care component of the Consumer Price Index (CPI) was used to adjust for this changes in medical costs over time,[158,159] so that the unadjusted costs can better reflect the differences in healthcare costs between two types of Part D plans. All costs are reported in 2010 U.S. dollars.

Table 4.3 Medical Care Component of CPI, 2006-2010

Year	CPI	Annual %	Annual Proportion
2006	201.600	3.226	1.032
2007	207.342	2.848	1.028
2008	215.303	3.840	1.038
2009	214.537	-0.356	0.996
2010	218.056	1.640	1.016

The following equation represents the formula used to obtain the 2010 U.S. dollar values.

$$\begin{aligned} 2010\ Dollar\ Value &= 2006\ Dollar\ Value \times CPI_{07} \times CPI_{08} \times CPI_{09} \times CPI_{10} \\ &= 2006\ Dollar\ Value \times 1.082 \end{aligned}$$

4.5.3 Cost-related nonadherence

Cost-related nonadherence (CRN) was measured based on self/proxy's reports by answering "yes" or "ever" on any of the following questions: "decide not to fill or refill a prescription because it was too expensive"; "skipped doses to make the medicine last

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longer"; "taken smaller doses of a medicine to make the medicine last longer", and "spent less money on food, heat, or other basic needs so that you would have money for medicine".[160] All four measures of CRN were incorporated in MCBS since 2004, and have demonstrated high test-retest reliability[161] and construct validity.[160,162,163].

4.5.4 Medication adherence

Medication Adherence was evaluated for beneficiaries with type 2 diabetes. Anti-diabetic medications were identified from MCBS PME files using drug names (both generic and brand names), which are summarized in Appendices B. Anti-diabetic medications include insulins, metformin, sulfonylureas, thiazolidinediones, dipeptidyl peptidase-4 inhibitors, combinations and other oral agents. Based on the widely accepted guideline treating diabetes,[164] medication therapy should be initiated at the time of diagnosis of diabetes. Since only beneficiaries who were previously diagnosed with diabetes were included in the study sample, they should be prescribed with anti-diabetic medications and filled the prescriptions during the whole study year. This approach has also been used in the published studies.[146,147] In addition, we also estimated the adherence to anti-hypertensive and antihyperlipidemic drugs (Appendix C&D)

Proportion of Days Covered (PDC) was calculated as the number of days with drugs supplies within a drug class divided by the time from the first fill until the end of follow up (December 31) for each panel.

$$\text{PDC} = \frac{\text{the number of days with drugs supplies}}{\text{the first fill until the end of follow up (December 31)}} \times 100\%$$

There are three major considerations in calculating PDC. First, the overlapping days supply were credited under the assumption that beneficiary is finishing the current fill before starting the refill prescription.[165] As shown in the example for prescription fills

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(Table 4.4), the patient filled a 30-day supply of the drug on 8/25/2011, and that fill finished on 9/23/2011. However, the patient refilled early on 9/5/2011, her refill date of this fill was adjusted to 9/24/2011, to avoid any overlapping of days supply. Second, any prescription fills after the study periods were excluded from the calculation of PDC. For example, the patient filled prescription on 12/10/2011 with a 30-day supply, and should use them up by 1/8/2012; however, the measurement period ended at 12/31/2011. Hence, the 30-day fill was adjusted to reflect a 22-day supply. Third, the leftover medications from previous year were considered in estimating PDC. For example, the patient filled a 30-day supply of prescription on 12/20/2010, which should be used up on 01/19/2011. Since the measurement period of PDC starts on 01/01/2011, the medication carried over to the next fill won't be taken in to account.

Table 4.4 Example of Prescription Fills

Patient ID	Drug Name	Fill Date	Days of Supply	Adjusted Days of Supply
A	metformin	12/20/2010	30	0
A	thiazolidinedione	8/25/2011	30	30
A	metformin	9/5/2011	30	30
A	metformin	9/26/2011	30	30
A	metformin	12/10/2011	30	22

Source: Wang et al. Measuring Medication Adherence with Simple Drug Use and Medication Switching. SAS Global Forum 2013. Paper 168-2013.
Link: http://support.sas.com/resources/papers/proceedings13/168-2013.pdf

As illustrated in Table 4.4, the start of measurement period is defined as the first refill in 2011, which is 8/25/2011. The adjusted days of supply are (30+30+30+22) = 112 days, and there are 129 days from the first refill until the last day of 2011. Therefore, the PDC for the patient in this example is 112/129=86.8%.

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Beneficiaries was defined as adherent with a PDC≥0.80, whereas non-adherent with a PDC<0.80. This cutoff point has been used in numerous literatures, and is a valid adherence measure of anti-diabetic drugs using administrative claims data.[166]

The following table summarizes the dependent and independent variables used in this dissertation.

Table 4.5 Summary of Dependent and Independent Variables

Variable		Description	Level	Source
Dependent variables	Utilizations	Self-reports, annual number of visits	Individual	MCBS
	Costs	Self-reports, annual costs	Individual	MCBS
	PDC	Pharmacy claims	Individual	MCBS
	Cost-related nonadherence	Self-reported nonadherence due to costs	Individual	MCBS
	Medication Affordability	Self-reports	Individual	MCBS
Independent Variable	Type of Part D	Medicare administrative data	Individual	MCBS
	Age	65-75, 75-85, >85 years	Individual	MCBS
	Sex	Male, female	Individual	MCBS
	Race/ethnicity	Self-identified race/ethnicity	Individual	MCBS
	Education level	< high school, high school/GED, >high school	Individual	MCBS
	Annual income	<$25,000, ≥$25,000	Individual	MCBS
	LIS	Medicare administrative data		
	MSA	Self-reports	Individual	MCBS
	Census region	Northeast, midwest, south, west	Individual	MCBS
	Marriage	Married, widowed, Divorced/separated, never married	Individual	MCBS
	Living conditions	Alone, with spouse, with children, with others	Individual	MCBS

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Variable		Description	Level	Source
	Smoking	Never, past, current	Individual	MCBS
	ADLs, IADLs	Self-reported number of living difficulties	Individual	MCBS
	Number of chronic conditions	Self-reported diagnosis of chronic diseases	Individual	MCBS
	CCI	Self-reports	Individual	MCBS
	Self-perceived health Status	Excellent, very good, good, fair and poor	Individual	MCBS
	BMI	<25.0, 25.0-29.9, ≥30.0 kg/m^2	Individual	MCBS
	Other drug coverage	Self-reports and claims	Individual	MCBS
	Care-seeking attitudes	Self-reports	Individual	MCBS
	Number of primary physicians	Continuous variable	County	AHRF
	Number of hospital beds	Continuous variable	County	AHRF
	Per capita income	Continuous variable	County	AHRF
	Education	Continuous variable	County	AHRF
	PDP penetration rate	Continuous variable	County	AHRF
	SPAP	Dummy variable	State	AHRF
	% white collar worker	Continuous variable	County	AHRF

Abbreviations: **MCBS**, Medicare Current Beneficiary Survey (MCBS); **AHRF**, Area Health Resource Files; **SPAP**, State Pharmaceutical Assistance Programs; **PDC**, Proportion of Days Covered; **PDP**, Stand-Alone Prescription Drug Plan; **MSA**, Metropolitan Statistical Area; **CCI**, Charlson Comorbidity Index; **ADLs**, Activities of daily living, includes bathing or showering, getting dressed, getting in and out of a chair, walking, and using the toilet; **IADLs**, Instrumental activities of daily living; **BMI**, body mass index.

4.6 Data Analysis

Univariate and bivariate analyses were conducted to describe and compare beneficiaries' baseline characteristics. Multivariable analyses were performed to control for potential confounders. Cross-sectional weights were applied to adjust for the complex

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survey design of the MCBS. Most data analysis was carried out using SAS version 9.4 (SAS Institute, Cary, NC). Model specification tests were performed using STATA (Version 14.0).

4.6.1 Descriptive analysis

Descriptive statistics were used to compare beneficiaries enrolled in PDPs and MA-PD plans in their baseline characteristics of age, gender, race, education, marital status, living conditions, census region, metropolitan statistical area, annual income, health status, IADLs/ADLs status, chronic diseases, BMI, smoking status. Significant differences in continuous variables were assessed using independent two-group t-tests. Chi-squared tests were used for categorical variables. Based on the recommendation in the MCBS technical documentation, cross-sectional weights were applied in the analysis to obtain the national estimates.

4.6.2 Multivariable regression analysis

In the naive model, the choice of part D plans was assumed to be exogenous, that is, there is no omitted variable that is related to both the choice of part D plans and outcomes (e.g., health services use and costs, adherence).

For Aim 2, generalized linear models (GLMs) were executed to estimate the association between choice of Part D plans and use and costs of health services. Health care cost and use data is usually right-hand skewed with inconsistent variance, indicating the violation of the assumption of ordinary least squares regression (OLS)-normality and homoscedasticity.[167,168] However, GLM loose the assumptions of OLS. Furthermore, the use of transformations improves the normality of data, but the back transformation to the original scales may yield biased estimates on the original scale if the error term is

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heteroskedastic, which is very common for health cost data. In addition, back transform raises the concern on the interpretation of the results,[169] because results from analysis using transformed scales cannot provide inferences about population mean costs, which are the primary interest of this study.[170] While the link function in GLM directly estimates on the original scales, which don't require back transformation. Therefore, generalized linear models were used in this dissertation to correct for the possible skewed distribution of health care cost and use data.

For Aim 3.1, since the occurrence of cost-related nonadherence (yes vs. no) is a binary variable, multivariable logistic regression was used to investigate the association between type of Part D plans and CRN.

For Aim 3.2, multivariable linear regression was used to access the association between type of Part D plans and PDC, which was treated as a continuous variable. Since being adherent (PDC≥0.80) a binary variable, multivariable logistic regression was used to investigate the effect of Part D plans on medication adherence, after adjusting the potential confounders mentioned earlier.

The following section describes the multivariable regression analysis carried out for Naïve models.

Aim 2.1 Health care utilizations

In this study, the utilization of healthcare was counted as the number of hospitalizations, visits to outpatient and medical providers (e.g., physician's office), and number of prescription fills. Hence, utilization data can be considered as count data, which has three statistical properties: (1) to be non-negative; (2) to have excessive zero outcomes; and (3) to have a skewed distribution.[171] Poisson regression model is

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commonly applied for count data. A key assumption of the Poisson model is that the mean and the variance of count data are equal. Overdispersion exists when the observed variance is larger than the assumed variance (or mean). Failure in taking into account overdispersion may lead to biased estimates by underestimating the variability of the data.[172] Currently, two major approaches can be used to handle overdispersion in count data: (1) to introduce a dispersion parameter in the Poisson regression (i.e. dscale in SAS); (2) to perform modified count model by introducing other probability distribution to control for dispersion, e.g., the negative binomial.[173] In addition, for data with excessive zeros, the zero-inflated models, such as zero-inflated Poisson (ZIP) [138,173-175], zero-inflated negative binomial (ZINB),[173,176] show superior fit than standard count models.

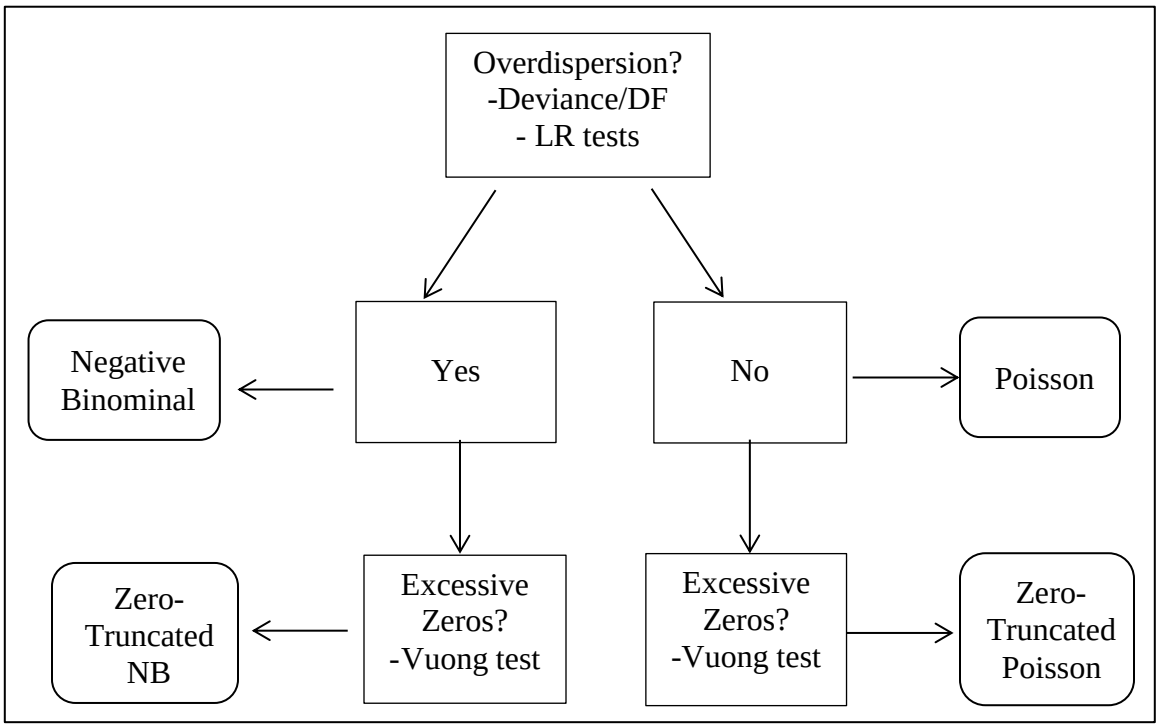

Figure 4.2 Flow Chart of Selecting Preferred Models for Healthcare Count Data

To select the most appropriate modified count model, three specification tests

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were performed: normality test, overdispersion, and Vuong test. The flow chart of choosing a regression model is shown in Figure 4.2. First, the distribution of data was checked graphically and by using normality tests (e.g., kurtosis). Second, the overdispersion of use data was then accessed by comparing of the deviance to the df in the Poisson regression model, and using a likelihood-ratio (LR) test. If Deviance / df is away from 1, then overdispersion may present. LR test compares the likelihood in the negative binomial (NB) specification against the Poisson model specification. When LR is greater than 1, indicating the rejection of Poisson specification and favor a negative binomial model).[175,177,178]

$$\mathrm{LR} = -2[\mathrm{LL\ (Poisson)} - \mathrm{LL\ (negative\ binomial\ ]}$$

Third, considering the possibility of zero values in the use data, I used the Vuong test for non-nested models to access whether the excess zero values will result in the rejection of standard count model against the zero-inflated count model.[179] If z-test is significant, indicating that the zero-inflated model is preferred.

Based on the Figure 4.2, the preferred models for healthcare utilizations were selected. However, it is still possible that there were slight differences in the results obtained from different models. In the sensitivity analysis, I also compared the estimates from different count models, including Poisson, scaled Poisson, ZIP, NB, and ZINB.

The naive GLM used to examine health care utilizations is indicated in Equation below. Specifically, the dependent variable represents the annual number of health services, g(use) represents the function of use data (e.g., log). the key independent variable is the type of part D plans. Equation was applied to both PDP and MA-PD groups, measuring the health care utilizations relative to the type of Part D plans.

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Therefore, β_1 is the estimate of the effect of the PDPs on health care utilizations compared to MA-PDs, controlling for the observed covariates. A Wald test of $\beta_1<0$ was used to test Hypothesis 3.1: PDP enrollees had higher expenditures of medical care than MA-PD enrollees

$$g\{E(use)\} = a + \beta_1 PartD + \beta_2 Demosocioeconomics + \beta_3 Health + \beta_4 Lifestyle + \beta_5 Altitudes + \beta_6 Year + \varepsilon_i$$

<u>Aim 2. Health care expenditures</u>

Given the highly skewed distributions of cost data, GLM with gamma distribution and log link was performed to estimate the association between type of Part D plans and health care expenditures. The transformation of cost data and GLM distribution were determined based on the statistical tests. First, the possible transformation of the cost data was chosen based on the results Box-Cox procedure.

λ	**Suggested Distribution**
-1	Inverse
0	Logarithm
0.5	Square Root
1	Linear
2	Square

Second, the GLM distribution was determined by using the modified Park test on the raw-scaled residuals to select a distribution, given a particular link function (e.g., log in the first step). The rule states that the distribution family was chosen based on the relationship between raw-scaled variance and the raw-scaled prediction.[180]

λ	**Suggested Distribution**
0	Gaussian NLLS
1	Poisson
2	Gamma

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λ	Suggested Distribution
3	Inverse Gaussian or Wald

To handle the excessive zero-values, a small positive value ($0.01) was assigned to beneficiaries without costs to avoid dropping them from the analyses. GLM adjusted for potential confounders mentioned above.

The naive GLM used to examine health care spending is indicated as Equation:

$$g\{E(cost)\} = a + \beta_1 PartD + \beta_2 Demosocioeconomics + \beta_3 Health + \beta_4 Lifestyle + \beta_5 Altitudes + \beta_6 Environment\ factors + \beta_7 Year + \varepsilon_i$$

Specifically, the dependent variable represents the annual health care costs in a certain year, g(cost) represents the function of cost and use data (e.g., log). the key independent variable is the type of part D plans. Equation was applied to both PDP and MA-PD groups, measuring the health care expenditures relative to the type of Part D plans. Therefore, β_1 is the estimate of the effect of the PDPs on health care expenditures compared to MA-PDs, controlling for the observed covariates. A Wald test of $\beta_1<0$ was used to test Aim 3.2: PDP enrollees had higher expenditures of medical care than MA-PD enrollees.

$$log\left(\frac{P(Incurred\ cost\ or\ use)}{1-P(Incurred\ cost\ or\ use)}\right) = a + \beta_1 PartD + \beta_2 Demosocioeconomics + \beta_3 Health + \beta_4 Lifestyle + \beta_5 Altitudes + \beta_6 Environment\ factors + \beta_7 Year + \varepsilon_i$$

Where P (Incurred cost or use) is the probability of having resource use or cost. In this specification, Part D is a dummy variable that equals 1 if an individual enrolled in PDPs, and 0 if the individual enrolled in MA-PDs. Demo-socioeconomics includes age,

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gender, race/ethnicity, marital status, living conditions, education, annual income, metropolitan status and census region; Health includes Charlson's comorbidity index, self-perceive health status and ADLs/IADLs functional status; Lifestyle includes BMI and smoking status; Attitudes is a vector that indicates self-reported attitudes towards seeking care and access to care; Year is a dummy variable indicating year (the target survivorship year) in which utilization and spending were measured.

<u>Aim 3.1 Cost-Related Nonadherence (CRN)</u>

Multivariable logistic regression was carried out to estimate the Odds Ratio (OR) of CRN. The dependent variable was a dummy variable, which was equal to 1 if an individual reported CRN, and 0 if an individual did not report CRN.

$$log\left(\frac{P(CRN)}{1-P(CRN)}\right) = a + \beta_1 PartD + \beta_2 Demosocioeconomics + \beta_3 Health + \beta_4 Lifestyle + \beta_5 Altitudes + \beta_6 Environment\ factors + \beta_7 Year + \varepsilon_i$$

Where P (CRN) is the probability of having CRN. In this specification, Part D is a dummy variable that equals 1 if an individual enrolled in PDPs, and 0 if the individual enrolled in MA-PDs. Demo-socioeconomics includes age, gender, race/ethnicity, marital status, living conditions, education, annual income, metropolitan status and census region; Health includes Charlson's comorbidity index, self-perceive health status and ADLs/IADLs functional status; Lifestyle includes BMI and smoking status; Attitudes is a vector that indicates self-reported attitudes towards seeking care and access to care; Year is a dummy variable indicating year (the target survivorship year) in which utilization and spending were measured.

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Aim 3.2 Medication Adherence

A multivariable linear regression was used to evaluate PDCs between beneficiaries enrolled in PDPs and MA-PDs. PDC is a continuous variable; Part D is the key independent variable; other covariates in the model include demo-socioeconomics, health, lifestyle, attitudes, and year. The model used to evaluate PDC and choice of Part D plans is shown in as below:

$$PDC = a + \beta_1 PartD + \beta_2 Demosocioeconomics + \beta_3 Health + \beta_4 Lifestyle + \beta_5 Altitudes + \beta_6 Environment\ factors + \beta_7 Year + \varepsilon_i$$

Beneficiaries were defined as adherent with a PDC≥0.80, whereas non-adherent with a PDC<0.80. Multivariable logistic regression was modeled to estimate the Odds Ratio (OR) of being adherence (PDC≥0.80). The dependent variable was a dummy variable, which was equal to 1 if an individual were adherent to the drug treatment, and 0 if the individual were non-adherent.

$$\log\left(\frac{P(non-adherent)}{1-P(non-adherent)}\right) = a + \beta_1 PartD + \beta_2 Demosocioeconomics + \beta_3 Health + \beta_4 Lifestyle + \beta_5 Altitudes + \beta_6 Environment\ factors + \beta_7 Year + \varepsilon_i$$

4.6.3 Instrumental variable approach

The covariate-adjusted GLMs are not able to address the possibility that the key explanatory variable-choice of part D plans-may be endogenous either because of unobserved confounders or reverse causality. As demonstrated in Figure 4.3, the unobserved confounders (U), such as an individual's preference and perceived demand for health care services, may influence both the choice of part D (X) and the outcomes (Y), indicating that the choice of part D plans is endogenous due to the correlation

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between X and the error term (u) in the specification of the traditional OLS regression model in Equation below. The variations on x are correlated with not only the changes in y, but also the changes in the error term u, suggesting that X is endogenous. The endogeneity of X results in biased and inconsistent estimates of β_1, therefore, the estimates from traditional regression is biased when accessing the effect of PDPs on health care utilization and expenditures and medication adherence.

$$y = \beta_0 + \beta_1 x + u$$

To address the problem of endogeneity, the instrumental variable (IV) approach was implemented. Figure 4.3 demonstrates how an IV works. Given an IV (Z) is associated with X, but is not correlated with unobserved confounders (U) and outcome (Y), IV can focus on the variations on X that is uncorrelated with U and discard the changes in X that may bias the OLS estimates. Hence, IV provides a consistent estimate of coefficient β_1. Although the IV approach is appealing, it is difficult of find a valid IV. The validity of an IV relies on three assumptions: (1) the independence assumption assumes that the IV is not correlated with observed confounders; (2) the non-zero casual effect of IV required that an IV is highly correlated with the endogenous variable (X); and (3) the exclusion restrict states the IVs are not directly associated with the changes in outcome variable (Y). For assumption of non-zero casual effect of IV on endogenous variable, the strength of association between IV and X was tested using the traditional rule of thumb the IV was a strong instrument if the F-statistic was greater than 10.[181] A partial or weak correlation between the IV and endogenous variable indicates that the instrument is a weak IV, leading to biased and inconsistent estimates, incorrect size for test of significance, and incorrect confidence intervals.[181] Since more than 1 instruments

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were used in the analysis, overidentification tests were performed to access if the instruments are valid. However, the third assumption of IV, which is the exclusion restrict, cannot be examined in the observational studies.

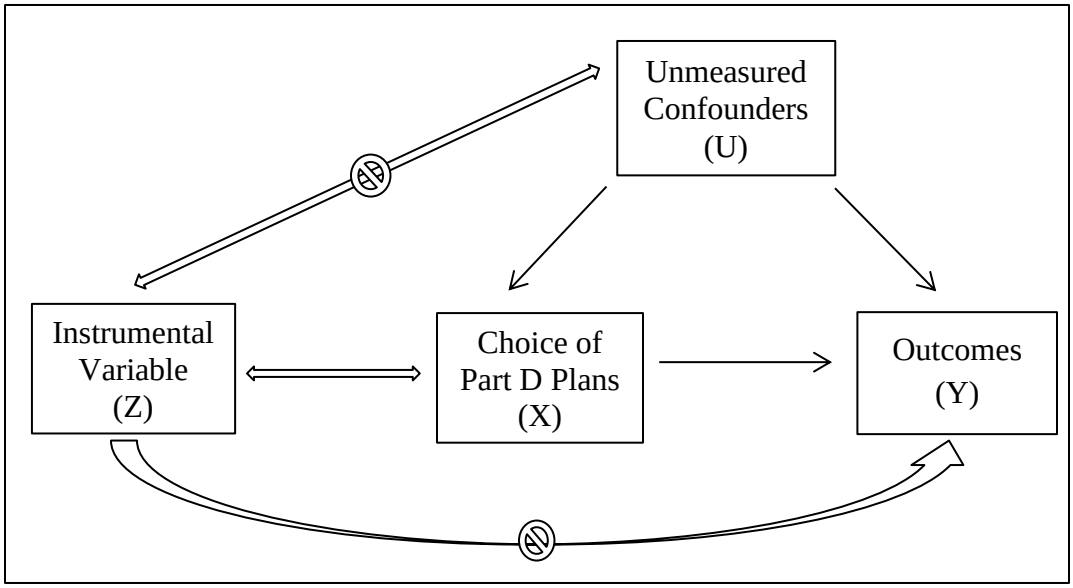

Figure 4.3 Instrumental Variable

The two-stage residual inclusion (2SRI) estimator was employed because it provides a consistent estimates for data with non-linear distribution.[182] The traditional linear instrumental variable estimator, two-stage least squares (2SLS) estimator and two-stage predictor substitution (2SPS), may result in biased estimates when applied to nonlinear models.[182,183] The 2SRI method was increasingly reported to use in health services research.[184-186]

In the first-stage of 2SRI, auxiliary (reduced-form) regressions was estimated for the endogenous variable by regressing on at least one IV. The results from the first stage were used to estimate the predicted values for the endogenous variables and calculate residuals. The second-stage regression was then conducted for the outcome of interest by including the endogenous variables, and predicted values for the endogenous variables

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and residuals from the auxiliary equations.[182]

$$PartD = M\{\alpha + \beta_1 PartD + \beta_2 Demosocioeconomics + \beta_3 Health + \beta_4 Lifestyle + \beta_5 Altitudes + \beta_6 Environment\ factors + \beta_7 Year + \beta_8 IV\} + \epsilon_i$$

The second-stage regression was conducted for the outcome of interest by including the endogenous variables, and predicted values for the endogenous variables and residuals from the auxiliary equations.[182]

$$g\{E(cost\ or\ use)\} = a + \beta_1 PartD + \beta_2 \varepsilon^{2SRI} + \beta_3 Demosocioeconomics + \beta_4 Health + \beta_5 Lifestyle + \beta_6 Altitudes + \beta_7 Environment\ factors + \beta_8 Year$$

Where ε^{2SRI} is the residual from first stage of IV, controlling for the endogeneity of choice of Part D plans due to selection bias or unobserved confounders. Other specification is similar to Na ïve model. If β_2 is statistically significant, the choice of part D is considered as endogenous; If β_2 is not statistically significant, there is no enough evidence to suggest the endogeneity if Part D plan.

The choice of IVs (Z) was guided by published research on the effect of HMOs on health outcomes and expenditures. State-level instrument (SPAP) and county-level instrument (PDP penetration and % white collar worker) were used in this dissertation, because they are related to the plan choices, but not directly related the study outcomes. Beneficiaries are more likely to enroll in PDPs if they reside in a county with higher number of PDP plans or lower average premiums for PDP plans, but the market share or the premiums of PDP plans don't directly influence the health care use and cost. Hence, the selected IVs meet the assumptions conceptually.[135] Furthermore, statistical

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specification tests indicated that the IVs meet the independence and the non-zero casual effect of IV. The results for IV specification tests are shown in Chapter 5.

4.6.4 Reporting results

Since both Naïve models and IV approach were carried out, the results were reported based on the existence of endogeneity of independent variable related to each outcomes of interest. If the key independent variable–type of Part D plans–is endogenous to the outcome variables (e.g., healthcare utilizations, costs), then the estimates from IV approach would be reported in the results chapter. On the other hand, if the type of part D plans is not endogenous, the results from naïve models would be reported.

4.7 Sensitivity Analysis

To test the robustness of the results, two sensitivity analyses were carried out.

Sensitivity Analysis 1. In the main analysis, beneficiaries with LIS were excluded from the study sample, because LIS provides more generous drug benefits compared to Part D plans, including both PDPs and MA-PDs. As described in Chapter 1, the copayment for generics is as low as $2 per prescription for beneficiaries with LIS, while Part D beneficiaries generally have a copayment of $10 for generic prescriptions. To account for the effects of LIS, two sensitivity analyses were conducted to compare the outcomes stratified by the presence of LIS.

Sensitivity Analysis 2. Beneficiaries with other drug coverage were excluded from the analysis. Self-reports were used to collect utilization and cost data, to account for the possibility of filling prescriptions outside of Medicare. However, the additional drug benefits may still influence the drug use. In the sensitivity analysis, beneficiaries with other drug benefits were excluded from the analysis.

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Sensitivity Analysis 3. Since income is an important factor influencing the health care utilizations and cost. The impact of PDPs on healthcare utilizations and costs were examined by stratifying the levels of incomes.

Sensitivity Analysis 4. Patients with chronic diseases (e.g., diabetes) may have different patterns in using healthcare compared to the general population. In the sensitivity analysis, the impact of PDPs among diabetic patients was examined, to better understand the effects of part D plans on healthcare utilizations and expenditures.

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CHAPTER 5

RESULTS

This chapter presents the results of this dissertation. The first section of this chapter contains results for sample size and descriptive analysis for Aim 1. Later, section 2 and 3 shows the results of health care use (Aim 2.1) and costs (Aim 2.2). Section 4 focuses on the results of cost-related non-adherence (Aim 3.1). Section 5 displays the sample selection, descriptive analysis, and results of medication adherence among Medicare beneficiaries with type 2 diabetes (Aim 3.2). Section 6 presents the results for sensitivity analysis.

5.1 Results for Aim 1. Baseline Characteristics

The following section describes the study sample, including sample size, demographic and socioeconomic characteristics, health conditions and health behaviors, health attitudes, and environment factors. This section also presents the predictors of enrollment in PDP plans among elderly Medicare beneficiaries.

5.1.1 Sample selection

The master datasets after merging MCBS files included 45,427 individuals who participated in the MCBS in 2006-2010. The initial sample size was 35,912 community-dwelling Medicare beneficiaries aged 66 years older who were not entitled Medicare due to ESRD and disabilities. A total of 17,477 individuals enrolled in Part D plans were identified, 10,788 beneficiaries in PDPs and 6,689 in MA-PDs. In the PDP group, 532

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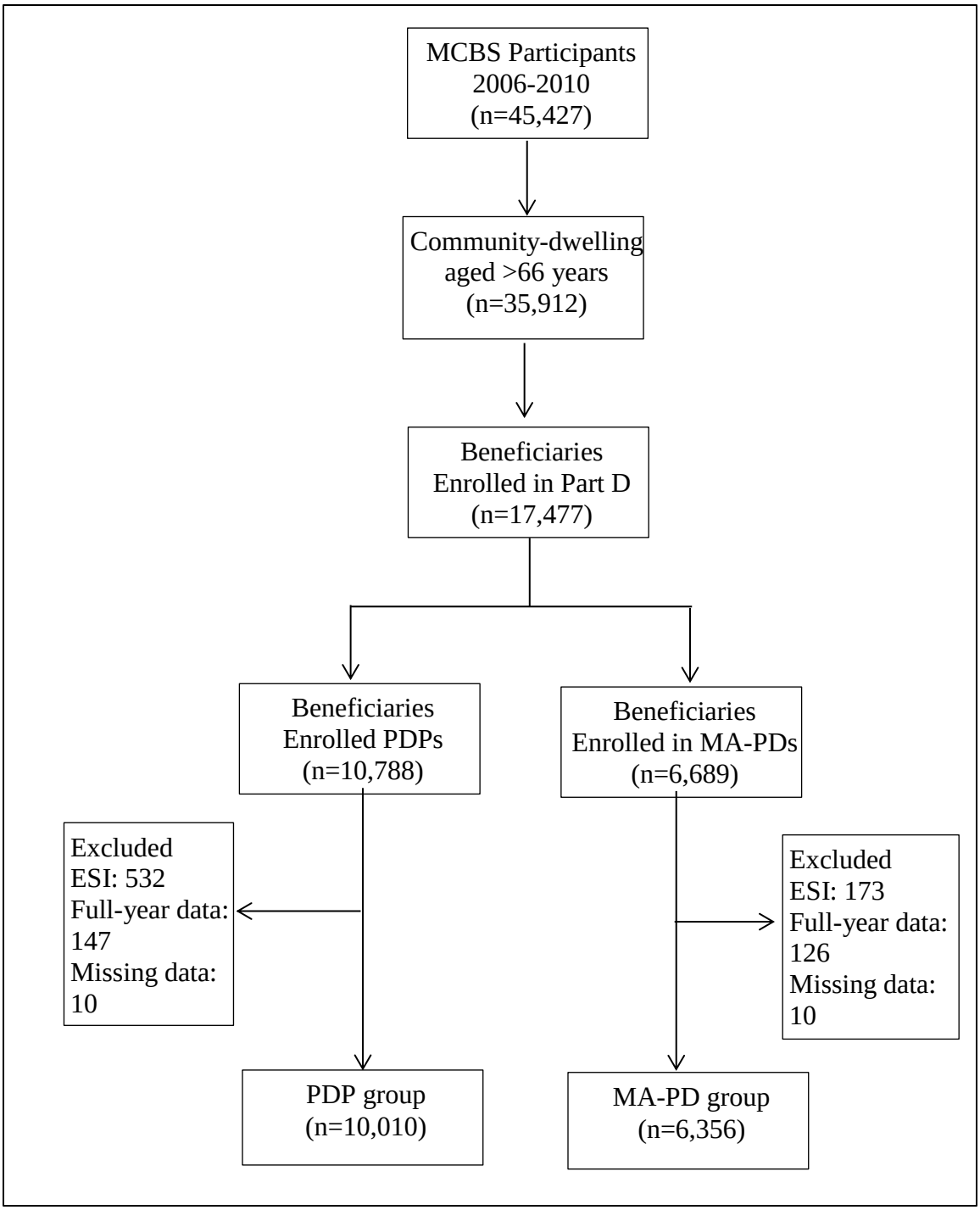

Figure 5.1 Flow Chart of Sample Selection for Aim 1 & 2 & 3.1

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individuals were excluded due to the enrollment in the employer sponsored insurance (ESI), 147 individuals were dropped due to lack of full-year data, and 10 individuals were dropped due to the missing data on self-reported measures, such as education, income, BMI. The final sample size for PDP group was 10,010. In the MA-PD group, 173 beneficiaries were excluded due to their enrollment in ESI, 126 individuals were excluded from the sample due to lack of full-year data, and 10 individuals were dropped due to missing data on self-reports. The final sample size is 6,356 in MA-PD group. Figure 5.1 demonstrate the sample selection flow chart for Aim 1&2 and Aim3.1 in this dissertation.

5.1.2 Demo-socioeconomic and clinical characteristics

The demo-socioeconomic characteristics and health conditions between PDPs vs. MA-PDs were compared in Table 5.1. PDP enrollees were older (aged 85+ years, 14.6% vs. 11.8%; p=0.0003), were more likely to be female (64.3% vs. 57.1%; p<0.0001), and non-Hispanic white (79.3% vs. 74.6%; p<0.0001), compared to MA-PD enrollees. Medicare beneficiaries enrolled in PDPs were less likely to be married (47.2% vs. 55.0%; p<0.0001), but more likely to be living alone (36.2% vs. 29.5%; p<0.0001). PDP enrollees had lower education level (more than high school, 31.6% vs. 35.8%; p<0.0001) than MA-PD enrollees, while PDP enrollees had lower annual income (more than $25,000, 31.6% vs. 35.8%; p<0.0001), and were more likely to receive low income subsidy (32.1% vs. 15.7%; p<0.0001). Beneficiaries enrolled in PDPs were less likely to live in Metropolitan Statistical Areas (68.0% vs. 92.9%; p<0.0001) and west census region (16.0% vs. 34.4%; p<0.0001). Compared to beneficiaries enrolled in MA-PDs, PDP enrollees were more likely to have other prescription drug coverage (19.5% vs.

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12.7%; p<0.0001). Specifically, PDP enrollees were more likely to have public prescription drug coverage (15.9% vs. 9.8%) and private or self-purchased prescription drug coverage (3.6% vs. 2.9%).

Compared to beneficiaries enrolled in MA-PDs, PDP enrollees had lower self-perceived health status (excellent health, 14.1% vs. 16.6%; very good health, 28.7% vs. 32.3%; good health, 34.0% vs. 32.7%; fair health, 17.5% vs. 14.7%; poor health, 5.7% vs. 3.7%; p<0.0001). In addition, PDP enrollees were more likely to have more than 4 chronic conditions (19.3% vs. 15.0%; p<0.0001), with Charlson Comorbidity Index (CCI) scores ≥ 3 (43.3% vs. 38.3%; p<0.0001), with three or more Activities of daily living (ADLs) disabilities (9.3% vs. 6.2%; p<0.0001), and with three or more Instrumental activities of daily living (IADLs) limitations (8.3% vs. 4.9%; p<0.0001).

Beneficiaries enrolled in PDPs were less likely to have a history of smoking (44.9% vs. 40.1%; p=0.0003), compared to MA-PD enrollees. In addition, PDP enrollees were less likely to visit physicians when they felt sick (27.4% vs. 23.7%; p=0.002), but were more likely to have the same physicians for more than five years (57.8% vs. 52.0%; p<0.0001).

Table 5.1 Demo-Socioeconomic Characteristics and Health Conditions among Medicare Beneficiaries

Characteristics	PDPs		MA-PDs		p-value
	n	Weighted %[a]	n	Weighted %[a]	
Age, years					**0.0003**
65-75	4108	47.5	2658	47.8	
75-85	4033	37.8	2715	40.4	
>85	1869	14.6	983	11.8	
Sex					**<.0001**
Male	3548	35.7	2741	42.9	
Female	6462	64.3	3615	57.1	
Race/ethnicity					**<.0001**

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Characteristics	PDPs		MA-PDs		p-value
	n	Weighted %[a]	n	Weighted %[a]	
Non-Hispanic White	7913	79.3	4767	74.6	
Non-Hispanic Black	797	7.4	650	9.8	
Hispanics	714	7.1	686	11.3	
Non-Hispanic Others	586	6.1	253	4.3	
Marriage					**<.0001**
Married	4475	47.2	3395	55.0	
Widowed	4063	37.4	2017	29.3	
Divorced/separated	1131	11.9	783	13.2	
Never married	341	3.5	161	2.6	
Living conditions					**<.0001**
Alone	3795	36.2	1946	29.5	
With spouse	4297	45.6	3260	53.0	
With children	1353	12.6	762	11.5	
With others	565	5.7	388	6.1	
Education level					**<.0001**
< high school	1747	15.7	721	10.4	
High school/GED	5345	52.7	3420	53.8	
>high school	2918	31.6	2215	35.8	
Annual income					**<.0001**
<$25,000	6253	59.5	3437	52.4	
≥$25,000	3757	40.5	2919	47.6	
LIS					**<.0001**
No	6596	67.9	5294	84.3	
Yes	3414	32.1	1062	15.7	
MSA					**<.0001**
No	3559	32.0	504	7.1	
Yes	6451	68.0	5852	92.9	
Census region					**<.0001**
Northeast	1513	16.9	1247	20.9	
Midwest	2583	25.2	1108	16.9	
South	4428	41.8	1898	27.7	
West	1486	16.0	2103	34.4	
Other RX coverage					**<.0001**
None	7975	80.5	5534	87.3	
Public	1686	15.9	649	9.8	
Private/self-purchased	349	3.6	173	2.9	
Self-perceived health status					**<.0001**
Excellent	1348	14.1	1048	16.6	
Very good	2819	28.7	2020	32.3	
Good	3442	34.0	2094	32.7	
Fair	1816	17.5	952	14.7	
Poor	585	5.7	242	3.7	

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Characteristics	PDPs		MA-PDs		p-value
	n	Weighted %[a]	n	Weighted %[a]	
Number of chronic conditions					**<.0001**
0-1	3516	36.6	2623	42.4	
2-4	4459	44.1	2747	42.5	
4+	2035	19.3	986	15.0	
CCI					**<.0001**
None	2415	25.5	1869	30.7	
1-2	3131	31.2	2002	31.0	
3+	4464	43.3	2485	38.3	
ADLs					**<.0001**
None	6796	69.9	4685	74.9	
1-2	2198	20.8	1246	18.9	
3+	1016	9.3	425	6.2	
IADLs					**<.0001**
None	6777	69.7	4840	77.1	
1-2	2318	22.0	1179	18.0	
3+	915	8.3	337	4.9	
BMI, kg/m^2					**0.030**
<25.0	3637	35.1	2430	36.9	
25.0-29.9	3787	38.1	2441	38.7	
≥30.0	2586	26.8	1485	24.4	
Smoking					**0.0003**
Never	4564	44.9	2605	40.1	
Past	4530	45.6	3164	50.1	
Current	916	9.6	587	9.8	
Care-seeking attitudes					
Avoid going to a physician	2786	27.4	1523	23.7	**0.002**
Visit a physician as soon as feel bad	3528	35.2	2308	36.1	0.392
Worry about health more than others	1596	15.9	925	15.1	0.324
Keep to self when sick	3684	36.5	2201	34.5	0.090
Same physician>5 years	5824	57.8	3313	52.0	**<.0001**

a. Percentages were calculated with national weights; p-value was obtained from Rao-Scott Chi-Square tests

Abbreviations: **MCBS**, Medicare Current Beneficiary Survey (MCBS); **MSA**, Metropolitan Statistical Areas; **CCI**, Charlson Comorbidity Index; **ADLs**, Activities of daily living, includes bathing or showering, getting dressed, getting in and out of a chair, walking, and using the toilet; **IADLs**, Instrumental activities of daily living, including using telephone, shopping, preparing food, housekeeping, laundry, traveling, taking medication, and managing financial matters independently; **BMI**, body mass index, calculated as weight in kilograms divided by height in meters squared.

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5.1.3 Environment factors

Table 5.2 shows environmental and healthcare system factors among beneficiaries enrolled in PDPs and MA-PDs. PDP enrollees were more likely to reside in the counties with lower number of primary physicians per 1,000 capita (0.70 vs. 0.75; p<0.0001), but higher number of hospital beds per 1,000 capita (3.15 vs. 3.05, p=0.030). In addition, compared to MA-PD enrollees, PDP enrollees were more likely to live in the counties with higher percentage of population below poverty line (16.50% vs. 16.14%; p<0.0001), and higher unemployment rate (6.57% vs. 6.49%; p<0.0001), and lower percentage of percentage of college graduates (25.75% vs. 29.18%; p<0.0001).

Table 5.2 Environment and Healthcare System Factors among Medicare Beneficiaries

Characteristics	**PDPs**		**MA-PDs**		**p-value**
	mean	std	mean	std	
Number of primary physicians per 1,000 capita[a]	0.70	0.01	0.75	0.01	**<.0001**
Number of hospital beds per 1,000 capita	3.15	0.11	3.05	0.08	**0.030**
Percent under poverty, %	16.50	0.40	16.14	0.21	**<.0001**
Unemployment rate, %	6.57	0.14	6.49	0.10	**<.0001**
Education higher than high school, %	25.75	0.55	29.18	0.58	**<.0001**

Primary Care includes general family medicine, general practice, general internal medicine and general pediatrics.
Abbreviations: **std**, standard deviation.

5.1.4 Predictors of enrollment in PDPs

When examining the predictors associated with enrolling in PDPs, results indicate that beneficiaries' demo-socioeconomic characteristics and clinical conditions were

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associated with their enrollments in PDPs compared to MA-PDs (Table 5.3). Beneficiaries aged 85 years and older were more likely to enroll in PDPs compared to those aged 65-75 (Odds Ratio [OR]=1.17; 95% Confidence Interval [CI]=1.01-1.35). Compared to male beneficiaries, female beneficiaries were more likely to enroll in PDPs (OR=1.19; 95% CI=1.05-1.36). Non-Hispanic blacks were less likely to enroll in PDPs than non-Hispanic whites (OR=0.49; 95% CI=0.38-0.64). Enrollment in PDPs was associated with having college educations (OR=1.25; 95% CI=1.09-1.44), having annual income≥$25,000 (OR=1.28; 95% CI=1.12-1.47), having LIS (OR=3.14; 95% CI=2.61-3.78), and living in Midwest (OR=1.73; 95% CI=1.23-2.43) or south census regions (OR=2.12; 95% CI=1.47-3.06). Enrollment in PDPs was associated with having CCI scores ≥3 (OR=1.20; 95% CI=1.01-1.42) and being obese (OR=1.14; 95% CI=1.00-1.30), but was not associated with self-perceived health status, ADLs and number of chronic conditions.

Table 5.3 Predictors of Enrollment in PDPs among Elderly Medicare Beneficiaries

Characteristics	OR	95% CI	p-value
Age, years			
65-75	Ref	–	–
75-85	0.90	(0.80-1.00)	0.055
>85	1.17	(1.01-1.35)	**0.035**
Sex			
Male	Ref	–	–
Female	1.19	(1.05-1.36)	**0.010**
Race/ethnicity			
Non-Hispanic White	Ref	–	**–**
Non-Hispanic Black	0.49	(0.38-0.64)	**<.0001**
Hispanics	0.69	(0.54-0.88)	**0.003**
Non-Hispanic others	1.39	(1.13-1.72)	**0.002**
Marriage			
Married	Ref	–	–
Widowed	1.49	(1.11-1.99)	**0.008**

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Characteristics	OR	95% CI	p-value
Divorced/separated	1.11	(0.81-1.53)	0.500
Never married	1.65	(1.13-2.41)	**0.010**
Living conditions			
Alone	Ref	–	–
With spouse	1.06	(0.79-1.41)	0.710
With children	0.82	(0.70-0.97)	**0.020**
With others	0.73	(0.54-0.98)	**0.036**
Education level			
< High school	1.15	(0.96-1.38)	0.138
High school/GED	Ref	–	–
> High school	1.25	(1.09-1.44)	**0.002**
Annual income			
< $25,000	Ref	–	–
≥ $25,000	1.28	(1.12-1.47)	**0.0004**
LIS			
Yes	3.14	(2.61-3.78)	**<.0001**
No	Ref	–	–
MSA			
Yes	0.18	(0.11-0.28)	**<.0001**
No	Ref	–	–
Census region			
Northeast	Ref	–	–
Midwest	1.73	(1.23-2.43)	**0.002**
South	2.12	(1.47-3.06)	**<.0001**
West	0.72	(0.51-1.00)	0.051
Other RX coverage			
None	Ref	–	–
Public	0.88	(0.78-0.99)	**0.040**
Private/self-purchased	0.85	(0.71-1.03)	0.095
Self-perceived health status			
Excellent	Ref	–	–
Very good	1.01	(0.86-1.18)	0.914
Good	1.10	(0.94-1.29)	0.251
Fair	1.09	(0.89-1.35)	0.408
Poor	1.15	(0.86-1.53)	0.344
Number of chronic conditions			
0-1	Ref	–	–
2-4	0.98	(0.85-1.14)	0.819
4+	0.89	(0.74-1.07)	0.223
CCI			
None	Ref	–	–
1-2	1.18	(1.02-1.37)	**0.030**
3+	1.20	(1.01-1.42)	**0.039**
ADLs			

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Characteristics	OR	95% CI	p-value
None	Ref	–	–
1-2	0.95	(0.83-1.09)	0.467
3+	1.11	(0.91-1.35)	0.302
IADLs			
None	Ref	–	–
1-2	1.11	(0.97-1.27)	0.136
3+	1.35	(1.10-1.66)	**0.005**
BMI, kg/m^2			
<25.0	Ref	–	–
25.0-29.9	1.11	(0.99-1.24)	0.066
≥30.0	1.14	(1.00-1.30)	**0.046**
Smoking			
Never	Ref	–	–
Past	1.52	(1.26-1.84)	**<.0001**
Current	1.52	(1.12-2.07)	**0.007**
Care-seeking attitudes			
Avoid going to a physician			
Yes	1.08	(0.95-1.23)	0.234
No	Ref	–	–
Visit a physician as soon as feel bad			
Yes	0.98	(0.89-1.08)	0.684
No	Ref	–	–
Worry about health more than others			
Yes	0.93	(0.81-1.07)	0.302
No	Ref	–	–
Keep to self when sick			
Yes	0.99	(0.88-1.11)	0.857
No	Ref	–	–
Same physician>5 years			
Yes	1.28	(1.14-1.43)	**<.0001**
No	Ref	–	–
Environment factors			
Number of primary physicians	0.73	(0.35-1.52)	0.393
Number of hospital beds	1.06	(0.97-1.16)	0.181
Percent under Poverty	0.96	(0.92-0.99)	**0.016**
Unemployment rate	1.00	(0.89-1.14)	0.956
Education higher than high school	1.00	(0.97-1.03)	0.940
Study year			
2006	Ref	–	–
2007	1.68	(1.51-1.88)	**<.0001**
2008	1.49	(1.28-1.73)	**<.0001**
2009	1.28	(1.10-1.49)	**0.002**
2010	1.73	(1.46-2.05)	**<.0001**

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Characteristics	OR	95% CI	p-value

Abbreviations: **MCBS**, Medicare Current Beneficiary Survey (MCBS); **MSA**, Metropolitan Statistical Areas; **CCI**, Charlson Comorbidity Index; **ADLs**, Activities of daily living, includes bathing or showering, getting dressed, getting in and out of a chair, walking, and using the toilet; **IADLs**, Instrumental activities of daily living, including using telephone, shopping, preparing food, housekeeping, laundry, traveling, taking medication, and managing financial matters independently; **BMI**, body mass index, calculated as weight in kilograms divided by height in meters squared.

5.2 Results for Aim 2.1: Healthcare Utilizations

The following section presents the model specification tests and selections of preferred multivariable models for each outcomes of interest, and the results of health care services use, including the descriptive statistics and multivariable regression analysis.

5.2.1 Descriptive statistics

Table 5.4 shows bivariate results regarding the use of health services between PDP enrollees and MA-PD enrollees. Compared to MA-PD enrollees, PDP enrollees were significantly more likely to have inpatient (15.79% vs. 12.82%; p<0.0001) and outpatient care (66.35% vs. 63.89%; p=0.001), but were less likely to visit doctor's office (96.74% vs. 97.36%; p=0.025). In addition, PDP enrollees had significantly higher annual average number of visits to hospitals (0.22 vs. 0.17; p<0.0001), outpatient settings (2.84 vs. 2.11; p<0.0001), doctor's office (17.02 vs. 11.77; p<0.0001), and prescription fills (39.83 vs. 32.30; p<0.0001).

Table 5.4 Unadjusted Healthcare Utilizations among Elderly Beneficiaries enrolled in PDPs vs. MA-PDs

Outcome measures	PDPs	MA-PDs	P-value
Hospitalization			
Patients with visits, n (%)	1581 (15.79%)	815 (12.82%)	**<.0001**

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Outcome measures	PDPs	MA-PDs	P-value
Numbers of visits, mean ± std	0.22 ± 0.59	0.17 ± 0.50	**<.0001**
Outpatient			
Patients with visits, n (%)	6642 (66.35%)	4061 (63.89%)	**0.001**
Numbers of visits, mean ± std	2.84 ± 2.73	2.11 ± 5.46	**<.0001**
Medical providers			
Patients with visits, n (%)	9684 (96.74%)	6188 (97.36%)	**0.025**
Numbers of visits, mean ± std	17.02 ± 19.17	11.77 ± 17.56	**<.0001**
Other medical services			
Patients with visits, n (%)	61 (0.61%)	161 (2.53%)	**<.0001**
Numbers of visits, mean ± std	0.01 ± 0.09	0.03 ± 0.19	**<.0001**
Prescriptions (claims)			
Patients with RX fills, n (%)	9501 (94.92%)	6093 (95.86%)	0.368
Numbers of fills, mean ± std	39.83 ± 32.55	32.30 ± 29.00	**<.0001**

Other Medical services include hospice and home health.
Abbreviations: **std**, standard deviation.

5.2.2 Naïve Model: Healthcare Utilizations

Based on the specification tests in Appendix E, zero-inflated negative binomial models were used for number of hospitalizations, other medical services, and prescriptions, while negative binomial models were modelled for the number of outpatient and physician's office visits.[173,176] The dependent variable is the annual number of health service use, and the key independent variable is the type of part D plans.

Naïve model: results for healthcare utilizations

Table 5.5 summarizes the results for the effects of PDP on health care utilizations from naïve model. For easier interpretation, Incidence Rate (IR), which was calculated using the equation ($e^{coefficient}$), is also described in Table 5.6 below. IR can be interpreted as multiplicative effects on the expected outcome measures. Thus, for example, holding

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beneficiaries' socio-demographic and clinical characteristics constant, the estimated expected number of hospitalizations is $e^{0.04}$=1.04 times as high in the PDP group as in a comparable MA-PD group. The results indicate that PDP enrollees had similar likelihood of using inpatient care (IR=1.04, p=0.36) and other medical services (IR=0.99, p=0.950), but had 21% higher likelihood of using outpatient care (p<0.0001), and 42% higher in physician's office (p<0.0001), and 3% higher in prescription drugs (p=0.007), compared to MA-PD enrollees.

The results also reveal various demo-socioeconomics and clinical factors that were significantly associated with the use of health services. As shown in Table 5.5, ADLs and number of chronic conditions were associated with the use of inpatient care. For use of outpatient care, the statistically significant factors include age, race/ethnicity, living conditions, education, annual income, MSA and census region, self-perceived health status, number of chronic conditions, ADLs, IADLs, smoking and care-seeking attitudes. For the doctor's office visits, the statistically significant factors include age, sex, race/ethnicity, living conditions, education, annual income, LIS status, MSA, having other RX coverage, self-perceived health status, number of chronic conditions, ADLs, IADLs, BMI, smoking, and care-seeking attitudes. For the use of prescription drugs, the statistically significant factors include age, sex, race/ethnicity, living conditions, LIS status, census region, having other RX coverage, self-perceived health status, number of chronic conditions, CCI, ADLs, IADLs, BMI, smoking, care-seeking attitudes, and environment factors.

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Table 5.5 Naïve Model: Effects of PDPs on the Utilizations of Healthcare Services

Characteristics	Hospital			Outpatient			Physician's Office			Other Services			Prescriptions		
	Est.	IR	p-value	Est.	IR	p-value	Est.	IR	p-value	Est.	IR	p-value	Est.	IR	p-value
Part D enrollment															
PDPs	**0.04**	**1.04**	**0.360**	**0.19**	**1.21**	**<.0001**	**0.35**	**1.42**	**<.0001**	**-0.01**	**0.99**	**0.950**	**0.03**	**1.03**	**0.007**
MA-PDs	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–
Age, years															
65-75	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–
75-85	0.02	1.03	0.555	0.04	1.04	0.060	0.06	1.07	**<.0001**	-0.02	0.98	0.903	0.06	1.06	**<.0001**
>85	0.00	1.00	0.935	-0.08	0.92	**0.007**	-0.02	0.98	0.431	0.02	1.02	0.947	0.08	1.08	**<.0001**
Sex															
Male	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–
Female	0.03	1.03	0.524	0.04	1.04	0.112	0.16	1.17	**<.0001**	0.07	1.07	0.695	0.08	1.08	**<.0001**
Race/ethnicity															
Non-Hispanic White	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–
Non-Hispanic Black	-0.02	0.98	0.754	-0.11	0.89	**0.003**	-0.32	0.73	**<.0001**	-0.13	0.87	0.681	-0.08	0.92	**<.0001**
Hispanics	0.00	1.00	0.955	-0.14	0.87	**0.0004**	-0.13	0.87	**<.0001**	-0.19	0.83	0.507	0.00	1.00	0.881
Non-Hispanic others	-0.08	0.92	0.340	-0.005	1.00	0.920	-0.17	0.85	**<.0001**	-0.12	0.89	0.736	-0.03	0.97	0.279
Marriage															
Married	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–
Widowed	0.01	1.01	0.927	0.11	1.12	0.110	0.07	1.07	0.158	0.14	1.15	0.808	-0.05	0.95	0.181
Divorced/Separated	0.04	1.04	0.756	0.12	1.13	0.105	0.09	1.09	0.092	0.09	1.10	0.880	-0.07	0.93	0.090
Never married	-0.12	0.89	0.529	0.09	1.10	0.274	0.09	1.09	0.151	0.05	1.05	0.945	-0.03	0.97	0.480
Living condition															
Alone	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–
With spouse	0.05	1.05	0.707	0.11	1.12	0.117	0.13	1.14	**0.007**	0.18	1.19	0.770	-0.10	0.91	**0.013**
With children	0.05	1.05	0.365	-0.08	0.92	**0.014**	-0.04	0.96	0.088	0.04	1.04	0.848	-0.04	0.97	0.055
With others	0.07	1.07	0.379	-0.01	0.99	0.780	0.11	1.11	**0.001**	0.10	1.11	0.731	-0.001	1.00	0.979
Education level															
< high school	0.04	1.00	0.502	-0.01	0.99	0.837	-0.10	0.90	**<.0001**	-0.0002	1.00	0.999	0.02	1.02	0.192
High school/GED	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–

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Characteristics	Hospital			Outpatient			Physician's Office			Other Services			Prescriptions		
	Est.	IR	p-value	Est.	IR	p-value	Est.	IR	p-value	Est.	IR	p-value	Est.	IR	p-value
>high school	-0.01	0.99	0.850	0.05	1.05	**0.026**	0.14	1.15	**<.0001**	0.05	1.05	0.789	-0.01	0.99	0.571
Annual income															
<$25,000	Ref	–		Ref	Ref	–	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–
>$25,000	-0.02	0.98	0.711	0.14	1.15	**<.0001**	0.10	1.11	**<.0001**	0.01	1.01	0.943	0.003	1.00	0.845
LIS															
Yes	-0.013	1.00	0.802	-0.05	0.95	0.071	-0.15	0.86	**<.0001**	-0.02	0.98	0.913	0.22	1.25	**<.0001**
No	Ref	–		Ref	Ref	–	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–
MSA															
Yes	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–
No	-0.04	0.96	0.488	-0.26	0.77	**<.0001**	0.10	1.11	**<.0001**	-0.08	0.92	0.781	-0.02	0.98	0.329
Census region															
Northeast	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–
Midwest	-0.06	0.94	0.340	-0.08	0.93	**0.013**	0.002	1.00	0.950	-0.13	0.88	0.602	0.09	1.09	**<.0001**
South	0.02	1.02	0.770	-0.28	0.76	**<.0001**	0.02	1.02	0.398	-0.02	0.98	0.927	0.13	1.14	**<.0001**
West	-0.06	0.94	0.347	-0.16	0.85	**<.0001**	-0.01	0.99	0.582	-0.02	0.98	0.932	-0.02	0.98	0.351
Other RX coverage															
None	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–
Public	-0.04	0.96	0.441	0.01	1.01	0.698	-0.06	0.94	**0.013**	-0.10	0.91	0.693	0.12	1.13	**<.0001**
Private/self-purchased	-0.06	0.94	0.584	-0.01	0.99	0.818	-0.06	0.94	0.128	-0.07	0.93	0.843	0.03	1.03	0.278
Self-perceived Health Status															
Excellent	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–
Very good	0.02	1.02	0.841	0.01	1.01	0.786	0.08	1.09	**<.0001**	-0.09	0.91	0.802	0.19	1.21	**<.0001**
Good	0.03	1.04	0.648	0.10	1.11	**0.001**	0.21	1.23	**<.0001**	-0.06	0.94	0.860	0.33	1.39	**<.0001**
Fair	0.06	1.06	0.477	0.21	1.23	**<.0001**	0.29	1.34	**<.0001**	-0.07	0.93	0.851	0.43	1.54	**<.0001**
Poor	0.1	1.1	0.286	0.14	1.15	**0.006**	0.28	1.32	**<.0001**	-0.13	0.88	0.749	0.45	1.57	**<.0001**
Number of chronic condition															
0-1	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–
2-4	0.09	1.1	0.129	0.04	1.04	0.172	0.09	1.10	**<.0001**	-0.06	0.94	0.794	0.30	1.36	**<.0001**
4+	0.16	1.18	**0.027**	0.10	1.10	**0.008**	0.25	1.28	**<.0001**	-0.05	0.95	0.857	0.54	1.72	**<.0001**
CCI															
None	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–
1-2	-0.02	0.98	0.792	0.14	1.15	**<.0001**	0.19	1.20	**<.0001**	0.17	1.18	0.565	0.13	1.14	**<.0001**
3+	-0.01	0.99	0.852	0.32	1.37	**<.0001**	0.32	1.38	**<.0001**	0.16	1.18	0.611	0.11	1.12	**<.0001**

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Characteristics	Hospital			Outpatient			Physician's Office			Other Services			Prescriptions		
	Est.	IR	p-value	Est.	IR	p-value	Est.	IR	p-value	Est.	IR	p-value	Est.	IR	p-value
ADL															
None	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–
1-2	0.05	1.05	0.316	0.10	1.11	**<.0001**	0.19	1.21	**<.0001**	0.07	1.07	0.718	0.07	1.08	**<.0001**
3+	0.15	1.16	**0.010**	0.17	1.18	**<.0001**	0.36	1.43	**<.0001**	-0.02	0.98	0.918	0.13	1.14	**<.0001**
IADL															
None	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–
1-2	0.01	1.01	0.790	0.10	1.11	**<.0001**	0.17	1.18	**<.0001**	0.13	1.13	0.463	0.05	1.06	**<.0001**
3+	-0.04	0.96	0.455	0.07	1.07	0.074	0.11	1.11	**<.0001**	0.06	1.06	0.806	0.06	1.06	**0.012**
BMI, kg/m2															
<25.0	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–
25.0-29.9	-0.01	0.99	0.786	0.02	1.02	0.344	0.03	1.03	0.053	-0.04	0.96	0.840	0.09	1.09	**<.0001**
≥30.0	0.004	1.00	0.934	0.02	1.02	0.331	0.05	1.05	**0.006**	0.03	1.03	0.885	0.13	1.14	**<.0001**
Smoking															
Never	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–
Past	0.05	1.05	0.200	-0.01	0.99	0.489	0.01	1.01	0.477	0.03	1.03	0.841	-0.001	1.00	0.918
Current	0.08	1.09	0.248	-0.09	0.91	**0.013**	-0.16	0.85	**<.0001**	-0.10	0.91	0.763	-0.04	0.96	**0.042**
Care-seeking attitude															
Avoid going to a physician															
Yes	-0.03	0.97	0.530	-0.10	0.91	**0.0001**	-0.23	0.80	**<.0001**	-0.03	0.97	0.861	-0.10	0.91	**<.0001**
No	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–
Visit a physician as soon as feel bad															
Yes	0.02	1.02	0.684	0.08	1.09	**0.0001**	0.11	1.12	**<.0001**	-0.03	0.97	0.853	0.07	1.08	**<.0001**
No	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–
Worry about health more than others															
Yes	-0.02	0.98	0.702	0.10	1.10	**0.0002**	0.15	1.16	**<.0001**	0.15	1.16	0.416	0.05	1.05	**0.003**
No	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–
Keep to self when sick															
Yes	0.01	1.01	0.906	-0.03	0.97	0.183	-0.01	0.99	0.365	0.06	1.06	0.749	-0.02	0.98	0.072
No	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–
Same physician>5 years															
Yes	-0.03	0.97	0.431	-0.005	1.00	0.800	0.04	1.04	**0.004**	0.01	1.01	0.922	-0.02	0.98	0.168
No	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–
Environment factors															

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Characteristics	Hospital			Outpatient			Physician's Office			Other Services			Prescriptions		
	Est.	**IR**	**p-value**	**Est.**	**IR**	**p-value**	**Est.**	**IR**	**p-value**	**Est.**	**IR**	**p-value**	**Est.**	**IR**	**p-value**
Number of primary physicians	0.04	1.04	0.766	0.104	1.11	0.083	0.21	1.24	**<.0001**	-0.26	0.77	0.663	-0.03	0.97	0.394
Number of hospital beds	-0.002	1.00	0.878	0.0004	1.00	0.948	-0.02	0.98	**<.0001**	0.01	1.01	0.844	0.01	1.01	**<.0001**
Percent under Poverty	-0.001	1.00	0.772	0.003	1.00	0.250	0.003	1.00	0.170	0.00	1.00	0.883	0.005	1.00	**0.005**
Unemployment rate	0.004	1.00	0.786	-0.02	0.98	**0.020**	-0.03	0.97	**<.0001**	0.01	1.01	0.920	-0.02	0.98	**<.0001**
Education higher than high school	-0.0002	1.00	0.952	0.004	1.00	0.067	-0.003	1.00	**0.017**	0.01	1.01	0.694	-0.004	1.00	**0.001**
Study year															
2006	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–
2007	-0.006	0.99	0.920	-0.03	0.97	0.388	0.01	1.01	0.712	-0.0004	1.00	0.999	-0.02	0.99	0.431
2008	-0.06	0.94	0.331	-0.02	0.98	0.608	-0.02	0.98	0.448	0.03	1.03	0.898	-0.01	0.99	0.490
2009	-0.05	0.95	0.401	-0.02	0.98	0.482	-0.02	0.98	0.319	-0.05	0.95	0.836	-0.04	0.96	0.061
2010	-0.03	0.97	0.659	0.06	1.07	0.053	0.02	1.02	0.357	-0.01	0.99	0.973	-0.04	0.97	0.072

Abbreviations: **MCBS**, Medicare Current Beneficiary Survey (MCBS); **SE**, standard error; **MSA**, Metropolitan Statistical Areas; **CCI**, Charlson Comorbidity Index; **ADLs**, Activities of daily living, includes bathing or showering, getting dressed, getting in and out of a chair, walking, and using the toilet; **IADLs**, Instrumental activities of daily living, including using telephone, shopping, preparing food, housekeeping, laundry, traveling, taking medication, and managing financial matters independently; **BMI**, body mass index, calculated as weight in kilograms divided by height in meters squared.

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5.2.3 IV model: healthcare utilizations

First stage of IV model

Table 5.6 shows the distributions of the instrumental variables used in the first-stage 2SRI model. Compared to MA enrollees, PDP enrollees were more likely to reside in the counties with higher PDP penetration rate (42.57% vs. 32.76%; p<0.0001), and states offering State Pharmaceutical Assistance Programs for the elderly (35.12% vs. 29.22%; p<0.0001), while PDP enrollees were less likely to live in the counties with higher percentage of white collar job (56.15% vs. 60.76%; p<0.0001).

Table 5.6 Descriptive Statistics for IVs of Study Sample

Instruments	PDPs	MA-PDs	p-value
PDP penetration rate, mean ± std	42.57 ± 11.45	32.76 ± 9.23	**<.0001**
%white collar job, mean ± std	56.15 ± 9.84	60.76 ± 7.41	**<.0001**
SPAP, n (%)	3516 (35.12%)	1852 (29.22%)	**<.0001**

Abbreviations: **std**, standard deviation; **SPAP**, State Pharmaceutical Assistance Programs

In the first stage of IV model, prohibit regression model was used to estimate the probability of enrolling in PDPs compared to MA-PDs. The statistical significant predictors of enrolling in PDPs include age, sex, race/ethnicity, marital status, living conditions, education, income, LIS status, MSA, census region, having other RX coverage, number of chronic conditions, CCI, IADLs, BMI, care-seeking attitudes, environment factors, and calendar year. The first stage of 2SRI estimation is presented in Tables 5.7 below.

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Table 5.7 Aim 2&Aim 3.1: The First Stage of IV Estimation

Characteristics	Coefficient	SE	p value
Instruments			
PDP penetration rate	0.06	0.002	**<.0001**
% White collar job	-0.01	0.005	**<.0001**
SPAP	0.09	0.04	**0.050**
Age, years			
65-75	Ref	–	–
75-85	-0.04	0.02	0.094
>85	0.12	0.04	**0.001**
Sex			
Male	Ref	–	–
Female	0.15	0.03	**<.0001**
Race/ethnicity			
Non-Hispanic White	Ref	–	–
Non-Hispanic Black	-0.50	0.04	**<.0001**
Hispanics	-0.21	0.04	**<.0001**
Non-Hispanic others	0.15	0.05	**0.004**
Marriage			
Married	Ref	–	–
Widowed	0.19	0.08	**0.011**
Divorced/separated	0.05	0.08	0.500
Never married	0.27	0.10	**0.006**
Living conditions			
Alone	Ref	–	–
With spouse	-0.01	0.08	0.938
With children	-0.10	0.04	**0.006**
With others	-0.16	0.05	**0.001**
Education level			
< high school	0.02	0.04	0.538
High school/GED	Ref	–	–
>high school	0.16	0.03	**<.0001**
Annual income			
<$25,000	Ref	–	–
≥$25,000	0.16	0.03	**<.0001**
LIS			
Yes	0.72	0.04	**<.0001**
No	Ref	–	–
MSA			
Yes	Ref	–	–
No	-0.63	0.05	**<.0001**
Census region			
Northeast	Ref	–	–
Midwest	0.23	0.04	**<.0001**

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Characteristics	Coefficient	SE	p value
South	0.42	0.05	**<.0001**
West	0.04	0.05	0.464
Other RX coverage			
None	Ref	–	–
Public	0.29	0.04	**<.0001**
Private/self-purchased	0.38	0.07	**<.0001**
Self-perceived health status			
Excellent	Ref	–	–
Very good	-0.002	0.03	0.947
Good	0.05	0.03	0.168
Fair	0.04	0.04	0.385
Poor	0.07	0.07	0.307
Number of chronic conditions			
0-1	Ref	–	–
2-4	-0.02	0.03	0.442
4+	-0.08	0.04	0.066
CCI			
None	Ref	–	–
1-2	0.10	0.03	**0.003**
3+	0.13	0.04	**0.001**
ADLs			
None	Ref	–	–
1-2	-0.02	0.03	0.450
3+	0.07	0.05	0.155
IADLs			
None	Ref	–	–
1-2	0.07	0.03	**0.017**
3+	0.20	0.05	**0.0002**
BMI, kg/m^2			
<25.0	Ref	–	–
25.0-29.9	0.04	0.03	0.090
≥30.0	0.08	0.03	**0.004**
Smoking			
Never	Ref	–	–
Past	-0.03	0.02	0.229
Current	-0.04	0.04	0.350
Care-seeking attitudes			
Avoid going to a physician			
Yes	0.02	0.03	0.503
No	Ref	–	–
Visit a physician as soon as feel bad			
Yes	0.01	0.02	0.821
No	Ref	–	–
Worry about health more than			

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Characteristics	Coefficient	SE	p value
others			
Yes	-0.06	0.03	0.059
No	Ref	–	–
Keep to self when sick			
Yes	0.005	0.03	0.847
No	Ref	–	–
Same physician>5 years			
Yes	0.11	0.02	**<.0001**
No	Ref	–	–
Environment factors			
Number of primary physicians	-0.02	0.08	0.818
Number of hospital beds	-0.02	0.01	**0.015**
Percent under Poverty	-0.03	0.00	**<.0001**
Unemployment rate	-0.05	0.01	**<.0001**
Education higher than high school	0.0001	0.004	0.970
Calendar year			
2006	Ref	–	–
2007	0.31	0.04	**<.0001**
2008	0.25	0.04	**<.0001**
2009	0.16	0.04	**<.0001**
2010	0.34	0.04	**<.0001**

Abbreviations: **MCBS**, Medicare Current Beneficiary Survey (MCBS); **SPAP**, State Pharmaceutical Assistance Programs; **SE**, standard error; **MSA**, Metropolitan Statistical Areas; **CCI**, Charlson Comorbidity Index; **ADLs**, Activities of daily living, includes bathing or showering, getting dressed, getting in and out of a chair, walking, and using the toilet; **IADLs**, Instrumental activities of daily living, including using telephone, shopping, preparing food, housekeeping, laundry, traveling, taking medication, and managing financial matters independently; **BMI**, body mass index, calculated as weight in kilograms divided by height in meters squared.

To test the assumption of IV, several model specification tests were performed (Table 5.8). First, Durbin-Wu-Hausman tests were performed to access whether endogeneity exists between type of Part D plans and outcome measures. The results indicate that type of Part D plan is endogenous for all the use data, only except the number of hospitalizations. Second, since multiple instruments were used in this analysis, Hansen's tests of overidentifying were performed to evaluate the validity of instruments. The results indicate that we cannot reject the hypotheses that the instruments are valid.

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Third, the F statistics for instruments is greater than 10, suggesting that the instruments are not weak.

Table 5.8 Model Specification Tests for IV: Healthcare Utilizations

Outcome Measures	**Endogeneity test** (Durbin-Wu-Hausman)	**Overidentification Test** (Sargan-Hansen J)	**Weak-IV Test** (Staiger-Stock)
Hospitalizations	1.47 (p = 0.23)	1.23 (p = 0.53)	13.91
Outpatient	21.92 (**p <.0001**)	5.17 (p = 0.08)	13.91
Medical Providers	4.87 (**p = 0.03**)	5.50 (p = 0.06)	13.91
Others medical services	0 .049 (p = 0.83)	1.62 (p = 0.44)	13.91
Pharmacy claims	12.91 (**p = 0.0003**)	2.84 (p = 0.24)	13.91

Second stage of IV models: healthcare utilizations

Table 5.9 summarizes the results for the effects of PDP on health care utilizations in 2SRI models. For easier interpretation, Incidence Rate (IR), which was calculated using the equation ($e^{coefficient}$), is also presented in Table 5.10 below. The results indicate that PDP enrollees had similar likelihood of filling prescription drugs (IR=1.05, p=0.161). However, PDP enrollees had 47% higher likelihood of using outpatient care (IR=1.47, p<0.0001), 39% higher likelihood of visiting physician's office (IR=1.39, p<0.0001), while 85% lower likelihood in using other medical services (IR=0.15, p=0.0001), compared to MA-PD enrollees.

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Table 5.9 IV Model: Effects of PDPs on the Healthcare Utilizations

Characteristics	Outpatient			Physician's office			Prescriptions		
	Est.	IR	p value	Est.	IR	p value	Est.	IR	p value
Residual from 1st stage	-0.21	**0.81**	**0.002**	0.02	1.02	0.684	-0.02	0.98	0.608
Part D enrollment									
PDPs	**0.38**	1.47	**<.0001**	**0.33**	1.39	**<.0001**	**0.05**	**1.05**	**0.161**
MA-PDs	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–
Age, years									
65-75	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–
75-85	0.04	1.04	**0.047**	0.06	1.07	**<.0001**	0.06	1.06	**0.000**
>85	-0.09	0.91	**0.004**	-0.02	0.98	0.453	0.08	1.08	**0.000**
Sex									
Male	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–
Female	0.03	1.03	0.181	0.16	1.17	**<.0001**	0.08	1.08	**<.0001**
Race/ethnicity									
Non-Hispanic White	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–
Non-Hispanic Black	-0.09	0.92	**0.025**	-0.32	0.73	**<.0001**	-0.08	0.92	**0.000**
Hispanics	-0.13	0.88	**0.001**	-0.13	0.87	**<.0001**	0.00	1.00	0.906
Non-Hispanic others	-0.01	0.99	0.765	-0.17	0.85	**<.0001**	-0.03	0.97	0.260
Marriage									
Married	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–
Widowed	0.10	1.11	0.131	0.07	1.07	0.156	-0.05	0.95	0.173
Divorced/separated	0.12	1.13	0.102	0.09	1.09	0.091	-0.07	0.93	0.088
Never married	0.09	1.09	0.323	0.09	1.09	0.146	-0.04	0.96	0.462
Living conditions									
Alone	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–
With spouse	0.11	1.12	0.102	0.13	1.14	**0.007**	-0.10	0.91	**0.013**
With children	-0.08	0.93	**0.020**	-0.04	0.96	0.078	-0.03	0.97	0.059
With others	0.00	1.00	0.929	0.11	1.11	**0.001**	0.00	1.00	0.994
Education level									
< high school	-0.01	0.99	0.819	-0.10	0.90	**<.0001**	0.02	1.02	0.197
High school/GED	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–

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Characteristics	Outpatient			Physician's office			Prescriptions		
	Est.	IR	p value	Est.	IR	p value	Est.	IR	p value
>high school	0.04	1.05	0.051	0.14	1.15	**<.0001**	-0.01	0.99	0.532
Annual income									
<$25,000	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–
≥$25,000	0.13	1.14	**<.0001**	0.10	1.11	**<.0001**	0.002	1.00	0.878
LIS									
Yes	-0.09	0.92	**0.005**	-0.15	0.86	**<.0001**	0.22	1.25	**<.0001**
No	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–
MSA									
Yes	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–
No	-0.20	0.82	**<.0001**	0.10	1.10	**0.0001**	-0.01	0.99	0.629
Census region									
Northeast	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–
Midwest	-0.10	0.91	**0.003**	0.00	1.00	0.891	0.08	1.09	**<.0001**
South	-0.31	0.74	**<.0001**	0.02	1.02	0.362	0.13	1.14	**<.0001**
West	-0.14	0.87	**<.0001**	-0.02	0.98	0.545	-0.02	0.98	0.404
Other RX coverage									
None	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–
Public	0.00	1.00	0.898	-0.06	0.95	**0.017**	0.12	1.13	**<.0001**
Private/self-purchased	-0.04	0.97	0.522	-0.06	0.94	0.150	0.03	1.03	0.317
Self-perceived health status									
Excellent	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–
Very good	0.00	1.00	0.900	0.08	1.09	**0.000**	0.19	1.21	**<.0001**
Good	0.10	1.10	**0.003**	0.21	1.23	**<.0001**	0.33	1.39	**<.0001**
Fair	0.20	1.22	**<.0001**	0.29	1.34	**<.0001**	0.43	1.54	**<.0001**
Poor	0.13	1.14	**0.010**	0.28	1.32	**<.0001**	0.45	1.57	**<.0001**
Number of chronic conditions									
0-1	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–
4-Feb	0.04	1.04	0.168	0.09	1.09	**<.0001**	0.30	1.36	**<.0001**
4+	0.10	1.11	**0.005**	0.24	1.28	**<.0001**	0.54	1.72	**<.0001**
CCI									
None	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–

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Characteristics	Outpatient			Physician's office			Prescriptions		
	Est.	IR	p value	Est.	IR	p value	Est.	IR	p value
2-Jan	0.14	1.15	**0.000**	0.19	1.21	**<.0001**	0.13	1.14	**<.0001**
3+	0.31	1.36	**<.0001**	0.32	1.38	**<.0001**	0.11	1.11	**<.0001**
ADLs									
None	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–
2-Jan	0.11	1.11	**<.0001**	0.19	1.21	**<.0001**	0.07	1.08	**<.0001**
3+	0.16	1.18	**<.0001**	0.36	1.43	**<.0001**	0.13	1.14	**<.0001**
IADLs									
None	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–
2-Jan	0.10	1.10	**<.0001**	0.17	1.18	**<.0001**	0.05	1.06	**0.000**
3+	0.06	1.06	0.138	0.11	1.11	**0.0001**	0.06	1.06	**0.014**
BMI, kg/m2									
<25.0	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–
25.0-29.9	0.02	1.02	0.411	0.03	1.03	0.051	0.09	1.09	**<.0001**
≥30.0	0.02	1.02	0.401	0.05	1.05	**0.006**	0.13	1.14	**<.0001**
Smoking									
Never	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–
Past	-0.01	0.99	0.651	0.01	1.01	0.485	0.00	1.00	0.939
Current	-0.09	0.91	**0.016**	-0.16	0.85	**<.0001**	-0.04	0.96	**0.044**
Care-seeking attitudes									
Avoid going to a physician									
Yes	-0.10	0.91	**<.0001**	-0.23	0.80	**<.0001**	-0.10	0.91	**<.0001**
No	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–
Visit a physician as soon as feel bad									
Yes	0.08	1.09	**<.0001**	0.11	1.12	**<.0001**	0.07	1.08	**<.0001**
No	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–
Worry about health more than others									
Yes	0.10	1.10	**<.0001**	0.15	1.16	**<.0001**	0.05	1.05	**0.003**
No	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–
Keep to self when sick									
Yes	-0.03	0.97	0.191	-0.02	0.99	0.344	-0.02	0.98	0.065
No	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–

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Characteristics	Outpatient			Physician's office			Prescriptions		
	Est.	IR	p value	Est.	IR	p value	Est.	IR	p value
Same physician>5 years									
Yes	-0.01	0.99	0.571	0.04	1.04	**0.004**	-0.02	0.98	0.142
No	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–
Environment factors									
Number of primary physicians	0.10	1.11	0.084	0.21	1.23	**<.0001**	-0.03	0.98	0.489
Number of hospital beds	0.00	1.00	0.799	-0.02	0.98	**<.0001**	0.01	1.01	**0.001**
Percent under Poverty	0.00	1.00	0.070	0.00	1.00	0.207	0.00	1.00	**0.005**
Unemployment rate	-0.02	0.98	**0.024**	-0.03	0.97	**<.0001**	-0.02	0.98	**<.0001**
Education higher than high school	0.00	1.00	0.055	0.00	1.00	**0.017**	0.00	1.00	**0.001**
Calendar year									
2006	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–
2007	-0.05	0.95	0.150	0.01	1.01	0.591	-0.02	0.98	0.398
2008	-0.03	0.97	0.304	-0.01	0.99	0.559	-0.01	0.99	0.462
2009	-0.03	0.97	0.316	-0.02	0.98	0.385	-0.04	0.96	0.059
2010	0.05	1.05	0.177	0.03	1.03	0.281	-0.04	0.96	0.064

Abbreviations: **MCBS**, Medicare Current Beneficiary Survey (MCBS); **SE**, standard error; **MSA**, Metropolitan Statistical Areas; **CCI**, Charlson Comorbidity Index; **ADLs**, Activities of daily living, includes bathing or showering, getting dressed, getting in and out of a chair, walking, and using the toilet; **IADLs**, Instrumental activities of daily living, including using telephone, shopping, preparing food, housekeeping, laundry, traveling, taking medication, and managing financial matters independently; **BMI**, body mass index, calculated as weight in kilograms divided by height in meters squared.

a. In the 2SRI Model, the instrumental variables are the county-level PDP penetration, percent of white collar job and State Pharmaceutical Assistance Programs for seniors in each study year.

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The results also reveal various demo-socioeconomics and clinical factors that were significantly associated with the use of health services. As shown in Appendix F (Table F.6-Table F.9), for the use of outpatient care, the statistically significant factors include age, race/ethnicity, living conditions, annual income, LIS status, MSA and census region, self-perceived health status, number of chronic conditions, CCI, ADLs, IADLs, smoking, BMI, and care-seeking attitudes. For the physician's office visits, the statistically significant factors include age, sex, race/ethnicity, living conditions, education, annual income, LIS status, MSA, having other RX coverage, self-perceived health status, number of chronic conditions, CCI, ADLs, IADL, BMI, smoking, care-seeking attitudes and environment factors. For the fill of prescriptions, the significant factors include age, sex, race/ethnicity, living conditions, LIS status, MSA, census region, having other RX coverage, self-perceived health status, number of chronic conditions, CCI, ADLs, IADLs, BMI, smoking, care-seeking attitudes, and environment factors.

5.3 Results for Aim 2.2: Healthcare Expenditures

The following section presents the model specification tests and selections of preferred multivariable models for each outcomes of interest, and the results of health care services costs, including the descriptive statistics and multivariable regression analysis.

5.3.1 Descriptive statistics

Table 5.10 presents bivariate results regarding healthcare costs between PDP enrollees and MA-PD enrollees. Compared to MA-PDs, PDPs were associated with higher costs for inpatient care ($1996.9 vs. $1711.4; p=0.015), outpatient care ($921.1 vs. $663.9; p<0.0001), physician's office ($2559.2 vs. $1663.1; p<0.0001) and prescription

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drugs ($3140.8 vs. $2319.7; p<0.0001), but had lower costs for other medical services ($29.3 vs. $143.8; p<0.0001). As a result, PDP group had statistically higher costs for all-type of medical services ($5506.5 vs. $4182.2; p<0.0001) and total healthcare costs ($8647.3 vs. $6501.8; p<0.0001).

Among different sources of payments, for Medicare spending, PDPs had similar costs for inpatient ($1700.8 vs. $1531.4; p=0.091) and outpatient care (614.3 vs. 545.6; p=0.152), compared to MA-PDs. For out-of-pocket spending, PDP enrollees had similar OOP costs for all medical services ($878.4 vs. 844.5; p=0.546), compared to MA-PDs. However, PDPs were associated with higher spending from public and private insurance.

Table 5.10 Unadjusted Healthcare Costs among Elderly Beneficiaries

Outcome measures	PDPs		MA-PDs		P-value
	Mean	Std.	Mean	Std.	
Hospitalization					
Medicare costs, $	1700.8	6042.4	1531.4	6373.1	0.091
Public insurance costs, $	55.2	923.0	19.9	489.9	**0.001**
Private insurance costs, $	127.8	870.3	12.6	541.5	**<.0001**
OOP costs, $	113.1	2152.6	147.7	2328.8	0.341
Total costs, $	1996.9	6881.0	1711.4	7518.0	**0.015**
Outpatient					
Medicare costs, $	614.3	2137.8	545.6	3423.2	0.152
Public insurance costs, $	29.6	333.8	9.8	149.4	**<.0001**
Private insurance costs, $	162.2	1173.3	5.5	116.9	**<.0001**
OOP costs, $	115.0	1392.7	103.1	671.5	0.462
Total costs, $	921.1	3264.4	663.9	3572.0	**<.0001**
Medical providers					
Medicare costs, $	1431.7	2521.1	1089.8	3293.3	**<.0001**
Public insurance costs, $	95.2	748.8	28.5	337.5	**<.0001**
Private insurance costs, $	393.9	916.8	15.1	232.8	**<.0001**
OOP costs, $	638.4	1919.1	529.7	1954.2	**0.001**
Total costs, $	2559.2	4105.6	1663.1	4040.3	**<.0001**
Others					
Medicare costs, $	6.2	251.6	78.2	918.6	**<.0001**
Public insurance costs, $	2.7	139.0	1.5	79.7	0.473
Private insurance costs, $	8.4	246.8	0.0	0.0	**0.001**
OOP costs, $	11.9	289.0	64.1	744.1	**<.0001**
Total costs, $	29.3	533.3	143.8	1236.7	**<.0001**

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Outcome measures	PDPs		MA-PDs		P-value
	Mean	Std.	Mean	Std.	
All medical services					
Medicare costs, $	3753.0	7864.9	3245.0	8887.1	**0.0001**
Public insurance costs, $	182.7	1375.2	59.6	663.6	**<.0001**
Private insurance costs, $	692.4	1947.2	33.1	639.8	**<.0001**
OOP costs, $	878.4	3443.8	844.5	3551.3	0.546
Total costs, $	5506.5	10168.4	4182.2	10549.6	**<.0001**
Prescriptions drugs					
Medicare costs, $	2204.8	3150.6	1653.1	2630.4	**<.0001**
Public insurance costs, $	155.6	724.2	61.3	347.7	**<.0001**
Private insurance costs, $	35.0	229.3	59.9	325.8	**<.0001**
OOP costs, $	745.6	1034.0	545.4	651.8	**<.0001**
Total costs, $	3140.8	3764.2	2319.7	2972.4	**<.0001**
Total Healthcare					
Medicare costs, $	5957.8	8828.2	4898.1	9633.6	**<.0001**
Public insurance costs, $	338.3	1601.4	120.9	779.9	**<.0001**
Private insurance costs, $	727.3	1973.2	93.1	758.4	**<.0001**
OOP costs, $	1624.0	3666.7	1389.8	3671.4	**<.0001**
Total costs, $	8647.3	11426.0	6501.8	11460.7	**<.0001**

5.3.2 Naïve model: healthcare expenditures

The following section presents the results for healthcare costs, including results from both naïve models and IV models

Naïve model: results for healthcare expenditures

Based on the specification tests in Appendix E, GLM models with gamma distribution and log link were used to estimate the effects of PDPs on healthcare costs among elderly Medicare beneficiaries.

Table 5.11 presents the results for the effects of PDP on healthcare expenditures from naïve model. The results indicate that PDPs had 15% higher costs for inpatient care (IR=1.15 p=0.021), 12% higher costs for outpatient care (IR=1.12, p=0.012), 50% higher costs for physician's office (IR=1.50, p<0.0001), but similar costs for other medical services (IR=1.02, p=0.912), Consequently, PDP enrollees 26% higher costs for all

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Table 5.11 Na ïve Model: Effects of PDPs on the Healthcare Expenditures

Characteristics	Hospital			Outpatient			Physician's office			Other Med. Services		
	Est.	IR	p-value	Est.	IR	p-value	Est.	IR	p value	Est.	IR	p value
Part D enrollment												
PDPs	**0.14**	**1.15**	**0.021**	**0.11**	**1.12**	**0.012**	**0.41**	**1.50**	**<.0001**	**-2.90**	**0.06**	**<.0001**
MA-PDs	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–
Age, years												
65-75	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–
75-85	0.12	1.13	0.061	0.02	1.02	0.723	0.12	1.13	**<.0001**	0.21	1.23	**0.027**
>85	0.02	1.03	0.793	-0.27	0.77	**<.0001**	0.00	1.00	0.988	2.18	8.86	**<.0001**
Sex												
Male	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–
Female	-0.21	0.81	**0.002**	0.02	1.02	0.660	0.09	1.09	**0.0003**	-0.79	0.46	**<.0001**
Race/ethnicity												
Non-Hispanic White	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–
Non-Hispanic Black	-0.13	0.88	0.248	-0.27	0.77	**0.001**	-0.39	0.68	**<.0001**	-0.12	0.88	0.381
Hispanics	-0.04	0.96	0.750	-0.35	0.71	**<.0001**	-0.08	0.93	0.056	0.41	1.50	**0.016**
Non-Hispanic others	-0.24	0.79	0.070	-0.42	0.65	**<.0001**	-0.34	0.71	**<.0001**	-2.38	0.09	**<.0001**
Marriage												
Married	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–
Widowed	0.23	1.26	0.239	0.02	1.02	0.892	0.13	1.14	0.061	1.36	3.91	**<.0001**
Divorced/separated	-0.02	0.99	0.941	-0.03	0.98	0.862	0.11	1.11	0.166	1.25	3.49	**<.0001**
Never married	-0.40	0.67	0.115	-0.11	0.90	0.529	0.06	1.06	0.534	2.81	16.53	**<.0001**
Living conditions												
Alone	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–
With spouse	0.18	1.20	0.351	0.13	1.14	0.360	0.17	1.19	**0.016**	0.88	2.42	**0.000**
With children	0.25	1.29	**0.006**	0.020	1.02	0.752	0.04	1.04	0.256	-1.14	0.32	**<.0001**
With others	0.12	1.13	0.355	0.06	1.06	0.529	0.11	1.11	**0.021**	0.52	1.68	**0.003**
Education level												
< high school	-0.09	0.91	0.291	-0.09	0.92	0.161	-0.15	0.86	**0.004**	-0.77	0.46	**<.0001**
High school/GED	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–

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Characteristics	Hospital			Outpatient			Physician's office			Other Med. Services		
	Est.	IR	p-value	Est.	IR	p-value	Est.	IR	p value	Est.	IR	p value
>high school	0.11	1.11	0.122	-0.03	0.97	0.520	0.20	1.22	**<.0001**	-0.29	0.75	**0.000**
Annual income												
<$25,000	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–
≥$25,000	-0.11	0.90	0.116	0.23	1.26	**<.0001**	0.12	1.12	**<.0001**	-0.65	0.52	**<.0001**
LIS												
Yes	-0.17	0.84	**0.038**	-0.06	0.94	0.300	-0.24	0.79	**<.0001**	-0.15	0.86	0.261
No	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–
MSA												
Yes	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–
No	0.06	1.06	0.476	-0.54	0.58	**<.0001**	0.03	1.03	0.306	-1.60	0.20	**<.0001**
Census region												
Northeast	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–
Midwest	-0.11	0.90	0.273	-0.03	0.97	0.675	0.01	1.01	0.701	-1.08	0.34	**<.0001**
South	-0.26	0.77	**0.007**	-0.06	0.95	0.388	0.02	1.02	0.600	-0.73	0.48	**<.0001**
West	-0.31	0.73	**0.002**	-0.20	0.82	**0.004**	-0.16	0.85	**<.0001**	-0.05	0.96	0.757
Other RX coverage												
None	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–
Public	0.00	1.00	0.964	-0.04	0.96	0.575	-0.04	0.96	0.269	0.46	1.58	**0.003**
Private/self-purchased	-0.11	0.89	0.479	0.19	1.20	0.095	0.05	1.06	0.356	0.25	1.29	0.199
Self-perceived health status												
Excellent	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–
Very good	0.18	1.20	**0.042**	0.07	1.07	0.259	0.06	1.06	0.075	1.15	3.15	**<.0001**
Good	0.47	1.60	**<.0001**	0.28	1.32	**<.0001**	0.20	1.22	**<.0001**	1.88	6.56	**<.0001**
Fair	0.74	2.10	**<.0001**	0.40	1.49	**<.0001**	0.28	1.32	**<.0001**	3.21	24.83	**<.0001**
Poor	1.03	2.81	**<.0001**	0.25	1.29	**0.023**	0.31	1.37	**<.0001**	4.12	61.46	**<.0001**
Number of chronic conditions												
0-1	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–
4-Feb	0.37	1.44	**<.0001**	0.15	1.16	0.066	0.13	1.14	**<.0001**	-0.18	0.83	0.105
4+	0.73	2.08	**<.0001**	0.38	1.47	**<.0001**	0.23	1.26	**<.0001**	0.31	1.36	0.059
CCI												

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Characteristics	Hospital			Outpatient			Physician's office			Other Med. Services		
	Est.	IR	p-value	Est.	IR	p-value	Est.	IR	p value	Est.	IR	p value
None	Ref	–		Ref	Ref	–	Ref	Ref	–	Ref	Ref	–
2-Jan	0.40	1.50	**<.0001**	0.24	1.28	**<.0001**	0.19	1.21	**<.0001**	2.58	13.18	**<.0001**
3+	0.43	1.54	**<.0001**	0.32	1.38	**0.000**	0.36	1.43	**<.0001**	1.36	3.89	**<.0001**
ADLs												
None	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–
2-Jan	0.30	1.35	**0.0001**	0.26	1.29	**0.020**	0.23	1.26	**<.0001**	0.54	1.72	**<.0001**
3+	0.59	1.81	**<.0001**	0.34	1.40	**0.029**	0.49	1.63	**<.0001**	1.18	3.25	**<.0001**
IADLs												
None	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–
2-Jan	0.15	1.17	**0.038**	0.09	1.09	0.100	0.26	1.29	**<.0001**	1.31	3.72	**<.0001**
3+	0.10	1.10	0.426	-0.05	0.95	0.523	0.15	1.16	**0.001**	1.58	4.84	**<.0001**
BMI, kg/m2												
<25.0	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–
25.0-29.9	-0.06	0.94	0.338	0.07	1.08	0.113	-0.02	0.98	0.497	-0.09	0.92	0.346
≥30.0	0.09	1.10	0.207	0.01	1.01	0.897	0.01	1.01	0.669	-1.04	0.35	**<.0001**
Smoking												
Never	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–
Past	0.20	1.22	**0.002**	0.01	1.01	0.823	0.08	1.09	**0.000**	0.29	1.34	**0.001**
Current	-0.05	0.95	0.629	-0.13	0.88	0.072	-0.16	0.86	**0.000**	1.17	3.22	**<.0001**
Care-seeking attitudes												
Avoid going to a physician												
Yes	-0.21	0.81	**0.003**	-0.13	0.88	**0.010**	-0.20	0.82	**<.0001**	0.44	1.55	**0.0001**
No	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–
Visit a physician as soon as feel bad												
Yes	0.15	1.16	**0.014**	0.12	1.13	**0.004**	0.08	1.09	**0.000**	-0.54	0.58	**<.0001**
No	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–
Worry about health more than others												
Yes	0.12	1.13	0.141	0.29	1.34	0.143	0.14	1.15	**<.0001**	-0.49	0.62	**<.0001**

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Characteristics	Hospital			Outpatient			Physician's office			Other Med. Services		
	Est.	IR	p-value	Est.	IR	p-value	Est.	IR	p value	Est.	IR	p value
No	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–
Keep to self when sick												
Yes	0.10	1.11	0.110	-0.004	1.00	0.935	-0.04	0.96	0.07	-1.39	0.25	**<.0001**
No	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–
Same physician>5 years												
Yes	-0.05	0.95	0.347	-0.02	0.98	0.615	0.05	1.06	**0.009**	-0.13	0.88	0.066
No	Ref	Ref	–	Ref	–		Ref	Ref	–	Ref	Ref	–
Environment factors												
Number of primary physicians	-0.57	0.57	**0.004**	-0.15	0.86	0.237	0.00	1.00	0.953	-2.20	0.11	**<.0001**
Number of hospital beds	0.01	1.01	0.631	0.01	1.01	0.284	0.00	1.00	0.984	0.02	1.03	0.420
Percent under Poverty	0.01	1.01	0.074	-0.01	0.99	0.057	0.00	1.00	0.660	-0.09	0.91	**<.0001**
Unemployment rate	-0.03	0.97	0.255	-0.01	0.99	0.630	-0.04	0.96	**<.0001**	-0.32	0.73	**<.0001**
Education higher than high school	0.01	1.01	0.082	0.01	1.01	**0.006**	0.001	1.00	0.580	0.08	1.08	**<.0001**
Calendar year												
2006	Ref	Ref	–	Ref	Ref	–	Ref	–		Ref	Ref	–
2007	0.03	1.03	0.767	0.17	1.18	**0.014**	0.06	1.06	0.108	-0.39	0.68	**0.001**
2008	0.02	1.02	0.842	0.11	1.12	0.099	0.12	1.13	**0.001**	0.95	2.59	**<.0001**
2009	-0.01	0.99	0.892	0.03	1.03	0.670	0.10	1.11	**0.005**	0.43	1.54	**0.0004**
2010	-0.05	0.95	0.592	0.25	1.29	**0.0003**	0.05	1.05	0.221	1.18	3.25	**<.0001**

Abbreviations: **MCBS**, Medicare Current Beneficiary Survey (MCBS); **SE**, standard error; **MSA**, Metropolitan Statistical Areas; **CCI**, Charlson Comorbidity Index; **ADLs**, Activities of daily living, includes bathing or showering, getting dressed, getting in and out of a chair, walking, and using the toilet; **IADLs**, Instrumental activities of daily living, including using telephone, shopping, preparing food, housekeeping, laundry, traveling, taking medication, and managing financial matters independently; **BMI**, body mass index, calculated as weight in kilograms divided by height in meters squared.
a. These results were adjusted for the variables listed in Table 5.1. In the Naïve Model, annual costs of health care services (including prescription drugs) were estimated using a GLM model with Gamma distribution and log link.

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Table 5.11 Na ïve Model: Effects of PDPs on the Healthcare Expenditures (Continued)

Characteristics	All Med. Services			Prescriptions			Total Healthcare		
	Est.	IR	p-value	Est.	IR	p-value	Est.	IR	p value
Part D enrollment									
PDPs	**0.230**	**1.26**	**<.0001**	**0.17**	**1.19**	**<.0001**	**0.22**	**1.25**	**<.0001**
MA-PDs	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–
Age, years									
65-75	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–
75-85	0.10	1.10	**0.0001**	-0.02	0.98	0.406	0.05	1.05	**0.005**
>85	-0.04	0.96	0.234	-0.05	0.95	0.077	-0.06	0.94	**0.016**
Sex									
Male	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–
Female	-0.03	0.97	0.335	0.10	1.11	**<.0001**	0.01	1.01	0.6120
Race/ethnicity									
Non-Hispanic White	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–
Non-Hispanic Black	-0.24	0.79	**<.0001**	-0.20	0.82	**<.0001**	-0.23	0.80	**<.0001**
Hispanics	-0.08	0.93	0.083	-0.07	0.94	0.059	-0.07	0.93	**0.016**
Non-Hispanic others	-0.30	0.74	**<.0001**	-0.06	0.94	0.129	-0.19	0.83	**0.002**
Marriage									
Married	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–
Widowed	0.16	1.17	**0.045**	0.01	1.01	0.854	0.09	1.09	0.087
Divorced/separated	0.05	1.05	0.545	-0.03	0.97	0.674	0.02	1.02	0.703
Never married	-0.13	0.88	0.197	-0.04	0.96	0.618	-0.08	0.92	0.228
Living conditions									
Alone	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–
With spouse	0.19	1.20	**0.019**	0.01	1.01	0.831	0.11	1.11	**0.043**
With children	0.13	1.14	**0.001**	0.020	1.02	0.612	0.07	1.08	**0.003**
With others	0.13	1.14	**0.012**	0.05	1.05	0.236	0.08	1.08	**0.026**
Education level									
< high school	-0.12	0.89	**0.001**	0.00	1.00	0.988	-0.06	0.94	**0.007**
High school/GED	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–
>high school	0.12	1.13	**<.0001**	0.11	1.12	**<.0001**	0.12	1.12	**<.0001**

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Characteristics	All Med. Services			Prescriptions			Total Healthcare		
	Est.	IR	p-value	Est.	IR	p-value	Est.	IR	p value
Annual income									
<$25,000	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–
≥$25,000	0.08	1.08	**0.008**	0.12	1.13	**<.0001**	0.08	1.08	**0.000**
LIS									
Yes	-0.18	0.83	**<.0001**	0.23	1.26	**<.0001**	-0.02	0.98	0.415
No	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–
MSA									
Yes	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–
No	-0.08	0.93	**0.026**	0.05	1.05	0.062	-0.04	0.96	0.117
Census region									
Northeast	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–
Midwest	-0.06	0.94	0.135	-0.02	0.98	0.448	-0.05	0.95	**0.045**
South	-0.13	0.88	**0.001**	0.03	1.03	0.329	-0.08	0.93	**0.003**
West	-0.25	0.78	**<.0001**	-0.12	0.89	**0.000**	-0.21	0.81	**<.0001**
Other RX coverage									
None	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–
Public	-0.02	0.98	0.549	0.23	1.26	**<.0001**	0.07	1.07	**0.007**
Private/self-purchased	0.06	1.06	0.357	0.13	1.14	**0.009**	0.08	1.09	0.050
Self-perceived health status									
Excellent	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–
Very good	0.10	1.10	**0.005**	0.27	1.32	**<.0001**	0.15	1.16	**<.0001**
Good	0.30	1.35	**<.0001**	0.42	1.53	**<.0001**	0.33	1.40	**<.0001**
Fair	0.47	1.60	**<.0001**	0.59	1.80	**<.0001**	0.50	1.65	**<.0001**
Poor	0.59	1.80	**<.0001**	0.66	1.93	**<.0001**	0.60	1.81	**<.0001**
Number of chronic conditions									
0-1	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–
4-Feb	0.18	1.20	**<.0001**	0.31	1.36	**<.0001**	0.22	1.24	**<.0001**
4+	0.39	1.48	**<.0001**	0.54	1.72	**<.0001**	0.42	1.53	**<.0001**
CCI									
None	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–
2-Jan	0.28	1.32	**<.0001**	0.24	1.27	**<.0001**	0.23	1.26	**<.0001**

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Characteristics	All Med. Services			Prescriptions			Total Healthcare		
	Est.	IR	p-value	Est.	IR	p-value	Est.	IR	p value
3+	0.44	1.56	**<.0001**	0.29	1.34	**<.0001**	0.36	1.43	**<.0001**
ADLs									
None	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–
2-Jan	0.26	1.30	**<.0001**	0.05	1.05	**0.045**	0.18	1.20	**<.0001**
3+	0.49	1.64	**<.0001**	0.10	1.10	**0.009**	0.35	1.42	**<.0001**
IADLs									
None	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–
2-Jan	0.18	1.20	**<.0001**	0.11	1.12	**<.0001**	0.15	1.16	**<.0001**
3+	0.11	1.11	**0.027**	0.15	1.17	**0.000**	0.11	1.12	**0.001**
BMI, kg/m2									
<25.0	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–
25.0-29.9	-0.04	0.96	0.122	0.09	1.10	**<.0001**	0.00	1.00	0.971
≥30.0	-0.01	0.99	0.861	0.10	1.11	**<.0001**	0.03	1.03	0.187
Smoking									
Never	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–
Past	0.10	1.11	**0.0002**	-0.01	0.99	0.732	0.05	1.06	**0.001**
Current	-0.12	0.89	**0.004**	-0.13	0.88	**0.000**	-0.10	0.90	**0.000**
Care-seeking attitudes									
Avoid going to a physician									
Yes	-0.19	0.83	**<.0001**	-0.21	0.81	**<.0001**	-0.18	0.84	**<.0001**
No	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–
Visit a physician as soon as feel bad									
Yes	0.11	1.11	**<.0001**	0.10	1.10	**<.0001**	0.10	1.11	**<.0001**
No	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–
Worry about health more than others									
Yes	0.16	1.17	**<.0001**	0.09	1.10	**0.000**	0.12	1.13	**<.0001**
No	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–
Keep to self when sick									
Yes	0.00	1.00	0.977	-0.010	0.99	0.723	-0.01	1.00	0.781
No	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–

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Characteristics	All Med. Services			Prescriptions			Total Healthcare		
	Est.	IR	p-value	Est.	IR	p-value	Est.	IR	p value
Same physician>5 years									
Yes	0.00	1.00	0.951	0.01	1.01	0.594	-0.01	0.99	0.508
No	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–
Environment factors									
Number of primary physicians	-0.21	0.81	**0.005**	0.00	1.00	0.997	-0.13	0.88	**0.008**
Number of hospital beds	0.00	1.00	0.643	0.00	1.00	0.623	0.00	1.00	0.523
Percent under Poverty	0.01	1.01	0.103	0.01	1.01	**0.017**	0.01	1.01	**0.008**
Unemployment rate	-0.04	0.96	**0.000**	0.00	1.00	0.693	-0.02	0.98	**0.001**
Education higher than high school	0.01	1.01	**0.010**	0.00	1.00	0.260	0.005	1.00	**0.003**
Calendar year									
2006	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–
2007	0.05	1.05	0.238	0.02	1.02	0.536	0.04	1.04	0.144
2008	0.08	1.08	0.051	0.04	1.05	0.155	0.07	1.07	**0.012**
2009	0.03	1.03	0.427	0.15	1.16	**<.0001**	0.08	1.08	**0.003**
2010	0.05	1.05	0.189	0.12	1.13	**0.0001**	0.08	1.09	**0.002**

Abbreviations: **MCBS**, Medicare Current Beneficiary Survey (MCBS); **SE**, standard error; **MSA**, Metropolitan Statistical Areas; **CCI**, Charlson Comorbidity Index; **ADLs**, Activities of daily living, includes bathing or showering, getting dressed, getting in and out of a chair, walking, and using the toilet; **IADLs**, Instrumental activities of daily living, including using telephone, shopping, preparing food, housekeeping, laundry, traveling, taking medication, and managing financial matters independently; **BMI**, body mass index, calculated as weight in kilograms divided by height in meters squared.

a. These results were adjusted for the variables listed in Table 5.1. In the Na ïve Model, annual costs of health care services (including prescription drugs) were estimated using a GLM model with Gamma distribution and log link.

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medical services (IR=1.26, p<0.0001). Additionally, PDPs were associated with 20% higher in prescription drugs (IR=1.20, p<0.0001), compared to MA-PD enrollees. As a result, PDP enrollees had 25% higher healthcare expenditures than MA-PD enrollees (IR=1.25, p<0.0001).

The results also reveal various demo-socioeconomics and clinical factors that were significantly associated with the healthcare expenditures. The costs of outpatient care were associated with various factors, including race/ethnicity, annual income, MSA, CCI, ADLs, self-perceived health status, number of chronic conditions, ADLs, IADLs, and care-seeking attitudes. For costs of outpatient care, the statistically significant factors include age, race/ethnicity, annual income, MSA, census region, self-perceived health status, number of chronic conditions, CCI, ADLs, self-perceived health status, number of chronic conditions, ADLs, and care-seeking attitudes. For the costs of doctor's office visits, the statistically significant factors include age, Race/Ethnicity, living conditions, education, annual income, LIS status, census region, self-perceived health status, number of chronic conditions, CCI, ADLs, IADLs, smoking, care-seeking attitudes and environment factors. For the costs of other medical services, the statistically significant factors include age, sex, race/ethnicity, marital status, living conditions, education, income, MSA, census region, having other RX coverage, number of chronic conditions, CCI, ADLs, IADLs, BMI, smoking, care-seeking attitudes, and environment factors. For the costs of all type of medical services, the statistically significant factors include age, race/ethnicity, marriage, living conditions, education, annual income, income, LIS status, MSA, census region, self-perceived health status, number of chronic conditions, CCI, ADLs, IADLs, smoking, care-seeking attitudes, and environment factors. For the costs of

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prescription drugs, the statistically significant factors include sex, race/ethnicity, education, annual income, LIS status, census region, having other RX coverage, self-perceived health status, number of chronic conditions, CCI, ADLs, IADLs, BMI, smoking, care-seeking attitudes, and environment factors. For the total healthcare costs (including both medical services and prescription drugs, the statistically significant factors include age, race/ethnicity, living conditions, education, LIS status, annual income, census region, having other RX coverage, self-perceived health status, number of chronic conditions, CCI, ADLs, IADLs, BMI, smoking, care-seeking attitudes, and environment factors.

5.3.3 IV Model: results for healthcare expenditures

First stage of IV

To test the assumption of IV, several model specification tests were performed (Table 5.12). First, Durbin-Wu-Hausman tests were performed to access whether endogeneity exists between type of Part D plans and outcome measures. The results for Durbin-Wu-Hausman tests indicate that type of Part D plan is endogenous for the outcome measures, only except the costs for other medical services. Second, since multiple instruments were used in this analysis, Hansen's tests of overidentifying were performed to evaluate the validity of instruments. The results indicate that we cannot reject the hypotheses that the instruments are valid. Third, the F statistics for instruments is greater than 10, suggesting that the instruments are not weak.

Table 5.12 Model Specification Tests for IV: Healthcare Costs

Outcome Measures	**Endogeneity test** (Durbin-Wu-Hausman)	**Overidentification Test** (Sargan-Hansen J)	**Weak-IV Test** (Staiger-Stock)
Hospitalizations	8.92	0.87	13.91

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Outcome Measures	**Endogeneity test** (Durbin-Wu-Hausman)	**Overidentification Test** (Sargan-Hansen J)	**Weak-IV Test** (Staiger-Stock)
	(**p = 0.003**)	(p = 0.65)	
Outpatient	16.84 (**p <0.0001**)	4.35 (p = 0.11)	13.91
Medical Providers	5.83 (**p = 0.016**)	3.66 (p = 0.16)	13.91
Others Medical Services	0.08 (p = 0.78)	2.70 (p = 0.26)	13.91
Total Medical Services	5.99 (**p = 0.015**)	4.02 (p = 0.13)	13.91
Pharmacy claims	2.00 (**p = 0.016**)	0.46 (p = 0.79)	13.91
Total Health costs	5.62 (**p = 0.018**)	2.40 (p = 0.31)	13.91

Second stage of IV model: healthcare expenditures

Table 5.13 summarizes the results for the effects of PDP on health care costs in 2SRI models. The results indicate that PDP enrollees had similar costs for inpatient care (IR=1.37, p=0.074) than MA-PD enrollees. However, PDP enrollees had 48% higher costs for outpatient care (IR=1.48, p=0.001), 54% higher costs of physician's office (IR=1.54, p<0.0001), and 18% higher costs of prescription drugs (IR=1.18, p=0.004), compared to MA-PD enrollees. Consequently, PDPs was associated with 39% higher costs for medical services (IR=1.39, p<0.0001) and 30% higher costs for healthcare (IR=1.30, p<0.0001)

The results also reveal various demo-socioeconomics and clinical factors that were significantly associated with the healthcare expenditures. As shown in Table 5.13, for the costs of inpatient care, the statistically significant factors include age, sex, race/ethnicity, living conditions, LIS status, census region, self-perceived health status, number of chronic conditions, CCI, ADLs, IADLs, smoking, care-seeking attitudes and

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Table 5.13 IV Model: Effects of PDPs on the Healthcare Expenditures

Characteristics	Hospital			Outpatient			Physician's office		
	Est.	IR	p-value	Est.	IR	p-value	Est.	IR	p value
Residual from 1st stage	**-0.19**	**0.82**	**0.295**	**-0.31**	**0.73**	**0.013**	**-0.03**	**0.97**	**0.675**
Part D enrollment									
PDPs	**0.31**	**1.37**	**0.074**	**0.39**	**1.48**	**0.001**	**0.43**	**1.54**	**<.0001**
MA-PDs	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–
Age, years									
65-75	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–
75-85	0.11	1.12	0.050	0.02	1.02	0.695	0.12	1.13	**<.0001**
>85	0.01	1.01	0.901	-0.28	0.75	**<.0001**	0.00	1.00	0.972
Sex									
Male	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–
Female	-0.22	0.81	**0.001**	0.01	1.01	0.759	0.09	1.09	**0.0002**
Race/ethnicity									
Non-Hispanic White	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–
Non-Hispanic Black	-0.10	0.91	0.329	-0.23	0.80	**0.002**	-0.39	0.68	**<.0001**
Hispanics	-0.02	0.98	0.821	-0.33	0.72	**<.0001**	-0.08	0.93	0.057
Non-Hispanic others	-0.26	0.78	**0.035**	-0.43	0.65	**<.0001**	-0.34	0.71	**<.0001**
Marriage									
Married	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–
Widowed	0.23	1.26	0.185	0.01	1.01	0.958	0.13	1.14	0.056
Divorced/separated	-0.01	0.99	0.949	-0.04	0.97	0.790	0.10	1.11	0.155
Never married	-0.41	0.66	0.073	-0.13	0.88	0.406	0.06	1.06	0.533
Living conditions									
Alone	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–
With spouse	0.20	1.22	0.274	0.13	1.14	0.318	0.17	1.19	**0.012**
With children	0.26	1.30	**0.002**	0.030	1.03	0.653	0.04	1.04	0.243
With others	0.13	1.14	0.256	0.06	1.07	0.430	0.11	1.12	**0.017**
Education level									
< high school	-0.10	0.91	0.232	-0.10	0.91	0.094	-0.15	0.86	**<.0001**
High school/GED	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–

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Characteristics	Hospital			Outpatient			Physician's office		
	Est.	IR	p-value	Est.	IR	p-value	Est.	IR	p value
>high school	0.10	1.11	0.097	-0.04	0.96	0.392	0.20	1.22	**<.0001**
Annual income									
<$25,000	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–
≥$25,000	-0.12	0.88	0.053	0.22	1.24	**<.0001**	0.12	1.12	**<.0001**
LIS									
Yes	-0.21	0.81	**0.012**	-0.12	0.89	**0.044**	-0.25	0.78	**<.0001**
No	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–
MSA									
Yes	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–
No	0.12	1.12	0.232	-0.45	0.64	**<.0001**	0.04	1.04	0.261
Census region									
Northeast	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–
Midwest	-0.12	0.89	0.173	-0.05	0.95	0.418	0.01	1.01	0.745
South	-0.28	0.75	**0.002**	-0.10	0.91	0.116	0.02	1.02	0.667
West	-0.30	0.74	**0.001**	-0.17	0.85	**0.012**	-0.16	0.85	**<.0001**
Other RX coverage									
None	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–
Public	-0.02	0.98	0.835	-0.06	0.94	0.349	-0.04	0.96	0.231
Private/self-purchased	-0.13	0.88	0.370	0.15	1.16	0.151	0.05	1.05	0.374
Self-perceived health status									
Excellent	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–
Very good	0.17	1.19	**0.036**	0.07	1.07	0.224	0.06	1.06	0.071
Good	0.45	1.57	**<.0001**	0.27	1.31	**<.0001**	0.20	1.22	**<.0001**
Fair	0.73	2.08	**<.0001**	0.39	1.48	**<.0001**	0.28	1.32	**<.0001**
Poor	1.03	2.79	**<.0001**	0.25	1.28	**0.015**	0.31	1.37	**<.0001**
Number of chronic conditions									
0-1	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–
4-Feb	0.35	1.42	**<.0001**	0.04	1.04	0.452	0.13	1.14	**<.0001**
4+	0.73	2.07	**<.0001**	0.16	1.17	**0.030**	0.23	1.26	**<.0001**
CCI									
None	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–

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Characteristics	Hospital			Outpatient			Physician's office		
	Est.	IR	p-value	Est.	IR	p-value	Est.	IR	p value
2-Jan	0.42	1.52	**<.0001**	0.37	1.46	**<.0001**	0.19	1.21	**<.0001**
3+	0.44	1.56	**<.0001**	0.69	2.00	**<.0001**	0.36	1.43	**<.0001**
ADLs									
None	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–
2-Jan	0.30	1.35	**<.0001**	0.24	1.28	**<.0001**	0.23	1.25	**<.0001**
3+	0.56	1.76	**<.0001**	0.31	1.37	**<.0001**	0.49	1.63	**<.0001**
IADLs									
None	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–
2-Jan	0.14	1.15	**0.035**	0.08	1.08	0.109	0.26	1.29	**<.0001**
3+	0.09	1.10	0.404	-0.08	0.93	0.322	0.15	1.16	**0.001**
BMI, kg/m2									
<25.0	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–
25.0-29.9	-0.07	0.93	0.254	0.07	1.07	0.106	-0.02	0.98	0.472
≥30.0	0.08	1.08	0.249	0.00	1.00	0.932	0.01	1.01	0.670
Smoking									
Never	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–
Past	0.19	1.21	**0.001**	0.02	1.02	0.636	0.08	1.09	**0.000**
Current	-0.05	0.95	0.600	-0.13	0.88	0.053	-0.16	0.86	**<.0001**
Care-seeking attitudes									
Avoid going to a physician									
Yes	-0.21	0.81	**0.001**	-0.13	0.88	**0.006**	-0.20	0.82	**<.0001**
No	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–
Visit a physician as soon as feel bad									
Yes	0.16	1.17	**0.005**	0.13	1.14	**0.001**	0.08	1.09	**0.000**
No	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–
Worry about health more than others									
Yes	0.12	1.13	0.094	0.30	1.35	**<.0001**	0.13	1.14	**<.0001**
No	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–
Keep to self when sick									
Yes	0.11	1.11	0.064	-	0.99	0.863	-0.04	0.96	0.064

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Characteristics	Hospital			Outpatient			Physician's office		
	Est.	IR	p-value	Est.	IR	p-value	Est.	IR	p value
				0.010					
No	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–
Same physician>5 years									
Yes	-0.06	0.94	0.219	-0.03	0.97	0.451	0.05	1.06	**0.009**
No	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–
Environment factors									
Number of primary physicians	-0.59	0.55	**0.001**	-0.15	0.86	0.206	0.01	1.01	0.929
Number of hospital beds	0.01	1.01	0.628	0.01	1.01	0.367	0.00	1.00	0.958
Percent under Poverty	0.02	1.02	**0.029**	-0.01	0.99	0.187	0.00	1.00	0.598
Unemployment rate	-0.03	0.97	0.216	-0.01	0.99	0.517	-0.04	0.96	**<.0001**
Education higher than high school	0.01	1.01	**0.040**	0.01	1.01	**0.003**	0.001	1.00	0.585
Calendar year									
2006	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–
2007	0.02	1.02	0.796	0.14	1.15	**0.034**	0.06	1.06	0.115
2008	0.02	1.02	0.865	0.08	1.09	0.190	0.12	1.13	**0.000**
2009	-0.01	0.99	0.884	0.01	1.01	0.867	0.10	1.10	**0.004**
2010	-0.06	0.94	0.504	0.22	1.25	**0.0010**	0.04	1.04	0.229

Abbreviations: **MCBS**, Medicare Current Beneficiary Survey (MCBS); **MSA**, Metropolitan Statistical Areas; **CCI**, Charlson Comorbidity Index; **ADLs**, Activities of daily living, includes bathing or showering, getting dressed, getting in and out of a chair, walking, and using the toilet; **IADLs**, Instrumental activities of daily living, including using telephone, shopping, preparing food, housekeeping, laundry, traveling, taking medication, and managing financial matters independently; **BMI**, body mass index, calculated as weight in kilograms divided by height in meters squared.

a. In the 2SRI Model, the instrumental variables are the county-level PDP penetration, percent of white collar job and State Pharmaceutical Assistance Programs for seniors in each study year

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Table 5.13 IV Model: Effects of PDPs on the Healthcare Expenditures (Continued)

Characteristics	All Med Services			Prescriptions			Total Healthcare		
	Est.	IR	p-value	Est.	IR	p-value	Est.	IR	p-value
Residual from 1st stage	-0.11	0.89	0.154	0.01	1.01	0.816	-0.06	0.94	0.31
Part D enrollment									
PDPs	**0.33**	**1.39**	**<.0001**	**0.16**	**1.18**	**0.004**	**0.27**	**1.30**	**<.0001**
MA-PDs	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–
Age, years									
65-75	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–
75-85	0.10	1.10	**0.0001**	-0.02	0.98	0.334	0.06	1.06	**0.004**
>85	-0.05	0.95	0.183	-0.05	0.95	0.054	-0.05	0.95	0.065
Sex									
Male	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–
Female	-0.03	0.97	0.252	0.10	1.11	**<.0001**	0.02	1.02	0.306
Race/ethnicity									
Non-Hispanic White	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–
Non-Hispanic Black	-0.23	0.80	**<.0001**	-0.21	0.81	**<.0001**	-0.22	0.80	**<.0001**
Hispanics	-0.07	0.93	0.112	-0.07	0.93	**0.037**	-0.07	0.93	**0.025**
Non-Hispanic others	-0.30	0.74	**<.0001**	-0.06	0.94	0.103	-0.19	0.83	**<.0001**
Marriage									
Married	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–
Widowed	0.15	1.17	**0.044**	0.01	1.01	0.846	0.09	1.10	0.108
Divorced/separated	0.05	1.05	0.546	-0.03	0.97	0.644	0.02	1.02	0.726
Never married	-0.13	0.87	0.170	-0.04	0.96	0.592	-0.08	0.92	0.270
Living conditions									
Alone	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–
With spouse	0.19	1.21	**0.015**	0.01	1.01	0.820	0.11	1.12	**0.049**
With children	0.13	1.14	**0.0004**	0.01	1.01	0.600	0.07	1.07	**0.009**
With others	0.13	1.14	**0.008**	0.04	1.05	0.233	0.09	1.09	**0.022**
Education level									
< high school	-0.12	0.89	**0.001**	0.00	1.00	0.962	-0.07	0.93	**0.006**
High school/GED	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–

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Characteristics	All Med Services			Prescriptions			Total Healthcare		
	Est.	IR	p-value	Est.	IR	p-value	Est.	IR	p-value
>high school	0.12	1.13	**<.0001**	0.11	1.12	**<.0001**	0.12	1.13	**<.0001**
Annual income									
<$25,000	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–
≥$25,000	0.07	1.07	**0.014**	0.12	1.13	**<.0001**	0.09	1.09	**0.000**
LIS									
Yes	-0.20	0.81	**<.0001**	0.22	1.25	**<.0001**	-0.04	0.96	0.173
No	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–
MSA									
Yes	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–
No	-0.04	0.96	0.282	0.05	1.05	0.114	-0.02	0.98	0.527
Census region									
Northeast	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–
Midwest	-0.07	0.94	0.088	-0.02	0.98	0.439	-0.05	0.95	0.074
South	-0.14	0.87	**0.0002**	0.03	1.03	0.274	-0.08	0.92	**0.005**
West	-0.24	0.79	**<.0001**	-0.12	0.88	**<.0001**	-0.20	0.82	**<.0001**
Other RX coverage									
None	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–
Public	-0.03	0.97	0.413	0.23	1.26	**<.0001**	0.07	1.07	**0.015**
Private/self-purchased	0.05	1.05	0.449	0.14	1.15	**0.004**	0.07	1.08	0.126
Self-perceived health status									
Excellent	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–
Very good	0.10	1.10	**0.006**	0.27	1.31	**<.0001**	0.16	1.18	**<.0001**
Good	0.29	1.34	**<.0001**	0.42	1.53	**<.0001**	0.35	1.42	**<.0001**
Fair	0.47	1.59	**<.0001**	0.58	1.79	**<.0001**	0.51	1.67	**<.0001**
Poor	0.59	1.80	**<.0001**	0.66	1.93	**<.0001**	0.61	1.84	**<.0001**
Number of chronic conditions									
0-1	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–
4-Feb	0.18	1.19	**<.0001**	0.31	1.36	**<.0001**	0.23	1.26	**<.0001**
4+	0.39	1.48	**<.0001**	0.54	1.72	**<.0001**	0.44	1.55	**<.0001**
CCI									
None	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–

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Characteristics	All Med Services			Prescriptions			Total Healthcare		
	Est.	IR	p-value	Est.	IR	p-value	Est.	IR	p-value
2-Jan	0.28	1.32	**<.0001**	0.24	1.28	**<.0001**	0.26	1.29	**<.0001**
3+	0.44	1.56	**<.0001**	0.30	1.35	**<.0001**	0.38	1.46	**<.0001**
ADLs									
None	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–
2-Jan	0.26	1.30	**<.0001**	0.05	1.05	**0.028**	0.18	1.20	**<.0001**
3+	0.49	1.63	**<.0001**	0.10	1.10	**0.004**	0.35	1.42	**<.0001**
IADLs									
None	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–
2-Jan	0.17	1.19	**<.0001**	0.11	1.12	**<.0001**	0.15	1.17	**<.0001**
3+	0.10	1.11	**0.033**	0.16	1.17	**<.0001**	0.12	1.12	**0.001**
BMI, kg/m2									
<25.0	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–
25.0-29.9	-0.04	0.96	0.098	0.09	1.10	**<.0001**	0.00	1.00	0.854
≥30.0	-0.01	0.99	0.747	0.10	1.11	**<.0001**	0.03	1.03	0.183
Smoking									
Never	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–
Past	0.10	1.11	**<.0001**	-0.01	0.99	0.711	0.06	1.06	**0.002**
Current	-0.12	0.89	**0.004**	-0.13	0.88	**<.0001**	-0.12	0.89	**0.000**
Care-seeking attitudes									
Avoid going to a physician									
Yes	-0.19	0.83	**<.0001**	-0.21	0.81	**<.0001**	-0.20	0.82	**<.0001**
No	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–
Visit a physician as soon as feel bad									
Yes	0.11	1.11	**<.0001**	0.10	1.10	**<.0001**	0.11	1.11	**<.0001**
No	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–
Worry about health more than others									
Yes	0.16	1.17	**<.0001**	0.09	1.10	**0.000**	0.14	1.15	**<.0001**
No	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–
Keep to self when sick									
Yes	0.00	1.00	0.922	-0.01	0.99	0.635	-0.01	1.00	0.794

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Characteristics	All Med Services			Prescriptions			Total Healthcare		
	Est.	**IR**	**p-value**	**Est.**	**IR**	**p-value**	**Est.**	**IR**	**p-value**
No	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–
Same physician>5 years									
Yes	-0.01	0.99	0.796	0.01	1.01	0.574	0.00	1.00	0.855
No	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–
Environment factors									
Number of primary physicians	-0.21	0.81	**0.003**	0.00	1.00	0.964	-0.13	0.87	**0.014**
Number of hospital beds	0.00	1.00	0.712	0.00	1.00	0.563	0.00	1.00	0.685
Percent under Poverty	0.01	1.01	**0.047**	0.01	1.01	**0.013**	0.01	1.01	**0.010**
Unemployment rate	-0.04	0.96	**0.000**	0.00	1.00	0.662	-0.02	0.98	**0.003**
Education higher than high school	0.01	1.01	**0.007**	0.00	1.00	0.243	0.01	1.00	**0.007**
Calendar year									
2006	Ref	Ref	–	Ref	Ref	–	Ref	Ref	–
2007	0.04	1.04	0.316	0.02	1.02	0.430	0.04	1.04	0.192
2008	0.07	1.07	0.070	0.05	1.05	0.100	0.07	1.07	**0.024**
2009	0.03	1.03	0.463	0.15	1.17	**<.0001**	0.08	1.08	**0.006**
2010	0.05	1.05	0.257	0.12	1.13	**<.0001**	0.08	1.09	**0.006**

Abbreviations: **MCBS**, Medicare Current Beneficiary Survey (MCBS); **MSA**, Metropolitan Statistical Areas; **CCI**, Charlson Comorbidity Index; **ADLs**, Activities of daily living, includes bathing or showering, getting dressed, getting in and out of a chair, walking, and using the toilet; **IADLs**, Instrumental activities of daily living, including using telephone, shopping, preparing food, housekeeping, laundry, traveling, taking medication, and managing financial matters independently; **BMI**, body mass index, calculated as weight in kilograms divided by height in meters squared.

a. In the 2SRI Model, the instrumental variables are the county-level PDP penetration, percent of white collar job and State Pharmaceutical Assistance Programs for seniors in each study year.

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environment factors. For the costs of outpatient care, the statistically significant factors include age, race/ethnicity, annual income, LIS status, MSA and census region, CCI, ADLs, self-perceived health status, number of chronic conditions, CCI, ADLs, care-seeking attitudes, and environment factors. For the costs for doctor's office visits, the statistically significant factors include age, sex, race/ethnicity, living conditions, education, annual income, LIS status, census region, self-perceived health status, number of chronic conditions, CCI, ADLs, IADLs, smoking, care-seeking attitudes and environment factors. For the costs of total medical services, the statistically significant factors include age, race/ethnicity, marital status, living conditions, education, annual income, LIS status, census region, self-perceived health status, number of chronic conditions, CCI, ADLs, IADLs, smoking, care-seeking attitudes and environment factors. For the costs of prescription drugs, the statistically significant factors include sex, race/ethnicity, education, annual income, LIS status, census region, having other RX coverage, self-perceived health status, number of chronic conditions, CCI, ADLs, IADLs, BMI, smoking, care-seeking attitudes and environment factors. For the total healthcare costs (including both medical services and prescription drugs, the statistically significant factors include age, race/ethnicity, living conditions, education, annual income, census region, having other RX coverage, self-perceived health status, number of chronic conditions, CCI, ADLs, IADLs, smoking, care-seeking attitudes, and environment factors.

5.4 Results for Aim 3.1: CRN & Affordability

The following section presents the results of cost-related nonadherence (CRN) and medication affordability, including the descriptive statistics, multivariable regression

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analysis, and IV.

5.4.1 Descriptive statistics

Table 5.14 shows the bivariate analysis of CRN and medication affordability among PDPs and MA-PDs. There were no significant differences in the prevalence of CRN between beneficiaries enrolled in PDPs and MA-PDs (12.1% vs. 11.1%; p=0.150), However, PDPs had higher prevalence of spending less on basic needs than MA-PDs (5.3% vs. 4.2%; p=0.030). In addition, PDP enrollees had higher prevalence of using generic drugs (52.1% vs. 47.6%; p=0.003), obtaining free samples from the doctors (44.4% vs.36.4%; p<0.0001), and comparing pharmacies (17.7% vs. 14.1%; p=0.002), but had lower prevalence of using mail orders (16.7% vs. 22.9%; p<0.0001), compared to MA-PD enrollees.

Table 5.14 CRN and Affordability among Elderly Medicare Beneficiaries

Outcome Measures	PDPs		MA-PDs		P-Value
	n	Weighted %	n	Weighted %	
Cost-related nonadherence	1177	12.1	702	11.1	0.150
Spending less on basic needs	540	5.3	270	4.2	**0.030**
Cost reduction strategies					
Use generics	5230	52.1	3036	47.6	**0.003**
Free samples	4476	44.4	2344	36.4	**<.0001**
Use mail-order/Internet	1583	16.7	1420	22.9	**<.0001**
Compare pharmacies	1725	17.7	897	14.1	**0.002**

a. Percentages were calculated with national weights; p-value was obtained from Rao-Scott Chi-Square tests.

5.4.2 Naïve model: CRN

Table 5.17 demonstrates the results for the effect of PDPs on Medication affordability. For the purpose of easier interpretation, the following tables display Odds Ratio (OR), which was calculated using the equation ($e^{coefficient}$), and the p-value of the

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effects of PDP on the healthcare costs.

After adjusting for demo-socioeconomic and clinical characteristics, the adjusted OR of having CRN among PDP enrollees was 1.00 (p=0.991), compared to MA-PD enrollees. The results also reveal that the likelihood of CRN was associated with various factors, including age, sex, race/ethnicity, education, annual income, LIS, census region, other RX coverage, self-perceived health status, number of chronic conditions, CCI, ADLs, IADLs, care-seeking attitudes, and environment factors.

There was no significant difference in the likelihood of spending less on basic needs between PDPs and MA-PDs (Table 5.17). The results also reveal that the likelihood of CRN was associated with various factors, including age, race/ethnicity, annual income, census region, self-perceived health status, number of chronic conditions, ADLs, IADLs, BMI, smoking, care-seeking attitudes, and environment factors.

Table 5.15 Na ïve Model: Effect of PDPs on CRN and Affordability

Characteristics	CRN			Affordability		
	Est.	OR	p-value	Est.	OR	p-value
Part D enrollment						
PDPs	**-0.001**	**1.00**	**0.991**	**-0.03**	**0.968**	**0.710**
MA-PDs	Ref	Ref	–	Ref	Ref	–
Age, years						
65-75	Ref	Ref	–	Ref	Ref	–
75-85	-0.30	0.74	**<.0001**	-0.25	0.78	**0.003**
>85	-0.85	0.43	**<.0001**	-0.69	0.50	**<.0001**
Sex						
Male	Ref	Ref	–	Ref	Ref	–
Female	0.23	1.25	**0.0002**	0.09	1.10	0.3135
Race/ethnicity						
Non-Hispanic White	Ref	Ref	–	Ref	Ref	–
Non-Hispanic Black	0.29	1.34	**0.001**	0.41	1.50	**0.001**
Hispanics	0.09	1.09	0.384	0.06	1.06	0.699
Non-Hispanic others	0.33	1.39	**0.003**	0.25	1.29	0.110
Marriage						
Married	Ref	Ref	–	Ref	Ref	–

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Characteristics	CRN			Affordability		
	Est.	OR	p-value	Est.	OR	p-value
Widowed	0.11	1.11	0.571	0.01	1.01	0.979
Divorced/Separated	0.38	1.46	0.055	0.14	1.16	0.597
Never married	-0.11	0.89	0.646	-0.17	0.84	0.609
Living conditions						
Alone	Ref	Ref	–	Ref	Ref	–
With spouse	0.21	1.23	0.273	-0.06	0.94	0.824
With children	-0.11	0.90	0.209	-0.15	0.86	0.185
With others	0.02	1.02	0.869	-0.06	0.94	0.676
Education level						
< high school	-0.01	0.99	0.931	0.11	1.12	0.260
High school/GED	Ref	Ref	–	Ref	Ref	–
>high school	0.14	1.15	**0.028**	0.11	1.12	0.270
Annual income						
<$25,000	Ref	Ref	–	Ref	Ref	–
≥$25,000	-0.34	0.71	**<.0001**	-0.65	0.52	**<.0001**
LIS						
Yes	-0.42	0.66	**<.0001**	-0.05	0.95	0.609
No	Ref	Ref	–	Ref	Ref	–
MSA						
Yes	Ref	Ref	–	Ref	Ref	–
No	0.04	1.04	0.638	0.20	1.22	0.079
Census region						
Northeast	Ref	Ref	–	Ref	Ref	–
Midwest	0.28	1.33	**0.003**	0.25	1.29	0.076
South	0.40	1.50	**<.0001**	0.52	1.68	**0.000**
West	0.15	1.16	0.121	0.09	1.10	0.544
Other RX coverage						
None	Ref	Ref	–	Ref	Ref	–
Public	-0.16	0.85	0.064	-0.15	0.86	0.187
Private/self-purchased	-0.39	0.68	**0.021**	0.14	1.15	0.554
Self-perceived health status						
Excellent	Ref	Ref	–	Ref	Ref	–
Very good	0.27	1.31	**0.005**	0.10	1.10	0.558
Good	0.37	1.45	**0.000**	0.24	1.28	0.121
Fair	0.33	1.39	**0.002**	0.49	1.63	**0.004**
Poor	0.69	1.99	**<.0001**	0.60	1.83	**0.002**
Number of chronic conditions						
0-1	Ref	Ref	–	Ref	Ref	–
2-4	0.24	1.27	**0.003**	0.20	1.22	0.111
4+	0.37	1.45	**0.0002**	0.54	1.71	**0.0004**
CCI						
None	Ref	Ref	–	Ref	Ref	–
1-2	0.18	1.19	**0.040**	0.21	1.23	0.145

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Characteristics	CRN			Affordability		
	Est.	OR	p-value	Est.	OR	p-value
3+	0.18	1.20	0.059	0.26	1.29	0.096
ADLs						
None	Ref	Ref	–	Ref	Ref	–
1-2	0.29	1.33	**<.0001**	0.26	1.29	**0.007**
3+	0.15	1.16	0.151	0.40	1.49	**0.002**
IADLs						
None	Ref	Ref	–	Ref	Ref	–
1-2	0.30	1.35	**<.0001**	0.20	1.22	**0.031**
3+	0.20	1.22	0.059	0.24	1.28	0.070
BMI, kg/m2						
<25.0	Ref	Ref	–	Ref	Ref	–
25.0-29.9	-0.001	1.00	0.987	-0.019	0.981	0.843
≥30.0	0.02	1.02	0.806	0.19	1.21	**0.049**
Smoking						
Never	Ref	Ref	–	Ref	Ref	–
Past	0.06	1.07	0.264	-0.20	0.82	**0.018**
Current	0.09	1.09	0.322	0.18	1.19	0.155
Care-seeking attitude						
Avoid going to a physician						
Yes	0.29	1.34	**<.0001**	0.24	1.27	**0.009**
No	Ref	Ref	–	Ref	Ref	–
Visit a physician as soon as feel bad						
Yes	-0.12	0.88	**0.031**	0.16	1.17	0.055
No	Ref	Ref	–	Ref	Ref	–
Worry about health more than others						
Yes	0.36	1.43	**<.0001**	0.69	2.00	**<.0001**
No	Ref	Ref	–	Ref	Ref	–
Keep to self when sick						
Yes	0.24	1.26	**<.0001**	0.29	1.33	**0.001**
No	Ref	Ref	–	Ref	Ref	–
Same physician>5 years						
Yes	-0.07	0.93	0.171	-0.08	0.93	0.315
No	Ref	Ref	–	Ref	Ref	–
Environment factors						
Number of primary physicians	-0.17	0.84	0.295	-0.31	0.73	0.194
Number of hospital beds	0.03	1.03	**0.043**	0.07	1.07	**0.005**
Percent under Poverty	0.002	1.00	0.788	-0.033	0.967	**0.002**
Unemployment rate	-0.05	0.95	**0.022**	-0.02	0.98	0.575
Education higher than high school	-0.002	1.00	0.653	-0.021	0.980	**0.007**
Calendar year						
2006	Ref	Ref	–	Ref	Ref	–

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Characteristics	CRN			Affordability		
	Est.	OR	p-value	Est.	OR	p-value
2007	-0.11	0.89	0.192	0.21	1.24	0.097
2008	-0.23	0.80	**0.009**	0.08	1.08	0.561
2009	-0.18	0.84	**0.039**	-0.18	0.83	0.182
2010	-0.15	0.86	0.092	0.02	1.02	0.857

Abbreviations: **MCBS**, Medicare Current Beneficiary Survey (MCBS); **MSA**, Metropolitan Statistical Areas; **CCI**, Charlson Comorbidity Index; **ADLs**, Activities of daily living, includes bathing or showering, getting dressed, getting in and out of a chair, walking, and using the toilet; **IADLs**, Instrumental activities of daily living, including using telephone, shopping, preparing food, housekeeping, laundry, traveling, taking medication, and managing financial matters independently; **BMI**, body mass index, calculated as weight in kilograms divided by height in meters squared.
a. These results were adjusted for the variables listed in Table 5.1.

5.4.3 IV model: CRN

First Stage of IV

To test the assumption of IV, several model specification tests were performed. As shown in Table 5.16, the results for Durbin-Wu-Hausman tests indicate that type of Part D plan is endogenous for medication affordability (p = 0.035), but not for CRN (p=0.23). Second, since multiple instruments were used in this analysis, Hansen's tests of overidentifying were performed to evaluate the validity of instruments. The results indicate that we cannot reject the hypotheses that the instruments are valid (CRN, p=0.49; Affordability, p=0.78). Third, the F statistics for instruments is 13.91, which is greater than 10, suggesting that the instruments are not weak.

Table 5.16 Model Specification Tests for IV: CRN and Affordability

Outcome Measures	**Endogeneity Test** (Durbin-Wu-Hausman)	**Overidentification Test** (Sargan-Hansen J)	**Weak-IV Test** (Staiger-Stock)
CRN	1.46 (p = 0.23)	1.44 (p = 0.49)	13.91
Medication Affordability	4.43 (**p = 0.035**)	0.48 (p = 0.78)	13.91

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Table 5.17 shows that PDP enrollees had 69% higher likelihood of spending less on basic needs (OR=1.69, p=0.042). The results also reveal that the likelihood of CRN was associated with various factors, including age, race/ethnicity, annual income, MSA, census region, self-perceived health status, number of chronic conditions, ADLs, IADLs, BMI, smoking, care-seeking attitudes, and environment factors.

Table 5.17 IV Model: Effect of PDPs on Medication Affordability

Characteristics	Estimate	SE	OR	p-value
Residual from the first stage	-0.63	0.27	0.54	0.022
Part D enrollment				
PDPs	**0.52**	**0.258**	**1.69**	**0.042**
MA-PDs	Ref	–	Ref	–
Age, years				
65-75	Ref	–	Ref	–
75-85	-0.24	0.09	0.79	**0.006**
>85	-0.70	0.13	0.50	**<.0001**
Sex				
Male	Ref	–	Ref	–
Female	0.08	0.09	1.08	0.4167
Race/ethnicity				
Non-Hispanic White	Ref	–	Ref	–
Non-Hispanic Black	0.48	0.13	1.61	**0.0001**
Hispanics	0.10	0.14	1.10	0.505
Non-Hispanic others	0.22	0.16	1.24	0.167
Marriage				
Married	Ref	–	Ref	–
Widowed	-0.02	0.26	0.98	0.937
Divorced/separated	0.14	0.27	1.15	0.618
Never married	-0.21	0.34	0.81	0.532
Living conditions				
Alone	Ref	–	Ref	–
With spouse	-0.06	0.27	0.94	0.829
With children	-0.15	0.12	0.86	0.205
With others	-0.04	0.15	0.96	0.798
Education level				
< high school	0.11	0.10	1.11	0.297
High school/GED	Ref	–	Ref	–
>high school	0.09	0.10	1.09	0.361
Annual income				
<$25,000	Ref	–	Ref	–

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Characteristics	Estimate	SE	OR	p-value
≥$25,000	-0.67	0.11	0.51	**<.0001**
LIS				
Yes	-0.15	0.11	0.86	0.164
No	Ref	–	Ref	–
MSA				
Yes	Ref	–	Ref	–
No	0.36	0.13	1.43	**0.007**
Census region				
Northeast	Ref	–	Ref	–
Midwest	0.19	0.14	1.21	0.185
South	0.43	0.14	1.54	**0.002**
West	0.14	0.15	1.15	0.364
Other RX coverage				
None	Ref	–	Ref	–
Public	-0.19	0.12	0.82	0.095
Private/self-purchased	0.07	0.23	1.07	0.762
Self-perceived health status				
Excellent	Ref	–	Ref	–
Very good	0.09	0.16	1.09	0.594
Good	0.23	0.16	1.26	0.136
Fair	0.49	0.17	1.63	**0.004**
Poor	0.59	0.20	1.81	**0.002**
Number of chronic conditions				
0-1	Ref	–	Ref	–
2-4	0.20	0.13	1.22	0.116
4+	0.55	0.15	1.72	**0.0004**
CCI				
None	Ref	–	Ref	–
1-2	0.19	0.14	1.21	0.182
3+	0.24	0.15	1.27	0.128
ADLs				
None	Ref	–	Ref	–
1-2	0.26	0.10	1.29	**0.007**
3+	0.38	0.13	1.47	**0.003**
IADLs				
None	Ref	–	Ref	–
1-2	0.18	0.09	1.20	**0.050**
3+	0.21	0.13	1.23	0.121
BMI, kg/m^2				
<25.0	Ref	–	Ref	–
25.0-29.9	-0.03	0.09	0.97	0.750
≥30.0	0.18	0.10	1.20	0.059
Smoking				
Never	Ref	–	Ref	–

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Characteristics	Estimate	SE	OR	p-value
Past	-0.19	0.09	0.83	**0.028**
Current	0.19	0.12	1.21	0.123
Care-seeking attitudes				
Avoid going to a physician				
Yes	0.23	0.09	1.26	**0.010**
No	Ref	–	Ref	–
Visit a physician as soon as feel bad				
Yes	0.16	0.08	1.17	0.053
No	Ref	–	Ref	–
Worry about health more than others				
Yes	0.69	0.09	1.99	**<.0001**
No	Ref	–	Ref	–
Keep to self when sick				
Yes	0.29	0.09	1.33	**0.001**
No	Ref	–	Ref	–
Same physician>5 years				
Yes	-0.10	0.08	0.91	0.208
No	Ref	–	Ref	–
Environment factors				
Number of primary physicians	-0.30	0.24	0.74	0.214
Number of hospital beds	0.06	0.02	1.06	**0.009**
Percent under Poverty	-0.03	0.01	0.97	**0.008**
Unemployment rate	-0.02	0.03	0.98	0.605
Education higher than high school	-0.02	0.01	0.98	**0.009**
Calendar year				
2006	Ref	–	Ref	–
2007	0.17	0.13	1.18	0.202
2008	0.03	0.13	1.03	0.806
2009	-0.21	0.14	0.81	0.134
2010	-0.02	0.14	0.98	0.876

Abbreviations: **MCBS**, Medicare Current Beneficiary Survey (MCBS); **MSA**, Metropolitan Statistical Areas; **CCI**, Charlson Comorbidity Index; **ADLs**, Activities of daily living, includes bathing or showering, getting dressed, getting in and out of a chair, walking, and using the toilet; **IADLs**, Instrumental activities of daily living, including using telephone, shopping, preparing food, housekeeping, laundry, traveling, taking medication, and managing financial matters independently; **BMI**, body mass index, calculated as weight in kilograms divided by height in meters squared.
a. In the 2SRI Model, the instrumental variables are the county-level PDP penetration, percent of white collar job and State Pharmaceutical Assistance Programs for seniors in each study year.

5.5 Results for Aim 3.2: Medication Adherence among Diabetic Beneficiaries

The following section describes the study sample, demographic and

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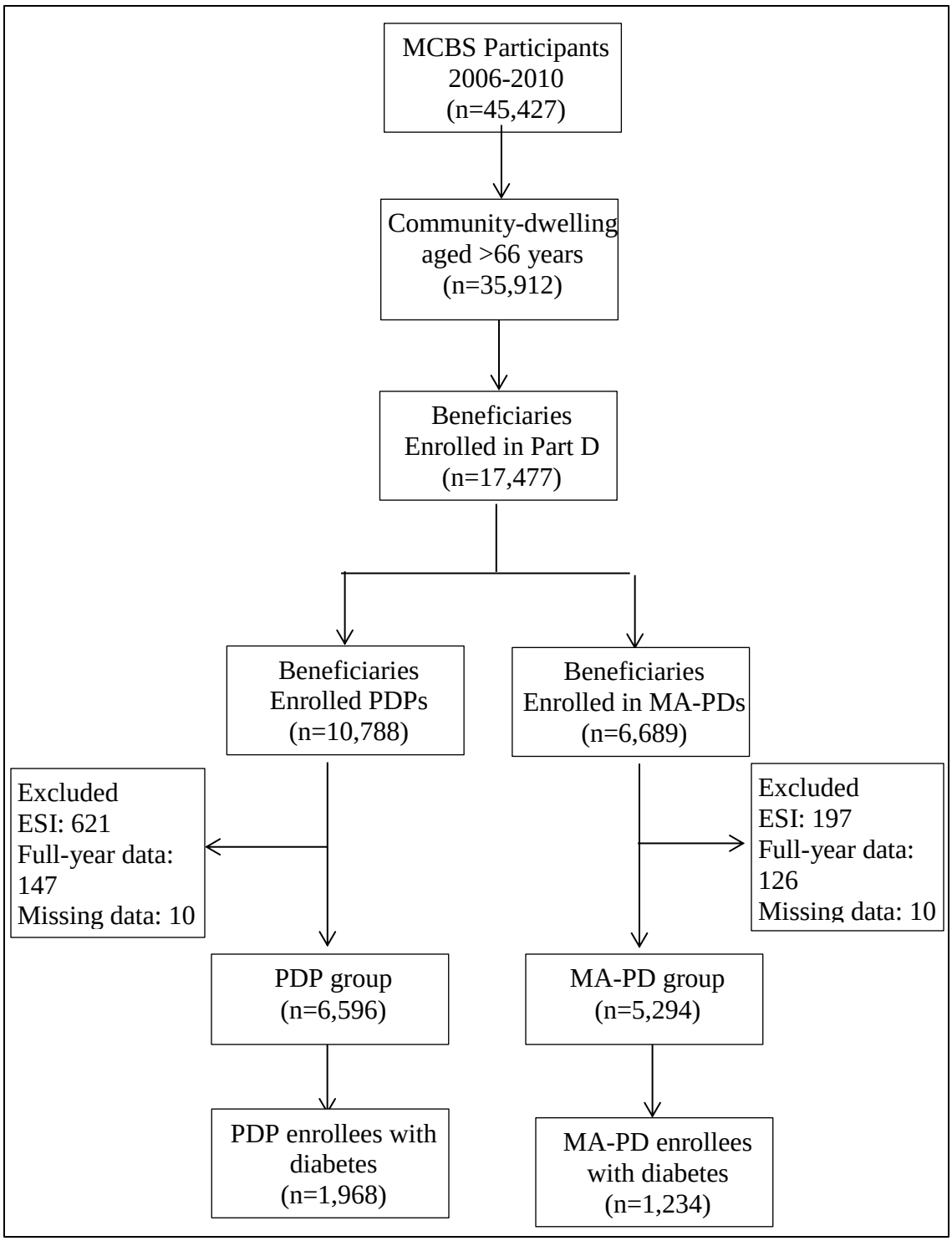

Figure 5.2 Flow Chart of Sample Selection for Aim 3.2

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socioeconomic characteristics, health conditions, and medication adherence among Medicare beneficiaries diagnosed with type 2 diabetes.

5.5.1 Study sample

The study sample for Aim 3.2 was limited to individuals in Aim 2 with diagnoses of type 2 diabetes. After excluding individual without diabetes, the final sample size was 1,968 individuals in PDP group, and 1,234 in MA-PD group. The following figure 5.2 demonstrate the sample selection flow chart for Aim 3.2 in this dissertation.

5.5.1.1. Demo-socioeconomic and clinical characteristics

The demo-socioeconomic characteristics and health conditions between PDPs vs. MA-PDs were compared in Table 5.18. PDP enrollees were more likely to be female (60.8% vs. 54.2%; p=0.010), non-Hispanic black (10.0% vs. 13.4%; p<0.0001), compared to MA-PD enrollees. Medicare beneficiaries enrolled in PDPs were less likely to be married (45.1% vs. 53.9%; p=0.001), and more likely to be living alone (35.4% vs. 28.1%; p=0.007). PDP enrollees had lower education levels (more than high school or GED, 25.8% vs. 29.5%; p=0.039) than MA-PD enrollees, while PDP enrollees had lower annual income (more than $25,000, 34.2% vs. 41.2%; p=0.005), and were more likely to receive low income subsidy (41.4% vs. 22.5%; p<0.0001). Beneficiaries enrolled in PDPs were less likely to live in Metropolitan Statistical Areas (67.3% vs. 91.9%; p<0.0001) and west census region (15.4% vs. 21.3%; p<0.0001). Compared to beneficiaries enrolled in MA-PDs, PDP enrollees were more likely to have other prescription drug coverage (19.5% vs. 12.7%; p=0.019). Specifically, PDP enrollees were more likely to have public prescription drug coverage (19.1% vs. 13.1%).

Compared to beneficiaries enrolled in MA-PDs, PDP enrollees had lower self-

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perceived health status (excellent health, 6.6% vs. 8.3%; very good health, 20.5% vs. 28.3%; good health, 37.7% vs. 36.6%; fair health, 25.2% vs. 20.6%; poor health, 10.0% vs. 6.2%; p<0.0001). However, PDP enrollees were more likely to have more than 4 chronic conditions (42.4% vs. 31.1%; p<0.0001), with Charlson Comorbidity Index scores ≥ 3 (76.6% vs. 67.1%; p=0.0001), with three or more Activities of daily living (ADLs) disabilities (14.2% vs. 9.3%; p=0.001), and with three or more Instrumental activities of daily living (IADLs) limitations (11.4% vs. 9.8%; p<0.0001). Finally, PDP enrollees were more likely to have the same physicians for more than five years (59.9% vs. 51.4%; p=0.003).

Table 5.18 Demo-Socioeconomic Characteristics and Health Conditions among Diabetic Beneficiaries

Characteristics	PDPs		MA-PDs		p-value
	n	Weighted %	n	Weighted %	
Age, years					0.488
65-75	890	50.7	567	50.8	
75-85	817	38.9	524	40.4	
>85	261	10.4	143	8.8	
Sex					**0.010**
Male	762	39.2	565	45.8	
Female	1206	60.8	669	54.2	
Race/ethnicity					**<.0001**
Non-Hispanic White	1447	73.8	804	65.0	
Non-Hispanic Black	216	10.0	176	13.4	
Hispanics	179	9.1	199	17.2	
Non-Hispanic Others	126	7.1	55	4.4	
Marriage					**0.001**
Married	848	45.1	649	53.9	
Widowed	808	38.4	397	30.0	
Divorced/separated	250	13.1	163	14.1	
Never married	62	3.4	25	2.1	
Living conditions					**0.007**
Alone	718	35.4	351	28.1	
With spouse	817	43.6	622	51.8	

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Characteristics	PDPs		MA-PDs		p-value
	n	Weighted %	n	Weighted %	
With children	313	14.8	164	12.8	
With others	120	6.2	97	7.3	
Education level					**0.039**
< high school	429	19.6	193	14.5	
High school/GED	1081	54.6	685	56.0	
>high school	458	25.8	356	29.5	
Annual income					**0.005**
<$25,000	1349	65.8	744	58.8	
≥$25,000	619	34.2	490	41.2	
LIS					**<.0001**
No	1106	58.6	946	77.5	
Yes	862	41.4	288	22.5	
MSA					**<.0001**
No	718	32.7	115	8.1	
Yes	1250	67.3	1119	91.9	
Census region					**<.0001**
Northeast	269	15.4	247	21.3	
Midwest	481	24.1	229	17.8	
South	968	46.2	381	29.0	
West	250	14.3	377	32.0	
Other RX coverage					**0.019**
None	1528	78.6	1039	84.4	
Public	395	19.1	168	13.1	
Private/self-purchased	45	2.3	27	2.5	
Self-perceived health status					**<.0001**
Excellent	129	6.6	107	8.3	
Very good	395	20.5	342	28.3	
Good	732	37.7	456	36.6	
Fair	511	25.2	252	20.6	
Poor	201	10.0	77	6.2	
Number of chronic conditions					**<.0001**
0-1	86	4.6	90	7.4	
2-4	1035	53.0	755	61.5	
4+	847	42.4	389	31.1	
CCI					**0.0001**
1-2	445	23.4	405	32.9	
3+	152	76.6	829	67.1	

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Characteristics	PDPs		MA-PDs		p-value
	n	Weighted %	n	Weighted %	
	3				
ADLs					**0.001**
None	1117	58.7	807	66.8	
1-2	564	27.1	301	23.9	
3+	287	14.2	126	9.3	
IADLs					**<.0001**
None	1180	61.9	869	71.1	
1-2	543	26.7	263	21.1	
3+	245	11.4	102	7.8	
BMI, kg/m^2					0.386
<25.0	416	20.2	296	22.9	
25.0-29.9	731	37.0	455	36.6	
≥30.0	821	42.8	483	40.5	
Smoking					0.130
Never	839	41.9	475	37.1	
Past	956	48.7	644	53.5	
Current	173	9.4	115	9.3	
Care-seeking attitudes					
Avoid going to a physician	534	27.1	301	24.2	0.185
Visit a physician as soon as feel bad	773	39.6	529	41.6	0.393
Worry about health more than others	422	21.5	259	21.6	0.958
Keep to self when sick	717	36.1	434	35.2	0.678
Same physician>5 years	1191	59.9	647	51.4	**0.003**

Abbreviations: **MCBS**, Medicare Current Beneficiary Survey (MCBS); **MSA**, Metropolitan Statistical Areas; **CCI**, Charlson Comorbidity Index; **ADLs**, Activities of daily living, includes bathing or showering, getting dressed, getting in and out of a chair, walking, and using the toilet; **IADLs,** Instrumental activities of daily living, including using telephone, shopping, preparing food, housekeeping, laundry, traveling, taking medication, and managing financial matters independently; **BMI**, body mass index, calculated as weight in kilograms divided by height in meters squared.
a. Percentages were calculated with national weights, p-value was obtained from Rao-Scott Chi-Square tests

5.5.1.2. Environment factors

Table 5.19 shows environmental and healthcare system factors among diabetic beneficiaries enrolled in PDPs and MA-PDs. PDP enrollees were more likely to reside in

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the county with similar number of primary physicians per 1,000 capita (0.68 vs. 0.73; p=0.540), but live in the county with higher number of hospital beds per 1,000 capita (3.1 vs. 3.1; p<0.0001). In addition, compared to MA-PD enrollees, PDP enrollees were more likely to live in the county with higher percentage of population below poverty line (16.8% vs. 16.7%; p<0.0001), and higher unemployment rate (6.7% vs. 6.6%; p=0.004), and lower percentage of college graduates (25.1% vs. 28.5%; p<0.0001).

Table 5.19 Environment Factors among Diabetic Beneficiaries

Characteristics	PDPs		MA-PDs		p-value
	mean	std	mean	std	
Number of primary physicians per 1,000 capita[a]	0.68	0.02	0.73	0.01	0.540
Number of hospital beds per 1,000 capita	3.1	0.1	3.1	0.1	**<.0001**
Percent under poverty, %	16.8	0.4	16.7	0.3	**<.0001**
Unemployment rate, %	6.7	0.2	6.6	0.1	**0.004**
Education higher than high school, %	25.1	0.6	28.5	0.6	**<.0001**

a. Primary Care includes general family medicine, general practice, general internal medicine and general pediatrics.
Abbreviations: **std**, standard deviation.

5.5.2 Descriptive statistics

Table 5.20 describes compares self-reported medication use among diabetic beneficiaries enrolled in PDPs and MA-PDs. The proportion of PDP enrollees with at least 1 prescription was similar to MA-PD enrollees. However, PDP enrollees had higher mean number of fills for anti-diabetic drugs (11.57 vs. 10.27, p=0.001), antihypertensive drugs (18.81 vs. 15.64, p<0.0001), and antihyperlipidemic drugs (6.65 vs.5.48, p<0.0001).

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Table 5.20 Self-Reported Medication Use among Diabetic Beneficiaries

Outcome Measures	PDPs	MA-PDs	p-value
Any anti-diabetic agents			
With at least 1 fill, n (%)	1675 (85.11%)	1076 (87.20%)	0.100
No. of fills, mean ±std	11.57 ±10.75	10.27 ±9.18	**0.001**
Antihypertensive drugs			
With at least 1 fill, n (%)	1799 (91.41%)	1145 (92.79%)	0.160
No. of fills, mean ±std	18.81 ±17.21	15.64 ±14.04	**<.0001**
Antihyperlipidemic drugs			
With at least 1 fill, n (%)	1365 (69.36%)	886 (71.80%)	0.14
No. of fills, mean ±std	6.65 ±7.83	5.48 ±5.92	**<.0001**

Table 5.21 compares medication use and adherence measured by pharmacy claims. The proportion of PDP enrollees with at least 1 prescription was similar to MA-PD enrollees. However, PDP enrollees had higher mean number of fills for anti-diabetic drugs (9.77 vs. 8.88, p=0.002), antihypertensive drugs (15.72 vs. 13.75, p<0.0001), and antihyperlipidemic drugs (5.49 vs.4.55, p<0.0001), compared to MA-PD enrollees. Medication adherence measured by PDC was similar among PDP and MA-PD enrollees, however, PDP enrollees were more likely to be adherent (PDC≥0.80) to anti-diabetic drugs (34.96% vs. 29.90%, p=0.001), antihypertensive drugs (41.19% vs. 34.76%, p=0.002), and antihyperlipidemic drugs (23.88% vs. 16.86%, p<0.0001).

Table 5.21 Claims-Based Medication Use and Adherence among Diabetic Beneficiaries

Outcome Measures	PDPs	MA-PDs	p-value
Any anti-diabetic agent			
With at least 1 fill, n (%)	1632 (82.93%)	1041 (84.36%)	0.288
No. of fills, mean ± std	9.77 ±8.01	8.88 ±7.60	**0.002**
PDC, mean ± std	0.59 ±0.32	0.58 ±0.31	0.372
PDC≥0.80, n (%)	688 (34.96%)	359 (29.09%)	**0.001**
Any antihypertensive drugs			
With at least 1 fill, n (%)	1758 (89.33%)	1120 (90.76%)	0.191
No. of fills, mean ± std	15.72 ±12.23	13.75 ±11.81	**<.0001**
PDC, mean ± std	0.66 ±0.28	0.64 ±0.28	0.156

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Outcome Measures	PDPs	MA-PDs	p-value
PDC≥0.80, n (%)	791 (41.19%)	429 (34.76%)	**0.002**
Any antihyperlipidemic drugs			
With at least 1 fill, n (%)	1328 (67.48%)	847 (68.64%)	0.494
No. of fills, mean ± std	5.49 ±5.93	4.55 ±4.75	**<.0001**
PDC, mean ± std	0.45 ±0.37	0.43 ±0.35	0.192
PDC≥0.80, n (%)	470 (23.88%)	208 (16.86%)	**<.0001**

Abbreviations: **std**, standard deviation; **PDC**, Proportion of Days Covered.

5.5.3 Naïve Model: Medication Adherence

Table 5.22 presents the results for the effects of PDPs on medication adherence. Since PDC is continuous variable with normal distribution, OLS was used to model the effects of PDPs on Medication adherence (PDC) among elderly beneficiaries. As shown in Table 5.22, compared to MA-PDs, PDP enrollees had similar PDC to anti-diabetic drugs and antihyperlipidemic drugs, but had 2.7% lower PDC of antihypertensive drugs (p=0.016). Table 23 shows the likelihood of being adherent (PDC≥0.80) to drug treatments among diabetic beneficiaries. PDP enrollees had similar likelihood of being adherent to anti-diabetic drugs (OR=1.01, p=0.883) and antihypertensive drugs (OR=0.91, p=0.313), and antihyperlipidemic drugs (OR=1.21, p=0.069).

The results also reveal that medication adherence to anti-diabetic drugs was associated with various factors. For adherence to anti-diabetic drugs, the statistically significant factors included race/ethnicity, marital status, living conditions, LIS, self-perceived health status, BMI, care-seeking attitudes, and environment factors. For adherence to antihypertensive drugs, the statistically significant factors included age, race/ethnicity, living conditions, LIS, having other RX coverage, self-perceived health status, number of chronic conditions, BMI, smoking, care-seeking attitudes, and environment factors. For adherence to antihyperlipidemic drugs, the statistically significant factors included age,

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Table 5.22 Naïve Model: Effects of PDPs on Medication Adherence (PDC)

Characteristics	Anti-diabetic Drugs			Antihypertensive Drugs			Antihyperlipidemic Drugs		
	Est.	SE	p-value	Est.	SE	p-value	Est.	SE	p-value
Part D enrollment									
PDPs	**-0.003**	**0.01**	**0.846**	**-0.027**	**0.01**	**0.016**	**0.0003**	**0.01**	**0.983**
MA-PDs	Ref	–	–	Ref	–	–	Ref	–	–
Age, years									
65-75	Ref	–	–	Ref	–	–	Ref	–	–
75-85	0.01	0.01	0.580	0.02	0.01	0.059	-0.04	0.01	**0.009**
>85	-0.03	0.02	0.172	0.05	0.02	**0.003**	-0.10	0.02	**<.0001**
Sex									
Male	Ref	–	–	Ref	–	–	Ref	–	–
Female	-0.02	0.01	0.215	0.03	0.01	**0.029**	0.02	0.02	0.210
Race/ethnicity									
Non-Hispanic White	Ref	–	–	Ref	–	–	Ref	–	–
Non-Hispanic Black	0.02	0.02	0.324	0.04	0.02	**0.036**	-0.08	0.02	**0.0003**
Hispanics	0.05	0.02	**0.024**	-0.03	0.02	0.061	0.01	0.02	0.805
Non-Hispanic others	0.02	0.03	0.357	0.02	0.02	0.391	0.003	0.03	0.924
Marriage									
Married	Ref	–	–	Ref	–	–	Ref	–	–
Widowed	-0.09	0.04	**0.024**	-0.04	0.03	0.245	-0.06	0.05	0.175
Divorced/Separated	-0.08	0.04	0.061	-0.02	0.04	0.632	-0.06	0.05	0.245
Never married	-0.01	0.05	0.813	-0.03	0.04	0.463	0.03	0.06	0.650
Living conditions									
Alone	Ref	–	–	Ref	–	–	Ref	–	–
With spouse	-0.08	0.04	**0.046**	-0.03	0.03	0.422	-0.04	0.05	0.411
With children	-0.04	0.02	**0.031**	-0.04	0.02	**0.011**	-0.01	0.02	0.617
With others	-0.01	0.02	0.726	-0.01	0.02	0.571	0.03	0.03	0.252
Education level									
< high school	0.03	0.02	0.051	0.02	0.01	0.246	-0.02	0.02	0.309
High school/GED	Ref	–	–	Ref	–	–	Ref	–	–
>high school	0.00	0.01	0.993	0.02	0.01	**0.048**	0.019	0.02	0.250

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Characteristics	Anti-diabetic Drugs			Antihypertensive Drugs			Antihyperlipidemic Drugs		
	Est.	**SE**	**p-value**	**Est.**	**SE**	**p-value**	**Est.**	**SE**	**p-value**
Annual income									
<$25,000	Ref	–	–	Ref	–	–	Ref	–	–
>$25,000	-0.02	0.02	0.157	0.00	0.01	0.808	0.004	0.02	0.827
LIS									
Yes	0.05	0.02	**0.001**	0.05	0.01	**0.0002**	0.06	0.02	**0.001**
No	Ref	–	–	Ref	–	–	Ref	–	–
MSA									
Yes	Ref	–	–	Ref	–	–	Ref	–	–
No	-0.02	0.02	0.368	0.01	0.01	0.334	0.02	0.02	0.348
Census region									
Northeast	Ref	–	–	Ref	–	–	Ref	–	–
Midwest	0.03	0.02	0.176	0.02	0.02	0.157	0.02	0.02	0.342
South	-0.02	0.02	0.218	0.02	0.02	0.222	0.02	0.02	0.351
West	-0.03	0.02	0.141	0.00	0.02	0.878	0.002	0.02	0.926
Other RX coverage									
None	Ref	–	–	Ref	–	–	Ref	–	–
Public	-0.03	0.02	0.1	0.03	0.01	**0.019**	0.01	0.02	0.560
Private/self-purchased	-0.01	0.04	0.728	0.01	0.03	0.747	-0.03	0.04	0.458
Self-perceived health Status									
Excellent	Ref	–	–	Ref	–	–	Ref	–	–
Very good	0.05	0.02	**0.040**	0.06	0.02	**0.005**	0.06	0.03	**0.022**
Good	0.05	0.02	**0.045**	0.05	0.02	**0.007**	0.04	0.03	0.098
Fair	0.04	0.02	0.069	0.08	0.02	**0.0002**	0.05	0.03	0.098
Poor	0.04	0.03	0.179	0.09	0.03	**0.001**	0.06	0.03	0.105
Number of chronic conditions									
0-1	Ref	–	–	Ref	–	–	Ref	–	–
2-3	0.03	0.03	0.213	0.28	0.02	**<.0001**	0.09	0.03	**0.003**
4+	0.04	0.03	0.202	0.33	0.02	**<.0001**	0.10	0.03	**0.004**
CCI									
1-2	Ref	–	–	Ref	–	–	Ref	–	–
3+	-0.01	0.01	0.442	-0.02	0.01	0.066	0.03	0.02	0.104

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Characteristics	Anti-diabetic Drugs			Antihypertensive Drugs			Antihyperlipidemic Drugs		
	Est.	**SE**	**p-value**	**Est.**	**SE**	**p-value**	**Est.**	**SE**	**p-value**
ADLs									
None	Ref	–	–	Ref	–	–	Ref	–	–
1-2	0.015	0.01	0.286	-0.003	0.01	0.821	-0.02	0.02	0.183
3+	-0.004	0.02	0.856	-0.03	0.02	0.109	-0.01	0.02	0.661
IADLs									
None	Ref	–	–	Ref	–	–	Ref	–	–
1-2	-0.03	0.01	0.058	-0.02	0.01	0.108	-0.02	0.02	0.210
3+	0.0004	0.02	0.986	-0.01	0.02	0.614	-0.01	0.02	0.588
BMI, kg/m^2									
<25.0	Ref	–	–	Ref	–	–	Ref	–	–
25.0-29.9	0.04	0.02	**0.005**	0.04	0.01	**0.001**	0.02	0.02	**0.192**
≥30.0	0.08	0.02	**<.0001**	0.04	0.01	**0.001**	0.03	0.02	**0.104**
Smoking									
Never	Ref	–	–	Ref	–	–	Ref	–	–
Past	-0.01	0.01	0.370	-0.02	0.01	**0.024**	-0.02	0.01	0.154
Current	0.03	0.02	0.147	-0.04	0.02	**0.025**	-0.03	0.02	0.177
Care-seeking attitudes									
Avoid going to a physician									
Yes	-0.01	0.01	0.577	-0.01	0.01	0.639	-0.05	0.02	**0.005**
No	Ref	–	–	Ref	–	–	Ref	–	–
Visit a physician as soon as feel bad									
Yes	-0.02	0.01	0.188	-0.01	0.01	0.554	-0.02	0.01	0.127
No	Ref	–	–	Ref	–	–	Ref	–	–
Worry about health more than others									
Yes	0.02	0.01	0.178	0.001	0.01	0.964	0.04	0.02	**0.034**
No	Ref	–	–	Ref	–	–	Ref	–	–
Keep to self when sick									
Yes	-0.01	0.01	0.312	-0.02	0.01	0.082	-0.02	0.01	0.281
No	Ref	–	–	Ref	–	–	Ref	–	–
Same physician>5 years									
Yes	0.03	0.01	**0.008**	0.02	0.01	**0.014**	0.03	0.01	**0.044**

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Characteristics	Anti-diabetic Drugs			Antihypertensive Drugs			Antihyperlipidemic Drugs		
	Est.	**SE**	**p-value**	**Est.**	**SE**	**p-value**	**Est.**	**SE**	**p-value**
No	Ref	–	–	Ref	–	–	Ref	–	–
Environment factors									
Number of primary physicians	-0.04	0.04	0.333	0.03	0.03	0.369	-0.01	0.04	0.725
Number of hospital beds	0.003	0.004	0.435	0.0001	0.003	0.983	-0.0003	0.004	0.952
Percent under Poverty	0.003	0.002	**0.029**	0.001	0.001	**0.422**	0.0004	0.002	**0.831**
Unemployment rate	-0.01	0.005	0.234	-0.01	0.004	**0.047**	-0.01	0.005	0.299
Education higher than high school	0.002	0.001	0.133	-0.001	0.001	0.318	0.003	0.001	**0.024**
Calendar year									
2006	Ref	–	–	Ref	–	–	Ref	–	–
2007	-0.03	0.02	0.179	0.01	0.02	0.398	0.01	0.02	0.571
2008	-0.03	0.02	0.086	-0.01	0.02	0.721	0.04	0.02	0.104
2009	-0.06	0.02	**0.001**	-0.02	0.02	**0.337**	0.05	0.02	**0.032**
2010	-0.06	0.02	**0.002**	-0.01	0.02	**0.438**	0.06	0.02	**0.006**

Abbreviations: **MCBS**, Medicare Current Beneficiary Survey (MCBS); **SE**, standard error; **MSA**, Metropolitan Statistical Areas; **CCI**, Charlson Comorbidity Index; **ADLs**, Activities of daily living, includes bathing or showering, getting dressed, getting in and out of a chair, walking, and using the toilet; **IADLs**, Instrumental activities of daily living, including using telephone, shopping, preparing food, housekeeping, laundry, traveling, taking medication, and managing financial matters independently; **BMI**, body mass index, calculated as weight in kilograms divided by height in meters squared.
a. These results were adjusted for the variables listed in Table 5.1.

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Table 5.23 Naïve Model: Effects of PDPs on Medication Adherence (PDC⩾0.80)

Characteristics	Anti-diabetic Drugs				Antihypertensive Drugs				Antihyperlipidemic Drugs			
	Est.	SE	OR	p-value	Est.	SE	OR	p-value	Est.	SE	OR	p-value
Part D enrollment												
PDPs	**0.01**	**0.09**	**1.01**	**0.883**	**-0.09**	**0.09**	**0.91**	**0.313**	**0.19**	**0.11**	**1.21**	**0.069**
MA-PDs	Ref	–	Ref	–	Ref	–	Ref	–	Ref	–	Ref	–
Age, years												
65-75	Ref	–	Ref	–	Ref	–	Ref	–	Ref	–	Ref	–
75-85	-0.13	0.09	0.88	0.149	-0.03	0.09	0.97	0.733	-0.06	0.10	0.94	0.557
>85	-0.3	0.14	0.74	**0.036**	0.19	0.14	1.21	0.154	-0.25	0.17	0.78	0.132
Sex												
Male	Ref	–	Ref	–	Ref	–	Ref	–	Ref	–	Ref	–
Female	-0.29	0.1	0.75	**0.003**	-0.03	0.09	0.97	0.743	-0.13	0.11	0.88	0.241
Race/ethnicity												
Non-Hispanic White	Ref	–	Ref	–	Ref	–	Ref	–	Ref	–	Ref	–
Non-Hispanic Black	-0.05	0.14	0.96	0.743	0.08	0.13	1.09	0.524	-0.17	0.16	0.84	0.277
Hispanics	0.14	0.14	1.15	0.324	-0.01	0.14	0.99	0.935	0.18	0.16	1.20	0.267
Non-Hispanic others	0.47	0.17	1.61	**0.007**	0.18	0.17	1.20	0.299	0.16	0.20	1.17	0.421
Marriage												
Married	Ref	–	Ref	–	Ref	–	Ref	–	Ref	–	Ref	–
Widowed	-0.49	0.27	0.61	**0.071**	-0.18	0.28	0.84	0.522	-0.21	0.32	0.81	0.506
Divorced/Separated	-0.37	0.28	0.69	0.19	0.01	0.29	1.01	0.978	-0.03	0.33	0.97	0.922
Never married	-0.13	0.35	0.88	0.712	0.25	0.35	1.28	0.477	0.39	0.39	1.48	0.317
Living conditions												
Alone	Ref	–	Ref	–	Ref	–	Ref	–	Ref	–	Ref	–
With spouse	-0.55	0.28	0.57	**0.044**	-0.16	0.28	0.85	0.565	-0.11	0.32	0.90	0.739
With children	-0.31	0.13	0.74	**0.015**	-0.22	0.12	0.80	0.068	-0.17	0.15	0.85	0.247
With others	-0.27	0.17	0.77	0.114	0.002	0.16	1.00	0.988	0.04	0.19	1.04	0.839
Education level												
< high school	0.17	0.11	1.18	0.124	0.13	0.11	1.14	0.235	-0.01	0.12	0.99	0.930
High school/GED	Ref	–	Ref	–	Ref	–	Ref	–	Ref	–	Ref	–
>high school	-0.01	0.10	0.99	0.944	0.09	0.10	1.09	0.382	0.02	0.12	1.02	0.894

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Characteristics	Anti-diabetic Drugs				Antihypertensive Drugs				Antihyperlipidemic Drugs			
	Est.	**SE**	**OR**	**p-value**	**Est.**	**SE**	**OR**	**p-value**	**Est.**	**SE**	**OR**	**p-value**
Annual income												
<$25,000	Ref	–	Ref	–	Ref	–	Ref	–	Ref	–	Ref	–
>$25,000	-0.23	0.11	0.79	**0.033**	-0.14	0.11	0.87	0.189	-0.01	0.13	0.99	0.964
LIS												
Yes	0.52	0.11	1.69	**<.0001**	0.32	0.11	1.38	**0.002**	0.37	0.12	1.45	**0.003**
No	Ref	–	Ref	–	Ref	–	Ref	–	Ref	–	Ref	–
MSA												
Yes	Ref	–	Ref	–	Ref	–	Ref	–	Ref	–	Ref	–
No	-0.16	0.12	0.85	0.196	-0.12	0.12	0.89	0.329	-0.25	0.14	0.78	0.064
Census region												
Northeast	Ref	–	Ref	–	Ref	–	Ref	–	Ref	–	Ref	–
Midwest	0.22	0.14	1.24	0.122	0.19	0.14	1.21	0.172	0.24	0.16	1.28	0.125
South	-0.13	0.14	0.88	0.338	0.13	0.13	1.13	0.345	0.07	0.16	1.08	0.645
West	-0.47	0.15	0.62	**0.002**	-0.34	0.15	0.71	**0.021**	-0.39	0.18	0.68	**0.028**
Other RX coverage												
None	Ref	–	Ref	–	Ref	–	Ref	–	Ref	–	Ref	–
Public	-0.05	0.12	0.95	0.687	0.36	0.12	1.43	**0.002**	0.28	0.13	1.32	**0.039**
Private/self-purchased	0.02	0.27	1.02	0.954	0.03	0.26	1.03	0.923	0.27	0.29	1.31	0.354
Self-perceived health status												
Excellent	Ref	–	Ref	–	Ref	–	Ref	–	Ref	–	Ref	–
Very good	0.06	0.17	1.06	0.714	0.61	0.18	1.85	**0.001**	0.34	0.20	1.41	0.096
Good	0.09	0.16	1.09	0.603	0.50	0.17	1.65	**0.003**	0.20	0.20	1.22	0.322
Fair	0.14	0.18	1.15	0.428	0.61	0.18	1.85	**0.001**	0.17	0.21	1.18	0.431
Poor	-0.03	0.22	0.97	0.902	0.67	0.22	1.96	**0.002**	0.12	0.25	1.13	0.627
Number of chronic conditions												
0-1	Ref	–	Ref	–	Ref	–	Ref	–	Ref	–	Ref	–
2-3	0.05	0.19	1.05	0.783	0.91	0.21	2.49	**<.0001**	0.31	0.23	1.36	0.186
4+	0.07	0.21	1.07	0.739	1.08	0.23	2.94	**<.0001**	0.31	0.25	1.36	0.227
CCI												
1-2	Ref	–	Ref	–	Ref	–	Ref	–	Ref	–	Ref	–
3+	-0.10	0.11	0.91	0.356	-0.06	0.10	0.95	0.587	0.05	0.12	1.05	0.709

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Characteristics	Anti-diabetic Drugs				Antihypertensive Drugs				Antihyperlipidemic Drugs			
	Est.	**SE**	**OR**	**p-value**	**Est.**	**SE**	**OR**	**p-value**	**Est.**	**SE**	**OR**	**p-value**
ADLs												
None	Ref	–	Ref	–	Ref	–	Ref	–	Ref	–	Ref	–
1-2	0.08	0.1	1.09	0.399	0.07	0.10	1.07	0.474	-0.02	0.11	0.98	0.832
3+	-0.05	0.15	0.95	0.746	-0.08	0.14	0.92	0.566	-0.03	0.16	0.97	0.873
IADLs												
None	Ref	–	Ref	–	Ref	–	Ref	–	Ref	–	Ref	–
1-2	-0.02	0.1	0.98	0.849	-0.05	0.10	0.95	0.592	0.19	0.11	1.21	0.097
3+	0.13	0.15	1.14	0.388	-0.02	0.15	0.98	0.895	0.29	0.17	1.34	0.082
BMI, kg/m2												
<25.0	Ref	–	Ref	–	Ref	–	Ref	–	Ref	–	Ref	–
25.0-29.9	0.02	0.11	1.02	0.830	0.01	0.10	1.01	0.936	0.02	0.12	1.02	0.883
≥30.0	0.23	0.11	1.26	**0.032**	-0.12	0.11	0.88	0.241	-0.03	0.12	0.97	0.813
Smoking												
Never	Ref	–	Ref	–	Ref	–	Ref	–	Ref	–	Ref	–
Past	-0.11	0.09	0.9	0.239	-0.12	0.09	0.88	0.161	-0.23	0.10	0.79	**0.023**
Current	-0.06	0.15	0.94	0.673	-0.30	0.15	0.74	**0.047**	-0.22	0.17	0.80	0.212
Care-seeking attitudes												
Avoid going to a physician												
Yes	0.1	0.1	1.1	0.322	0.03	0.10	1.03	0.735	-0.06	0.11	0.94	0.590
No	Ref	–	Ref	–	Ref	–	Ref	–	Ref	–	Ref	–
Visit a physician as soon as feel bad												
Yes	-0.11	0.09	0.9	0.196	-0.14	0.08	0.87	0.092	-0.06	0.10	0.94	0.527
No	Ref	–	Ref	–	Ref	–	Ref	–	Ref	–	Ref	–
Worry about health more than others												
Yes	0.05	0.1	1.05	0.648	0.07	0.10	1.08	0.448	0.08	0.11	1.09	0.469
No	Ref	–	Ref	–	Ref	–	Ref	–	Ref	–	Ref	–
Keep to self when sick												
Yes	-0.18	0.09	0.84	0.053	-0.23	0.09	0.79	**0.009**	-0.07	0.10	0.93	0.515
No	Ref	–	Ref	–	Ref	–	Ref	–	Ref	–	Ref	–
Same physician>5 years												
Yes	0.15	0.08	1.16	0.061	0.03	0.08	1.03	0.718	0.13	0.09	1.14	0.161

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Characteristics	Anti-diabetic Drugs				Antihypertensive Drugs				Antihyperlipidemic Drugs			
	Est.	**SE**	**OR**	**p-value**	**Est.**	**SE**	**OR**	**p-value**	**Est.**	**SE**	**OR**	**p-value**
No	Ref	–	Ref	–	Ref	–	Ref	–	Ref	–	Ref	–
Environment factors												
Number of primary physicians	0.05	0.25	1.06	0.831	0.002	0.25	1.00	0.993	0.05	0.28	1.05	0.869
Number of hospital beds	-0.01	0.03	0.99	0.737	0.01	0.03	1.01	0.643	-0.01	0.03	0.99	0.735
Percent under Poverty	0.01	0.01	1.01	0.264	0.02	0.01	1.02	0.109	0.02	0.01	1.02	0.116
Unemployment rate	-0.1	0.03	0.9	**0.002**	-0.15	0.03	0.86	**<.0001**	-0.13	0.04	0.88	**0.001**
Education higher than high school	-0.01	0.01	0.99	0.315	-0.02	0.01	0.98	**0.012**	0.00	0.01	1.00	0.850
Calendar year												
2006	Ref	–	Ref	–	Ref	–	Ref	–	Ref	–	Ref	–
2007	-0.15	0.14	0.86	0.269	0.05	0.13	1.05	0.701	0.04	0.16	1.04	0.795
2008	-0.28	0.13	0.76	**0.037**	-0.16	0.13	0.85	0.210	0.06	0.16	1.07	0.686
2009	-0.51	0.14	0.6	**0.000**	-0.26	0.13	0.77	**0.049**	0.12	0.16	1.12	0.471
2010	-0.47	0.14	0.62	**0.001**	-0.38	0.14	0.69	**0.006**	0.18	0.16	1.20	0.254

Abbreviations: **MCBS**, Medicare Current Beneficiary Survey (MCBS); **SE**, standard error; **MSA**, Metropolitan Statistical Areas; **CCI**, Charlson Comorbidity Index; **ADLs**, Activities of daily living, includes bathing or showering, getting dressed, getting in and out of a chair, walking, and using the toilet; **IADLs**, Instrumental activities of daily living, including using telephone, shopping, preparing food, housekeeping, laundry, traveling, taking medication, and managing financial matters independently; **BMI**, body mass index, calculated as weight in kilograms divided by height in meters squared.

a. These results are adjusted for the variables listed in Table 5.1. In the Naïve Model, the OR of adherence was estimated using logistic regression models.

b. OR was calculated as using the equation ($e^{coefficient}$).

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race/ethnicity, LIS, self-perceived health status, care-seeking attitudes, and environment factors.

5.5.4 IV model: medication adherence

First Stage of IV Model

Table 5.26 shows the distributions of the instrumental variables used in the first-stage 2SRI models. Compared to MA enrollees, PDP enrollees were more likely to reside in the counties with higher PDP penetration rate (43.02% vs. 33.58%), and states offering State Pharmaceutical Assistance Programs for the elderly (34.55% vs. 31.52%). PDP enrollees were less likely to live in the counties with higher percentage of white collar job (55.70% vs. 60.13%), but it didn't reach statistical significance (p=0.0795).

Table 5.24 Descriptive Statistics for Instrumental Variables of Diabetic Beneficiaries

Instruments	PDPs	MA-PDs	p-value
PDP penetration rate, mean ± std	43.02 ± 11.28	33.58 ± 9.42	**<.0001**
Percent white collar job, mean ± std	55.70 ± 9.75	60.13 ± 7.70	**<.0001**
State Pharmaceutical Assistance Programs for seniors, n (%)	680 (34.55%)	389 (31.52%)	0.0795

Abbreviations: **std**, standard deviation; **PDC**, Proportion of Days Covered.

In the first stage of 2SRI, prohibit regression model was used to estimate the probability of enrolling in PDPs compared to MA-PDs. The statistical significant predictors of enrolling in PDPs include PDP penetration rate, % white collar job, race/ethnicity, living conditions, annual income, LIS status, MSA, census region, having other RX coverage, number of chronic conditions, self-perceived health status, CCI, IADLs, BMI, care-seeking attitudes, environment factors, and calendar year. The first stage of 2SRI estimation is presented in Tables 5.25 below.

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Table 5.25 The First Stage of IV Estimation: Medication Adherence

Characteristics	Estimate	SE	OR	p-value
Instruments				
PDP penetration rate	0.06	0.00	1.06	**<.0001**
Age, years				
65-75	Ref	–	Ref	–
75-85	-0.05	0.06	0.96	0.432
>85	0.04	0.09	1.04	0.685
Sex				
Male	Ref	–	Ref	–
Female	0.05	0.06	1.05	0.429
Race/ethnicity				
Non-Hispanic White	Ref	–	Ref	–
Non-Hispanic Black	-0.65	0.09	0.52	**<.0001**
Hispanics	-0.30	0.09	0.74	**0.001**
Non-Hispanic others	0.09	0.13	1.10	0.458
Marriage				
Married	Ref	–	Ref	–
Widowed	0.14	0.18	1.15	0.422
Divorced/separated	-0.06	0.19	0.94	0.737
Never married	0.17	0.23	1.18	0.474
Living conditions				
Alone	Ref	–	Ref	–
With spouse	-0.11	0.18	0.90	0.556
With children	-0.02	0.08	0.98	0.790
With others	-0.25	0.11	0.78	**0.029**
Education level				
< high school	-0.05	0.08	0.95	0.484
High school/GED	Ref	–	Ref	–
>high school	0.07	0.06	1.08	0.259
Annual income				
<$25,000	Ref	–	Ref	–
≥$25,000	0.24	0.07	1.27	**0.0003**
LIS				
Yes	0.93	0.08	2.53	**<.0001**
No	Ref	–	Ref	–
MSA				
Yes	Ref	–	Ref	–
No	-0.58	0.10	0.56	**<.0001**
Census region				
Northeast	Ref	–	Ref	**–**
Midwest	0.23	0.08	1.26	**0.007**
South	0.59	0.09	1.80	**<.0001**
West	-0.05	0.09	0.96	0.609

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Characteristics	Estimate	SE	OR	p-value
Other RX coverage				
None	Ref	–	Ref	–
Public	0.31	0.08	1.37	**0.0002**
Private/self-purchased	0.18	0.17	1.19	0.308
Self-perceived health status				
Excellent	Ref	–	Ref	–
Very good	-0.23	0.10	0.80	**0.030**
Good	0.02	0.10	1.02	0.878
Fair	0.14	0.11	1.16	0.194
Poor	0.22	0.15	1.24	0.159
Number of chronic conditions				
0-1	Ref	–	Ref	–
2-4	0.09	0.10	1.09	0.389
4+	0.04	0.12	1.04	0.730
CCI				
0-2	Ref	–	Ref	–
3+	0.17	0.06	1.18	**0.010**
ADLs				
None	Ref	–	Ref	–
1-2	0.09	0.06	1.10	0.145
3+	0.12	0.10	1.13	0.212
IADLs				
None	Ref	–	Ref	–
1-2	0.05	0.07	1.05	0.486
3+	0.05	0.11	1.05	0.619
BMI, kg/m^2				
<25.0	Ref	–	Ref	–
25.0-29.9	0.06	0.07	1.06	0.368
≥30.0	0.05	0.07	1.05	0.504
Smoking				
Never	Ref	–	Ref	–
Past	0.00	0.06	1.00	0.935
Current	-0.05	0.10	0.96	0.638
Care-seeking attitudes				
Avoid going to a physician				
Yes	-0.01	0.07	0.99	0.841
No	Ref	–	Ref	–
Visit a physician as soon as feel bad				
Yes	-0.07	0.06	0.94	0.234
No	Ref	–	Ref	–
Worry about health more than others				
Yes	-0.15	0.07	0.86	**0.023**
No	Ref	–	Ref	–
Keep to self when sick				

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Characteristics	Estimate	SE	OR	p-value
Yes	-0.02	0.06	0.98	0.685
No	Ref	–	Ref	–
Same physician>5 years				
Yes	0.17	0.05	1.19	**0.001**
No	Ref	–	Ref	–
Environment factors				
Number of primary physicians	0.49	0.17	1.63	**0.005**
Number of hospital beds	-0.05	0.02	0.95	**0.005**
Percent under Poverty	-0.05	0.01	0.95	**<.0001**
Unemployment rate	0.0001	0.02	1.00	0.996
Education higher than high school	-0.01	0.01	0.99	**0.025**
Calendar year				
2006	Ref	–	Ref	–
2007	0.26	0.09	1.30	**0.003**
2008	0.16	0.09	1.18	0.057
2009	0.09	0.09	1.09	0.328
2010	0.28	0.09	1.33	**0.002**

Abbreviations: **MCBS**, Medicare Current Beneficiary Survey (MCBS); **SE**, standard error; **MSA**, Metropolitan Statistical Areas; **CCI**, Charlson Comorbidity Index; **ADLs**, Activities of daily living, includes bathing or showering, getting dressed, getting in and out of a chair, walking, and using the toilet; **IADLs**, Instrumental activities of daily living, including using telephone, shopping, preparing food, housekeeping, laundry, traveling, taking medication, and managing financial matters independently; **BMI**, body mass index, calculated as weight in kilograms divided by height in meters squared.

To test the assumption of IV, several model specification tests were performed (Table 5.28). The results for Durbin-Wu-Hausman tests indicate that type of Part D plan is exogenous for the medication adherence measured in PDC, but endogenous for being adherent (PDC≥0.80). Second, since multiple instruments were used in this analysis, Hansen's tests of overidentifying were performed to evaluate the validity of instruments. However, the three instruments, which include county-level PDP penetration, percent of white collar job and State Pharmaceutical Assistance Programs for seniors in each study year, were not valid. The results for overidentification tests indicate that we can only use one instrument, which is the PDP penetration rate. Third, the F statistics for instruments is greater than 10, suggesting that the instruments are not weak.

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Table 5.26 Model Specification Tests for IV: Medication Adherence

Outcome Measures	**Endogeneity Test** (Durbin-Wu-Hausman)	**Overidentification Test** (Sargan-Hansen J)	**Weak-IV Test** (Staiger-Stock)
Adherence (PDC)			
Antidiabetic drugs	2.70 (p = 0.10)	3.83 (p = 0.15)	16.38
Antihypertensive drugs	0.52 (p = 0.47)	0.34 (p = 0.85)	16.38
Antihyperlipidemic drugs	1.144 (p = 0.28)	8.35 (p = 0.02)	16.38
Adherent (PDC≥0.80)			
Antidiabetic drugs	6.50 (p = 0.011)	7.32 (p = 0.03)	16.38
Antihypertensive drugs	7.91 (p = 0.005)	0.34 (p = 0.85)	16.38
Antihyperlipidemic drugs	4.36 (p = 0.037)	6.75 (p = 0.034)	16.38

Table 5.27 describes the results for the effect of PDPs on the likelihood of being adherent (PDC≥0.80) in the IV. Since PDC are not endogenous, and it was not estimated in the IV. Compared to MA-PDs, PDP enrollees had lower likelihood of using anti-diabetic drugs (OR=0.51, p=0.050). PDPs also were associated with lower likelihood of being adherent to antihypertensive drugs (OR=0.72, p=0.309) and antihyperlipidemic drugs (OR=0.91, p=0.806), but didn't reach statistically significance. The results also reveal that medication adherence to anti-diabetic drugs was associated with various factors, including age, sex, race/ethnicity, living conditions, annual income, LIS, census region, care-seeking attitudes, and environment factors. For adherence to antihypertensive drugs, the statistically significant factors included LIS, census region,

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Table 5.27 IV Model: Effects of PDPs on Medication Adherence

Characteristics	Anti-diabetic Drugs				Antihypertensive Drugs				Antihyperlipidemic Drugs			
	Est.	SE	OR	p-value	Est.	SE	OR	p-value	Est.	SE	OR	p-value
Residual from the first stage	-0.61	0.29	0.54	**0.037**	-0.22	0.28	0.8	0.442	-0.26	0.34	0.77	0.448
Part D enrollment												
PDPs	**-0.67**	**0.34**	**0.51**	**0.050**	**-0.33**	**0.33**	**0.72**	**0.309**	**-0.10**	**0.39**	**0.91**	**0.806**
MA-PDs	Ref	–	Ref	–	Ref	–	Ref	–	Ref	–	Ref	–
Age, years												
65-75	Ref	–	Ref	–	Ref	–	Ref	–	Ref	–	Ref	–
75-85	-0.11	0.09	0.89	0.217	-0.03	0.09	0.97	0.753	-0.06	0.10	0.95	0.587
>85	-0.31	0.15	0.74	**0.035**	0.19	0.14	1.21	0.171	-0.26	0.17	0.77	0.123
Sex												
Male	Ref	–	Ref	–	Ref	–	Ref	–	Ref	–	Ref	–
Female	-0.30	0.10	0.74	**0.002**	-0.04	0.09	0.97	0.702	-0.13	0.11	0.88	0.221
Race/ethnicity												
Non-Hispanic White	Ref	–	Ref	–	Ref	–	Ref	–	Ref	–	Ref	–
Non-Hispanic Black	-0.49	0.27	0.61	0.070	0.13	0.14	1.13	0.382	-0.13	0.17	0.88	0.465
Hispanics	-0.37	0.29	0.69	0.190	0.01	0.15	1.01	0.926	0.21	0.17	1.24	0.209
Non-Hispanic others	-0.15	0.35	0.86	0.662	0.17	0.17	1.19	0.319	0.15	0.20	1.16	0.445
Marriage												
Married	Ref	–	Ref	–	Ref	–	Ref	–	Ref	–	Ref	–
Widowed	-0.17	0.28	0.84	0.530	-0.17	0.28	0.84	0.530	-0.21	0.32	0.81	0.509
Divorced/Separated	0.01	0.29	1.01	0.974	0.01	0.29	1.01	0.974	-0.03	0.33	0.97	0.924
Never married	0.24	0.35	1.28	0.487	0.24	0.35	1.28	0.487	0.39	0.39	1.47	0.327
Living conditions												
Alone	Ref	–	Ref	–	Ref	–	Ref	–	Ref	–	Ref	–
With spouse	-0.53	0.28	0.59	0.057	-0.15	0.28	0.86	0.596	-0.10	0.32	0.91	0.768
With children	-0.31	0.13	0.73	**0.014**	-0.22	0.12	0.81	0.077	-0.16	0.15	0.85	0.259
With others	-0.21	0.17	0.81	0.210	0.02	0.16	1.02	0.890	0.06	0.19	1.06	0.751
Education level												
< high school	0.16	0.11	1.17	0.153	0.12	0.11	1.13	0.255	-0.02	0.12	0.98	0.895
High school/GED	Ref	–	Ref	–	Ref	–	Ref	–	Ref	–	Ref	–

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Characteristics	Anti-diabetic Drugs				Antihypertensive Drugs				Antihyperlipidemic Drugs			
	Est.	**SE**	**OR**	**p-value**	**Est.**	**SE**	**OR**	**p-value**	**Est.**	**SE**	**OR**	**p-value**
>high school	0.00	0.10	1.00	0.999	0.09	0.1	1.09	0.379	0.02	0.12	1.02	0.886
Annual income												
<$25,000	Ref	–	Ref	–	Ref	–	Ref	–	Ref	–	Ref	–
>$25,000	-0.26	0.11	0.77	**0.020**	-0.15	0.11	0.86	0.160	-0.02	0.13	0.98	0.896
LIS												
Yes	0.41	0.12	1.51	**0.001**	0.28	0.12	1.32	**0.020**	0.32	0.14	1.38	**0.021**
No	Ref	–	Ref	–	Ref	–	Ref	–	Ref	–	Ref	–
MSA												
Yes	Ref	–	Ref	–	Ref	–	Ref	–	Ref	–	Ref	–
No	0.01	0.14	1.01	0.952	0.06	0.14	1.06	0.660	0.19	0.16	1.21	0.236
Census region												
Northeast	Ref	–	Ref	–	Ref	–	Ref	–	Ref	–	Ref	–
Midwest	0.17	0.14	1.19	0.217	0.17	0.14	1.19	0.217	0.23	0.16	1.26	0.157
South	-0.21	0.14	0.81	0.147	0.1	0.14	1.11	0.452	0.05	0.16	1.05	0.774
West	-0.39	0.15	0.68	**0.012**	-0.31	0.15	0.73	**0.040**	-0.35	0.18	0.70	0.052
Other RX coverage												
None	Ref	–	Ref	–	Ref	–	Ref	–	Ref	–	Ref	–
Public	-0.05	0.12	0.96	0.702	0.36	0.12	1.43	**0.002**	0.28	0.13	1.32	**0.039**
Private/self-purchased	0.04	0.27	1.04	0.897	0.03	0.26	1.03	0.910	0.28	0.29	1.32	0.341
Self-perceived health status												
Excellent	Ref	–	Ref	–	Ref	–	Ref	–	Ref	–	Ref	–
Very good	0.07	0.17	1.08	0.666	0.62	0.18	1.86	**0.000**	0.35	0.20	1.42	0.089
Good	0.07	0.17	1.08	0.654	0.49	0.17	1.64	**0.004**	0.19	0.20	1.21	0.336
Fair	0.11	0.18	1.12	0.529	0.6	0.18	1.82	**0.001**	0.15	0.21	1.17	0.470
Poor	-0.06	0.22	0.94	0.791	0.66	0.22	1.93	**0.003**	0.11	0.25	1.11	0.671
Number of chronic condition												
0-1	Ref	–	Ref	–	Ref	–	Ref	–	Ref	–	Ref	–
2-4	0.04	0.19	1.04	0.834	0.91	0.21	2.48	**<.0001**	0.30	0.23	1.35	0.193
4+	0.06	0.21	1.06	0.786	1.08	0.23	2.94	**<.0001**	0.30	0.25	1.35	0.232
CCI												
0-2	Ref	–	Ref	–	Ref	–	Ref	–	Ref	–	Ref	–

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Characteristics	Anti-diabetic Drugs				Antihypertensive Drugs				Antihyperlipidemic Drugs			
	Est.	**SE**	**OR**	**p-value**	**Est.**	**SE**	**OR**	**p-value**	**Est.**	**SE**	**OR**	**p-value**
3+	-0.13	0.11	0.88	0.215	-0.07	0.1	0.93	0.516	0.03	0.12	1.03	0.798
ADL												
None	Ref	–	Ref	–	Ref	–	Ref	–	Ref	–	Ref	–
1-2	0.07	0.10	1.08	0.456	0.07	0.10	1.07	0.466	-0.02	0.11	0.98	0.827
3+	-0.07	0.15	0.93	0.632	-0.09	0.14	0.92	0.539	-0.03	0.16	0.97	0.838
IADL												
None	Ref	–	Ref	–	Ref	–	Ref	–	Ref	–	Ref	–
1-2	-0.03	0.10	0.97	0.763	-0.05	0.1	0.95	0.585	0.19	0.11	1.21	0.100
3+	0.13	0.15	1.14	0.392	-0.02	0.15	0.98	0.886	0.29	0.17	1.34	0.083
BMI, kg/m2												
<25.0	Ref	–	Ref	–	Ref	–	Ref	–	Ref	–	Ref	–
25.0-29.9	0.02	0.11	1.02	0.846	0.01	0.1	1.01	0.929	0.02	0.12	1.02	0.877
≥30.0	0.24	0.11	1.27	**0.029**	-0.12	0.11	0.88	0.241	-0.03	0.12	0.97	0.816
Smoking												
Never	Ref	–	Ref	–	Ref	–	Ref	–	Ref	–	Ref	–
Past	-0.10	0.09	0.91	0.292	-0.12	0.09	0.89	0.165	-0.23	0.10	0.80	**0.025**
Current	-0.05	0.15	0.95	0.731	-0.3	0.15	0.74	**0.047**	-0.22	0.17	0.81	0.216
Care-seeking attitudes												
Avoid going to a physician												
Yes	0.11	0.10	1.11	0.291	0.03	0.1	1.03	0.751	-0.06	0.11	0.94	0.586
No	Ref	–	Ref	–	Ref	–	Ref	–	Ref	–	Ref	–
Visit a physician as soon as feel bad												
Yes	-0.1	0.09	0.90	0.228	-0.14	0.08	0.87	0.094	-0.06	0.10	0.94	0.542
No	Ref	–	Ref	–	Ref	–	Ref	–	Ref	–	Ref	–
Worry about health more than others												
Yes	0.06	0.10	1.06	0.586	0.08	0.1	1.09	0.403	0.09	0.11	1.09	0.429
No	Ref	–	Ref	–	Ref	–	Ref	–	Ref	–	Ref	–
Keep to self when sick												
Yes	-0.18	0.09	0.84	0.053	-0.23	0.09	0.79	**0.010**	-0.07	0.10	0.94	0.527
No	Ref	–	Ref	–	Ref	–	Ref	–	Ref	–	Ref	–
Same physician>5 years												

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Characteristics	Anti-diabetic Drugs				Antihypertensive Drugs				Antihyperlipidemic Drugs			
	Est.	**SE**	**OR**	**p-value**	**Est.**	**SE**	**OR**	**p-value**	**Est.**	**SE**	**OR**	**p-value**
Yes	0.15	0.08	1.16	0.069	0.02	0.08	1.02	0.754	0.13	0.09	1.13	0.172
No	Ref	–	Ref	–	Ref	–	Ref	–	Ref	–	Ref	–
Environment factors												
Number of primary physicians	-0.011	0.25	0.99	0.966	-0.002	0.25	1	0.995	0.03	0.28	1.03	0.903
Number of hospital beds	-0.004	0.03	1.00	0.880	0.01	0.03	1.01	0.608	-0.01	0.03	0.99	0.775
Percent under Poverty	0.01	0.01	1.01	0.313	0.02	0.01	1.02	0.127	0.02	0.01	1.02	0.134
Unemployment rate	-0.11	0.03	0.90	**0.001**	-0.16	0.03	0.86	**<.0001**	-0.13	0.04	0.88	**0.001**
Education higher than high school	-0.01	0.01	0.99	0.294	-0.02	0.01	0.98	**0.010**	0.00	0.01	1.00	0.810
Calendar year												
2006	Ref	–	Ref	–	Ref	–	Ref	–	Ref	–	Ref	–
2007	-0.18	0.14	0.84	0.191	0.03	0.14	1.03	0.805	0.02	0.16	1.02	0.882
2008	-0.30	0.13	0.74	**0.025**	-0.18	0.13	0.83	0.173	0.05	0.16	1.05	0.759
2009	-0.52	0.14	0.60	**0.000**	-0.27	0.13	0.76	**0.043**	0.11	0.16	1.11	0.496
2010	-0.50	0.14	0.61	**0.000**	-0.4	0.14	0.67	**0.004**	0.17	0.16	1.18	0.304

Abbreviations: **MCBS**, Medicare Current Beneficiary Survey (MCBS); **SE**, standard error; **MSA**, Metropolitan Statistical Areas; **CCI**, Charlson Comorbidity Index; **ADLs**, Activities of daily living, includes bathing or showering, getting dressed, getting in and out of a chair, walking, and using the toilet; **IADLs**, Instrumental activities of daily living, including using telephone, shopping, preparing food, housekeeping, laundry, traveling, taking medication, and managing financial matters independently; **BMI**, body mass index, calculated as weight in kilograms divided by height in meters squared.

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and other RX coverage, self-perceived health status, number of chronic conditions, smoking, care-seeking attitudes, and environment factors. For adherence to antihyperlipidemic drugs, the statistically significant factors included sex, LIS, census region, other RX coverage, and smoking.

5.6 Results for Sensitivity Analysis

5.6.1 Results for Sensitivity Analysis 1: Beneficiaries without LIS

Since Medicare beneficiaries with LIS had different cost-sharing (e.g., copays) for prescriptions, and we found PDP enrollees were more like to have LIS than MA-PD enrollees. In this sensitivity analysis, beneficiaries with LIS were excluded from the study sample. A total of 11,890 beneficiaries were included in the analysis, 6,596 in PDP group and 5,294 in MA-PD group, respectively. Appendix F compares the descriptive statistics for outcomes of interest between PDPs and MA-PDs. As shown in Table F.1, PDP enrollees had significantly higher annual average number of visits to hospitals (0.21 vs. 0.15; $p<0.0001$), outpatient settings (2.9 vs. 2.1; $p<0.0001$), doctor's office (18.2 vs. 11.9; $p<0.0001$), and prescription fills (40.0 vs. 28.8; $p<0.0001$). Table F.2 indicates that PDPs were associated with higher costs of inpatient care ($1905.2 vs. $1528.6; $p=0.001$), outpatient care ($1020.3 vs. $643.6; $p<0.0001$), physician's office ($2858.1 vs. $1663.1; $p<0.0001$) and prescription drugs ($3140.8 vs. $2319.7; $p<0.0001$), all-type of medical services ($5811.8 vs. $3982.0; $p<0.0001$), and total healthcare costs ($8535.7 vs. $6064.7; $p<0.0001$). Table F.3 shows that PDP group had higher prevalence of CRN than MA-PD (12.2% vs. 10.7%; $p=0.030$), However, PDPs had similar prevalence of spending less on basic needs than MA-PDs (4.2% vs. 3.4%; $p=0.076$). Table F.4 demonstrates that PDP enrollees had higher mean number of fills for antihypertensive drugs (17.0 vs. 14.5,

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p=0.0003) and antihyperlipidemic drugs (6.3 vs.5.3, p=0.001), compared to MA-PD enrollees, but similar Medication adherence measured by PDC.

Table 5.28 shows the effect of PDPs on healthcare utilizations and costs in both Naïve and IV models. For healthcare utilizations, in naïve models, the results indicate that PDP enrollees had similar likelihood of using inpatient care (IR=1.09; p=0.098) and other medical services (IR=0.90; p=0.665), but had 24% higher likelihood of using outpatient care (p<0.0001), 48% higher in physician's office (p<0.0001), 5% higher in prescriptions (p=0.0003). In the IV models, the two groups still had similar utilizations on inpatient care (IR=1.04; p=0.868), other medical services (IR=0.57; p=0.568), and prescriptions (IR=0.96; p=0.600), but PDP group had 39% higher likelihood of using outpatient care (p=0.021) and 41% higher likelihood for visiting physician's office (p=0.001).

For healthcare costs, in naïve models, the results indicate that PDPs had similar costs for inpatient care (IR=1.31; p=0.942), but had 24% higher costs of outpatient care (p<0.0001), 65% on physician's office (p<0.0001), and 22% higher on prescriptions (p<0.0001). As expected, PDP group had 37% higher costs for all-type medical services (p<0.0001) and 32% higher total healthcare costs (p<0.0001). Similar results were found in the IV models, the two groups had similar costs of inpatient care (IR=1.26; p=0.255), but PDP group had 63% higher costs for outpatient care (p=0.001), 53% higher on physician's office visits (p<0.0001), and 18% higher on prescriptions (p=0.012). As a result, PDP group had 37% higher costs of all-type medical services (p=0.0002) and 29% higher costs for total healthcare spending (p<0.0001). Table 5.28 also suggests that PDP enrollees had similar risks for CRN, but significantly higher risks for spending less on

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basic needs (IR=2.39; p=0.008), compared to MA-PD enrollees. In addition, among diabetic beneficiaries, PDP enrollees had similar medication adherence measured by PDC, but were less likely to be adherent to antihypertensive drugs (OR=0.97; p=0.034).

Table 5.28 Sensitivity Analysis 1: Medicare Beneficiaries without LIS

Outcome Measure	Naïve Model[a]			IV Model[b]		
	Est.	OR	p-value	Est.	OR	p-value
Healthcare Utilizations						
Hospitalizations	0.08	1.09	0.098	–	–	–
Outpatient	0.21	1.24	**<.0001**	0.33	1.39	**0.021**
Medical Providers	0.39	1.48	**<.0001**	0.34	1.41	**0.001**
Others Medical services	-0.11	0.9	0.665	-0.56	0.57	0.568
Prescriptions	0.05	1.05	**0.0003**	-0.04	0.96	0.6
Healthcare Costs						
Hospitalizations	0.27	1.31	0.942	0.23	1.26	0.255
Outpatient	0.22	1.24	**<.0001**	0.49	1.63	**0.001**
Medical Providers	0.5	1.65	**<.0001**	0.43	1.53	**<.0001**
Others Medical services	-3.43	0.03	**<.0001**	–	–	–
All medical services	0.32	1.37	**<.0001**	0.31	1.37	**0.0002**
Prescriptions drugs	0.2	1.22	**<.0001**	0.16	1.18	**0.012**
Total Healthcare	0.28	1.32	**<.0001**	0.26	1.29	**<.0001**
Cost-related nonadherence	0.09	1.1	0.166	–	–	–
Spending less on basic needs	0.13	1.14	0.251	0.87	2.39	**0.008**
Proportion of Days Covered (PDC)						
Any antidiabetic agent	-0.02	–	0.852	–	–	–
Any antihypertensive drugs	-0.19	–	0.085	–	–	–
Any antihyperlipidemic drugs	0.09	–	0.491	–	–	–
Adherent (PDC≥0.80)						
Any antidiabetic agent	-0.01	0.99	0.598	-0.04	0.96	0.436
Any antihypertensive drugs	-0.03	0.97	**0.034**	0.02	1.02	0.668
Any antihyperlipidemic drugs	-0.01	0.99	0.412	-0.03	0.98	0.65

a. These results were adjusted for the variables listed in Table 5.1. In the Naïve Model, annual number of health services use was estimated using a zero-inflated negative binomial model.

b. In the IV Model, the instrumental variables are the county-level PDP penetration.

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5.6.2 Results for Sensitivity Analysis 2: Beneficiaries with LIS

In this sensitivity analysis, the outcomes measures were compared among beneficiaries with LIS. Table 5.29 shows the effect of PDPs on healthcare utilizations and costs in both Naïve and IV models. For healthcare utilizations, in naïve models, the results indicate that PDP enrollees had similar likelihood of using inpatient care (IR=0.95; p=0.511), other medical services (IR=1.31; p=0.653), and prescription drugs (IR= 0.97; p=0.265), but had 18% higher likelihood of using outpatient care (p<0.0001), and 21% higher in physician's office (p<0.0001), respectively. In the IV models, the two groups still had similar utilizations on outpatient care (IR=1.11; p=0.380), other medical services (IR=0.46; p=0.333), and prescriptions (IR=0.97; p=0.684), but PDP group had still had 41% higher likelihood for visiting physician's office (p=0.001).

For healthcare costs, in naïve models, the results indicate that PDPs had similar costs for inpatient care (IR= 0.87; p=0.315), outpatient care (IR= 0.87; p=0.155), all-type medical services (IR=0.99; p=0.918), and total healthcare (IR= 1.03; p=0.453), but had 15% higher costs of on physician's office (p=0.008), and 8% higher on prescriptions (p=0.021). In the IV models, however, the two groups had similar costs of inpatient care (IR= 1.03; p=0.950), outpatient care (IR= 1.05; p=0.847), all-type medical services (IR=1.32; p=0.117), prescription drugs (IR=1.26; p=0.076), and total healthcare costs (IR=1.27; p=0.071), while had 61% higher on physician's office visits (p=0.003).

Table 5.29 also suggests that PDP enrollees with LIS had lower risks for CRN (OR=0.75; p=0.019), and lower risks for spending less on basic needs (IR=0.63; p=0.225), compared to MA-PD enrollees. In addition, among diabetic beneficiaries, PDP enrollees had similar medication adherence measured by PDC, but were more likely to be

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adherent to antihypertensive drugs (OR=1.52; p=0.031).

Table 5.29 Sensitivity Analysis 1: Medicare Beneficiaries with LIS

Outcome Measure	Naïve Model[a]			IV Model[b]		
	Est.	OR	p-value	Est.	OR	p-value
Healthcare Utilizations						
Hospitalizations	-0.05	0.95	0.511	–	–	–
Outpatient	0.16	1.18	**<.0001**	0.11	1.11	0.380
Medical Providers	0.19	1.21	**<.0001**	0.34	1.41	**<.0001**
Others Medical services	0.27	1.31	0.653	-0.78	0.46	0.333
Prescriptions	-0.03	0.97	0.265	-0.03	0.97	0.684
Healthcare Costs						
Hospitalizations	-0.14	0.87	0.315	0.03	1.03	0.950
Outpatient	-0.14	0.87	0.155	0.05	1.05	0.847
Medical Providers	0.14	1.15	**0.008**	0.48	1.61	**0.003**
Others Medical services	-3.93	0.02	**<.0001**	–	–	–
All medical services	-0.01	0.99	0.918	0.28	1.32	0.117
Prescriptions drugs	0.08	1.08	**0.021**	0.23	1.26	0.076
Total Healthcare	0.03	1.03	0.453	0.24	1.27	0.071
Cost-related nonadherence	-0.28	0.75	**0.019**	–	–	–
Spending less on basic needs	-0.24	0.78	0.101	-0.46	0.63	**0.225**
Proportion of Days Covered (PDC)						
Any antidiabetic agent	0.01	–	0.553	–	–	–
Any antihypertensive drugs	-0.02	–	0.370	–	–	–
Any antihyperlipidemic drugs	0.04	–	0.156	–	–	–
Adherent (PDC≥0.80)						
Any antidiabetic agent	0.07	1.08	0.655	-0.15	0.86	0.773
Any antihypertensive drugs	0.06	1.06	0.718	0.79	2.21	0.121
Any antihyperlipidemic drugs	0.42	1.52	**0.031**	-0.32	0.73	0.594

a. These results were adjusted for the variables listed in Table 5.1. In the Naïve Model, annual number of health services use was estimated using a zero-inflated negative binomial model.

b. In the IV Model, the instrumental variables are the county-level PDP penetration.

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5.6.3 Results for Sensitivity Analysis 3: annual income

In this sensitivity analysis, annual income was categorized into four levels, <$15,000, $15,000-$30,000, $30,000-$45,000, and >$45,000. Table 5.30 compared the annual income between beneficiaries enrolled in PDPs vs. MA-PDs. PDP enrollees were more likely to have incomes less than $15,000 (37.6% vs. 26.1%), but less likely to have incomes of $15,000-$30,000 (30.1% vs. 37.8%), and incomes of $30,000-$45,000 (13.3% vs. 17.3%), compared to MA-PD enrollees.

Table 5.30 Sensitivity Analysis 3: Annual Income at Baseline

Characteristics	PDPs		MA-PDs		p-value
	n	Weighted %[a]	n	Weighted %[a]	
Annual income					**<.0001**
<$15,000	4051	37.6	1768	26.1	
$15,000-$30,000	3021	30.1	2395	37.8	
$30,000-$45,000	1247	13.3	1055	17.3	
>$45,000	1691	18.9	1138	18.8	

a. Percentages were calculated with national weights, p-value was obtained from Rao-Scott Chi-Square tests

The effects of PDPs on healthcare utilizations and expenditures were also stratified by the levels of the annual income. As shown in Table 5.31, for healthcare utilizations, PDPs had higher use of outpatient care and physician's office than MA-PDs, which was observed across all the income levels. For healthcare costs, similar patterns were observed across different levels of annual income.

Table 5.31 Sensitivity Analysis 3: Annual Income

Outcome Measure	<$15,000		$15,000-$30,000		$30,000-$45,000		>$45,000	
	OR	p-value	OR	p-value	OR	p-value	OR	p-value
Healthcare Utilizations								
Hospitalizations	1.01	0.917	1.06	0.392	1.07	0.572	1.10	0.431

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Outcome Measure	<$15,000		$15,000-$30,000		$30,000-$45,000		>$45,000	
	OR	**p-value**	**OR**	**p-value**	**OR**	**p-value**	**OR**	**p-value**
Outpatient	1.22	**<.0001**	1.13	**0.001**	1.25	**<.0001**	1.32	**<.0001**
Medical providers	1.27	**<.0001**	1.44	**<.0001**	1.51	**<.0001**	1.48	**<.0001**
Others medical services	1.05	0.906	1.00	0.991	0.83	0.963	3.04	0.400
Prescriptions	1.06	**0.013**	1.05	**0.012**	1.10	**0.002**	1.07	0.02
Healthcare Costs								
Hospitalizations	1.16	0.149	1.26	0.065	1.84	**0.0003**	1.27	0.098
Outpatient	1.03	0.734	1.48	**0.0040**	1.51	**0.0002**	1.31	**0.006**
Medical providers	1.27	**<.0001**	1.59	**<.0001**	1.73	**<.0001**	1.71	**<.0001**
Others medical services	0.04	**<.0001**	0.08	**<.0001**	0.18	**<.0001**	0.15	**<.0001**
All medical services	1.16	**0.002**	1.37	**<.0001**	1.56	**<.0001**	1.43	**<.0001**
Prescriptions drugs	1.23	**<.0001**	1.24	**<.0001**	1.20	**<.0001**	1.27	**<.0001**
Total Healthcare	1.18	**<.0001**	1.29	**<.0001**	1.39	**<.0001**	1.36	**<.0001**

a. These results were adjusted for the variables listed in Table 5.1. In the Naïve Model, annual number of helath services use was estimated using a zero-inflated negative binomial model.
b. IR was calculated as using the equation ($e^{Coefficient}$).

5.6.4 Results for Sensitivity Analysis 4: Beneficiaries with diabetes

This sensitivity analysis compared the healthcare utilizations and expenditures among beneficiaries with diabetes. As shown in Table 5.32, in naïve models, PDP enrollees had similar likelihood of using inpatient care (IR=0.96; p=0.655), other medical services (IR=1.20; p=0.996), and prescription drugs (IR= 1.02; p=0.394), but had 39% higher likelihood of using outpatient care (p<0.0001), and 41% higher in physician's office (p<0.0001), respectively. In the IV models, the two groups had similar utilizations on outpatient care (IR=0.91; p=0.599) and prescriptions (IR=1.03; p=0.732), but PDP group had still had 42% higher likelihood for visiting physician's office (p=0.002).

For healthcare costs, in naïve models, the results indicate that PDPs had similar costs for inpatient care (IR= 1.05; p=0.699), but higher costs for outpatient care (IR=1.70;

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p<.0001), physician's office (IR=1.46; p<.0001), all-type medical services (IR=1.29; p<.0001), prescriptions (IR=1.14; p<.0001), and total healthcare costs (IR=1.23; p<.0001). In the IV models, however, the two groups had similar costs of inpatient care (IR=0.70; p=0.213), all-type medical services (IR=0.83; p=0.286), prescription drugs (IR=1.07; p=0.530), and total healthcare costs (IR=0.90; p=0.382), while had 91% higher on outpatient care (p=0.010) and 56% higher costs on physician's office (p=0.004).

Table 5.32 Sensitivity Analysis 4: Medicare Beneficiaries without LIS

Outcome Measure	Naïve Model[a]			IV Model[b]		
	Est.	OR	p-value	Est.	OR	p-value
Healthcare Utilizations						
Hospitalizations	-0.04	0.96	0.655	–	–	–
Outpatient	0.33	1.39	**<.0001**	-0.09	0.91	0.599
Medical Providers	0.34	1.41	**<.0001**	0.35	1.42	**0.002**
Others Medical services	0.18	1.20	0.996	-3.64	0.03	**0.003**
Prescriptions	0.02	1.02	0.394	0.03	1.03	0.732
Healthcare Costs						
Hospitalizations	0.05	1.05	0.699	-0.35	0.70	0.213
Outpatient	0.53	1.70	**<.0001**	0.64	1.91	**0.010**
Medical Providers	0.38	1.46	**<.0001**	0.44	1.56	**0.004**
Others Medical services	-1.51	0.22	**<.0001**	–	–	**–**
All medical services	0.26	1.29	**<.0001**	-0.19	0.83	0.286
Prescriptions drugs	0.13	1.14	**<.0001**	0.07	1.07	0.530
Total Healthcare	0.21	1.23	**<.0001**	-0.11	0.90	0.382

a. These results were adjusted for the variables listed in Table 5.1. In the Naïve Model, annual number of health services use was estimated using a zero-inflated negative binomial model.
b. In the IV Model, the instrumental variables are the county-level PDP penetration.

5.6.5 Results for Sensitivity Analysis 4: Beneficiaries with other drug benefits

This sensitivity analysis excluded beneficiaries with other drug benefits. A total of 13,509 beneficiaries were included in the analysis, 7,975in PDP group and 5,534 in MA-PD group, respectively. Appendix F compares the descriptive statistics for outcomes of

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interest between PDPs and MA-PDs. As shown in Table F.5, PDP enrollees had significantly higher annual average number of visits to hospitals (0.21 vs. 0.16; p<0.0001), outpatient settings (2.8 vs. 2.1; p<0.0001), doctor's office (17.4 vs. 11.9; p<0.0001), and prescription fills (44.5 vs. 33.1; p<0.0001)., compared to MA-PD enrollees. Table F.6 suggests that, PDPs were associated with higher costs for inpatient care ($1905.2 vs. $1528.6; p=0.001), outpatient care ($955.6 vs. $643.6; p<0.0001), physician's office ($2645.0 vs. $1665.0; p<0.0001), and prescription drugs ($2953.6 vs. $2144.9.7; p<0.0001), compared to MA-PDs. As a result, PDP group had statistically higher costs for all-type of medical services ($5581.1 vs. $4051.1; p<0.0001) and total healthcare costs ($8534.7 vs. $6196.0; p<0.0001). Table F.7 shows that PDP group had similar prevalence of CRN (12.5% vs. 11.3%; p=0.090), but PDPs had higher prevalence of spending less on basic needs than MA-PDs (5.2% vs. 3.9%; p=0.018). In Table F.8, PDP enrollees had higher mean number of fills for anti-diabetic drugs (9.4 vs. 8.8; p=0.001), antihypertensive drugs (15.1 vs. 13.2, p<0.0001), and antihyperlipidemic drugs (5.5 vs.4.5, p<0.0001), compared to MA-PD enrollees. PDP enrollees had higher PDC for anti-diabetic drugs (0.59 vs. 0.58; p=0.039), but similar PDC for antihypertensive drugs and antihyperlipidemic drugs.

Table 5.33 shows the effect of PDPs on healthcare utilizations and costs in both Naïve and IV models. For healthcare utilizations, in naïve models, the results indicate that PDP enrollees had similar likelihood of using inpatient care (IR=1.04; p=0.398) and other medical services (IR=00.96; p=0.848), but had 25% higher likelihood of using outpatient care (p<0.0001), 43% higher in physician's office (p<0.0001), 5% higher in prescriptions (p=0.001). In the IV models, the two groups still had similar utilizations on

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prescription drugs (IR=1.05; p=0.249), but PDP group had 53% higher likelihood of using outpatient care (p<0.0001), 34% higher likelihood for visiting physician's office (p=0.001), and 10% higher likelihood for using other medical services (p<0.0001).

For healthcare costs, in naïve models, the results indicate that PDPs had 19% higher costs for inpatient care (p=0.010), 22% higher costs of outpatient care (p<0.0001), 57% on physician's office (p<0.0001), and 20% higher on prescriptions (p<0.0001). As a result, PDP group had 31% higher costs for all-type medical services (p<0.0001) and 28% higher total healthcare costs (p<0.0001). In the IV models, the two groups had similar costs for inpatient care (IR=1.36; p=0.111) and prescriptions (IR=1.09; p=0.182), but PDP group had 72% higher costs of outpatient care (p=0.001), 58% higher on physician's office visits (p<0.0001), 44% higher costs for all-type medical services (p=0.0002) and 29% higher costs for total healthcare spending (p<0.0001).

Table 5.33 also suggests that PDP enrollees had similar risks for CRN (IR=1.00; p=0.955) and spending less on basic needs (IR=1.05; p=0.650), compared to MA-PD enrollees. In addition, among diabetic beneficiaries, PDP enrollees had similar medication adherence measured by PDC, and similar likelihood to be adherent to medication treatments.

Table 5.33 Sensitivity Analysis 4: Beneficiaries with Other Drug Benefits

Outcome Measure	Naïve Model[a]			IV Model[b]		
	Est.	OR	p-value	Est.	OR	p-value
Healthcare Utilizations						
Hospitalizations	0.04	1.04	0.398	–	–	–
Outpatient	0.22	1.25	**<.0001**	0.43	1.53	**<.0001**
Medical Providers	0.36	1.43	**<.0001**	0.3	1.34	**<.0001**
Others Medical services	-0.04	0.96	0.848	-2.28	0.1	**<.0001**
Prescriptions	0.04	1.05	**0.001**	0.05	1.05	0.249
Healthcare Costs						
Hospitalizations	0.18	1.19	**0.01**	0.31	1.36	0.111

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Outcome Measure	Na ïve Model[a]			IV Model[b]		
	Est.	OR	p-value	Est.	OR	p-value
Outpatient	0.2	1.22	**<.0001**	0.54	1.72	**<.0001**
Medical Providers	0.45	1.57	**<.0001**	0.45	1.58	**<.0001**
Others Medical services	-2.71	0.07	**<.0001**	–	–	**–**
All medical services	0.27	1.31	**<.0001**	0.36	1.44	**<.0001**
Prescriptions drugs	0.18	1.2	**<.0001**	0.08	1.09	0.182
Total Healthcare	0.25	1.28	**<.0001**	0.25	1.29	**<.0001**
Cost-related nonadherence	0.004	1	0.955	–	–	–
Spending less on basic needs	0.05	1.05	0.65	0.47	1.6	0.106
Proportion of Days Covered (PDC)						
Any antidiabetic agent	-0.02	–	0.856	–	–	–
Any antihypertension drugs	-0.08	–	0.424	–	–	–
Any antihyperlipidemic drugs	0.20	–	0.100	–	–	–
Adherent (PDC≥0.80)						
Any antidiabetic agent	0.003	1.00	0.812	-0.06	0.94	0.225
Any antihypertension drugs	-0.02	0.98	0.055	0.003	1.00	0.951
Any antihyperlipidemic drugs	0.000	1.00	0.792	-0.05	0.95	0.389

a. These results were adjusted for the variables listed in Table 5.1. In the Na ïve Model, annual number of health services use was estimated using a zero-inflated negative binomial model.

b. In the IV Model, the instrumental variables are the county-level PDP penetration.

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CHAPTER 6

DISCUSSION

This chapter discusses the results of the study as well as implications of the findings. It also presents the strengths and limitations of this dissertation.

6.1 Aim 1: Baseline Characteristics

One objective of this study is to compare the demographic, socioeconomic and clinical characteristics between PDP and MA-PD enrollees. Our findings suggest that PDP enrollees had lower socio-economic status and more comorbidities than MA-PD enrollees, which is consistent with the published literature.[137] Riley et al. projected that MA-PD enrollees would be healthier than PDP enrollees, by comparing the characteristics of beneficiaries enrolled in FFS and MA in 2005, which is one year prior to the introduction of Medicare Part D.[137] Hence, this dissertation provides timely and important results comparing the baseline characteristics between Medicare beneficiaries enrolled in PDPs vs. MA-PDs.

Although there are very limited studies comparing PDP and MA-PD enrollees, a large body of studies compared characteristics of FFS and MA enrollees, providing indirect but important evidence on the characteristics of PDP and MA-PD enrollees. Before the introduction of Medicare Part D, FFS beneficiaries had no outpatient prescription drug benefits, unless they obtained their drug coverage through Employer Sponsored Insurance (ESI) or public insurance plans (e.g., Medicaid, VA), but most MA

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enrollees had drug benefits because they were enrolled in MA plans with outpatient prescription drug coverage. With the implementation of Medicare Part D, however, FFS beneficiaries without drug benefits were more likely to enroll in PDPs, while MA enrollees might keep their MA plans or MA-PDs.[137] The published studies indicated that beneficiaries enrolled in FFS plans were more likely to be older, unmarried, lower income, and enrolled in Medicaid,[123,187,188] compared to HMO enrollees. In the studies comparing HMO vs. FFS, HMO enrollees were associated with significantly better self-reported health statuses and function statuses, lower prior-enrollment severity score and healthcare use, lower post-enrollment mortality rates, and lower pre-enrollment health care utilization.[120-126,132,188-191] In addition to the substantial differences in health conditions between HMOs and FFS plans, early studies of HMO have also shown favorable HMO selection on sociodemographic characteristics, including income and marital status.[123,187] Enrollment of low-cost beneficiaries into HMOs suggests favorable selection observed in the MA plans.[127] This favorable selection was further exacerbated through disenrollment of high-cost or sicker beneficiaries from the MA plans. Compared to the FFS enrollees, beneficiaries dis-enrolled from MA plans had significantly higher risk scores and higher risk-adjusted payments.[119] These findings demonstrate a pattern of selective enrollment of healthy beneficiaries and disenrollment of beneficiaries with higher costs or worse health conditions, leading to substantial differences between PDPs and MA-PDs.

This imbalance between PDP and MA-PD enrollees might be driven by the risk adjustment payment methodology that is implemented to estimate payment rates for MA enrollees. As discussed in the Background section, MA plans receive monthly capitated

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payments for each enrollee, therefore, MA plans have financial incentives to attract beneficiaries whose incurred costs are lower than the predicted costs. Prior to 2004, risk adjustment of MA payments was based heavily on demographics (e.g., age, gender, Medicaid eligibility, institutional status, and working aged status), but only minimally for clinical diagnoses (e.g., diabetes, ischemic heart disease).[16] Consequently, MA plans had the incentives to enroll healthy and avoid chronically ill beneficiaries. In the 1980s and 1990s, new enrollees in MA plans had lower prior-enrollment costs than their FFS counterparts,[120,121,130,192,193] while HMO dis-enrollees often had higher healthcare costs after disenrollment.[130,192,193] To address favorable selection in MA plans, CMS recently implemented a gradual phase-in risk-adjustment system, which initially adjusted only a percentage of the total payment based on Principal Inpatient Diagnostic Cost Group (PIP-DCG) and later the CMS Hierarchical Condition Category (HCC) methodology. However, this dissertation still found the imbalance in demo-socioeconomic and health characteristics between PDP and MA-PD enrollees.

6.2 Aim 2: Healthcare Utilizations and Costs

One of the major objectives of this dissertation is to examine the impact of PDPs on healthcare utilizations and costs compared to MA-PDs. This study provided new evidence regarding the impact of PDPs on healthcare use and costs among Medicare beneficiaries. Using nationally representative sample data and an instrumental variable approach to address selection bias, this dissertation found that PDPs had similar annual use and spending for inpatient care. Additionally, PDPs were associated with significantly higher use and costs for outpatient care and prescription drugs, among community-living Medicare beneficiaries from 2006 to 2010. In the sensitivity analysis,

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we found a similar pattern of health resources use and costs, only except the analysis for beneficiaries with LIS. Compared to MA-PDs, PDPs had higher total healthcare costs among beneficiaries with LIS, but had similar healthcare use and costs among beneficiaries with LIS. Considering the special design of Medicare Part D and LIS, the results from the sensitivity analysis suggest that offering beneficiaries similar drug benefits (e.g., $2/prescription for LIS beneficiaries) may lead to similar healthcare spending. This finding, on the other hand, proves that drug plans with less generous drug plans are associated with higher healthcare spending. Therefore, these results are consistent with our hypothesis that PDPs have higher costs than MA-PDs after controlling baseline characteristics and favorable selection of MA plans.

Although these two types of Part D plans demonstrate substantial differences on their baseline characteristics that may influence their healthcare use and costs, there was no statistically significant difference in the annual utilizations hospitalizations in both naïve and IV models. In the naïve models, after controlling individual-level characteristics (e.g., demographics, socioeconomics, health status and functional conditions) and environment characteristics (e.g., number of hospital beds), the results indicate that PDP enrollees had similar annual use of inpatient services, but had 21% higher use of outpatient care, 42% higher use of physician's office, and 3% higher prescription drugs use, respectively, compared to MA-PD enrollees. Since PDP enrollees are sicker than MA-PD enrollees, they are more likely to have higher use and costs during the study follow-up period. To address the selection bias related to the type of part D plans, we performed IV models and found that PDP enrollees had similar use of prescription drugs, compared to MA-PD enrollees. However, PDP enrollees had 47%

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higher likelihood of using outpatient care, and 39% higher likelihood of visiting physician's office than MA-PD enrollees.

After controlling the baseline characteristics, however, we found that PDPs had higher costs for both prescription drugs and non-drug medication services. PDPs were associated with 15% higher costs of hospitalization, 12% higher costs of outpatient care, 50% higher costs of physician's office, 26% higher of all types of medical services, and 20% higher of prescription drugs respectively, compared to MA-PD enrollees. Consequently, PDP enrollees had 25% higher healthcare expenditures than MA-PD enrollees. After controlling the selection bias, the results indicate that PDPs had similar costs for inpatient care, but PDPs were associated with 48% higher costs of outpatient care, 54% higher costs for physician's office visits, 39% higher of all types of medical services, and 18% higher in prescription drugs respectively, compared to MA-PD enrollees. As a result, PDP enrollees had 30% higher healthcare expenditures than MA-PD enrollees.

Although there are very few studies comparing the healthcare utilizations and expenditures associated with these two types of part D plans, the impact of MA plans compared to FFS has been well-examined in the literature. In the earlier studies, HMOs have shown positive impact on reducing health utilizations and expenditures, compared to FFS. MA plans were associated with less utilization of overall care, but there was no clear pattern in the evidence for inpatient care.[97] Some data indicated that HMO was associated with a lower rate of preventable hospitalizations and overall hospitalizations, while other studies suggested that HMOs and FFS plans had similar use of inpatient care.[96] Although HMOs in the early stages achieved significant reduction of healthcare

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use, the advantage over FFS was not sustained. By the 2000s, the health services use among HMOs and traditional FFS had converged. This convergence was, in part, attributed to the application of innovated econometric/statistical methods to eliminate selection bias between FFS and MA plans. The favorable selection into HMO has been demonstrated since the introduction of managed care. Captivated payments for HMOs might be the incentives for HMOs to enroll healthy beneficiaries or disenroll those with higher health costs, leading to a healthier and lower-cost population in the HMOs. As a result, we might observe that HMOs had significantly lower costs than FFS plans. In this dissertation, we found that the impact of PDPs was diminished after controlling selection bias, indicating that selection bias may an important role in the differences between PDPs vs MA-PDs. However, the magnitude of the positive outcomes associated with MA-PDs is still unclear. For example, the positive impact of HMOs cannot be fully explained by the selection of healthier beneficiaries into HMOs.[97]

Another possible explanation for this convergence is that traditional health plans implemented similar cost-saving strategies to HMOs. For example, managed care plans can influence the healthcare utilizations by denying expensive tests or surgical procedures, restricting access to specialists, and providing payment incentives to providers, which have been recently adopted by FFS. Recent data indicates that FFS plans achieved similar admission rates or length of stay to those of HMOs.[194] In addition to direct effects on clinical practices, managed care also has demonstrated influences on the market level.[195-197] Improved managed care penetration into the healthcare market is associated with increased competition, leading to changes on the practice patterns in the regional market. There is substantial evidence suggesting that physicians are more likely

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to shorten the duration of visits,[198]and are less likely to provide charity care without any compensation.[199,200]

In this study, PDPs have generally higher cost-sharing than MA-PDs, and PDP enrollees may face higher drug costs. Based on the economic theory of demand for health services, the demands for health services (including prescription drugs) increase with reduced cost-sharing of drug plans, which has been proven in the RAND study. In the RAND study, the patients with free care (or 0% cost-sharing) used 5 prescriptions monthly, while those with 25% and 50% cost sharing filled 4 prescriptions. Hence, these findings indicated that higher cost-sharing is associated with reduced use of prescription drugs. However, our study found that PDPs had significantly higher annual numbers of prescriptions, which is consistent with published literatures suggesting that HMOs were associated with lower use of prescription drugs compared to FFS.[48] As discussed previously, PDP enrollees were sicker and had more chronic conditions than MA-PDs, so they may fill more prescriptions and spend more on prescription drugs. Even though we applied the instrumental variable technique to address selection bias, we still found that PDP enrollees had a higher use of prescriptions. This finding may be explained by the price responsiveness that is different for varied conditions. In response to increased cost-sharing, the reduced use of prescriptions was more salient for drugs used to treat symptoms than those used to treat chronic diseases.[158,159] In this study, elderly beneficiaries had relatively high prevalence of chronic diseases, and may not have been sensitive to the differences in the cost-sharing between these two types of Part D plans, we observed similar utilizations of prescriptions in PDPs and MA-PDs.

Additionally, the higher costs of prescriptions in PDP group may be explained by

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HMO's incentive to use generic drugs. To reduce the drug costs, HMOs influence beneficiaries' decisions on purchasing generic drugs, by applying higher brand versus generic cost-sharing differentials.[201] If patients face high cost differences between brand-name and generic drugs, they are more likely to purchase generic drugs rather than brand-name drugs. This leads to increased use of generic drugs, which are relatively inexpensive than brand-name drugs.[202] In the study, we found MA-PD enrollees were more likely to use generic drugs than PDP enrollees, which is a possible explanation for the similar costs observed between two groups.

Based on the conceptual framework, environment and individual characteristics are very important factors influencing healthcare use and costs. In this dissertation, we found higher use of healthcare was associated with demographics, socioeconomics, life style (e.g., smoking), regions, health conditions, health altitude, and availability of primary physicians and hospital bed, which are consistent with existing literature. In the sensitivity analysis, two factors, LIS and annual income, were stratified to better understand the risk factors associated with healthcare use and costs. We found that when Medicare beneficiaries facing similar coinsurance (e.g., $2 copayment for LIS), PDPs had similar impact on healthcare use than MA-PDs, indicating that coinsurance is an important factor determining the use of healthcare. However, PDPs demonstrated similar impact on the use of health services across different levels of annual income, compared to MA-PDs. For example, Weissman et al. reported that increased likelihood of delayed care was observed among patients who are black, low income, uninsured, or without a regular physician.[203] Quesenberry et al. indicated that higher BMI is associated with increased use and cost of health services.[204]

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6.3 Aim 3: Medication Adherence

For medication adherence, we accessed CRN among all beneficiaries, and medication adherence to anti-diabetic drugs among beneficiaries with diabetes. After adjusting baseline characteristics and selection bias, PDP enrollees had similar risks of having CRN and spending less on basic needs than MA-PD enrollees. The results also reveal that the likelihood of CRN was associated with various factors, including age, race/ethnicity, annual income, MSA, census region, self-perceived health status, number of chronic conditions, ADLs, care-seeking attitudes, and environment factors.

Approximately half of the patients failed to take medication as prescribed.[205] With the aging of the U.S. population, nonadherence will be more prevalent because patients take more medications to control their conditions.[206] To date, the concern about nonadherence is rising because of a growing body of evidence showing that nonadherence is related to adverse outcomes and higher health care costs.[207] Osterberg et al. estimated that poor medication adherence contributed to at least one-third of medication-related hospitalizations in the U.S.[207] Drug cost has been considered as an important factor of nonadherence,[208,209] and CRN can be solved by reducing the out-of-pocket costs for acquiring medication. The Medicare Part D program was introduced to reduce the financial burden of prescription medications for Medicare beneficiaries. After the implementing Part D, CRN among elderly decreased.[71,210] Even though we hypothesized that PDPs had higher OOP and more risks of CRN, there is no substantial evidence suggesting the differences in the risk of CRN between these two types of Part D plans. However, our results revealed risk factors for CRN among elderly beneficiaries, including age, sex, race/ethnicity, annual income, LIS, census region, other RX coverage,

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self-perceived health status, number of chronic conditions, CCI, ADLs, IADLs, and care-seeking attitudes. This finding is consistent with those from existing studies.[160,162,211,212] For example, African Americans had higher risks of CRN than their white counterparts,[213,214] even after controlling for prescription drug insurance.

Among beneficiaries with diabetes, our findings indicated that PDP enrollees had similar PDC for anti-diabetic drugs, but were more likely to have PDC≥0.80, compared to those enrolled in MA-PDs. This finding is consistent with existing studies using 5% sample. The results also revealed that medication adherence to anti-diabetic drugs was associated with various factors, including marital status, living conditions, LIS, self-perceived health status, BMI, care-seeking attitudes, and environment factors. In the sensitivity analysis, we also compared the healthcare use and costs among beneficiaries with diabetes who enrolled in PDPs vs. MA-PDs. PDP enrollees still had higher healthcare utilizations and expenditures than MA-PD enrollees.

As demonstrated in the conceptual framework, medication adherence is considered as health behavior. In this dissertation, we found a wide variety of factors influencing medication adherence, including demographics, socioeconomics, life style (e.g., smoking), regions, health conditions, health altitude, and availability of primary physicians and hospital bed. These findings are consistent with the published review by Osterberg et al.[207]

6.4 Limitations and Strengths

There are several limitations in this dissertation. This study is non-randomized and observational. The major limitation of natural experiments is that omitted variables may exist. Failure to control for unobserved confounders leads to biased results.

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However, an IV approach allowed us to control for unobserved variables and adjust for a broad range of potential confounders. Therefore, we do not expect omitted variables will result in substantial bias to the results, but still consider the possibility that unobserved differences between the MA-PD and PDP enrollees could bias the results. Second, self-reports were used to estimate healthcare use and costs, and we cannot exclude the possibility of recall bias, because PDP and MA-PD enrollees had different health conditions and might have different likelihood of having recall bias. However, MCBS surveyed Medicare beneficiaries three times a year, and asked them to bring all the medical bills and receipts to the interview, to minimize the recall bias. Even if the recall bias exists, we don't expect there is substantial bias due to the use of self-reports. Third, only three drug classes were examined among diabetic patients, and it is unclear whether the results can be generalized to other drug classes or Medicare beneficiaries without diabetes. Fourth, self-reported diagnosis was used to identify diabetic patients, and we cannot rule out the possibility that some diabetic patients are not included in the sample. However, using patients' self-reports has been treated as a gold standard in the identification of patients with diabetes, and therefore it is less likely to underestimate the patients with diabetes. Fifth, adherence was defined as having PDC≥80%, which might be too arbitrary. However, this cutoff point has been validated and widely used in the current literature. Furthermore, PDC was also treated as continuous variable in the regression models.

Despite the limitations described above, this study has several strengths. First, the observational study design contributes to the generalizability of results. Since only a few exclusion criteria were applied, the study sample may be demographically representative

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of the elderly Medicare population with diabetes. Second, MCBS data includes both medical claims and patient-reported sources, which makes robust analyses possible. Third, I applied instrumental variable methods to adjust for unmeasured confounders, to obtain more consistent estimates of the effect of part D plans on adherence.

6.5 Conclusion

This dissertation found that PDP enrollees tended to use more health services and had higher costs of total healthcare and prescription drugs, while had higher cost-related nonadherence and difficulties in affording prescription drugs, compared to those enrolled in MA-PDs. Therefore, the findings suggest that providing more generous drug insurance may reduce the total healthcare spending. To our knowledge, this study is the first study to compare the effects of two specific Part D plans on healthcare utilizations and expenditure. Further studies are warranted to better understand the effects of PDPs among other populations.

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APPENDIX A – KEY VARIABLES IN MCBS FILES

The section describes the key variables utilized for this dissertation. Table A.1 summarizes the key variables in MCBS database.

Table A.1 Lists of Key Variables in MCBS Files

Module/Files	Variable	Type	Description
Cost and Use/RIC K	BASEID	C	Unique SP Identification Number
	TYPE	C	Beneficiary's living situation for year
	STATUS	N	Completeness of survey data for the year
	C_DAYS	N	Number of community days
	TOT_DAYS	N	Total person days
Cost and Use/RIC A	BASEID	C	Unique SP Identification Number
	H_ENT01 - H_ENT12	C	Medicare entitlement code for Jan to Dec
	H_MEDSTA	C	C Medicare status code as of 12/31
	H_RESST	C	SSA State code of residence as of 12/31
	H_ZIP	C	Postal zip code of residence as of 12/31
	H_CENSUS	C	Census Region of residence as of 12/31
	H_METRO	C	Metro status
	H_GHPSW	C	Some group health participation in year
	H_PDTP01- H_PDTP12	C	Part D plan type for Jan to Dec
	H_PDLS01- H_PDLS12	C	LIS Indicator for Jan to Dec
	H_MCDE01- H_MCDE12	C	Medicaid eligibility for Jan to Dec
Cost and Use/RIC 1	BASEID	C	Unique SP Identification Number
	D_DOB	C	Date of birth (YYYYMM)
	ROSTSEX	N	Gender of SP
	D_RACE2	N	Race of SP
	HISPORIG	N	Is SP of Hispanic or Latino origin
	SPDEGRCV	N	Highest grade SP completed
	SPMARSTA	N	Marital status of SP
	INCOME	N	Income range of SP
	D_DIVCUR	C	Census division of SP's residence
Cost and Use/RIC 2	HEIGHTIN	N	Height of SP--inches
	WEIGHT	N	Weight of SP in pounds

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Module/Files	Variable	Type	Description
	EVERSMOK	N	SP ever smoked cigarettes/cigars/tobacco
	SMOKNOW	N	Does SP smoke now
	OCARTERY	N	Ever told had hardening of arteries
	OCHBP	N	Ever told had hypertension/hi blood pres
	OCMYOCAR	N	Ever told had myocard infarct/hrt attack
	OCCHD	N	Ever told had angina pectoris/CHD
	OCOTHHRT	N	Ever told had other heart conditions
	OCCFAIL	N	Ever told had heart failure
	OCCVALVE	N	Ever told had problems with valves
	OCRHYTHM	N	Ever told had prbs w/ heart rhythm
	OCSTROKE	N	Ever told had stroke/braihemorrhage
	OCCSKIN	N	Ever told had skicancer
	OCCANCER	N	Ever told had other (non-skin) cancer
	OCBETES	N	Ever told had diabetes
	OCDTYPE	N	Type of diabetes diagnosed
	OCDVISIT	N	Was SP told o1+ visits they had diabet
	OCARTHRH	N	Ever told had rheumatoid arthritis
	OCARTH	N	Ever told had non-rheumatoid arthritis
	OCMENTAL	N	Ever told had mental retardation
	OCALZMER	N	Ever told had Alzheimer's/dementia
	OCDEMENT	N	Ever been diagnosed with dementia
	OCDEPRSS	N	Ever told you had depression
	OCPSYCHO	N	Ever told had mental disorder
	OCOSTEOP	N	Ever told had osteoporosis/soft bones
	OCBRKHIP	N	Ever told had broken hip
	OCPARKIN	N	Ever told had Parkinson's disease
	OCEMPHYS	N	Ever told had emphysema/asthma/COPD
	OCPPARAL	N	Ever told had complete/partial paralysis
	HAVEPROS	N	SP ever be told: Enlarged prostate/BPH
	OCCHOLES	N	Ever be told you had high cholesterol
Cost and Use/RIC 4	D_PHI1-D_PHI12	C	Private health insurance coverage – January to December
	DRUGCAID	N	Medicaid prescription drug coverage
	DRUGOTH	N	Other public plan pres drug cov
	D_RX1-D_RX4	N	Drug coverage Plan #1 - #4
Cost and Use/RIC IPE, OPE, MPE, DUE, FAE	OREVTYPE	C	Original reported event type
	SOURCE	C	Source of event: survey, claim, or both?
	AMTTOT	N	Total payment
	AMTCARE	N	Amount paid by Medicare
	AMTCAID	N	Amount paid by Medicaid
	AMTHMOM	N	Amount paid by Medicare HMO
	AMTVA	N	Amount paid by Veterans Administration
	AMTPRVE	N	Amt paid by employer-sponsored priv ins

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Module/Files	Variable	Type	Description
	AMTPRVI	N	Amt paid by individually-purch priv ins
	AMTPRVU	N	Amt paid by priv ins (unknown purchased)
	AMTOOP	N	Amount paid out-of-pocket (OOP)
	AMTDISC	N	Amount of uncollected SP liability
	AMTOTH	N	Amount paid by other payor(s)
	ODIAG1	C	Primary ICD-9 diagnosis code from claim
	ODIAG2	C	Second ICD-9 diagnosis code from claim
	ODIAG3	C	Third ICD-9 diagnosis code from claim
Cost and Use/RIC PME	TYPE	C	Event type-Prescribed Medicine
	DRUGNAME	C	Prescribed Medicine name
	THERCC	C	F.D.B. generic therapeutic class
	OTCLEG	C	Over-the-counter/legend indicator
	FDB_BN	C	First Databank brand name
	FDB_GNN	C	First Databank generic name
	SERV_DT	C	Service Date
	QNTY	N	Quantity
	DAYSUPP	N	Days Supplied
	PDEFLAG	N	PDE Match Indicator
	AMTTOT	N	Total payment
	AMTCARE	N	Amount paid by Medicare
	AMTCAID	N	Amount paid by Medicaid
	AMTHMOM	N	Amount paid by Medicare HMO
	AMTVA	N	Amount paid by Veterans Administration
	AMTPRVE	N	Amt paid by employer-sponsored priv ins
	AMTPRVI	N	Amt paid by individually-purch priv ins
	AMTPRVU	N	Amt paid by priv ins (unknown purchased)
	AMTOOP	N	Amount paid out-of-pocket (OOP)
	AMTDISC	N	Amount of uncollected SP liability
	AMTOTH	N	Amount paid by other payor(s)
Access to Care/RIC 3	SCPMCOST	N	Reas not obtain Rx - cost too much
	SCPMMAIN	N	Main reason not obtain prescription
	GENERRX	N	Did SP ask for generic form of Rx?
	MAILRX	N	Has SP purchased Rx via mail/internet?
	DOSESRX	N	SP took smaller does of Rx
	SKIPRX	N	Skipped doses to make Rx last longer
	DELAYRX	N	Delayed getting Rx because of cost
	NOFILLRX	N	Decided not to get Rx because of cost
	SPENTLRX	N	Spent less $ to save for needed Rx

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APPENDIX B – LIST OF ANTI-DIABETIC DRUGS

The following table describes the generic and brand names of anti-diabetic drugs, including both oral anti-diabetic drugs and insulins, which were used to identify the drug utilized among beneficiaries with diagnosis of type 2 diabetes.

Table B.1 Generic and Brand Names of Anti-Diabetic Drugs

Generic Name	Brand Name
DPP-4 Inhibitors	
sitagliptin	Januvia
alogliptin	Nesina
linagliptin	Jentadueto
linagliptin	Tradjenta
saxagliptin	Onglyza
Biguanidine	
metformin hydrochloride	Metformin Hydrochloride, Fortamet, glucophage, Glumetza, Riomet
Sulfonylurea	
glipizide	Glipizide, Glipizide XL, GlipizideER, Glucotrol, Glucotrol XL
glyburide	Glyburide, DiaBeta, Glynase, micronase
glimepiride	Glimepiride, amaryl
chlorpropamide	Diabinese, Chlorpropamide
tolazamide	Tolazamide, tolinase
tolbutamide	Tolbutamide
TZDs	
rosiglitazone maleate	Avandia
pioglitazone	Pioglitazone, Actos
SGLT-2	
Canagliflozin	Invokana
Dapagliflozin	Forxiga, Farxiga
Empagliflozin	Jardiance
Combinations	
pioglitazone /metformin	Actoplus met
rosiglitazone/metformin	Avandamet
rosiglitazone/glimepiride	Avandaryl

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Generic Name	Brand Name
glipizide / metformin	Glucovance
glyburide /metformin	
repaglinide / metformin	Prandimet
dapagliflozin / metformin	Xigduo
canagliflozin / metformin	Invokamet
pioglitazone/ glimepiride	
Others	
bromocriptine	Parlodel, cycloset
colesevelam	Welchol, cholestagel, lodalis
pramlintide	Symlin
exenatide	Byetta
lixisenatide	Lyxumia
liraglutide	Victoza
albiglutide	Tanzeum
dulaglutide	Trulicity
exenatide	Bydureon
acarbose	Precose, glucobay
miglitol	Glyset
voglibose	Basen
nateglinide	Starlix
repaglinide	Prandin, novonorm
sitagliptin and metformin hydrochloride	Janumet
alogliptin and metformin hydrochloride	Kazano
saxagliptin and metformin hydrochloride	Kombiglyze
alogliptin and pioglitazone	Oseni
Insulins	
Insulin aspart	Novolog
Insulin glulisine	Apidra
Insulin lispro	Humalog
Insulin human	Afrezza Inhalation Powder
Regular insulin	Humulin R, Novolin R
Insulin NPH	Hagedorn NPH , Humulin N, Novolin N
Insulin detemir	Levemir
Insulin glargine	Lantus
Insulin aspart protamine/insulin aspart	NovoLog 50/50, NovoLog 70/30
Insulin lispro protamine/insulin lispro	Humalog 50/50, Humalog 75/25

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APPENDIX C – LIST OF ANTI-HYPERTENSIVE DRUGS

The following table describes the generic and brand names of anti-hypertensive drugs, which were used to identify the drug utilized among beneficiaries with diagnosis of type 2 diabetes.

Table C.1 Generic and Brand Names of Anti--Hypertensive Drugs

Generic	Brand Name
Alpha-Blockers (Antihypertensive)	
Doxazosin	Cardura, Carduran
Prazosin	Minipress, Minipress XL
Terazosin	Hytrin
Alpha-2 Agonists, Central-Acting	
Clonidine	Catapres, Catapres TTS (patch), Dixarit, Duraclon, Jenloga, Kapvay, Nexiclon XR
Guanabenz	Wytensin
Guanfacine	Intuniv, Tenex
Methyldopa	Aldomet
Lofexidine	Britlofex
Aldosterone Antagonists, Selective	
Eplerenone	Inspra
Angiotensin II Receptor Blockers	
Azilsartan	Edarbi
Candesartan	Atacand
Eprosartan	Teveten
Irbesartan	Avapro
Losartan	Cozaar
Olmesartan	Benicar
Telmisartan	Micardis
Valsartan	Diovan
ACE (Angiotensin Converting Enzyme) Inhibitors	
Benazepril	Lotensin
Captopril	Capoten
Enalapril	Vasotec
Fosinopril	Monopril
Lisinopril	Prinivil

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Generic Name	Brand Name
Moexipril	Univasc
Perindopril	Aceon
Quinapril	Accupril
Ramipril	Altace
Trandolapril	Mavik
Beta-blockers	
Carvedilol	Coreg, Coreg CR
Labetalol	Trandate
Acebutolol	Sectral
Pindolol	Visken
Penbutolol	Levatol
Atenolol	Tenormin
Betaxolol	Kerlone
Bisoprolol	Zebeta
Celiprolol	Selectol
Metoprolol	Lopressor, Toprol XL
Nebivolol	Bystolic
Sotalol	Betapace, Betapace AF, Sorine
Nadolol	Corgard
Propranolol	Inderal LA, InnoPran XL
Timolol	Blocadren
Calcium Channel Blockers	
Amlodipine	Norvasc, Lotrel
Bepridil	Vascor
Clevidipine	Cleviprex
Diltiazem	Calan, Calan SR, Cardizem, Covera HS, Isoptin SR, Verelan, Verelan PM
Felodipine	Plendil
Lacidipine	Caldine, Lacimen, Lacipil, Midotens, Motens
Lercanidipine	Lercadip, Zanidip
Levamlodipine	EsCordi Cor, Esam, Eslo, S-Amlip
Isradipine	DynaCirc, DynaCirc CR
Nicardipine	Cardene SR
Nifedipine	Adalat, Nifediac, Nifedical, Procardia
Nimodipine	Nimotop
Nisoldipine	Sular
Verapamil	Calan, Calan SR, Covera-HS, Isoptin SR, Verelan, Verelan PM
Diuretics	
Bumetanide	Bumex
Ethacrynic acid	Edecrin
Furosemide	Lasix
Piretanide	

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Torsemide	Demadex
Amiloride	Midamore
Spironolactone	Aldactone
Triamterene	Dyrenium
Bendroflumethiazide	Aprinox
Chlorothiazide	Diuril
Chlorthalidone	Hygroton
Indapamide	Lozol
Hydrochlorothiazide	Hydrodiuril
Methyclothiazide	Enduron
Metolazone	Zaroxolyn, Diulo, Mykrox
Peripheral Adrenergic Inhibitors	
Guanadrel	Hylorel
Guanethidine	Ismelin
Reserpine	Serpasil
Renin Inhibitors	
Aliskiren	Tekturna
Vasodilators	
Diazoxide	Proglycem
Hydralazine	Apresoline, Dralzine
Minoxidil	Loniten
Nitroprusside	Nipride, Nitropress, Sodium Nitroprusside

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APPENDIX D – LIST OF ANTI-HYPERLIPIDEMIC DRUGS

The following table describes the generic and brand names of antihyperlipidemic drugs, which were used to identify the drug utilized among beneficiaries with diagnosis of type 2 diabetes.

Table D.1 Generic and Brand Names of Anti-Hyperlipidemic Drugs

Generic Name	Brand Name
statins	
amlodipine / atorvastatin	Caduet
Atorvastatin	Lipitor
Fluvastatin	Lescol, Lescol XL
Lovastatin	Altoprev, Mevacor
Pitavastatin	Livalo
Pravastatin	Pravachol
Simvastatin	Zocor
Rosuvastatin	Crestor
bile acid sequestrants	
cholestyramine	Prevalite, Questran
colesevelam	Welchol
colestipol	Colestid
fibrates	
fenofibrate	Antara, Lipofen, Lofibra, Tricor, Fenoglide, Triglide
fenofibric acid	Trilipix, Fibricor
gemfibrozil	Lopid
Cholesterol Absorption Inhibitors	
ezetimibe	Zetia
ezetimibe / atorvastatin	Liptruzet
ezetimibe / simvastatin	Vytorin
Nicotinic Acids	
niacin	Niaspan, Simcor
niacinamide	N/A
lovastatin / niacin extended-release	Advicor
Others	
icosapent ethyl	Vascepa
lomitapide	Juxtapid

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Generic Name	Brand Name
mipomersen	Kynamro
omega-3 fatty acid supplement	Lovaza, Omtryg
Icosapent ethyl	Vascepa
alirocumab	Praluent
evolocumab	Repatha

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APPENDIX E – ADDITIONAL RESULTS FOR SELECTION OF PREFERRED MODELS

This chapter presents the model specification tests and selections of preferred multivariable models for each outcomes of interest.

1. Aim 2.1 Healthcare Utilizations

1.1 Distribution of count data

Figure E.1 demonstrates the distribution of count data. All types of healthcare utilizations have a positively skewed distribution, indicating the violation of OLS assumption.

1.2 Model specification tests for naïve model

The following section describes the specification tests for selecting preferred models for healthcare count data.

First, normality tests were performed for each type of healthcare utilizations. As shown in Figure E.1, all types of healthcare count data have a positively skewed distribution. Table E.1 shows the results from normality tests. The count data has very high skewness (>1) and kurtosis (> 3), indicating the violation of the assumption of the normal distribution.

Second, the overdispersion of count data was accessed based on flow chart shown in Figure 4.2. Table E.1 shows that the variance of data is greater than the mean, which suggests the presence of overdispersion in the utilization data of all types of healthcare. In addition, the likelihood-ratio (LR) tests indicates the overdispersion of count data, and

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hence, would reject the Poisson specification and favor for a negative binomial model.[175,177,178]

Table E.1 Specification Tests for GLM Models: Healthcare Utilizations

Outcome Measure	Mean	Variance	Skewness	Kurtosis	LR	Vuong test
Hospitalizations	0.20	0.31	4.18	29.88	1072 (p<.0001)	zinb
Outpatient	2.56	2.56	10.44	241.84	48000 (p<.0001)	nb
Medical Providers	14.98	351.11	7.83	167.17	180000 (p<.0001)	nb
Others Medical services	0.01	0.02	11.05	162.02	78.98 (p<.0001)	zinb
Prescriptions (Claims)	36.90	987.86	1.66	5.83	340000 (p<.0001)	zinb
Prescriptions (self-reports)	41.76	1482.11	2.25	9.83	43000 (p<.0001)	zinb

Third, a large proportion of beneficiaries reported no use of health services or prescription drugs, leading to excess zero values. Based on Vuong tests in Table E.1, the zero-inflated negative binomial models fit better than negative binomial models for number of hospitalizations, other medical services, and prescriptions, and hence reject the standard count model (Table 5.5). While negative binomial models are the best fit for the number of outpatient and physician's office visits.[173,176] The dependent variable is the annual number of health service use, and the key independent variable is the type of part D plans.

As shown in Table E.2, negative binomial models had the relative smaller AIC than Poisson models.

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Table E.2 Summary of Model Fit Statistics from Poisson and Negative Binominal Models

Outcome Measure	Original Poisson	Scaled Poisson	ZIP	NB	ZINB
Hospitalizations					
Log Likelihood	-7723	-10825	-7472	-7421	-8140
AIC (smaller is better)	16975	16975	16477	16374	16378
AICC (smaller is better)	16975	16975	16477	16374	16378
BIC (smaller is better)	17329	17329	16846	16736	16756
Outpatient					
Log Likelihood	1893	405	7277	22103	-32960
AIC (smaller is better)	106431	106431	95666	66013	66017
AICC (smaller is better)	106431	106431	95667	66013	66017
BIC (smaller is better)	106785	106785	96036	66375	66395
Medical Providers					
Log Likelihood	441159	38295	443857	508706	-59299
AIC (smaller is better)	253784	253784	248391	118692	118696
AICC (smaller is better)	253784	253784	248391	118692	118696
BIC (smaller is better)	254139	254139	248761	119054	119073
Others Medical services					
Log Likelihood	-1089	-10116	-1073	-1075	-1089
AIC (smaller is better)	2305	2305	2278	2278	2276
AICC (smaller is better)	2305	2305	2278	2279	2276
BIC (smaller is better)	2659	2659	2647	2640	2653
Prescriptions (Claims)					
Log Likelihood	1636429	93045	1655287	1746683	-72364
AIC (smaller is better)	367096	367096	329384	146591	144826
AICC (smaller is better)	367096	367096	329384	146591	144827
BIC (smaller is better)	367450	367450	329753	146953	145204
Prescriptions (self-reports)					
Log Likelihood	1942665	91121	1956684	2082636	-74629
AIC (smaller is better)	430161	430161	402127	150222	149357
AICC (smaller is better)	430162	430162	402127	150223	149357
BIC (smaller is better)	430516	430516	402496	150584	149734

2. Aim 2.1 Healthcare Costs

2.1 Distribution of cost data

Figure E.2 demonstrates the distribution of cost data. All types of healthcare costs have a positively skewed distribution, indicating the violation of OLS assumption.

2.2 Model specification tests for naïve model

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This section presents the specification tests for selecting preferred models for the analysis of health costs.

First, normality tests indicate that each type of healthcare costs is skewed (Table E.3, skewness>1), indicating the violation of OLS assumption.

Second, the Box-Cox statistics (λ) in Table E.3 are close to 0, suggesting a log transformation for the cost data.

Third, the Modified Park's tests statistics (λ) is ranged from 1.02 to 1.99, which is close to 2, indicating a gamma distribution for the cost data.

Hence, based on the model specification statistics mentioned in Chapter 4, GLM models with gamma distribution and log link were used to estimate the effects of PDPs on healthcare costs among elderly Medicare beneficiaries.

Table E.3 Specification Tests for Costs Data

Outcome Measure	**Skewness**	**Box-Cox Test** (λ)	**Modified Park's Test** (λ)
Hospitalizations	11.10	0.09	1.48
Outpatient	18.96	-0.01	1.85
Medical Providers	9.17	0.08	1.54
Others Medical services	16.12	0.34	1.83
Total Medical Services	7.58	0.03	1.02
Pharmacy claims	5.59	0.26	1.99
Total Health costs	6.40	0.13	1.97

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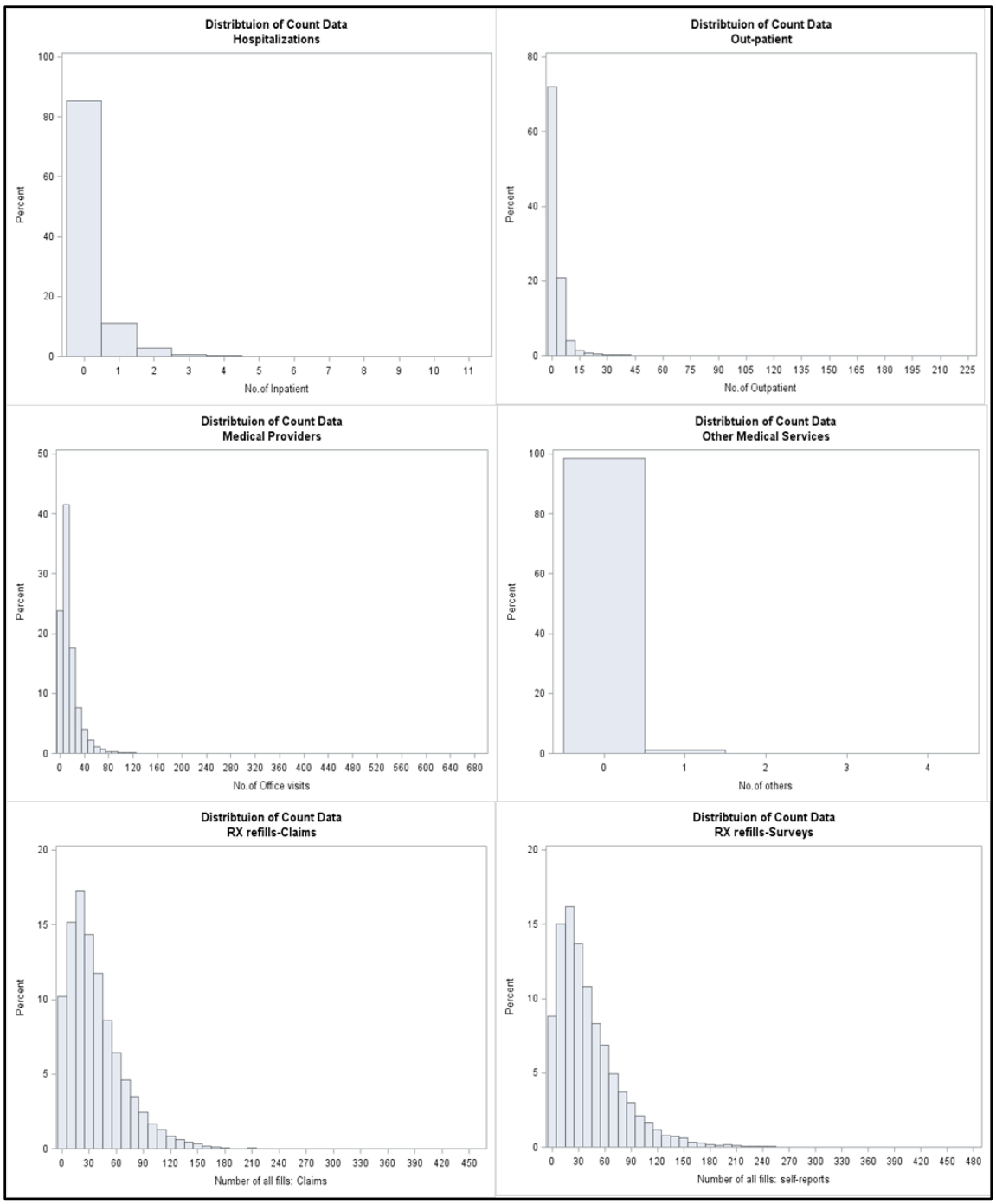

Figure E.1 Distribution of Count Data

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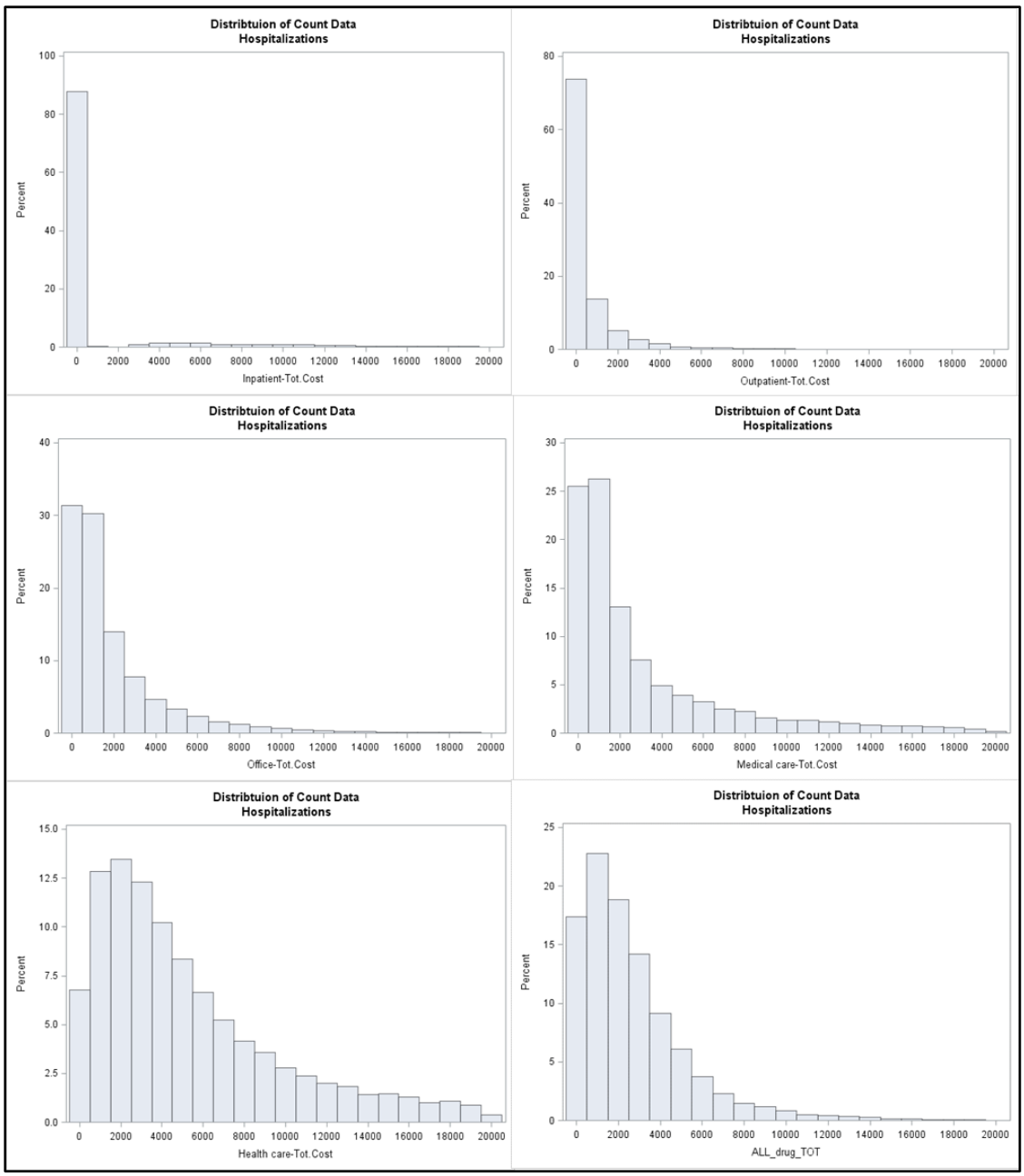

Figure E.2 Distribution of Cost Data

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APPENDIX F – ADDITIONAL RESULTS FOR SENSITIVITY ANALYSIS

This chapter presents the additional results for sensitivity analysis, including the descriptive statistics for outcome measures between PDPs and MA-PDs.

1. Sensitivity Analysis 1 – Exclude Beneficiaries with LIS

1.1 Aim 2.1 Healthcare Utilizations

Table F.1 presents the unadjusted healthcare utilizations among PDPs and MA-PDs. Compared to MA-PD enrollees, PDP enrollees were significantly more likely to have inpatient (15.1% vs. 12.0%; p<0.0001) and outpatient care (66.8% vs. 63.7%; p=0.001), but had similar likelihood of visiting doctor's office (97.7% vs. 97.6%; p=0.598). In addition, PDP enrollees had significantly higher annual average number of visits to hospitals (0.21 vs. 0.15; p<0.0001), outpatient settings (2.9 vs. 2.1; p<0.0001), doctor's office (18.2 vs. 11.9; p<0.0001), and prescription fills (40.0 vs. 28.8; p<0.0001).

Table F.1 Sensitivity Analysis 1: Unadjusted Healthcare Utilizations

Outcome measures	PDPs	MA-PDs	P-value
Hospitalization			
Patients with visits, n (%)	994 (15.1%)	634 (12.0%)	**<.0001**
Numbers of visits, mean ±std	0.21 ±0.58	0.15 ±0.45	**<.0001**
Outpatient			
Patients with visits, n (%)	4405 (66.8%)	3373 (63.7%)	**0.001**
Numbers of visits, mean ±std	2.9 ±5.8	2.1 ±5.5	**<.0001**
Medical providers			
Patients with visits, n (%)	6445 (97.7%)	5165 (97.6%)	0.598
Numbers of visits, mean ±std	18.2 ±19.5	11.9 ±18.4	**<.0001**

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Outcome measures	PDPs	MA-PDs	P-value
Other medical services			
Patients with visits, n (%)	33 (0.5%)	123 (2.3%)	**<.0001**
Numbers of visits, mean ±std	0.01 ±0.08	0.03 ±0.18	**<.0001**
Prescriptions (self-reports)			
Patients with RX fills, n (%)	6380 (96.7%)	5066 (95.7%)	**0.003**
Numbers of fills, mean ±std	40.0 ±36.6	28.8 ±23.9	**<.0001**
Prescriptions (claims)			
Patients with RX fills, n (%)	6305 (95.6%)	5006 (94.6%)	**0.010**
Numbers of fills, mean ±std	33.6 ±25.9	31.9 ±28.2	**<.0001**

1.2 Aim 2.1 Healthcare Costs

Table F.2 presents bivariate results regarding healthcare costs between PDP enrollees and MA-PD enrollees. Compared to MA-PDs, PDPs were associated with higher costs for inpatient care ($1905.2 vs. $1528.6; p=0.001), outpatient care ($1020.3 vs. $643.6; p<0.0001), physician's office ($2858.1 vs. $1663.1; p<0.0001) and prescription drugs ($3140.8 vs. $2319.7; p<0.0001), but had lower costs for other medical services ($28.2 vs. $143.4; p<0.0001). As a result, PDP group had statistically higher costs for all-type of medical services ($5811.8 vs. $3982.0; p<0.0001) and total healthcare costs ($8535.7 vs. $6064.7; p<0.0001).

Among different sources of payments, for out-of-pocket spending, PDP enrollees had similar OOP costs for hospital ($91.6 vs. 121.1; p=0.286) and outpatient ($136.8 vs. 108.3; p=0.207), compared to MA-PDs. For the costs from public insurance, PDPs had similar costs for hospital ($15.3 vs. 18.3; p=0.749), physician's office ($9.0 vs. $14.2; p=0.149), and all medical services ($28.2 vs. 39.9; p=0.277). However, PDPs were associated with higher Medicare spending for all the clinical settings.

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Table F.2 Sensitivity Analysis 1: Unadjusted Healthcare Costs

Outcome measures	PDPs		MA-PDs		P-value
	Mean	Std.	Mean	Std.	
Hospitalization					
Medicare costs, $	1643.2	5977.5	1375.1	5719.8	**0.013**
Public insurance costs, $	15.3	526.4	18.3	491.8	0.749
Private insurance costs, $	155.0	799.8	14.1	588.8	**<.0001**
OOP costs, $	91.6	1439.3	121.1	1535.9	0.286
Total costs, $	1905.2	6611.7	1528.6	6133.8	**0.001**
Outpatient					
Medicare costs, $	655.2	2215.8	521.6	3467.0	**0.015**
Public insurance costs, $	3.3	84.1	7.4	114.0	**0.028**
Private insurance costs, $	225.0	1426.7	6.4	127.9	**<.0001**
OOP costs, $	136.8	1675.9	108.3	671.7	0.207
Total costs, $	1020.3	3654.8	643.6	3599.0	**<.0001**
Medical providers					
Medicare costs, $	1585.9	2749.0	1081.6	3415.7	**<.0001**
Public insurance costs, $	9.0	167.5	14.2	214.4	0.149
Private insurance costs, $	538.3	1040.4	15.9	221.3	**<.0001**
OOP costs, $	724.9	2125.4	554.6	2064.4	**<.0001**
Total costs, $	2858.1	4461.2	1666.3	4192.1	**<.0001**
Others					
Medicare costs, $	4.3	202.3	82.0	960.9	**<.0001**
Public insurance costs, $	0.7	41.6	0.0	0.0	0.192
Private insurance costs, $	10.6	271.8	0.0	0.0	**0.002**
OOP costs, $	12.5	317.6	61.5	735.9	**<.0001**
Total costs, $	28.2	501.5	143.4	1266.1	**<.0001**
All medical services					
Medicare costs, $	3888.6	7908.0	3060.2	8376.8	**<.0001**
Public insurance costs, $	28.2	577.5	39.9	583.8	0.277
Private insurance costs, $	929.0	2167.7	36.4	671.0	**<.0001**
OOP costs, $	965.9	3382.2	845.5	3075.3	**0.042**
Total costs, $	5811.8	10370.7	3982.0	9418.6	**<.0001**
Prescriptions (claims)					
Medicare costs, $	1570.7	2642.5	1365.6	2029.1	**<.0001**
Public insurance costs, $	96.2	555.4	52.2	333.6	**<.0001**
Private insurance costs, $	46.5	266.9	56.3	302.1	0.062
OOP costs, $	1010.7	1166.4	608.7	683.6	**<.0001**
Total costs, $	2723.9	3572.4	2082.8	2489.1	**<.0001**
Total Healthcare					
Medicare costs, $	5459.3	8570.4	4425.8	8883.7	**<.0001**
Public insurance costs, $	124.4	808.3	92.1	704.3	**0.020**
Private insurance costs, $	975.4	2195.0	92.7	779.8	**<.0001**
OOP costs, $	1976.6	3656.8	1454.2	3216.8	**<.0001**
Total costs, $	8535.7	11445.9	6064.7	10146.3	**<.0001**

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1.3 Aim 3.1 Cost Related Non-adherence

Table F.3 shows the bivariate analysis of CRN and medication affordability among PDPs and MA-PDs. PDP group had higher prevalence of CRN than MA-PD (12.2% vs. 10.7%; p=0.030), However, PDPs had similar prevalence of spending less on basic needs than MA-PDs (4.2% vs. 3.4%; p=0.076). In addition, PDP enrollees had higher prevalence of using generic drugs (56.9% vs. 49.1%; p<0.0001), obtaining free samples from the doctors (48.2% vs.36.9%; p<0.0001), and comparing pharmacies (21.3% vs. 14.8%; p<0.0001), but had lower prevalence of using mail orders (21.7% vs. 25.7%; p=0.007), compared to MA-PD enrollees.

Table F.3 Sensitivity Analysis 1: CRN and Affordability

Outcome Measures	**PDPs**		**MA-PDs**		**P-Value**
	n	Weighted %	n	Weighted %	
Cost-related nonadherence	780	12.2	565	10.7	**0.030**
Spending less on basic needs	279	4.2	186	3.4	0.076
Cost reduction strategies					
Use generics	3783	56.9	2603	49.1	**<.0001**
Free samples	3226	48.2	1989	36.9	**<.0001**
Use mail-order/Internet	1377	21.7	1339	25.7	**0.007**
Compare pharmacies	1381	21.3	789	14.8	**<.0001**

1.4 Aim 3.2 Medication Adherence

Table F.4 compares medication use and adherence measured by pharmacy claims. The proportion of PDP enrollees with at least 1 prescription was similar to MA-PD enrollees. However, PDP enrollees had higher mean number of fills for antihypertensive drugs (17.0 vs. 14.5, p=0.0003) and antihyperlipidemic drugs (6.3 vs.5.3, p=0.001), compared to MA-PD enrollees. Medication adherence measured by PDC was similar among PDP and MA-PD enrollees, however, PDP enrollees were more likely to be

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adherent (PDC≥0.80) to antihyperlipidemic drugs (20.9% vs. 15.6%, p=0.002), compared to MA-PD enrollees.

Table F.4 Sensitivity Analysis 1: Medication Use among Beneficiaries with Type 2 Diabetes

Outcome Measures	PDPs	MA-PDs	p-value
Any antidiabetic agent			
With at least 1 fill, n (%)	890 (80.5%)	790 (83.5%)	0.075
No. of refills, mean ±std	10.5 ±10.	9.9 ±9.3%	0.207
PDC,mean ±std	0.56 ±0.33	0.57 ±0.31	0.314
PDC>0.80, n(%)	321 (29.0%)	251 (26.5%)	0.210
Any antihypertensive drugs			
With at least 1 fill, n (%)	974 (88.1%)	846 (89.4%)	0.331
No. of refills, mean ±std	17.0 ±17.5	14.5 ±13.2	**0.0003**
PDC,mean ±std	0.63 ±0.30	0.63 ±0.28	0.991
PDC>0.80, n(%)	382 (34.5%)	307 (32.5%)	0.319
Any antihyperlipidemic drugs			
With at least 1 fill, n (%)	742 (67.1%)	646 (68.3%)	0.563
No. of refills, mean ±std	6.3 ±7.7	5.3 ±5.7	**0.001**
PDC,mean ±std	0.43 ±0.36	0.43 ±0.35	0.884
PDC>0.80, n(%)	231 (20.9%)	148 (15.6%)	**0.002**

2. Sensitivity Analysis 1 – Exclude Beneficiaries with Other Drug Benefits

2.1 Aim 2.1 Healthcare Utilizations

Table F.5 presents the unadjusted healthcare utilizations among PDPs and MA-PDs. Compared to MA-PD enrollees, PDP enrollees were significantly more likely to have inpatient (15.3% vs. 12.2%; p<0.0001) and outpatient care (66.2% vs. 63.4%; p=0.001), but had similar likelihood of visiting doctor's office (96.9% vs. 97.4%; p=0.053). In addition, PDP enrollees had significantly higher annual average number of visits to hospitals (0.21 vs. 0.16; p<0.0001), outpatient settings (2.8 vs. 2.1; p<0.0001), doctor's office (17.4 vs. 11.9; p<0.0001), and prescription fills (44.5 vs. 33.1; p<0.0001).

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Table F.5 Sensitivity Analysis 2: Unadjusted Healthcare Utilizations

Outcome measures	PDPs	MA-PDs	P-value
Hospitalization			
Patients with visits, n (%)	1222 (15.3%)	676 (12.2%)	**<.0001**
Numbers of visits, mean ±std	0.21 ±0.59	0.16 ±0.48	**<.0001**
Outpatient			
Patients with visits, n (%)	5281 (66.2%)	3507 (63.4%)	**0.001**
Numbers of visits, mean ±std	2.8 ±5.6	2.1 ±5.3	**<.0001**
Medical providers			
Patients with visits, n (%)	7725 (96.9%)	5392 (97.4%)	0.053
Numbers of visits, mean ±std	17.4 ±19.6	11.9 ±18.2	**<.0001**
Other medical services			
Patients with visits, n (%)	43 (0.54%)	138 (2.5%)	**<.0001**
Numbers of visits, mean ±std	0.01 ±0.08	0.03 ±0.19	**<.0001**
Prescriptions (self-reports)			
Patients with RX fills, n (%)	7668 (96.2%)	5245 (94.8%)	0.317
Numbers of fills, mean ±std	44.5 ±41.0	33.1 ±29.7	**<.0001**
Prescriptions (claims)			
Patients with RX fills, n (%)	7560 (94.8%)	5302 (95.8%)	0.962
Numbers of fills, mean ±std	37.8 ±31.1	30.3 ±26.4	**<.0001**

2.2 Aim 2.2 Healthcare Costs

Table F.6 presents bivariate results regarding healthcare costs between PDP enrollees and MA-PD enrollees. Compared to MA-PDs, PDPs were associated with higher costs for inpatient care ($1905.2 vs. $1528.6; p=0.001), outpatient care ($955.6 vs. $643.6; p<0.0001), physician's office ($2645.0 vs. $1665.0; p<0.0001), and prescription drugs ($2953.6 vs. $2144.9.7; p<0.0001), but had lower costs for other medical services ($28.2 vs. $143.4; p<0.0001). As a result, PDP group had statistically higher costs for all-type of medical services ($5581.1 vs. $4051.1; p<0.0001) and total healthcare costs ($8534.7 vs. $6196.0; p<0.0001).

Among different sources of payments, for out-of-pocket spending, PDP enrollees

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had similar OOP costs for hospital ($101.6 vs. 151.8; p=0.169), outpatient ($126.9 vs. 109.5; p=0.381), and all medical services ($900.7 vs. 871.7; p=0.636), compared to MA-PDs. However, PDPs were associated with higher Medicare spending for all the clinical settings.

Table F.6 Sensitivity Analysis 2: Unadjusted Healthcare Costs

Outcome measures	PDPs		MA-PDs		P-value
	Mean	Std.	Mean	Std.	
Hospitalization					
Medicare costs, $	1672.3	6045.8	1422.2	6096.9	**0.019**
Public insurance costs, $	48.2	1019.2	20.1	516.7	**0.035**
Private insurance costs, $	132.2	849.5	3.4	177.2	**<.0001**
OOP costs, $	101.6	1413.4	151.8	2446.0	0.169
Total costs, $	1954.4	6715.7	1597.4	7393.7	**0.004**
Outpatient					
Medicare costs, $	633.5	2193.1	523.7	3442.9	**0.036**
Public insurance costs, $	21.3	218.6	8.1	114.6	**<.0001**
Private insurance costs, $	174.0	784.7	4.7	110.7	**<.0001**
OOP costs, $	126.9	1548.6	109.5	708.7	0.381
Total costs, $	955.6	3308.2	646.0	3587.3	**<.0001**
Medical providers					
Medicare costs, $	1489.5	2649.4	1082.3	3394.0	**<.0001**
Public insurance costs, $	64.1	582.9	20.2	239.2	**<.0001**
Private insurance costs, $	431.5	950.3	11.6	196.4	**<.0001**
OOP costs, $	659.8	1920.1	550.8	2054.4	**0.002**
Total costs, $	2645.0	4219.6	1665.0	4175.7	**<.0001**
Others					
Medicare costs, $	3.2	154.6	82.0	939.3	**<.0001**
Public insurance costs, $	2.4	148.5	1.1	83.2	0.538
Private insurance costs, $	8.3	232.6	0	0	**0.002**
OOP costs, $	12.3	296.9	59.5	708.0	**<.0001**
Total costs, $	26.2	476.9	142.7	1239.5	**<.0001**
All medical services					
Medicare costs, $	3798.5	7883.1	3110.2	8724.1	**<.0001**
Public insurance costs, $	136.0	1277.2	49.5	619.8	**<.0001**
Private insurance costs, $	746.0	1722.3	19.7	309.4	**<.0001**
OOP costs, $	900.7	3141.3	871.7	3720.9	0.636
Total costs, $	5581.1	10104.6	4051.1	10534.9	**<.0001**
Prescriptions (claims)					
Medicare costs, $	2041.8	3007.0	1503.4	2394.3	**<.0001**
Public insurance costs, $	77.0	467.3	32.3	241.0	**<.0001**
Private insurance costs, $	25.3	184.6	55.0	319.8	**<.0001**

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Outcome measures	PDPs		MA-PDs		P-value
	Mean	Std.	Mean	Std.	
OOP costs, $	809.5	1071.1	554.3	651.1	**<.0001**
Total costs, $	2953.6	3609.7	2144.9	2730.9	**<.0001**
Total healthcare					
Medicare costs, $	5840.3	8788.9	4613.6	9404.1	**<.0001**
Public insurance costs, $	213.0	1399.5	81.8	699.7	**<.0001**
Private insurance costs, $	771.3	1743.4	74.7	443.5	**<.0001**
OOP costs, $	1710.2	3401.0	1426.0	3838.4	**<.0001**
Total costs, $	8534.7	11308.0	6196.0	11344.9	**<.0001**

2.3 Aim 3.1 Cost Related Non-adherence

Table F.7 shows the bivariate analysis of CRN and medication affordability among PDPs and MA-PDs. PDP group had similar prevalence of CRN (12.5% vs. 11.3%; p=0.090), but PDPs had higher prevalence of spending less on basic needs than MA-PDs (5.2% vs. 3.9%; p=0.018). In addition, PDP enrollees had higher prevalence of using generic drugs (54.7% vs. 47.9%; p<0.0001), obtaining free samples from the doctors (46.0% vs.35.8%; p<0.0001), and comparing pharmacies (19.4% vs. 14.1%; p<0.0001), but had lower prevalence of using mail orders (19.0% vs. 24.6%; p<0.0001), compared to MA-PD enrollees.

Table F.7 Sensitivity Analysis 2: CRN and Affordability

Outcome Measures	PDPs		MA-PDs		P-Value
	n	Weighted %	n	Weighted %	
Cost-related nonadherence	969	12.5	622	11.3	0.090
Spending less on basic needs	425	5.2	215	3.9	**0.018**
Cost reduction strategies					
Use generics	4389	54.7	2656	47.9	**<.0001**
Free samples	3709	46.0	2016	35.8	**<.0001**
Use mail-order/Internet	1439	19.0	1340	24.6	**<.0001**
Compare pharmacies	1516	19.4	788	14.1	**<.0001**

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2.4 Aim 3.2 Medication Adherence

Table F.8 compares medication use and adherence measured by pharmacy claims. The proportion of PDP enrollees with at least 1 prescription was similar to MA-PD enrollees. However, PDP enrollees had higher mean number of fills for anti-diabetic drugs (9.4 vs. 8.8; p=0.001), antihypertensive drugs (15.1 vs. 13.2, p<0.0001), and antihyperlipidemic drugs (5.5 vs.4.5, p<0.0001), compared to MA-PD enrollees. PDP enrollees had higher PDC for anti-diabetic drugs (0.59 vs. 0.58; p=0.039), but similar PDC for antihypertensive drugs and antihyperlipidemic drugs. In addition, PDP enrollees were more likely to be adherent (PDC≥0.80) to antidiabetic drugs (33.8% vs. 28.6%, p=0.006), antihyperlipidemic drugs (38.2% vs. 32.7%, p=0.004), and antihyperlipidemic drugs (22.9% vs. 16.0%; p<0.0001), compared to MA-PD enrollees.

Table F.8 Sensitivity Analysis 2: Medication Use among Beneficiaries with Type 2 Diabetes

Outcome Measures	PDPs	MA-PDs	p-value
Any antidiabetic agent			
With at least 1 fill, n (%)	1266 (82.9%)	870 (83.7%)	0.558
No. of refills, mean±std	9.4±7.7	8.8±7.5	**0.001**
PDC,mean±std	0.59±0.32	0.58±0.31	**0.039**
PDC>0.80, n(%)	516 (33.8%)	297 (28.6%)	**0.006**
Any antihypertensive drugs			
With at least 1 fill, n (%)	1358 (88.9%)	937 (90.2%)	0.290
No. of refills, mean±std	15.1±12.1	13.2±11.3	**<.0001**
PDC,mean±std	0.65±0.29	0.63±0.28	0.166
PDC>0.80, n(%)	584 (38.2%)	340 (32.7%)	**0.004**
Any antihyperlipidemic drugs			
With at least 1 fill, n (%)	1044 (68.3%)	714 (68.7%)	0.832
No. of refills, mean±std	5.5±5.9	4.5±4.7	**<.0001**
PDC,mean±std	0.45±0.36	0.43±0.35	0.167
PDC>0.80, n(%)	350 (22.9%)	166 (16.0%)	**<.0001**

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