Impact of Care Quality and Coinsurance on End-stage Renal Disease Patients' Disenrollment from Medicare Advantage

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Curriculum Vitae

Qijuan Li was born and raised in Kunming, in China's Yunnan province. She received a BA in 2000 and a MA in 2005 from West China University of Medical Sciences.[1] She also earned an MPH from the Yale School of Public Health in 2008.

Her medical training in China and her further academic work at the Yale School of Public Health built a strong foundation in basic medicine and provided her with rigorous training in quantitative and qualitative analytical skills. After completing her MPH, Li worked for five years at a health insurance consulting firm, collaborating with prestigious health economists, nationwide Blue Cross and Blue Shield health plans, provider groups, large private health insurance companies, and pharmaceutical and bioscience companies. Her skills at claim-based analyses and creativity in product development led to her management of the design and delivery of the value-based benefit design (VBBD) application, which can identify an optimal benefit design or financial incentive program through computer-based simulations and scenario analyses. This application is in the patenting process and has helped many health insurance companies, pharmaceutical companies, and care management organizations to improve quality of care and reduce health expenditures; it is a tool that stands to benefit chronically ill Medicare beneficiaries as well. It was her interest in improving the quality of care and benefit policies for Medicare beneficiaries that led her to pursue doctoral training in health services research.

In her first year at Brown, Li completed an innovative quality improvement project examining the cost implications of the Care Transitions Intervention (developed

[1] West China University of Medical Sciences was merged into Sichuan University in 2000.

by Eric Coleman and others), which is designed to reduce hospital readmissions among the elderly. She played a key role in refining the study design, generating an analytic data file, identifying and matching intervention and propensity-matched subjects, constructing complex regression models accounting for clustered data, and coauthoring a paper published in the *Journal of General Internal Medicine*. She was named the Brown University Community Health Pre-doctoral Fellow (one Ph.D. student per year is awarded this fellowship).

In her second year, Li worked as a research assistant on a project funded by the US Department of Health and Human Services' Assistant Secretary for Planning and Evaluation (Vincent Mor, PhD, PI) to conduct beta-testing of the Multipayer Clinical Dataset. In collaboration with Drs. Vincent Mor, Amal Trivedi, and Shailender Swaminathan, she assessed the insurance transitions of persons who developed end-stage renal disease (ESRD) and thereafter acquire Medicare coverage. The results were written into manuscripts and presented at the 2014 AcademyHealth Annual Meeting.

In her third year, she was awarded an R36 dissertation grant by Agency for Healthcare Research and Quality (AHRQ). Her education, work, and research experience — focused on chronic kidney disease (CKD) patients, cost-sharing, and claims data — together with additional coursework in health economics, biostatistics, and health policies, provided the tools necessary to create and analyze the cohorts required to complete this dissertation.

Acknowledgments

My graduate program has provided me with resources to think creatively, taught me how to solve problems logically, and prepared me to be an independent investigator. In my four years at Brown, I have met many wonderful professors, friends, and collaborators. I am lucky to have been part of this great community.

I am grateful for my dissertation committee—Professors Vincent Mor, Amal Trivedi, Omar Galarraga from Brown University, Professor Michael Chernew from Harvard Medical School, and Professor Daniel Weiner from Tufts Medical Center—for their support and guidance. They improved my dissertation focus and trained me to be a better researcher.

I would like to give a special thanks to my dissertation chair and advisor, Professor Vincent Mor. He has been a great mentor, who has provided constant guidance and support, and found time to give advice on balancing life and career—lessons that are invaluable to me.

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I am grateful for the support of the many great friends and collaborators that I have met at Brown, who have encouraged me and helped me throughout my study and dissertation writing process.

Closest to my heart, I would like to thank my family. My parents came from China to support me, and have encouraged me whenever I met difficulties. My husband

has taken the responsibility for commuting between Providence and New York for two years to support my study at Brown. My husband and I are excited to start the next phase of our lives by welcoming a third member to our family.

Finally, I would like to acknowledge AHRQ, which has funded my study (grant number 1R36HS023959-01). The content of this dissertation is solely the responsibility of the authors and does not necessarily represent the official views of the AHRQ.

This dissertation by Qijuan Li is accepted in its present form by the Department of Health Services, Policy, and Practice as satisfying the dissertation requirement for the degree of Doctor of Philosophy.

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General Introduction

In the U.S., End-stage Renal Disease (ESRD) patients, who constitute less than 1% of the Medicare beneficiary population, account for 7.1% of all Medicare expenditures.[1] In 2013, annual Medicare spending on ESRD patients reached 34.3 billion dollars.[2] Currently, most ESRD patients are served by Traditional Medicare. However, there are still a significant number of patients enrolled in Medicare Advantage (MA) plans. The law stipulates three conditions related to ESRD: Medicare beneficiaries may not enroll in MA plans after they develop ESRD; beneficiaries may remain in MA plans if they were enrolled in MA plans prior to developing ESRD; and ESRD patients who disenroll must leave the MA program unless their original plan no longer provides insurance coverage or they move out of their MA plan's geographic area.[3] The disenrollment of ESRD patients from MA plans due to the favorable selection of MA plans would result in shifting cost from MA plans to Traditional Medicare.[4-6] Further, the switch from MA plans to Traditional Medicare may cause worse health outcomes and higher costs for ESRD patients.[5,7 -10] Thus, there are significant policy implications to understanding potential drivers for ESRD patients' disenrollment from MA plans to Traditional Medicare and subsequent health outcomes.

Conceptual Framework

Beneficiaries make decisions about health plans based on their preferences, perceived quality of care, and financial resources.[5] For chronically ill patients, quality of care of providers and financial resources often play primary roles in this decision-making process.[5] In my dissertation, chapters 1 and 2 assessed the impact of baseline plan quality

levels and dialysis coinsurance increase on ESRD patients' disenrollment from MA plans in favor of Traditional Medicare. Then, Chapter 3 examined the impact of disenrollment of ESRD patients from MA plans on patient outcomes attributable to dialysis coinsurance increase.

Chapter 1 examined the association between MA plan quality ratings and incident ESRD patients' quality experience as reflected in decisions to disenroll from MA plans to Traditional Medicare.[7,11-12] The US Center for Medicare & Medicaid Services (CMS) developed a five-star rating system for MA plans to reflect each plan's quality of care and inform enrollment decisions.[13] Beneficiaries may consider information about quality when choosing health plans[14-17] and may exit health plans if they are dissatisfied with their experience.[11] We focused on the disenrollment of incident ESRD patients because such patients may be particularly sensitive to plan quality, as their care becomes increasingly complex and they require more over time. By law, ESRD patients who disenroll must leave the MA program unless their original plan no longer provides insurance coverage or they move out of their MA plan's geographic area.[3] In other words, in most cases ESRD patients cannot switch to another MA plan with a higher star rating. If they leave their plan, they must enroll in Traditional Medicare. Thus, the regulations governing ESRD patients in MA plans provided us a unique opportunity to "validate" MA plan star ratings in this particularly high-cost, high-need population. To control for a competing risk, death, we restricted the analysis to ESRD patients who survived through the end of the baseline year. The disenrollment status has two levels: switching from MA plans to Traditional Medicare and remaining in MA plans (Figure 1).

In Chapter 2 we employed a quasi-experimental design to examine the impact of increased dialysis coinsurance on ESRD patients' decisions to exit MA plans in favor of Traditional Medicare. Many studies suggest that given the fixed per-member-per-month capitation payment received from the government — designed to cover the entire cost of an individual's care[18-23] — MA plans have an incentive to select individuals they expect to be low cost and to avoid covering individuals who are chronically ill. This is often called "risk selection."[21-23] By law, MA plans cannot select enrollees based on health status directly. They can, however, offer extra benefits that are not available in Traditional Medicare or reduce out-of-pocket costs to attract certain types of Medicare beneficiaries.[11] The Medicare Payment Advisory Commission (MEDPAC) reported in 2004 that MA plans were likely to have higher cost sharing for dialysis.[13] Yet, there is little empirical evidence to predict the impact of risk selection strategies on ESRD patients in MA plans.

Since the 2011 implementation of the Affordable Care Act (ACA), MA plans have been required to place a limit on beneficiaries' out-of-pocket payment for covered medical services. At the same time, they are also allowed to charge beneficiaries higher cost-sharing for some services, including dialysis.[24] Once a beneficiary reaches his plan's maximum out-of-pocket limit, the insurance plan will pay 100% of additional covered charges incurred in the remaining calendar year.[24] The out-of-pocket limit may provide more financial protection for high-cost and high-need beneficiaries like ESRD patients, as they are likely to hit the out-of-pocket limit. However, increased cost sharing on the most needed service like dialysis may also drive ESRD patients to exit MA plans.[24] Researchers have found that the favorable risk selection of MA plans has been reduced

due to a new risk adjustment system, expansion of MA coverage, and other policy changes in recent years.[23] But most of these studies have focused on general MA beneficiaries. Thus, it is unclear whether new benefit policies have attenuated favorable risk selection of MA plans among high-cost populations with intensive health care needs like ESRD patients.[7, 11-12]

In a difference-in-differences analysis, Chapter 2 assessed changes in disenrollment of ESRD patients from MA plans as a consequence of increased dialysis coinsurance for ESRD patients compared with concurrent changes in control plans where such coinsurance remained unchanged between 2008 and 2013 (Figure 1). To test whether new benefit policies in the ACA may have attenuated favorable risk selection of MA plans among ESRD patients, we compare the results with and without the ACA period (2011-2013).

Chapter 3 used the increase in dialysis coinsurance as an instrumental variable to assess the impact of disenrollment of ESRD patients from MA plans on patient outcomes. The use of the instrumental variable is based on the following assumptions: (1) the institution of dialysis coinsurance is not correlated with hospital and post-acute nursing home care of ESRD patients but correlated with disenrollment, and (2) the change in dialysis coinsurance can only affect health outcomes through the mechanism of ESRD patients' disenrollment from MA plans (Figure 1). We used two-stage least squares (2SLS) models, which first estimated the probability of disenrollment from MA plans and then estimated the associated changes in hospital care and post-acute nursing home care measures for persons who switched versus those who did not (Figure 1). The risk selection between MA and Traditional Medicare has been consistently revealed in studies

assessing the factors that impact the choice of MA plans. However, we are unaware of any empirical evidence to predict the impact of increased dialysis coinsurance on disenrollment and health outcomes of ESRD patients, who are intensive users of dialysis.

The objective of this dissertation is to evaluate the impact of plan quality and increased dialysis coinsurance on ESRD patients' disenrollment from MA plans and associated health outcomes using three quasi-experimental research designs based on seven national databases of Medicare enrollees. The results of this dissertation may enrich the existing literature and provide policymakers evidence that they can use to optimize benefit policy and patient protection systems. Moreover, research findings may contribute to enhancing risk mitigation strategies in the ACA, which similarly provides a greater number and variety of plan choices to beneficiaries as a way of promoting market competition.

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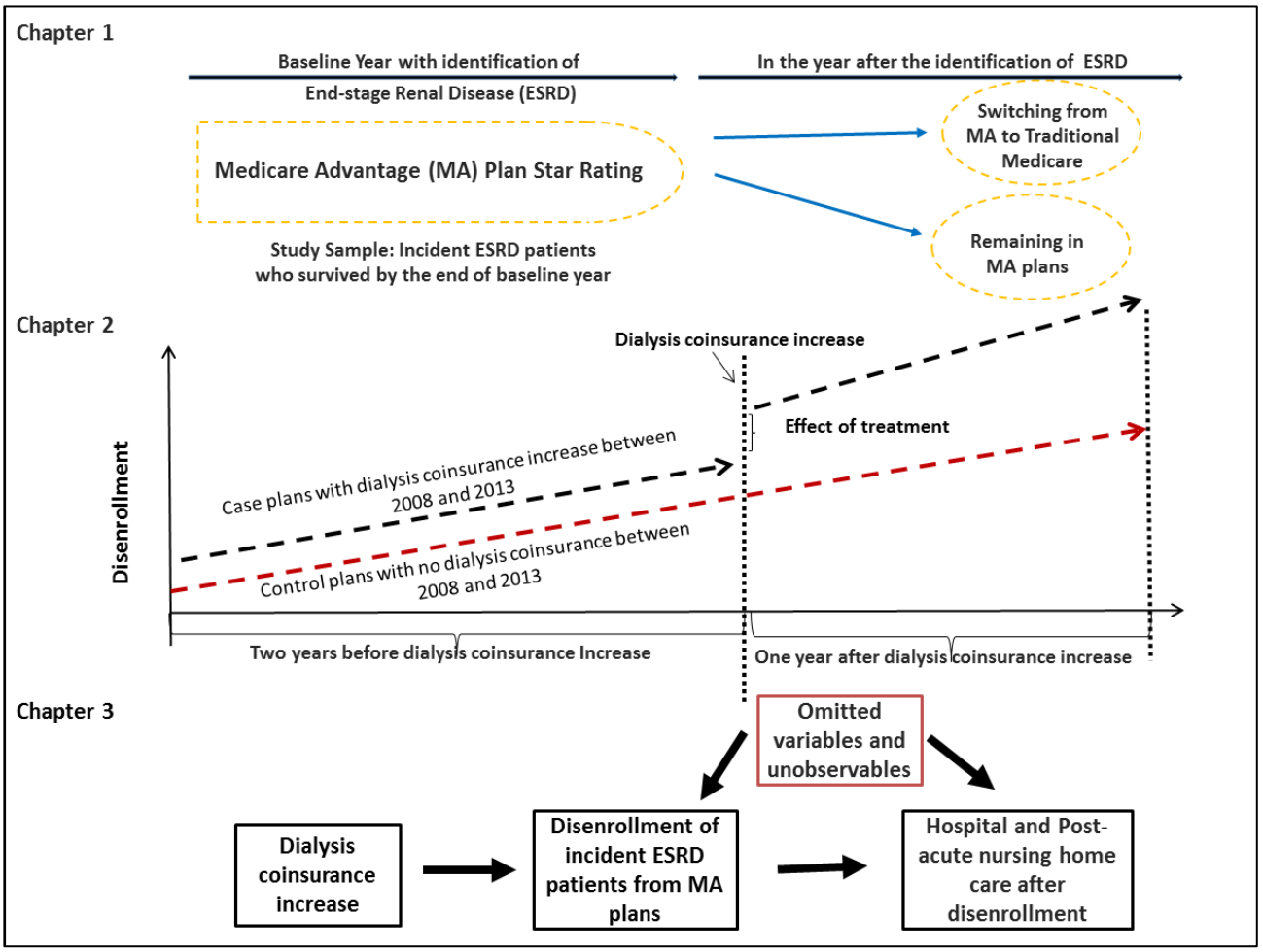
Figure 1 Conceptual Diagram



Chapter 1: Medicare Advantage Plan Star Rating and Voluntary Disenrollment of Incident Dialysis Patients

Introduction

The proportion of Medicare beneficiaries enrolling in Medicare Advantage (MA) plans has doubled in the past decade, currently standing at 31% of the Medicare population.[1] Policymakers have sought to monitor quality of care for MA beneficiaries and publicly disseminate information on plan performance. In 2007, the US Center for Medicare & Medicaid Services (CMS) developed a five-star rating system for Medicare Advantage (MA) plans to reflect each plan's quality of care and inform enrollment decisions.[2] These star ratings incorporate widely accepted quality and patient experience measures from multiple sources (e.g., Healthcare Effectiveness Data and Information Set (HEDIS) quality measures, Consumer Assessment of Healthcare Providers and Systems (CAHPS) surveys, the Health Outcomes Survey, and other administrative data).[3] In response to the Affordable Care Act (ACA) provisions dictating payment incentives for better overall performance, many MA plans are seeking to improve their star ratings.[4-7] While there is growing evidence of an association between higher star ratings and beneficiaries' enrollment decisions,[2] there has been limited focus on the association between quality ratings and beneficiaries' quality experience as reflected in decisions to disenroll, particularly among high-cost populations with intensive health care needs.[8-10]

Beneficiaries may consider information about quality when choosing health plans[11-14] and may exit health plans if they are dissatisfied with their experience.[8] They are more likely to choose better performing health plans and are responsive to initiatives

that provide quality information.[2, 11] The voluntary disenrollment rates from MA plans are strongly related to direct measures of beneficiary reported patient experience.[9] Although MA plans with higher star ratings may attract more beneficiaries, it is unclear whether these plans also retain more beneficiaries in the following years, a measure that would serve as evidence of a positive beneficiary experience.

Understanding the association between MA plan star ratings at a baseline year and voluntary disenrollment of beneficiaries in the follow-up year is particularly important for frail patients with intensive health care needs. Many studies suggest that, given the per member per month capitation payment received from the federal government that is designed to cover the entire cost of an individual's care,[15-18] MA plans have an incentive to select individuals they expect to be low-cost and to shirk covering individuals who are chronically ill.[17,18] By law, MA plans cannot select enrollees directly based on their health status; however, they can selectively contract with care providers[19] and often restrict provider choice in an effort to control costs. Restricted provider networks may lead to voluntary disenrollment of beneficiaries, particularly elderly patients with greater needs for on-going care.[10,20] Thus, it is important to understand whether MA plan star ratings can reflect plan quality for vulnerable elderly patients.

In this study, we examined the relationship between publicly reported MA plan star ratings and voluntary disenrollment of incident dialysis patients from MA plans to Traditional Medicare. We focused on the disenrollment of incident end-stage renal disease (ESRD) patients because such patients may be particularly sensitive to plan quality, as they become increasingly complex and require more needs over time. Moreover, it is unlikely for incident ESRD patients to disenroll from an MA plan

solely on the basis of a low star rating because, by law, ESRD patients who disenroll must leave the MA program unless their original plan no longer provides insurance coverage or they move out of their MA plan's geographic area.[21] In other words, in most cases incident ESRD patients cannot switch to another MA plan with a higher star rating. If they leave their plan, they must enroll in Traditional Medicare. Thus, these regulations for incident ESRD patients in MA plans provided us a unique opportunity to "validate" MA plan star ratings in this particularly high-cost, high-need population.

Methods

Data Sources

We merged data from five national databases spanning 2007 and 2013: (1) Part C Medicare Star Ratings data contains star ratings for MA plans, which reflect plans' quality ratings when patients initiated dialysis; (2) Renal Management Information System (REMIS) data contains dates of initiation of dialysis, hospitalizations, hemoglobin levels, and other quality measures for ESRD patients; (3) Medicare Healthcare Effectiveness Data and Information Set (HEDIS) data contains individual-level information on enrollment in MA plans; (4) CMS' Out-of-pocket Costs (OOPC) data provides a summary measure of the generosity of each plan's benefits, which estimates average expected monthly medical out-of-pocket costs (including premiums and cost-sharing) in each MA plan; and (5) Medicare Beneficiary Summary File provides the demographic characteristics of enrollees. We matched 97% of the observations in the HEDIS data set to the Medicare Beneficiary Summary File.

Study Sample

The Medicare Beneficiary Summary File contained between 6.9 and 12.4 million MA enrollees for each year between 2007 and 2013. Using the initial dialysis dates in the REMIS data between 2007 and 2012, we identified a total of 87,780 incident dialysis patients. We excluded patients who died or were under 65 years of age in the year of dialysis initiation. We also excluded plan contracts without star rating information or those that were terminated in the year after dialysis initiation (the follow-up year). Our final sample included 50,391 patients (Figure 1).

Variables

The dependent variable has two categories: (1) remaining in the MA plan throughout the follow-up year or until death; and (2) disenrollment from MA plans at any time in the following year. The primary independent variable is the MA plan star rating. We grouped star ratings into four categories: 2.5 or fewer stars, 3, 3.5, and 4 or more stars. To control for pre-existing conditions and comorbidities, we included three conditions for primary cause of ESRD and sixteen comorbid conditions at dialysis initiation from the Medicare Evidence Form (CMS-2728)[22] obtained from the REMIS data. We used a categorical variable for the year of dialysis initiation to control for time trends. Other covariates included patient age, sex, race, US Census region of residence, socioeconomic status derived from zip-code level income information, a summary measure of the generosity of each plan's benefits derived from OOPC data, and dual eligibility for Medicaid coverage available from the Medicare Beneficiary Summary File.

Statistical Analyses

The baseline year was the year of dialysis initiation. We used bivariate and multivariate methods to examine the relationship between MA plan star ratings at a baseline year and disenrollment rates of incident dialysis patients from MA plans to Traditional Medicare in the follow-up year. We used a logit model to assess the association between MA plans' star ratings and disenrollment among incident patients who survived through the end of the baseline year. We included a plan fixed-effect to account for clustering of observations in health plans. Our model therefore estimated the mean within-plan effect of MA plan star ratings. All models were weighted by the number of months subjects were enrolled in their plan. To control for death, a competing risk of disenrollment, we restricted the analysis to those who did not die during the follow-up year.

To test the robustness of the models, we restricted the analysis to MA plans with OOPC data and further controlled for projected medical cost sharing for each MA plan. We performed a series of sensitivity analyses: We stratified the analysis by dual eligibility status and socioeconomic status. We also used multinomial logit models to assess the association between MA plans' star ratings and disenrollment while accounting for death as a competing risk. In this case, disenrollment status is a multivalued outcome variable that has three levels: (1) remaining in an MA plan, (2) disenrollment from MA plans, and (3) death. All regression analyses above used the same covariates as the main analysis. To understand the differences in disenrollment between incident ESRD patients (less than 0.5%) and all beneficiaries in the same MA plans, we stratified the analysis by 2012 star rating level and compared the disenrollment rates between all beneficiaries and incident ESRD patients in 2013, including switching rates from MA plans to Traditional

Medicare and switching rates between MA plans. For this analysis, we controlled for age, sex, race, US Census region of residence, and the fixed-effect of hospital referral regions (HRR). We used both logit and mlogit commands from Stata to fit binary and multinomial logit models.[23] The marginal effects were estimated by the margins command.[24] Results were reported with two-tailed 95% confidence intervals. All analyses were performed with Stata, Version 14. The Brown University Human Research Protections Office and the CMS Privacy Board approved the study protocol.

Results

Enrollees in MA plans with lower star ratings were more likely to be younger, female, black, dual eligible, living in lower income areas, and located in the South; these attributes significantly differed by plan star rating ($p<0.01$) (Table 1). Enrollees in low star plans were also more likely to have diabetes as the primary cause of ESRD ($p<0.01$) and comorbid conditions, such as cerebrovascular diseases ($p=0.04$), hypertension ($p<0.01$), amputation ($p=0.04$), diabetes on insulin ($p=0.03$), diabetes on oral medications or with complications ($p<0.01$), tobacco use ($p<0.01$), and inability to ambulate or need assistance with daily activities ($p<0.01$). In recent years, patients were likely to initiate dialysis in MA plans with higher star ratings ($p<0.01$).

Table 2 presents unadjusted and adjusted marginal effects of MA plan star ratings on voluntary disenrollment. In the year after the initiation of dialysis, we observed a 14.0% disenrollment rate for the overall incident ESRD patients, ranging from 8.8% for plans with 4 or more stars to 22.7% for plans with 2.5 or fewer stars. Compared to MA plans with star ratings of 4 or more stars, adjusted disenrollment rates were 12.1

percentage points (95% CI 9.9 to 14.3), 5.0 percentage points (95% CI 3.5 to 6.5), and 3.9 percentage points (95% CI 2.4 to 5.5) higher among MA plans with star ratings of 2.5 or fewer stars, 3, and 3.5 respectively. We also observed greater disenrollment rates in the Northeast (3.9 percentage points, 95% CI 1.6 to 6.2) and South (4.5 percentage points, 95% CI 2.6 to 6.5) compared to those in the West. Partial dual eligible enrollees were 2.4 percentage points (95% CI 1.2 to 3.7) and full dual eligible enrollees were 13.0 percentage points (95% CI 11.3 to 14.6) more likely to disenroll than those without dual eligibility. Compared to patients who initiated dialysis in 2007, patients who started dialysis in 2012 had a 2.4 percentage points (95% CI 0.4 to 4.5) greater rate of disenrollment. Compared with patients without any of the 16 comorbid conditions documented, we observed 0.9 (95% CI 0.01 to 1.9), 0.9 (95% CI 0.005 to 1.7), and 2.2 (95% CI 1.1 to 3.4) percentage points higher disenrollment among patients with cerebrovascular diseases, diabetes currently on insulin, and an inability to ambulate, respectively. Both binary and multinomial logit models with and without controlling for cost-sharing yielded similar results. In stratified analyses, MA plans with 2.5 or fewer stars had significantly higher disenrollment rates compared with plans with 4 or more stars for all population subgroups, especially among full duals. For the subgroup living in a zip-code where annual income is lower than $30,000 or for those with dual eligibility, there was no significant difference in disenrollment among MA plans with 3, 3.5, or 4 or more stars (results available in an online appendix).

In adjusted analyses, we observed a graded relationship between lower MA plan star ratings and increased rates of disenrollment in the year following patients' initiation of dialysis (Figure 2). The adjusted disenrollment rate among MA plans with 4 or more

stars was 9.5% (95% CI 8.4% to 10.7%). Compared with MA plans with 4 or more stars, MA plans with lower stars (2.5 or fewer stars, 3, and 3.5) had significantly higher disenrollment rates, which were 21.7% (95% CI 19.8% to 23.5%), 14.5% (95% CI 13.5% to 15.6%), and 13.5% (95% CI 12.2% to 14.7%) respectively.

The overall disenrollment rate from MA plans among incident ESRD patients was significantly higher than among all MA beneficiaries (14.9% vs 12.0%; $p<0.01$). Moreover, incident ESRD patients had a consistently higher overall disenrollment rate than that of all MA beneficiaries across four levels of star ratings (Table 3). For instance, among low-quality MA plans with a star rating of 2.5 or fewer stars, the adjusted disenrollment rate of incident dialysis patients was about 5.8 percentage points (95% CI 1.4 to 10.1) higher than that of all beneficiaries. There were two types of disenrollment in MA plans: switching from MA plans to Traditional Medicare among ESRD patients and switching between MA plans.[21] The switching rate from MA plans to Traditional Medicare among incident ESRD patients was significantly higher ($p<0.01$) than that of all MA beneficiaries, especially in MA plans with lower star ratings (Table 3).

Discussion

MA plans with lower star ratings had higher rates of voluntary disenrollment by incident dialysis patients in the following year. The association between star ratings and disenrollment was stronger among incident dialysis patients than among all MA beneficiaries. The difference in disenrollment between these two populations was driven by the switching rate from MA to Traditional Medicare.

This is the first study to assess the association between MA plan star ratings and voluntary disenrollment of vulnerable elderly patients from MA plans. The MA plan star rating is calculated based on clinical quality and patient experience for overall beneficiaries, which may not reflect plan quality for vulnerable elderly patients with intensive health care needs. Previously, Kolstad and Chernew found that consumers were more likely to choose better performing health plans and were responsive to initiatives that provide quality information.[11] Reid et al. observed a positive association between CMS's star ratings of MA plans and enrollment,[2] while Cleary et al. demonstrated that voluntary disenrollment rates from MA plans were strongly related to direct measures of beneficiary reported experience from CAHPS.[9] Recently, Rahman et al. found that patients with home health care, short-term and long-term nursing home care exited their MA plans for the traditional Medicare program at substantial rates.[25] Our findings are consistent with Cleary's study, which demonstrated that voluntary disenrollment rates from Medicare managed care were strongly related to quality measures for health plan performance.[9] We extended Reid's finding of a positive association between CMS's 5-star Medicare Advantage quality ratings and enrollment.[2] More importantly, the special law for incident ESRD patients in MA plans provided us a unique opportunity to "validate" MA plan star rating in this particularly high-cost, high-need population. The findings of these studies provided CMS with justification to continue to advance quality reporting.

Policymakers introduced MA plan star ratings in public reporting to help patients make better insurance choices. Therefore, it is critical to ensure this composite rating reflect both clinical quality and patient experience, particularly for high-cost populations

with intensive health care needs. In managed care, health insurers selectively contract with care providers,[19] thus increasing competition not only between care providers but also between health insurers, giving beneficiaries the option to switch insurers if they are not satisfied with their providers or their experience in health plans.[26,8] Voluntary disenrollment in the subsequent year is a potentially important quality indicator, particularly for elderly patients with complex health care needs.[20] Our study shows that disenrollment rates of incident dialysis patients, especially switching rates from MA to Traditional Medicare, were significantly higher than those of all MA beneficiaries (Table 3). By regulation, most dialysis patients who disenroll from an MA plan cannot enter another MA plan and must join Traditional Medicare. Therefore, higher disenrollment and switching rates in low-quality plans appear to directly transfer these patients' costs from MA to Traditional Medicare. Moreover, we also observed higher disenrollment rates of incident dialysis patients from lower quality plans. Further research on the mechanism of this voluntary disenrollment may help to provide more protection for vulnerable elderly patients.

This study has several limitations. First, we cannot fully exclude the possibility that unobserved differences among MA plan populations may have influenced our results. However, we focused on incident dialysis patients, and included an extensive set of sociodemographic and clinical covariates in our models. Second, we could not directly assess the relationship between beneficiary experience and disenrollment from MA plans. Nevertheless, our findings were consistent with Cleary's study, which was based on beneficiary reported experience from CAHPS.[9] Further study on the mechanisms for disenrollment based on patient-reported data will enhance the current analysis.

Conclusion

Our study shows a strong association between MA plans' star ratings and ESRD patients' voluntary disenrollment from MA plans to Traditional Medicare in the year following initiation of dialysis. Disenrollment rates of incident dialysis patients, especially switching rates from MA to Traditional Medicare, were significantly higher than all MA beneficiaries. These findings suggest: (1) that the rate of voluntary disenrollment among high-cost, high-need patients may be an important measure of MA plan quality and that CMS and other policy stakeholders may want to monitor such disenrollment rates and (2) that low plan quality may lead to increased expenditures in Traditional Medicare by shifting this high-cost population from some MA plans to Traditional Medicare. Further research is needed to understand whether these findings extend to other chronically-ill populations.

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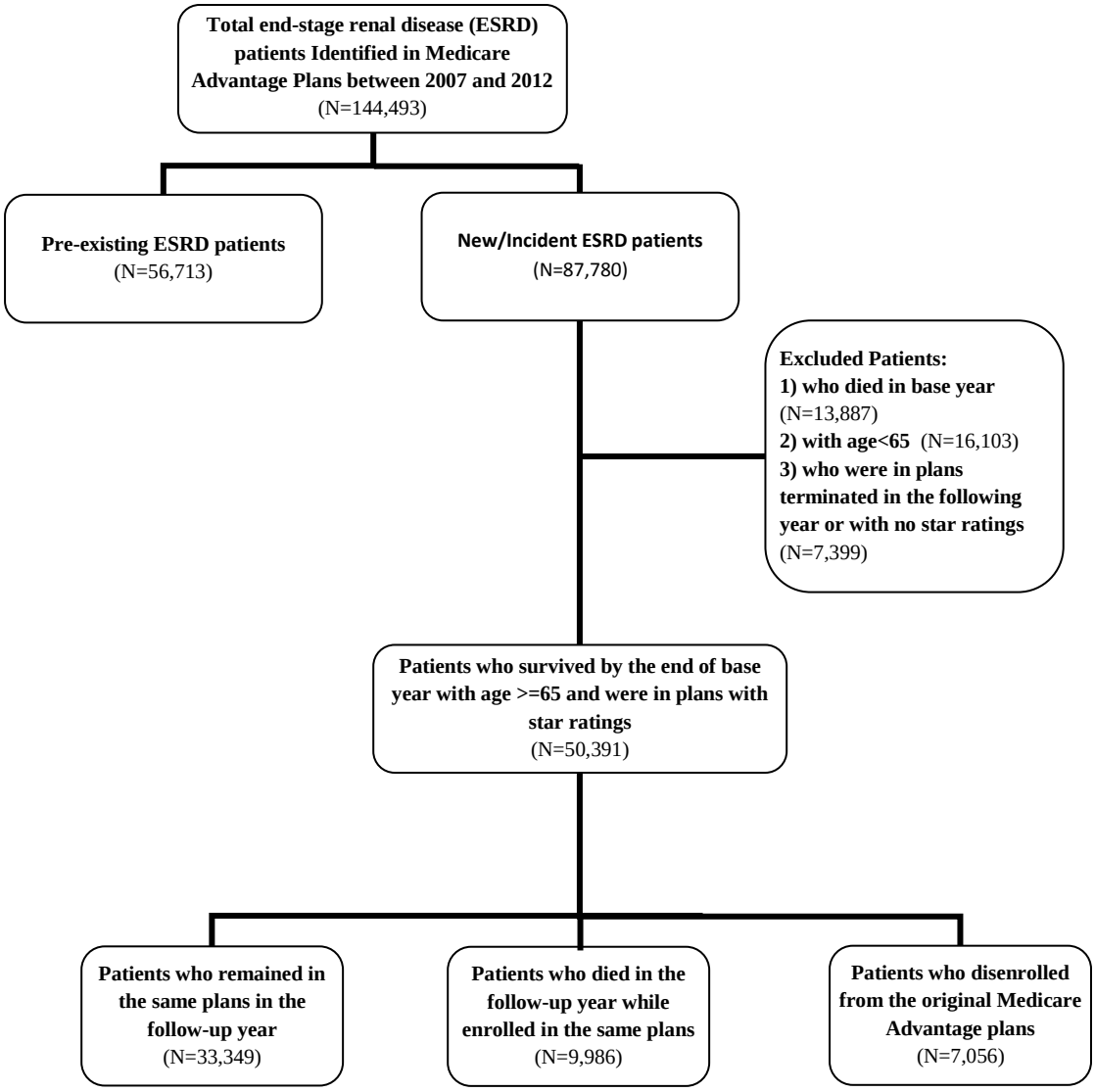
Figure 1 Inclusion and Exclusion Criteria for Study Population*



*The Medicare Beneficiary Summary File included between 6.9 and 12.4 million Medicare Advantage enrollees for each year between 2007 and 2013. Among these, 87,780 were incident dialysis patients identified by initial dialysis dates in the Renal Management Information System (REMIS) data between 2007 and 2012. We excluded patients who died or with age less than 65 in the year of dialysis initiation. We also excluded plan contracts without star rating information or were terminated in the year after dialysis initiation (the follow-up year). Our final sample included 50,391 patients.

Table 1 Baseline Characteristics of Incident End-stage Renal Disease Patients by Medicare Advantage Plan Star Rating

	<=2.5 Star (N=7,043)	3 Star (N=17,503)	3.5 Star (N=11,753)	4+ Star (N=14,092)	Total (N=50,391)	P-Value
Age						
85+	6.2	7.5	9.2	9.9	8.4	<0.01
75-84	34.3	39.0	40.7	42.6	39.7	<0.01
65-74	59.5	53.5	50.1	47.5	51.9	<0.01
Female	47.1	46.7	44.0	43.2	45.1	<0.01
Race						<0.01
Black	34.2	28.0	20.7	15.7	23.7	<0.01
Hispanic	21.3	22.1	16.9	11.3	17.7	<0.01
Asian	3.0	3.6	2.7	4.6	3.6	<0.01
Other	1.5	1.3	1.2	1.7	1.4	0.01
White	40.1	45.0	58.5	66.7	53.5	<0.01
Region						
Northeast	17.0	21.4	22.7	27.8	22.8	<0.01
Midwest	17.2	12.8	18.7	20.6	17.0	<0.01
South	45.3	36.6	31.9	18.1	31.6	<0.01
Other	6.6	5.1	2.2	1.4	3.6	<0.01
West	13.9	24.2	24.5	32.1	25.1	<0.01
Socioeconomic Status						
< 30K	19.0	15.2	9.6	5.9	11.8	<0.01
30-50K	47.5	42.5	42.5	38.6	42.1	<0.01
50K+	33.5	42.2	47.9	55.5	46.0	<0.01
Dual						
Partial duals	10.2	9.0	7.7	4.7	7.7	<0.01
Full duals	26.4	22.5	15.1	12.5	18.5	<0.01
Other	0.9	0.4	0.2	0.5	0.5	<0.01
Non-duals	62.6	68.1	76.9	82.3	73.4	<0.01
Year of Dialysis Initiation						
2012	4.9	14.5	30.9	28.4	20.9	<0.01
2011	9.0	14.8	24.9	29.0	20.3	<0.01
2010	14.0	15.1	22.9	17.8	17.5	<0.01
2009	23.4	18.7	12.0	10.8	15.6	<0.01
2008	36.6	13.7	9.3	6.3	13.8	<0.01
2007	12.1	23.2	0.0	7.7	11.9	<0.01
Primary Cause of End-Stage Renal Disease						
Diabetes	49.2	46.6	44.4	44.0	45.7	<0.01
Hypertension	34.1	36.0	34.9	33.3	34.7	<0.01
Glomerulonephritis	3.4	3.5	4.1	4.7	4.0	<0.01
Other	13.3	14.0	16.6	18.0	15.6	<0.01
Comorbid Conditions at Dialysis Initiation						
Congestive heart failure	36.0	36.2	37.1	36.1	36.3	0.27
Atherosclerotic heart disease	25.7	25.8	25.9	26.8	26.1	0.16
Other cardiac disease	19.9	19.8	23.0	24.2	21.8	<0.01
Cerebrovascular disease	11.1	10.9	10.2	10.1	10.6	0.04
Peripheral vascular disease	15.7	16.0	14.6	15.4	15.5	0.02
History of hypertension	88.8	88.3	88.1	86.9	87.9	<0.01
Amputation	2.8	2.3	2.2	2.2	2.3	0.04
Diabetes, currently on insulin	36.7	35.1	35.7	34.7	35.4	0.03
Diabetes, on oral medications	16.8	15.8	14.5	14.0	15.1	<0.01
Diabetes, without medications	6.2	6.0	5.8	6.2	6.0	0.69

Diabetic retinopathy	8.2	7.1	6.1	7.0	7.0	<0.01
Chronic obstructive pulmonary disease	10.1	10.1	11.3	11.6	10.8	<0.01
Tobacco use (current smoker)	4.4	3.4	3.7	3.4	3.6	<0.01
Malignant neoplasm, Cancer	7.6	8.9	10.2	10.9	9.6	<0.01
Inability to ambulate	7.6	7.5	7.3	6.0	7.1	<0.01
Needs assistance with daily activities	14.4	14.0	14.2	12.0	13.5	<0.01

*This study used five national databases. Primary cause of end-stage renal disease and comorbid conditions were from Medicare Evidence Form (CMS-2728) of the Renal Management Information System (REMIS) data. Socioeconomic status was derived based on zip-code level income from national census data. This table presents percentages except age.

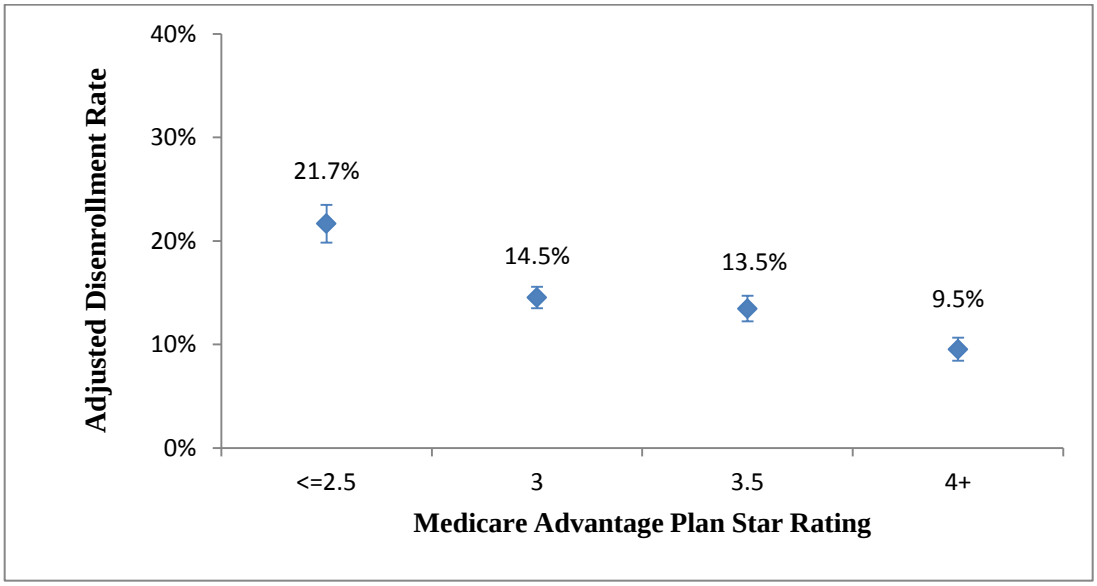
Table 2 Marginal Effect of Plan Star Ratings on Disenrollment of Incident End-stage Renal Disease Patients from Original Medicare Advantage Contracts*

Variable	Number of Patients	Disenrollment Rate	Marginal Effect (95% Confidence Interval)	
			Unadjusted (N=50,391)	Adjusted** (N=50,391)
Star Rating				
<=2.5	7,043	22.7	13.9 (12.9 to 14.9)	12.1 (9.9 to 14.3)
3	17,503	15.2	6.4 (5.66 to 7.2)	5.0 (3.5 to 6.5)
3.5	11,753	13.3	4.5 (3.7 to 5.4)	3.9 (2.4 to 5.5)
4+	14,092	8.8	Reference	Reference
Age				
85+	4,216	13.8	-0.9 (-2 to 0.3)	0.6 (-0.6 to 1.8)
75-84	20,030	13.1	-1.6 (-2.2 to -0.9)	-0.5 (-1.2 to 0.1)
65-74	26,145	14.7	Reference	Reference
Gender				
Female	22,744	15.0	1.8 (1.2 to 2.4)	-0.1 (-0.7 to 0.5)
Male	27,647	13.2	Reference	Reference
Race				
Black	11,959	17.1	4.7 (4 to 5.5)	-0.3 (-1.3 to 0.7)
Hispanic	8,934	15.1	2.8 (1.9 to 3.6)	0.2 (-1.1 to 1.5)
Asian	1,815	13.4	1 (-0.6 to 2.7)	-1 (-3.1 to 1.2)
Other	711	12.2	-0.1 (-2.7 to 2.5)	-1.8 (-4.7 to 1)
White	26,971	12.4	Reference	Reference
Region				
Northeast	11,514	15.1	4.5 (3.6 to 5.3)	3.9 (1.6 to 6.2)
Midwest	8,549	12.9	2.2 (1.3 to 3.2)	2.2 (-0.2 to 4.7)
South	15,899	16.9	6.2 (5.4 to 7)	4.5 (2.6 to 6.5)
Other	1,806	11.0	0.4 (-1.31 to 2.1)	0.03 (-3.7 to 3.8)
West	12,623	10.6	Reference	Reference
Socioeconomic Status				
< 30K	5,971	16.3	3.6 (2.6 to 4.6)	-0.3 (-1.5 to 1)
30-50K	21,219	14.7	2 (1.4 to 2.7)	-0.4 (-1.2 to 0.4)
50K+	23,201	12.7	Reference	Reference
Dual				
Full duals	9,336	26.1	15.3 (14.5 to 16.1)	13.0 (11.3 to 14.6)
Partial duals	3,857	15.6	4.8 (3.7 to 6.0)	2.4 (1.2 to 3.7)
Other	229	11.4	0.6 (-3.9 to 5.0)	-0.2 (-4.9 to 4.5)
Non-duals	36,969	10.8	Reference	Reference
Year of Dialysis Initiation				
2012	10,515	14.9	0.2 (-0.9 to 1.3)	2.4 (0.4 to 4.5)
2011	10,225	11.7	-3 (-4.1 to -1.8)	-1.2 (-3.3 to 0.9)
2010	8,837	13.2	-1.5 (-2.6 to -0.3)	-0.6 (-2.6 to 1.5)
2009	7,847	16.2	1.6 (0.4 to 2.8)	0.7 (-1.2 to 2.7)
2008	6,967	14.0	-0.6 (-1.8 to 0.6)	-2.4 (-4.3 to -0.5)
2007	6,000	14.7	Reference	Reference
Primary Cause of End-Stage Renal Disease				
Diabetes	23,035	14.6	1.5 (0.6 to 2.4)	-0.3 (-1.3 to 0.8)
Hypertension	17,488	13.8	0.6 (-0.3 to 1.6)	-0.2 (-1.2 to 0.8)
Glomerulonephritis	1,993	12.3	-0.8 (-2.5 to 0.9)	0.2 (-1.5 to 1.9)
Other	7,875	13.1	Reference	Reference
Comorbid Conditions**				
Congestive heart failure	18,307	14.6	0.7 (0.03 to 1.4)	0.5 (-0.17 to 1.2)

Atherosclerotic heart disease ASHD	13,151	14.0	-0.5 (-1.3 to 0.2)	-0.1 (-0.8 to 0.7)
Other cardiac disease	10,969	13.3	-1.4 (-2.2 to -0.7)	-0.9 (-1.7 to -0.12)
Cerebrovascular disease, CVA, TIA	5,322	16.2	1.8 (0.8 to 2.8)	0.9 (0.01 to 1.9)
Peripheral vascular disease	7,790	14.7	0.2 (-0.7 to 1.1)	0.5 (-0.3 to 1.4)
History of hypertension	44,301	14.0	-0.2 (-1.1 to 0.7)	-0.6 (-1.5 to 0.4)
Amputation	1,163	17.5	1.7 (-0.4 to 3.8)	0.7 (-1.2 to 2.5)
Diabetes, currently on insulin	17,814	15.1	1.7 (1 to 2.4)	0.9 (0.005 to 1.7)
Diabetes, on oral medications	7,633	14.0	0.7 (-0.1 to 1.6)	0.03 (-0.93 to 0.98)
Diabetes, without medications	3,032	14.6	1.3 (0.04 to 2.7)	0.7 (-0.7 to 2)
Diabetic retinopathy	3,521	13.1	-2.3 (-3.6 to -1.1)	-1.4 (-2.6 to -0.17)
Chronic obstructive pulmonary disease	5,428	14.6	0.2 (-0.8 to 1.2)	0.1 (-0.9 to 1.1)
Tobacco use (current smoker)	1,817	15.1	1.3 (-0.3 to 3)	0.4 (-1.2 to 2)
Malignant neoplasm, Cancer	4,827	12.6	-1.4 (-2.4 to -0.4)	-0.4 (-1.5 to 0.6)
Inability to ambulate	3,557	19.7	4.2 (2.9 to 5.6)	2.2 (1.1 to 3.4)
Needs assistance with daily activities	6,814	17.6	2.5 (1.5 to 3.5)	0.9 (-0.1 to 1.8)

*The model included all incident patients (N=50,391) with a binary outcome variable for disenrollment status: remaining in the same Medicare Advantage plans and having disenrolled from original Medicare Advantage plans. ** The reference group is ESRD patients without any of these 16 conditions above.

Figure 2 Adjusted Disenrollment Rates of Incident End-stage Renal Disease Patients by Star Rating with 95% Confidence Interval*



*This study used four national databases. The adjusted results were based on the binary logistic model with 4 or more stars as the reference group. The marginal effects were estimated by the margins command.[24] Compared with MA plans with 4 or more stars, MA plans with lower stars (i.e. 2.5 or fewer stars, 3, and 3.5) had significantly higher disenrollment rates (P<0.01).

Table 3 Comparison of Adjusted 2013 Disenrollment Rates by Medicare Advantage Plan Star Rating between Incident End-stage Renal Disease Patients and All Beneficiaries*

	No. of Beneficiaries	No. of Incident End-stage Renal Disease Patients	Disenrollment, %		
			All Beneficiaries	Incident End-stage Renal Disease Patients	Adjusted Difference (95% CI)**
Disenrollment					
<=2.5 Star	235,812	343	21.8	28.9	5.8 (1.4 to 10.1)
3 Star	1,999,601	2,539	16.4	18.9	3.0 (1.6 to 4.4)
3.5 Star	3,345,418	3,633	13.9	15.9	1.9 (0.8 to 3.0)
4+ Star	4,068,826	4,000	7.7	10.2	1.8 (1.0 to 2.6)
Switching from Medicare Advantage Plans to Medicare Fee-for-service Plans***					
<=2.5 Star	235,812	343	6.7	21.9	15.7 (12.9 to 18.5)
3 Star	1,999,601	2,539	5.4	16.4	10.4 (9.5 to 11.2)
3.5 Star	3,345,418	3,633	4.4	11.6	6.8 (6.1 to 7.5)
4+ Star	4,068,826	4,000	3.2	8.7	4.9 (4.4 to 5.5)

* The study used five national databases. Five-star quality ratings were from Part C Medicare Star Ratings Data. The study excluded beneficiaries who died or with age less than 65 in 2012.

** The 95% CI denotes the 95% confidence interval. Stratified regression analyses were used to obtain adjusted results, controlling for age, gender, race, US Census region of residence, and the fixed-effect of hospital referral regions (HRR).

***End-stage renal disease (ESRD) patients in MA plans may have a one-time special enrollment period (SEP) to join another MA plan if their original plans no longer provide insurance coverage or ESRD patients move out of their MA plans' area.[21]

Supplemental Table Marginal Effect of Plan Star Ratings on Disenrollment of End-stage Renal Disease Patients from Medicare Advantage Plans (Sensitivity Analyses)

Variable	Marginal Effect (95% Confidence Interval)							
	Multinomial Logit Model (N=50,391)*	**Binary Logit Adjusted for Cost-sharing (N=32,538)****	**Zip-code Income <= 30K (N=5,971)**	**Zip-code Income 30K-50K (N=21,219)**	**Zip-code Income >= 50K (N=23,201)**	**Non-Duals (N=36,969)**	**Full Duals (N=3,857)**	**Partial Duals (N=9.336)**
Star Rating								
<=2.5	11.8 (9.7 to 13.9)	13.2 (10.9 to 15.5)	6.2 (1.7 to 10.7)	13.2 (10.4 to 16)	11.6 (9.4 to 13.8)	11.5 (9.5 to 13.5)	15.8 (11.3 to 20.3)	10.2 (4.5 to 15.8)
3	4.8 (3.3 to 6.2)	5.0 (3.5 to 6.5)	-0.7 (-4.6 to 3.1)	4.6 (2.8 to 6.5)	7.5 (5.6 to 9.4)	6 (4.3 to 7.7)	3.4 (-0.2 to 6.9)	4.2 (-0.5 to 8.9)
3.5	3.5 (2.1 to 4.9)	3.5 (2.0 to 5.1)	-0.6 (-4.6 to 3.5)	3.4 (1.6 to 5.2)	5.7 (3.6 to 7.8)	5.1 (3.3 to 7)	0.1 (-3.2 to 3.5)	2.3 (-2.3 to 6.9)
4+	Reference	Reference	Reference	Reference	Reference	Reference	Reference	Reference

* The multinomial logit model to assess the association between plan star ratings and disenrollment while accounting for death as a competing risk. In this case, disenrollment status is a multivalued outcome variable that has three levels: 1) remaining in an MA plan, 2) disenrollment from MA plans, and 3) death.

**The binary logit model included all incident patients from Medical Advantage Plans with Out-of-payment Costs Data (N=32,538). The binary outcome variable for disenrollment status: remaining in the same Medicare Advantage plans and having disenrolled from original Medicare Advantage plans.

Chapter 2: Impact of Dialysis Cost-sharing on Disenrollment of End-stage Renal Disease Patients from Medicare Advantage

Introduction

In the U.S., End-stage Renal Disease (ESRD) patients, who constitute less than 1% of the Medicare beneficiary population, account for 7.1% of all Medicare expenditures.[1] In 2013, annual Medicare spending on ESRD patients reached 34.3 billion dollars.[2] Currently, most ESRD patients are served by Traditional Medicare; however, a significant number are still enrolled in Medicare Advantage (MA) plans. By law, a Medicare beneficiary may not enroll in MA plans after they develop ESRD unless their original plan no longer provides insurance coverage or they move out of their MA plan's area.[3] And although beneficiaries may remain in MA plans if they were enrolled prior to developing ESRD, many switch to Traditional Medicare. It is unclear what factors account for this disenrollment.

Many studies suggest that given the per-member-per-month capitation payment received from the government — designed to cover the entire cost of an individual's care[4-9] — MA plans have an incentive to select individuals they expect to be low cost and to avoid covering individuals who are chronically ill. This is often called "risk selection."[7-9] Many studies have assessed the factors that impact the choice of MA plans, suggesting the existence of selection between MA plans and Traditional Medicare. Compared with those in Traditional Medicare, beneficiaries in MA plans report better overall health,[10] tend to use less expensive services,[11] and have lower inpatient utilization.[9,12] The US Center for Medicare & Medicaid Services (CMS) gives MA plans flexibility in designing their benefits as long as they provide all Medicare-covered

services and use cost-sharing requirements that are actuarially equivalent to those under Traditional Medicare.[13] By law, MA plans cannot directly select enrollees based on health status. They can, however, offer extra benefits that are not available in Traditional Medicare or reduce out-of-pocket costs to attract certain types of Medicare beneficiaries.[11] In 2004, the Medicare Payment Advisory Commission (MEDPAC) reported that MA plans were likely to have higher cost sharing for dialysis.[13] Yet, there is little empirical evidence to predict the impact of risk selection strategies on ESRD patients in MA plans.

Since the 2011 implementation of the Affordable Care Act (ACA), MA plans have been required to place a limit on beneficiaries' out-of-pocket payment for covered medical services. At the same time, they are also allowed to charge higher cost-sharing for some services, including dialysis.[14] The government-set out-of-pocket limit in 2015 was $6,700; once a beneficiary reaches his plan's out-of-pocket limit, insurance will pay 100% of additional covered charges incurred in the remainder of the calendar year.[14] The out-of-pocket limit provides more financial protection for high-cost and high-need beneficiaries like ESRD patients, as they are more likely to exceed the maximum. However, increased cost sharing on the most essential services, such as dialysis, may also drive ESRD patients to exit MA plans.[14] Researchers have found that favorable risk selection of MA plans has been reduced due to a new risk adjustment system, expansion of MA coverage, and other policy changes in recent years.[9,15-16] But most of these studies focused on general MA beneficiaries. Thus, it is unclear whether new benefit policies may have attenuated favorable risk selection of MA plans among high-cost populations with intensive health care needs like ESRD patients.[12,17-18]

In this study, we employed a quasi-experimental design to examine the impact of increased dialysis coinsurance on ESRD patients' decisions to exit MA plans in favor of Traditional Medicare. In a difference-in-differences analysis, this study assessed changes in disenrollment of ESRD patients from MA plans as consequence of increased dialysis coinsurance for ESRD patients compared with concurrent changes in control plans where such coinsurance remained unchanged. To test whether new benefit policies in the ACA may have attenuated favorable risk selection of MA plans among ESRD patients, we compared the results with and without the ACA period.

Methods

Data Sources

We merged data from six national databases spanning from 2007 to 2013: 1) Renal Management Information System (REMIS) data contains dates of initiation of dialysis, primary cause of ESRD, and comorbid conditions for ESRD patients; 2) The Medicare Health Plan Compare (MHPC) Database provides information on MA plans' benefits for Medicare-covered services, including the required copayment for each dialysis session; 3) CMS' Out-of-pocket Costs (OOPC) data was used to obtain a summary measure of the generosity of each plan's benefits, which estimates average expected monthly medical out-of-pocket costs (including premiums and cost-sharing) in each MA plan; 4) Medicare Healthcare Effectiveness Data and Information Set (HEDIS) data contains individual-level information on enrollment in MA plans; 5) Part C Medicare Star Ratings data contains star ratings for MA plans, which reflect plans' quality ratings when patients initiated dialysis; and 6) the Medicare Beneficiary Summary File, which provides

demographic characteristics of enrollees. We matched 97% of the observations in the HEDIS data set to the Medicare Beneficiary Summary File.

Study Sample

There were 4,258 MA plans with dialysis benefit information between 2007 and 2013. Among them, we excluded 3,237 MA plans that were not available for at least three consecutive years or did not have zero dialysis cost sharing for the first two years. Among the remaining plans, 392 plans were terminated in the second or third year. After excluding these plans along with 21 small contracts without star ratings, 125 plans with no ESRD patients over 65 years old at base year, and 51 plans with only ESRD patients who had Medicare and full Medicaid benefits, we identified 125 case plans — MA plans that instituted dialysis coinsurance — and 307 control plans — MA plans that had no dialysis coinsurance. There were 2,688 and 13,972 ESRD patients in case and control plans respectively. We conducted one-to-one propensity matching for case and control plans on the basis of size, region, overall benefit generosity (expected average monthly out-of-pocket payment for medical services), out-of-pocket maximums for the year before and the year after the dialysis coinsurance insurance, MA plan type, and enrollees' demographic characteristics (age, sex, race, ZIP-code-level income). After the propensity score matching, 125 pairs of matched plans were included in the analysis, in which 2,688 and 2,434 ESRD patients were identified in case and control plans respectively after excluding patients with full Medicaid benefits (Figure 1). The case plans included 843 incident ESRD patients; the control plans included 818.

Variables

The dependent variable has two categories: (1) remaining in the MA plan throughout the follow-up year or until death; and (2) disenrollment from MA plans at any time in the following year. The primary independent variables were an indicator of whether an ESRD enrollee was in an MA plan that increased coinsurance or a control plan that did not increase cost sharing for dialysis, an indicator for time (before or after the coinsurance change), and an interaction term for these two variables. To control for pre-existing conditions and comorbidities, we included the number of years on dialysis, three conditions for primary cause of ESRD, and sixteen comorbid conditions at dialysis initiation from the Medicare Evidence Form (CMS-2728)[19] obtained from the REMIS data. We used a categorical variable for year of dialysis coinsurance increase to control for time trends. Other covariates included: age, sex, race, US Census region of residence, socioeconomic status derived from zip-code level income information, a summary measure of the generosity of each plan's benefits derived from OOPC data, MA plan star ratings obtained from the Part C Medicare Star Rating data, and dual eligibility for partial Medicaid coverage available from the Medicare Beneficiary Summary File.

Statistical Analyses

We used a difference-in-differences approach to assess the effect of increased dialysis coinsurance on ESRD patients' disenrollment from MA plans in favor of Traditional Medicare. This method accounted for trends in outcomes by subtracting the change in disenrollment rate in control plans from the concurrent change in plans that increased cost sharing. The baseline was a two-year period before the dialysis coinsurance increase;

the measurement period was the first year with a dialysis coinsurance increase. We assessed disenrollment rates in the second baseline year and in the year of the increase. Because our objective was to examine how ESRD patients in MA plans responded to new dialysis copayments, we identified 125 MA plans that introduced copayments for dialysis in any year between 2009 and 2013, hereafter referred to as "case plans." We were able to match these 125 case plans to 125 concurrent control MA plans that maintained no cost-sharing for dialysis over the same time period in which case plans introduced copayments. We fitted multilevel generalized linear models that included the independent variables and covariates described above. We included a plan fixed-effect to account for clustering of observations in health plans. Our model therefore estimates the mean within-plan effect of dialysis coinsurance increase. All models were weighted by the number of months subjects were enrolled in their plans. To control for a competing risk, death, we also restricted the analysis to ESRD patients who survived through the end of the baseline period. Further, we used multinomial logit models to assess the relationship between dialysis coinsurance increase and disenrollment while accounting for death as a competing risk. In this case, disenrollment status is a multivalued outcome variable that has three levels: (1) remaining in an MA plan, (2) disenrollment from MA plans, and (3) death.

To test the robustness of the models, we performed a series of sensitivity analyses. We compared the results with and without the ACA period (post 2011) and performed the analysis for both prevalent and incident ESRD patients. As plan quality is a key driver for disenrollment of ESRD patients, we performed a binary logit regression analysis without controlling for MA plan star ratings. We also stratified the analysis by

dual eligibility status, socioeconomic status, and MA plan star rating levels. All regression analyses above used the same covariates as the main analysis. We used both logit and mlogit commands from Stata to fit binary and multinomial logit models.[20] The marginal effects were estimated by the margins command.[21] Results were reported with two-tailed 95% confidence intervals. All analyses were performed with Stata, Version 14. The Brown University Human Research Protections Office and the CMS Privacy Board approved the study protocol.

Results

Before propensity score matching, enrollees in case plans were more likely to be black, to have lower out-of-pocket payment or maximums, to live in lower income areas, to be located in the South, to choose the lowest star-rated plans, to have hypertension as the primary case for ESRD, and to be part of a health management organization (HMO) (Table 1). These attributes significantly differed across case and control plans ($p<0.01$). Case plans were likely to have dialysis coinsurance increase in earlier years ($p<0.01$). As the matching was done at the plan level, we still observed some discrepancies between case and control plans at the individual level, but characteristics of the two groups became more similar.

Table 2 presents marginal effects of the difference in voluntary disenrollment changes before and after dialysis coinsurance increase between case and control plans. We compared the results with and without the ACA period and performed the analysis for both prevalent and incident ESRD patients. For the analysis including the ACA period, we observed that prevalent ESRD patients in case plans had 7.5 percentage points

(95% CI 1.5 to 13.4) and 7.8 percentage points (95% CI 0.8 to 14.8) higher rates of disenrollment change compared to those in control plans before and after matching. Incident ESRD patients in case plans had 9.1 percentage points (95% CI 1.9 to 16.4) higher rates of disenrollment change compared to those in matched control plans. Similar results were found for the pre-ACA period, but the effects were larger: 12.3 percentage points (95% CI 2.9 to 21.7) and 12.8 percentage points (95% CI 1.1 to 24.5) higher for the prevalence ESRD patients and incident patients respectively in the matched plans.

As can be seen in Table 2 and Table 3, binary logit models with and without controlling for MA plan star ratings yielded similar results. We observed that prevalent ESRD patients in matched case and control plans had 8.2% and 10.9% disenrollment rates respectively in the first year; the mortality rates were 22.0% and 21.8% respectively. The multinomial logit model showed significant difference in disenrollment changes but no difference in mortality changes before and after dialysis coinsurance increase between case and control plans. In stratified analyses, we observed ESRD patients in case plans who lived in a zip code where annual income is higher than $50,000, had no Medicaid benefits, or chose MA plans with more than four stars were more likely to disenroll from MA plans after the dialysis coinsurance increase compared to those in control plans.

Discussion

We examined the relationship between introducing dialysis coinsurance and disenrollment of ESRD patients from MA plans in a large, nationally representative sample of MA enrollees. We found evidence that introducing dialysis coinsurance was associated with increased disenrollment of both prevalence and incident ESRD patients

from MA plans, especially in case plans with four or more stars or among ESRD patients with higher socioeconomic status. The effect of dialysis coinsurance increase on disenrollment was attenuated after the implementation of ACA but still significant.

This study extended findings to a new service in the cost-sharing literature. Proponents assert that greater cost-sharing encourages patients to consider costs and refrain from using services where the expected value is less than the out-of-pocket expense.[1, 22] In this study, we did not directly assess the impact of dialysis coinsurance increase on utilization change, as it is unlikely for ESRD patients to reduce their use of dialysis in response to out-of-pocket costs, as skipping dialysis treatments may lead to death. Instead, ESRD patients are more likely to disenroll from MA plans to reduce the out-of-pocket payment. Our findings suggest that the introduction of dialysis copayments was associated with increased disenrollment of ESRD patients from MA plans.

Our study was consistent with an emerging body of evidence that suggests important unintended consequences to increasing cost-sharing for elderly patients. Empirical evidence suggests that lower utilization was not accompanied by adverse health outcomes, with the important exception of a chronically-ill, low-income subgroup.[23] In our study, we found increased cost-sharing may affect elderly patients' decisions to exit MA plans, especially among high-cost and high-need patients like those with ESRD. Our findings extend previous work demonstrating that the design of benefits among MA plans may be associated with prompting high-cost beneficiaries to leave.[11] The increase in dialysis coinsurance reduced the risk of MA plans through a shifting of sicker ESRD patients from MA plans to the Traditional Medicare program.

To control for this favorable risk selection in MA plans, CMS has required MA plans to place a limit on beneficiaries' out-of-pocket payments for covered medical services since the implementation of the ACA. At the same time, they are also allowed to charge higher cost-sharing for some services, including dialysis.[24] Figure 2 shows that after 2011 over 98% of MA plans had an out-of-pocket limit; in 2013, about 70% of MA plans increased dialysis coinsurance to the maximum, 20%. The out-of-pocket limit may provide more financial protection for high-cost and high-need beneficiaries like ESRD patients, but increased cost sharing on an essential service like dialysis may also drive ESRD patients to exit MA plans.[13] Our findings suggest that the effect of dialysis coinsurance increase on disenrollment was attenuated after the implementation of the ACA but still significant. Policymakers and plan managers should consider more regulations that limit these behaviors.

It is important to note our study's limitations. First, enrollees in our sample were not randomly assigned to case and control plans. We cannot fully exclude the possibility that unmeasured differences between case and control plans influenced our results. Second, our study findings may not be generalizable to beneficiaries in Traditional Medicare. Previous research has suggested that there are differences in these two populations.[22,23] However, we found that the duration of dialysis care was similar among Traditional Medicare and Medicare Advantage enrollees in case plans. Third, we do not have claims data from MA plans to directly measure the number of dialysis visits per MA member. However, REMIS data provided us the clinical risk adjusters for both MA and Traditional Medicare beneficiaries.

Conclusion

In conclusion, our study suggests that the introduction of dialysis coinsurance among MA plans was associated with increased disenrollment of ESRD patients from MA plans, especially in case plans with four or more stars or among ESRD patients with higher socioeconomic status. The increase in dialysis coinsurance reduced the risk of MA plans through a shifting of sicker ESRD patients from MA plans to the Traditional Medicare program. The effect of dialysis coinsurance increase on disenrollment was attenuated after the implementation of the ACA but still significant. Policymakers and plan managers should consider more regulations that limit these behaviors.

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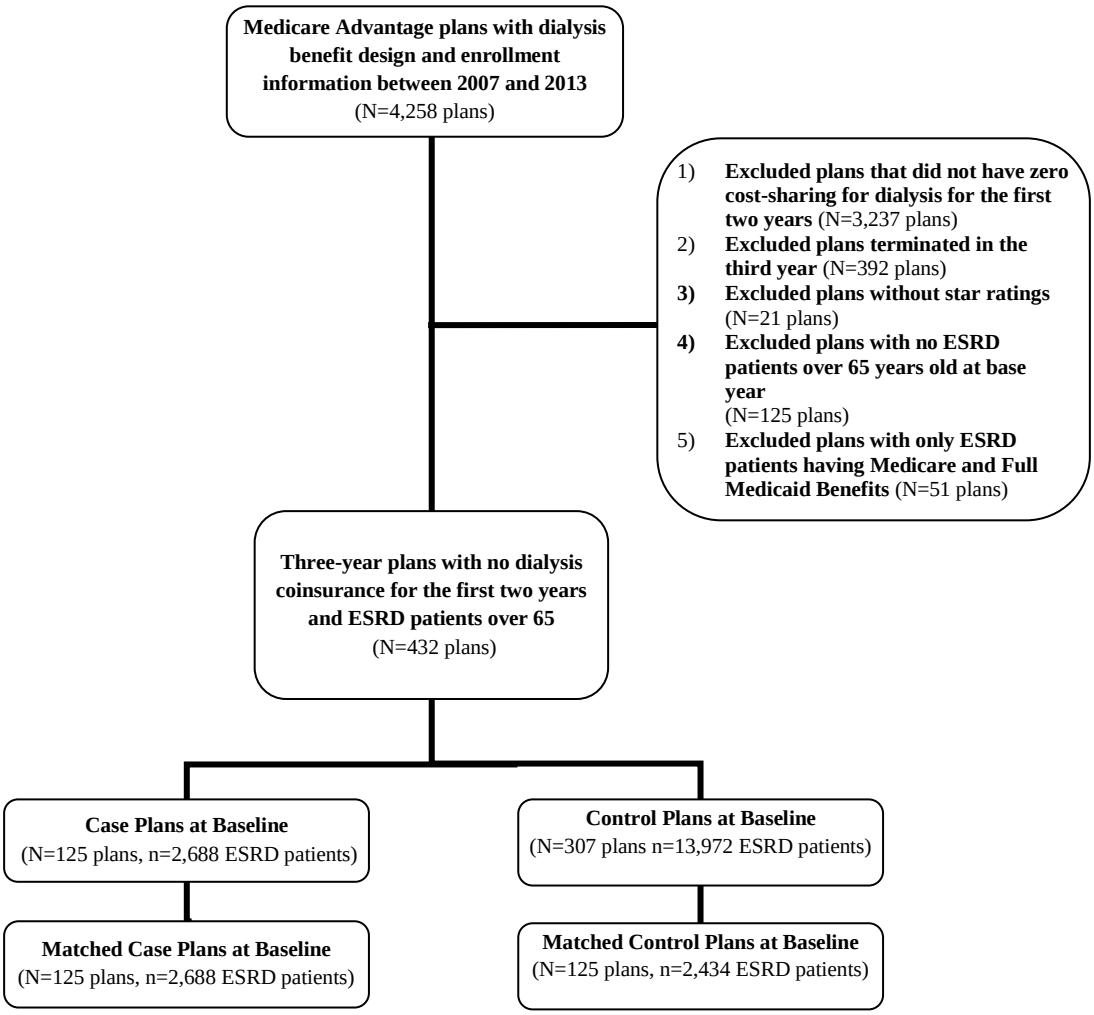
Figure 1 Inclusion and Exclusion Criteria for Study Plan Contracts*



*There were 4,258 MA plans with dialysis benefit information between 2007 and 2013. Among them, we excluded 3,237 Medicare Advantage plans that were not available for at least three consecutive years or did not have zero dialysis cost sharing for the first two years. Among the remaining plans, 392 plans were terminated in the second or third year. After excluding these plans along with 21 small contracts without star ratings, 125 plans with no ESRD patients over 65 years old at base year, and 51 plans with only ESRD patients having Medicare and Full Medicaid Benefits, we identified 125 MA plans that instituted dialysis coinsurance as case plans and 307 MA plans that had no dialysis coinsurance as control plans. After the propensity score matching, 125 pairs of matched plans were included in the analysis.

Table 1 Baseline Characteristics of End-stage Renal Disease Patients in Medicare Advantage Plans*

Variable	Unmatched		Matched	
	Case Plans (n=2,688)	Control Plans (n=13,972)	Case Plans (n=2,688)	Control Plans (n=2,434)
Age (SD)	75.8 (6.5)	75.4 (6.6)	75.8 (6.5)	75.4 (6.5)
Female	43.7	41.9	43.7	41.4
Race				
White	58.4	57.3	58.4	58.3
Black	19.6	11.4	19.6	14.9
Hispanic	17.0	25.9	17.0	20.7
Asian	3.4	3.9	3.4	4.4
Other	1.6	1.6	1.6	1.6
Region				
Northeast	23.3	28.9	23.3	30.0
Midwest	6.8	13.7	6.8	4.8
South	36.9	20.3	36.9	19.5
West	33.0	37.1	33.0	45.7
Projected Medical Out-of-Pocket Payment (SD)	204.6 (49.9)	282.8 (202.4)	204.6 (49.9)	239.9 (160.8)
Out-of-Pocket Maximum (SD)				
The Year Prior to Dialysis Coinsurance Increase	1,714.3 (2,497.4)	2,641.8 (2,114.3)	1,714.3 (2,497.4)	2,254.3 (2,389.0)
The Year with Dialysis Coinsurance Increase	2,503.2 (2,454.0)	3,106.8 (1,896.9)	2,503.2 (2,454.0)	2,693.3 (2,363.3)
Medicare Advantage Plan Star Rating Level				
<=3 Star	53.1	37.7	53.1	51.0
3.5 Star	21.3	17.5	21.3	23.0
4+ Star	25.6	44.9	25.6	26.0
Socioeconomic Status				
< 30K	9.5	12.3	9.5	4.9
30-50K	42.2	32.3	42.2	41.7
50K+	48.3	55.4	48.3	53.4
Dual				
Non-duals	90.1	92.0	90.1	88.7
Partial duals	9.4	7.4	9.4	10.9
Other	0.6	0.6	0.6	0.4
Year of Copayment Increase				
2013	5.8	30.2	5.8	11.7
2012	18.9	21.8	18.9	20.2
2011	16.0	16.6	16.0	15.1
2010	17.4	14.3	17.4	14.7
2009	41.9	17.1	41.9	38.3
Number of Years on Dialysis (SD)	2.1 (2.7)	2.2 (2.7)	2.1 (2.7)	2.0 (2.5)
Primary Cause of End-Stage Renal Disease				
Diabetes	39.9	43.4	39.9	43.1
Hypertension	38.1	31.7	38.1	34.3
Glomerulonephritis	5.7	6.7	5.7	6.1
Other	16.3	18.2	16.3	16.5
Conditions				
Congestive heart failure	31.7	32.2	31.7	31.3
Atherosclerotic heart disease	21.8	24.8	21.8	20.3

ASHD				
Other cardiac disease	14.5	15.6	14.5	16.4
Cerebrovascular disease, CVA, TIA	9.2	8.9	9.2	8.8
Peripheral vascular disease	14.1	15.6	14.1	12.0
History of hypertension	86.6	85.9	86.6	84.7
Amputation	1.2	2.1	1.2	1.2
Diabetes, currently on insulin	25.8	29.9	25.8	28.2
Diabetes, on oral medications	11.9	12.2	11.9	13.1
Diabetes, without medications	4.3	4.7	4.3	4.6
Diabetic retinopathy	4.9	7.3	4.9	4.1
Chronic obstructive pulmonary disease	8.5	8.5	8.5	9.5
Tobacco use (current smoker)	3.2	2.6	3.2	2.7
Malignant neoplasm, Cancer	7.6	8.5	7.6	8.1
Inability to ambulate	3.3	4.9	3.3	4.6
Needs assistance with daily activities	6.8	8.8	6.8	8.0
Plan Type, Health Management Organization	93.3	88.6	93.3	93.2

*This study used five national databases. Primary cause of end-stage renal disease and comorbid conditions were from Medicare Evidence Form (CMS-2728) of the Renal Management Information System (REMIS) data. Socioeconomic status was derived based on zip-code level income from national census data. This table presents percentages except age, number of years on dialysis, out-of-pocket maximum, and projected out-of-pocket payment.

Table 2 Difference in Disenrollment Changes before and after Dialysis Coinsurance Increase between Case and Control Plans

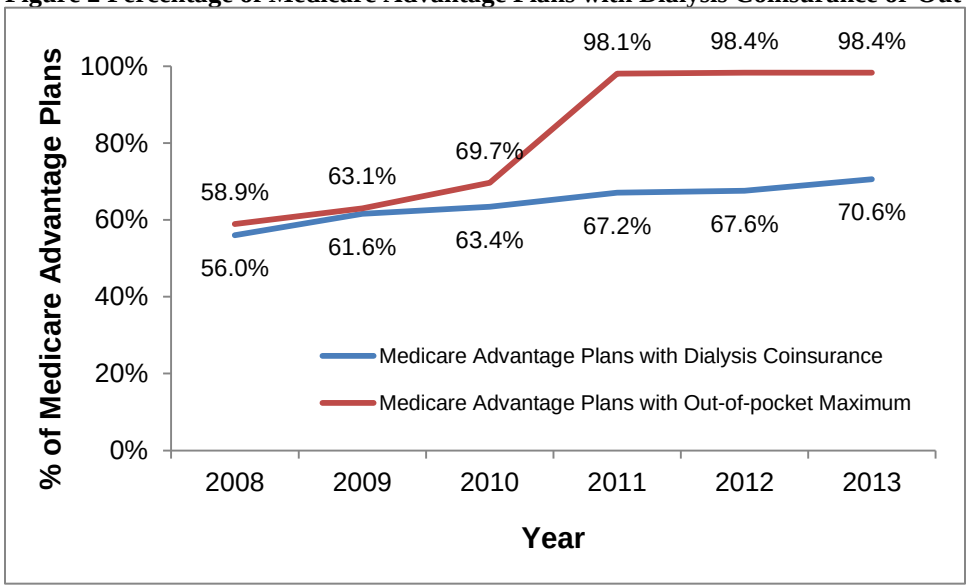
Sample	Case Plans			Control Plans			Diff-in-Diff (Crude)	Diff-in-Diff (Adjusted) (95% CL)*
	Pre-coinsurance Increase	Post-coinsurance Increase	Change	Pre-coinsurance Increase	Post-coinsurance Increase	Change		
Prevalent End-Stage Renal Disease Patients, All								
Pre- and Post-ACA (2007-2013)	8.2	16.0	7.8	12.1	14.2	2.0	5.7	7.5 (1.5 to 13.4)
Sample Size	2,688	3,636		13,972	23,651			
Excluded Post-ACA Period (2007-2011)	5.9	13.6	7.7	6.8	6.9	0.1	7.6	12.0 (4.1 to 19.8)
Sample Size	2,023	2,643		6,709	10,558			
Prevalent End-Stage Renal Disease Patients, Matched								
Pre- and Post-ACA (2007-2013)	8.2	16.0	7.8	10.9	10.6	-0.3	8.1	7.8 (0.8 to 14.8)
Sample Size	2,688	3,636		2,434	4,120			
Excluded Post-ACA Period (2007-2011)	5.9	13.6	7.7	8.3	6.6	-1.7	9.4	12.3 (2.9 to 21.7)
Sample Size	2,023	2,643		1,658	2,334			
Incident End-Stage Renal Disease Patients, Matched								
Pre- and Post-ACA (2007-2013)	9.5	16.2	6.7	14.3	10.4	-3.9	10.6	9.9 (0.8 to 19)
Sample Size	843	772		818	867			
Excluded Post-ACA Period (2007-2011)	7.0	14.1	7.1	10.3	6.7	-3.6	10.7	12.8 (1.1 to 24.5)
Sample Size	640	564		607	540			

*95% CI denotes 95% confidence interval.

Table 3 Difference in Disenrollment Changes before and after Dialysis Coinsurance Increase between Case and Control Plans (Sensitivity Analyses)

Sample	Marginal Effect (95% Confidence Interval)									
	Multinomial Logit Model	**Binary Logit Model without Adjusting for Star Ratings**	**Partial Duals**	**Non-Duals**	**Zip-code Income <= 30K**	**Zip-code Income 30K-50K**	**Zip-code Income >= 50K**	**<=3 Stars**	**3.5 Stars**	**4+ Stars**
Prevalent End-Stage Renal Disease Patients, All										
Pre- and Post-ACA (2007-2013)	5.5 (0.4 to 10.6)	7.6 (1.5 to 13.8)	5.2 (-3.4 to 13.8)	8.4 (1.6 to 15.2)	2.5 (-4.5 to 9.5)	5.5 (0.7 to 10.4)	10.0 (0.9 to 19.1)	2.5 (-6.4 to 11.4)	5.3 (-3.8 to 14.4)	12.9 (1.1 to 24.7)
Sample Size	16,660	16,660	1,289	15,273	1,981	5,645	9,034	6,688	3,013	6,959
Pre-ACA Period (2007-2010)	9.6 (2.9 to 16.3)	12.2 (4.4 to 20)	11.8 (-0.1 to 23.6)	12.8 (4.2 to 21.3)	7.3 (-3.3 to 17.9)	7.5 (1.1 to 14)	15.8 (5.1 to 26.6)	5.7 (-6.4 to 17.8)	5.1 (-7.8 to 18.0)	17.4 (6.1 to 28.8)
Sample Size	8,732	8,732	575	8,118	662	3,098	4,972	4,943	784	3,005
Prevalent End-Stage Renal Disease Patients, Matched										
Pre- and Post-ACA (2007-2013)	5.4 (-0.6 to 11.4)	7.9 (1 to 14.8)	11.4 (1 to 21.9)	9.1 (1.3 to 16.9)	5.4 (-5.5 to 16.3)	4.6 (-0.7 to 9.9)	11.0 (0.9 to 21.2)	5.8 (-3.1 to 14.6)	-0.8 (-7.3 to 5.7)	18.4 (5.9 to 30.9)
Sample Size	5,122	5,122	518	4,579	376	2,149	2,597	2,668	1,131	1,323
Pre-ACA Period (2007-2010)	8.7 (0.6 to 16.8)	12.2 (2.9 to 21.6)	8.7 (-5.6 to 23)	13.1 (2.9 to 23.2)	1.2 (-12.1 to 14.4)	5.8 (-1.4 to 13)	18.6 (5.8 to 31.3)	7.9 (-1.9 to 17.8)	2.8 (-7.3 to 12.9)	23.4 (10.1 to 36.7)
Sample Size	3,681	3,681	280	3,391	261	1,480	1,940	2,466	239	976

Figure 2 Percentage of Medicare Advantage Plans with Dialysis Coinsurance or Out-of-pocket Maximum Over Time



Chapter 3: Impact of Disenrollment Associated with Dialysis Coinsurance Increase on Patients with Incident End-stage Renal Disease

Introduction

Medicare is the principal payer for medical services for patients with end-stage renal disease (ESRD). In 2013, annual Medicare spending on ESRD patients reached 34.3 billion dollars.[1] Currently, most ESRD patients are served by Traditional Medicare; however, a significant number are still enrolled in Medicare Advantage (MA) plans. The law stipulates three conditions related to ESRD: Medicare beneficiaries may not enroll in MA plans after they develop ESRD; beneficiaries may remain in MA plans if they were enrolled in MA plans prior to developing ESRD; and ESRD patients who disenroll must leave the MA program unless their original plan no longer provides insurance coverage or they move out of their MA plan's geographic area.[2] Given this 'one-way' path, disenrollment of ESRD patients from MA plans due to the favorable selection of MA plans results in shifting cost from MA plans to Traditional Medicare.[3-5] Further, the switch from MA plans to Traditional Medicare may cause discontinuity of care, worse health outcomes, and consequently higher cost for ESRD patients. [5,6-9] Thus, there are significant policy implications to understanding ESRD patients' disenrollment from MA plans to Traditional Medicare and subsequent health outcomes.

Many studies suggest that given the per-member-per-month capitation payment received from the government — designed to cover the entire cost of an individual's care[10-15] — MA plans have an incentive to select individuals they expect to be low cost and to avoid covering individuals who are chronically ill. This is often called "risk selection."[13-15] The risk selection between MA and Traditional Medicare has been

consistently revealed in studies assessing the factors that impact the choice of MA plans.[13-17] By law, MA plans cannot select enrollees based on health status directly. Their main instruments for doing so are their choice of networks of providers, covered benefits, and structure of drug formularies, as well as their marketing and choice of geographic area in which to operate.[18-19] The Medicare Payment Advisory Commission (MEDPAC) reported in 2004 that MA plans were likely to have higher cost sharing for dialysis.[13] Increased cost sharing on this essential treatment may drive ESRD patients to exit MA plans. However, we are unaware of any empirical evidence to examine the impact of increased coinsurance on this disenrollment.

Understanding subsequent health outcomes after disenrollment from MA plans due to risk selection is particularly important for frail patients with intensive health care needs. Physicians across the care continuum increasingly believe that coordinated care can improve patient outcomes.[20] MA plans often offer disease management, care management, and case management programs for chronically ill patients like ESRD patients in a coordinated care system.[20] Brunelli and colleagues found that patients enrolled in an MA plan upon initiation of dialysis had a lower mortality rate than their counterparts in Traditional Medicare. This beneficial association of MA enrollment was found to be sustained over the first two years of dialysis treatment.[20] The disenrollment of an ESRD patient from an MA plan to Traditional Medicare has the potential to break the coordinated care and lead to worse health outcomes. Thus, it is critical for policymakers to understand the eventual health outcomes of ESRD patients who disenrolled from MA plans to Traditional Medicare.

The objective of this study is to evaluate the impact of disenrollment associated with dialysis coinsurance increase on ESRD patients. To accomplish this objective, we tested the hypothesis that increased dialysis coinsurance promotes disenrollment from MA plans, and consequently affects hospitalizations and post-acute nursing home care among ESRD patients. We used a quasi-experimental design with cost-sharing change indicator as the instrumental variable (IV). This causal framework allowed us to examine the relationship between dialysis coinsurance increase and patient outcomes primarily through the mechanism of disenrollment of ESRD patients from MA plans.

Methods

Data Sources

We merged data from seven national databases spanning from 2008 to 2013: (1) Renal Management Information System (REMIS) data contains dates of initiation of dialysis, dialysis utilization, hospitalizations, and comorbid conditions for ESRD patients; (2) The Medicare Health Plan Compare (MHPC) Database provides information on MA plans' benefits for Medicare-covered services, including the required copayment for each dialysis session; (3) CMS' Out-of-pocket Costs (OOPC) data was used to obtain a summary measure of the generosity of each plan's benefits, which estimates average expected monthly medical out-of-pocket costs (including premiums and cost-sharing) in each MA plan; (4) Medicare Healthcare Effectiveness Data and Information Set (HEDIS) data contains individual-level information on enrollment in MA plans; (5) The Minimum Data Set (MDS) is part of the federally mandated process for clinical assessment of all residents in Medicare or Medicaid certified nursing facilities, which provides post-acute

nursing home utilization measures; (6) Part C Medicare Star Ratings data contains star ratings for MA plans, which reflect plans' quality ratings when patients initiated dialysis; and (7) Medicare Beneficiary Summary File provides the demographic characteristics of enrollees. We matched 97% of the observations in the HEDIS data set to the Medicare Beneficiary Summary File.

Study Sample

There were 4,658 MA plans with dialysis benefit information between 2008 and 2013. Among them, we excluded 3,461 MA plans that did not have zero dialysis cost sharing for the first two years and available for at least three consecutive years. Among the remaining plans, 130 plans were terminated in the second or third year. After excluding these plans along with 54 small contracts without star ratings and 270 plans with no ESRD patients over 65 years old at base year, we identified 200 MA plans that instituted dialysis coinsurance in any year between 2009 and 2013 as case plans and 513 MA plans that had no dialysis coinsurance as control plans. There were 3,863 and 25,659 ESRD patients in case and control plans respectively. After excluding patients with full Medicaid benefits, there were 3,272 and 18,582 ESRD patients in case and control plans respectively (Figure 1). Among them, 1,095 and 5,446 were incident ESRD patients in case and control plans respectively.

Variables

The dependent variables included: (1) Percentage of patients with hospitalizations; (2) percentage of patients with post-acute nursing home care; (3) post-acute nursing home

days per patient; and (4) hospital days per patient. Hospital days were defined as the distinct days in hospitals. We used HEDIS and Medicare claims to obtain hospital care measures for beneficiaries in MA and Traditional Medicare plans respectively. Post-acute nursing home days were defined as the distinct days covered by nursing home services after the discharge from hospitals using MDS data. The primary independent variable had two categories: remaining in the MA plan throughout the follow-up year or until death; and disenrollment from MA plans at any time in the following year. The instrumental variable was an indicator of whether an ESRD enrollee was in an MA plan that increased coinsurance or a control plan that did not increase cost sharing for dialysis. To control for pre-existing conditions and comorbidities, we included the number of years on dialysis, three conditions for primary cause of ESRD and sixteen comorbid conditions at dialysis initiation from the Medicare Evidence Form (CMS-2728)[21] obtained from the REMIS data. We used a categorical variable for year of dialysis coinsurance increase to control for time trends. Other covariates included: age, sex, race, US Census region of residence, socioeconomic status derived from zip-code level income information, a summary measure of the generosity of each plan's benefits derived from OOPC data and dual eligibility for Medicaid coverage available from the Medicare Beneficiary Summary File.

Statistical Analyses

We employed a two-stage SLS model with the indicator of dialysis coinsurance change as the instrumental variable. The model first estimated the probability of disenrollment from MA plans and then estimated the associated changes of hospital care or post-acute nursing home care measures for patients who disenrolled versus those who did not. We

selected MA plans that instituted coinsurance for dialysis services between 2009 and 2013 as case plans and MA plans that retained no cost sharing over this time period as control plans. The baseline was the year before the dialysis coinsurance increase and measure period was the first year with dialysis coinsurance increase. We used an instrumental variable model to assess changes in disenrollment due to the increased dialysis coinsurance while controlling for the covariates mentioned above. The use of the instrumental variable is based on the following assumptions: (1) the institution of dialysis coinsurance is not correlated with hospital care or post-acute nursing home care of ESRD patients but correlated with disenrollment, and (2) the change in dialysis coinsurance can only affect health outcomes through the mechanism of ESRD patients' disenrollment from MA plans. Then we estimated the magnitude of hospital care and post-acute nursing home care changes for ESRD patients attributable to increased dialysis coinsurance. To control for potential survival bias, the analysis was restricted to beneficiaries who survived by the end of the baseline year and also examined the mortality rates during the measurement period. We also used multinomial logit models to assess the relationship between dialysis coinsurance increase and disenrollment while accounting for death as a competing risk. In this case, disenrollment status is a multivalued outcome variable that has three levels: (1) remaining in an MA plan, (2) disenrollment from MA plans, and (3) death.

To test the robustness of the models, we performed a series of sensitivity analyses. We compared the results with and without disenrollment and performed the analysis for both prevalent and incident ESRD patients. We also stratified the analysis by dual eligibility status, socioeconomic status, and MA plan star rating levels. All

regression analyses above used the same covariates as the main analysis. We used mlogit and ivreg commands from Stata to fit multinomial logit and 2SLS models.[22]The marginal effects were estimated by the margins command.[23] Results were reported with two-tailed 95% confidence intervals. All analyses were performed with Stata, Version 14. The Brown University Human Research Protections Office and the CMS Privacy Board approved the study protocol.

Results

Enrollees in case plans were likely to be white, to live in mid-income areas, to be located in the South, to have chosen plans with lower out-of-pocket payment and higher out-of-pocket limit, and to have hypertension of primary cause for ESRD or tobacco use (Table 1); these attributes differed significantly between case and control plans ($p<0.01$). Case plans were likely to have dialysis coinsurance increase in earlier years ($p<0.01$). We compared the patients by disenrollment status in case and control plans respectively. The disenrolled patients are more likely to be male, white, living in higher-income areas, located in the Northeast, and to have plans with higher projected out-of-pocket payment but higher out-of-pocket limit. The characteristics of disenrollees are similar between case and control plans.

Table 2 presents differences in health outcome changes before and after dialysis coinsurance increase between ESRD patients with and without disenrollment. The mortality and percentage of patients becoming eligible for full Medicaid benefits among disenrollees are 3.6 (95% CI 2.7 to 4.4) and 7.4 (95% CI 4.2 to 10.6) percentage points higher than those who did not disenroll respectively. We did not find significant

differences for utilization measures with the exception of post-acute nursing home days per patient, which is 2.9 (95% CI 1.1 to 4.7) percentage points higher among disenrolled ESRD patients.

Table 3 presents differences in health outcome changes before and after dialysis coinsurance increase between case and control plans. The mortality was not significantly different between case and control plans. Nevertheless, disenrollment from MA plans and the percentage of patients becoming eligible for full Medicaid benefits in case plans are1.2 (95% CI 0.2 to 2.3) and 5.8 (95% CI 1.8 to 9.8) percentage points higher than those in control plans. We did not find significant differences for utilization measures except dialysis sessions per week which is 0.3 (95% CI 0.1 to 0.4) sessions per week higher among disenrolled ESRD patients.

Table 4 shows the results for 2SL model based on IV estimates. For both incident and prevalent ESRD patients, we found higher disenrollment rates in case plans but the magnitude is higher among prevalent ESRD patients. The instrument has strong first-stage F-statistics (79.3) for the adjusted results among prevalent ESRD patients. The IV estimates show that for one percentage point increase in disenrollment attributable to dialysis coinsurance increase, there is a 0.3 ($P<.05$) percentage points increase in percentage of patients with hospitalizations, 0.3 ($P<.05$) percentage points increase in percentage of patients with post-acute nursing home care, and 0.2 ($P<.05$) day increase in post-acute nursing home days per patient among prevalent ESRD patients. We found higher effects of disenrollment attributable to dialysis coinsurance increase on percentage of patients with post-acute nursing home care ($P<.1$) among incident ESRD patients. To test the alternative mechanism for the impact of dialysis coinsurance increase on health

outcomes, we also assessed the difference in dialysis utilization between case and control plans, which shows no difference among both prevalent and incident ESRD patients (Table 1A).

The multinomial logit model showed significant difference in disenrollment changes but no difference in mortality changes before and after dialysis coinsurance increase between case and control plans. In stratified analyses, we observed ESRD patients in case plans who had no Medicaid benefits or chose MA plans with more than 3 stars were more likely to disenroll from MA plans after the dialysis coinsurance increase compared to those in control plans. Patients in higher quality plans were likely to have higher utilization in hospital care (Table 2A).

Discussion

We examined the impact of disenrollment associated with dialysis coinsurance increase on health outcomes of ESRD patients in a large, nationally representative sample of Medicare Advantage enrollees. We found evidence that dialysis coinsurance increase was associated with increased disenrollment and higher utilization in hospital care and post-acute nursing home care among ESRD patients. ESRD patients who disenrolled were more likely to have higher rates of mortality, to be covered by full Medicaid benefits, and to use dialysis at higher rates.

This study extended findings to a new service in the cost-sharing literature. Proponents assert that greater cost-sharing encourages patients to consider costs and refrain from using services where the expected value is less than the out-of-pocket expense. [1,24] In this study, we found dialysis utilization was not associated with dialysis

coinsurance increase. This suggests that it is unlikely for ESRD patients to reduce their use of dialysis in response to out-of-pocket costs, as skipping dialysis treatments may lead to death. In response to dialysis coinsurance increase, ESRD patients were more likely to disenroll from MA plans to Traditional Medicare or become eligible for full Medicaid benefits. Moreover, counterintuitively, we found dialysis utilization for ESRD patients in case plans had increased before and after the increase in dialysis coinsurance. Our findings suggest that the introduction of dialysis coinsurance and was associated with increased disenrollment of ESRD patients from MA plans, which may increase rather than reduce overall dialysis utilization for the Medicare program.

Our study was consistent with an emerging body of evidence that suggests important unintended consequences to increasing cost-sharing for elderly patients. In our study, we found increased cost-sharing may affect elderly patients' decisions to exit MA plans, especially among high-cost and high-need patients like ESRD. Our findings extend previous work demonstrating that the design of benefits among MA plans may be associated with prompting high-cost beneficiaries to leave.[25] The increase in dialysis coinsurance reduced the risk of MA plans through a shifting of sicker ESRD patients from MA plans to Traditional Medicare. However, this may break the continuum of care for ESRD patients, as most ESRD patients in MA plans are in disease or case management programs under a coordinated care system.[20] After disenrollment, they would no longer benefit from this coordinated care. As a result, we found the utilization of hospital care and post-acute nursing home care had increased before and after dialysis coinsurance increase. Our findings suggest imposing cost-sharing on essential treatments for frail patients may help MA plans to contain cost through cost shifting but it may lead

to worse health outcomes and consequently higher cost for the patients, especially among higher quality plans.

It is important to note our study's limitations. First, enrollees in our sample were not randomly assigned to case and control plans. We cannot fully exclude the possibility that unmeasured differences between case and control plans influenced our results. Second, given the complexity of prevalent ESRD patients, we may not fully adjust for risk differences among patients. To address this issue, we used the clinical risk adjusters from REMIS data and the duration of dialysis care. We replicated the analyses using incident ESRD patients, which showed consistent results even though some estimates were not statistically significant due to small sample size. Third, we do not have claims data from MA plans to directly measure the utilization of hospital care, post-acute nursing home care, and dialysis sessions. We used three national databases, HEDIS, REMIS, and MDS data, to obtain these measures. We also validated these measures using claims data for Traditional Medicare.

Conclusion

In conclusion, our study suggests that the introduction of dialysis coinsurance among MA plans was associated with increased disenrollment of ESRD patients from MA plans and higher utilization in hospital care and post-acute nursing home care. The increase in dialysis coinsurance reduced the risk of MA plans through a shifting of sicker ESRD patients from MA plans to Traditional Medicare. It may also lead to worse health outcomes and subsequent higher spending on ESRD patients, especially among higher quality plans.

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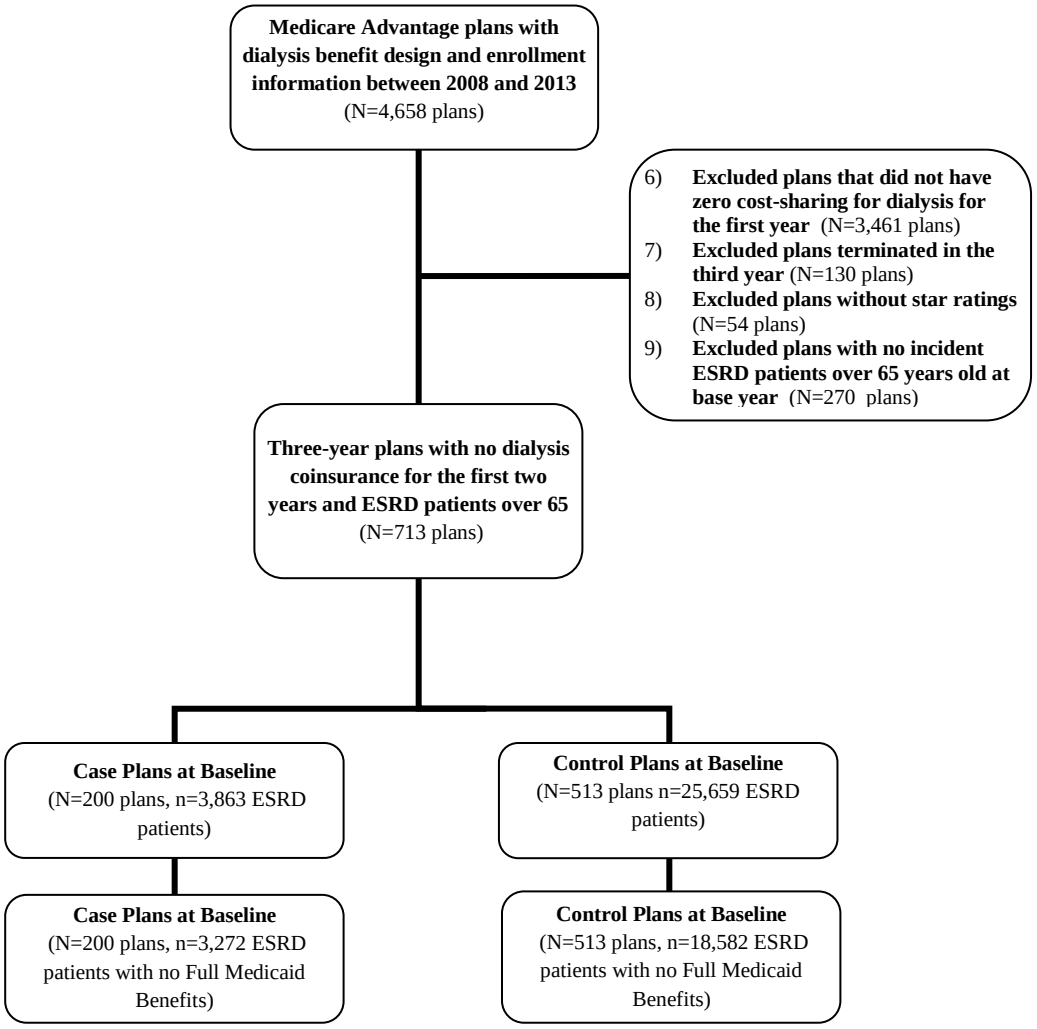
Figure 1 Inclusion and Exclusion Criteria for Study Plan Contracts*



*There were 4,658 Medicare Advantage (MA) plans with dialysis benefit information between 2008 and 2013. Among them, we excluded 3,461 MA plans that did not have zero dialysis cost sharing for the first two years and available for at least three consecutive years. Among the remaining plans, 130 plans were terminated in the second or third year. After excluding these plans along with 54 small contracts without star ratings and 270 plans with no ESRD patients over 65 years old at base year, we identified 200 MA plans that instituted dialysis coinsurance in any year between 2009 and 2013 as "case plans" and 513 MA plans that had no dialysis coinsurance as "control plans." There were 3,863 and 25,659 ESRD patients in case and control plans respectively. After excluding patients with full Medicaid benefits, there were 3,272 and 18,582 incident ESRD patients in case and control plans respectively

Table 1 Baseline Characteristics of End-Stage Renal Disease Patients in Medicare Advantage Plans

	Case	Control	Case		Control	
Variable	**All (n=3,272)**	**All (n=18,582)**	**Disenrolled (n=512)**	**Not Disenrolled (n=2,760)**	**Disenrolled (n=2,153)**	**Not Disenrolled (n=16,429)**
Age (SD)	76.1 (6.2)	75.9 (6.4)	76.8 (6.4)	76 (6.2)	75.7 (6.5)	75.9 (6.4)
Female	41.8	41.6	36.9	42.7	42.5	41.5
Race						
White	58.6	55.8	67.2	57.0	50.8	56.5
Black	18.1	11.4	15.0	18.7	15.4	10.8
Hispanic	18.9	26.6	13.5	19.9	26.2	26.7
Asian	3.0	4.5	2.7	3.0	6.0	4.3
Other	1.4	1.7	1.6	1.3	1.5	1.7
Region						
Northeast	25.2	25.3	48.4	20.9	27.4	25.0
Midwest	8.4	13.7	2.7	9.5	13.3	13.8
South	38.0	21.9	22.1	40.9	18.4	22.4
West	28.4	39.1	26.8	28.7	41.0	38.8
Out-of-pocket Maximum (SD)	2,432.4 (2,368.2)	2,002.2 (2,162.9)	2,864.9 (2,605.5)	2,352.1 (2,313.2)	1,847.7 (2,259.8)	2,022.4 (2,149.1)
Projected Out-of-Pocket Payment (SD)	209.9 (55.5)	269.5 (196.8)	227.1 (59.0)	206.7 (54.3)	292.1 (242.5)	266.5 (189.8)
Socioeconomic Status						
< 30K	10.8	12.0	9.4	11.1	9.8	12.3
30-50K	40.7	32.7	29.7	42.8	33.6	32.5
50K+	48.4	55.4	60.9	46.1	56.7	55.2
Dual						
Non-duals	89.9	91.6	88.5	90.1	88.6	92.0
Partial duals	9.6	7.9	11.3	9.3	11.0	7.5
Other	0.5	0.5	0.2	0.5	0.4	0.5
Year of Copayment Increase						
2013	5.6	28.2	4.9	5.8	32.6	27.6
2012	21.1	23.4	9.4	23.2	18.3	24.0
2011	15.8	15.4	30.3	13.2	17.6	15.1
2010	15.1	15.2	13.7	15.4	21.5	14.4
2009	42.4	17.8	41.8	42.5	9.9	18.8
Years on Dialysis (SD)	2.0 (2.7)	2.3 (2.7)	2.1 (2.8)	2 (2.6)	2.3 (2.8)	2.2 (2.7)
Primary Cause of End-Stage Renal Disease						
Diabetes	40.0	44.0	36.5	40.7	46.3	43.6
Hypertension	37.1	32.4	39.8	36.6	32.8	32.3
Glomerulonephritis	6.1	6.1	6.1	6.1	5.7	6.2
Other	16.8	17.6	17.6	16.7	15.2	17.9
Conditions						

Congestive heart failure	31.7	32.2	36.1	30.9	32.7	32.2
Atherosclerotic heart disease	23.6	24.8	27.9	22.8	22.5	25.1
Other cardiac disease	17.1	16.7	18.2	17.0	17.0	16.7
Cerebrovascular disease	9.1	8.7	10.0	8.9	7.2	8.9
Peripheral vascular disease	13.8	15.1	14.6	13.6	13.2	15.4
History of hypertension	86.7	86.9	87.3	86.6	86.3	87.0
Amputation	1.6	2.1	1.4	1.6	2.3	2.0
Diabetes on insulin	27.1	30.8	26.0	27.4	30.8	30.8
Diabetes on oral medications	12.6	13.4	11.7	12.8	14.7	13.2
Diabetes, without medications	4.6	5.1	3.7	4.8	5.0	5.1
Diabetic retinopathy	5.8	7.7	5.5	5.9	6.3	7.9
Chronic obstructive pulmonary disease	8.1	8.4	9.6	7.8	9.0	8.3
Tobacco use	3.1	2.6	3.1	3.1	1.9	2.7
Malignant neoplasm, Cancer	8.8	8.6	7.8	8.9	8.5	8.6
Inability to ambulate	3.7	4.8	3.5	3.7	5.0	4.8
Assistance with daily activities	7.9	9.6	7.2	8.0	9.2	9.6

This study used seven national databases. Primary cause of end-stage renal disease and comorbid conditions were from Medicare Evidence Form (CMS-2728) of the Renal Management Information System (REMIS) data. Socioeconomic status was derived based on zip-code level income from national census data. This table presents percentages except age, number of years on dialysis, out-of-pocket maximum, and projected out-of-pocket payment.

Table 2 Difference in Outcome Changes before and after Dialysis Coinsurance Increase between Disenrolled and Not Disenrolled Patients with End-stage Renal Disease

Outcomes	Disenrolled			Not Disenrolled			Diff-in-diff (Crude)	Diff-in-diff (Adjusted)
	Year 1 (n=2,665)	Year 2 (n=2,665)	Change	Year 1 (n=19,189)	Year 2 (n=19,189)	Change		
Percentage of patients with acute inpatient care	62.9	58.2	-4.7	57.4	54.3	-3.1	-1.6	-1.6 (-4.3 to 1.2)
Percentage of patients with post-acute nursing home care	17.6	21.3	3.7	13.7	15.7	2.0	1.7	1.7 (-0.4 to 3.9)
Hospital days per patient	10.2	13.6	3.4	8.1	12.3	4.2	-0.8	-0.8 (-2.1 to 0.5)
Post-acute nursing home days per patient	7.2	14.4	7.2	4.6	8.9	4.3	2.9	2.9 (1.1 to 4.7)
Average sessions per week	3.1	3.4	0.3	3.0	3.2	0.3	0.01	0.01 (-0.1 to 0.2)
Death, %		28.9			21.4		7.6	7.4 (4.2 to 10.6)
Turning into full duals,* %		9.5			4.2		5.3	3.6 (2.7 to 4.4)

*****Full duals are Medicare beneficiaries with full Medicaid benefits, whose cost-sharing is covered by Medicaid.

Table 3 Difference in Outcome Changes before and after Dialysis Coinsurance Increase between Case and Control plans

Outcomes	Case			Control			Diff-in-diff (Unadjusted)	Diff-in-Diff (Adjusted)
	Year 1 (n=3,272)	Year 2 (n=3,272)	Change	Year 1 (n=18,582)	Year 2 (n=18,582)	Change		
Percentage of patients with acute inpatient care	61.3	57.1	-4.2	57.5	54.4	-3.1	-1.1	-1.1 (-3.6 to 1.5)
Percentage of patients with post-acute nursing home care	15.8	17.5	1.7	13.9	16.2	2.3	-0.6	-0.6 (-2.5 to 1.3)
Hospital days per patient	9.6	13.9	4.3	8.1	12.2	4.1	0.1	0.1 (-1.1 to 1.4)
Post-acute nursing home days per patient	5.6	10.8	5.2	4.8	9.4	4.5	0.6	0.6 (-0.8 to 2.1)
Average sessions per week	2.5	3.1	0.5	3.0	3.3	0.3	0.2	0.3 (0.1 to 0.4)
Death, %		23.4			22.1		1.3	0.3 (-1.4 to 2)
Turning into full duals,* %		6.0			4.6		1.4	1.2 (0.2 to 2.3)
Disenrollment, %		15.6			11.6		4.1	5.8 (1.8 to 9.8)

*****Full duals are Medicare beneficiaries with full Medicaid benefits, whose cost-sharing can be covered by Medicaid.

Table 4 Estimated Effect of Voluntary Disenrollment from Medicare Advantage Plans on Health Outcomes Attributable Dialysis Coinsurance Increase

	Unadjusted (Prevalent ESRD)	Adjusted for Main Effects (Prevalent ESRD)	Unadjusted (Incident ESRD)	Adjusted for Main Effects (Incident ESRD)
First Stage	**Voluntary Disenrollment from Medicare Advantage Plans**			
Dialysis coinsurance increase	4.1 (0.5)**	6.3 (0.5)**	2.4 (0.8)**	3.0 (2.2)**
F-statistics dialysis coinsurance increase	71.6	160.4	8.4	11.5
Adjusted R-square	0.002	0.02	0.001	0.02
	The IV Estimate			
Percentage of patients with acute inpatient care	0.7 (0.3)***	0.3 (0.2)**	1.2 (0.9)	0.7 (0.7)
Percentage of patients with post-acute nursing home care	0.3 (0.2)*	0.3 (0.1)**	1.1 (0.8)	1.4 (0.75)*
Hospital days per patient	0.4 (0.2)**	0.1 (0.1)	1.0 (0.7)	0.6 (0.5)
Post-acute nursing home days per patient	0.4 (0.2)**	0.2 (0.1)**	0.8 (0.6)	0.9 (0.6)
Sample Size	21,854	21,854	6,535	6,535

Notes: ***, **, and * indicates statistical significance at 1, 5, and 10 percent level, respectively. The first stage model presents disenrollment increase in percentage points if plans institute dialysis coinsurance. The IV estimate presents the increase in percentage points or days for one percentage point increase in disenrollment.

Appendix

Table 1A Estimates of the Impact of Dialysis Coinsurance Increase on Dialysis Utilization

	Unadjusted (Prevalent ESRD)	Adjusted for Main Effects (Prevalent ESRD)	Unadjusted (Incident ESRD)	Adjusted for Main Effects (Incident ESRD)
Dialysis Coinsurance Increase	-0.1 (0.1)	-0.1 (0.1)	-0.1 (0.1)	-0.04 (0.11)
F-Statistics Dialysis Coinsurance Increase	0.9	0.67	0.25	0.15
Adjusted R-square	0.0001	0.05	0.0001	0.06

Notes: ***, **, and * indicates statistical significance at 1, 5, and 10 percent level, respectively. The table presents the increase in days for one percentage point increase in disenrollment.

Table 2A Estimated Effect of Voluntary Disenrollment from Medicare Advantage Plans on Health Outcomes Attributable Dialysis Coinsurance Increase (Sensitivity Analyses)

Variable	Marginal Effect (95% Confidence Interval)								
	Multinomial Logit Model	Partial Duals	Non-Duals	Zip-code Income <= 30K	Zip-code Income 30K-50K	Zip-code Income >= 50K	<=3 Stars	3.5 Stars	4+ Stars
First Stage	**Voluntary Disenrollment from Medicare Advantage Plans**								
Dialysis Coinsurance Increase	3.8 (0.5)*	4.4 (2.6)*	6.5 (0.7)***	1.9 (2.3)	1.0 (1.0)	10.4 (1.1)***	-0.9 (1.2)	6.8 (1.2)***	10.5 (1.6)***
F-Statistics Dialysis Coinsurance Increase		2.9	79.4	0.7	1.0	95.9	0.6	31.4	42.1
Adjusted R-square		0.04	0.02	0.03	0.02	0.03	0.06	0.09	0.01
	Instrumental Variable Estimates								
Percentage of patients with acute inpatient care		1 (0.9)	0.3 (0.2)*	1.4 (2.5)	2.4 (2.8)	0.2 (0.1)	0.9 (2.5)	0.6 (0.3)**	0.4 (0.2)**
Percentage of patients with post-acute nursing home care		0.5 (0.6)	0.3 (0.1)**	1.6 (2.2)	2.2 (2.5)	0.1 (0.1)	-3.2 (4.5)	0.3 (0.2)	-0.1 (0.2)
Hospital days per patient		-0.3 (0.5)	0.2 (0.1)	-1.8 (2.3)	1.7 (1.9)	0.1 (0.1)	1.2 (2.2)	0.02 (0.1)	0.25 (0.1)*
Post-acute nursing home days per patient		0.5 (0.6)	0.2 (0.1)*	0.1 (0.8)	2.4 (2.6)	0.04 (0.1)	-1 (2)	0.3 (0.2)	0.2 (0.2)
Sample Size	21,851	1,791	19,960	2,567	7,371	11,913	5,111	6,639	10,101

Notes: ***, **, and * indicates statistical significance at 1, 5, and 10 percent level, respectively. The first stage model presents disenrollment increase in percentage points if plans institute dialysis coinsurance. The IV estimate presents the increase in percentage points or days for one percentage point increase in disenrollment.

Table 3A Utilization of Dialysis Sessions Over Time

Year	No. of Patients	Dialysis Sessions	Quarters	Average Sessions per Quarter	Average Sessions per Week	Average Sessions Per Patient	Cost per Dialysis	Total Cost per Year	Cost Sharing 20%
2008	377,224	44,360,685	1,095,960	40	3.1	118	$130	$15,288	$3,058
2009	387,988	42,239,221	1,044,866	40	3.1	109	$130	$14,153	$2,831
2010	401,295	47,170,173	1,167,657	40	3.1	118	$130	$15,281	$3,056
2011	392,047	48,219,482	1,166,542	41	3.2	123	$130	$15,989	$3,198
2012	373,578	60,228,015	1,109,954	54	4.2	161	$130	$20,959	$4,192
2013	358,214	58,165,543	1,055,630	55	4.2	162	$130	$21,109	$4,222