Payment Reform and Health Disparities: Changes in Dialysis Modality under the New Medicare Dialysis Payment System

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Objective. To evaluate the effect of the Medicare dialysis payment reform on potential disparities in the selection of peritoneal dialysis (PD) for the treatment of end-stage renal disease (ESRD).

Data Sources. Centers for Medicare & Medicaid Services (CMS) ESRD Medical Evidence Form, Medicare claims, and other CMS data for 2008–2013.

Study Design. We examined the association of patient age, race/ethnicity, urban/rural location, pre-ESRD care, comorbidities, insurance, and other factors with the selection of PD as initial dialysis modality across prereform (2008–2009), interim (2010), and postreform (2011–2013) time periods.

Principal Findings. Selection of PD increased among diverse patient subgroups following the payment reform. However, the lower PD selection observed with older age, black race, Hispanic ethnicity, less pre-ESRD care, and Medicaid insurance before the reform largely remained in the initial postreform years.

Conclusions. Despite recent growth in PD, there may be ongoing disparities in access to PD that have largely not been mitigated by the payment reform. There is potential for modifying provider financial incentives to achieve policy goals related to cost and quality of care. However, even with a substantial shift in financial incentives, separate initiatives to reduce existing disparities in care may be needed.

Key Words. Payment systems, provider incentives, treatment options, health care disparities, Medicare

Little is known about the effects on health disparities of ongoing innovations in payment for health care. Payment reforms may alter the financial incentives of providers or redistribute resources in ways that could either reduce or worsen health disparities. This study evaluates whether the implementation of a fully bundled Medicare prospective payment system for outpatient dialysis-related services may have implications for disparities in the selection of a dialysis modality for the treatment of end-stage renal disease (ESRD).

Background on Peritoneal Dialysis and Medicare Payment Policy

Patients diagnosed with ESRD may choose between two primary types of dialysis: hemodialysis and peritoneal dialysis (PD). The most common form of dialysis for treating ESRD is hemodialysis, which filters waste products from the blood and removes excess fluid through a vascular access and is typically performed in a dialysis facility three times per week for 3–4 hours per treatment. The major alternative dialysis therapy, PD, relies on the insertion of dialysate fluid in the abdomen using a peritoneal catheter and is generally a home-based therapy. Modality selection may be influenced by both providers and patients. Providers need to identify any medical contraindications to PD (Mendelssohn et al. 2009). For patients considered eligible for PD, the manner in which treatment options are presented by providers and the preferences of patients may both have important roles. Some patients may prefer PD due to greater perceived independence and flexibility in the timing and location of treatments (e.g., to facilitate work or travel) and fewer dietary and fluid restrictions. A potential disadvantage of PD is the need to perform self-dialysis or have sufficient assistance from a family member or other caregiver.

Until recently, there was a longstanding decline in the use of PD in the United States, from 14 percent of prevalent dialysis patients in 1991 (USRDS 1994) to 7.6 percent in 2008, which was lower relative to most other countries (USRDS 2014). The optimal level of PD use is not known, although U.S. levels have been below those that studies of the attitudes of nephrologists have indicated would be appropriate (Thamer et al. 2000; Mendelssohn et al. 2001). Factors that have been cited as potentially limiting PD use in the United States include barriers to self-care such as a lack of family support (Oliver et al. 2007, 2010; Blake, Quinn, and Oliver 2013), concern that PD is associated with inferior outcomes (Blake and Finkelstein 2001; Khawar et al. 2007), a lack of nephrologist training and experience with PD (Mehrotra et al. 2002), a lack of patient education about PD (Mehrotra et al. 2005; Finkelstein et al. 2008), and the advancing age and comorbidity burden of dialysis patients (Blake and Finkelstein 2001; Khawar et al. 2007). In addition, economic

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[Correction added on 15 June 2017, after first online publication: the credentials for Elizabeth Cope has been changed to “Ph.D., M.P.H.” instead of “M.D.”.]

factors may have previously favored the use of hemodialysis, such as a perceived low marginal cost of hemodialysis relative to PD in facilities with capacity for additional hemodialysis patients (Nissenson et al. 1993; Blake 2004; Mehrotra et al. 2007).

An economic factor that has likely grown in importance since the 1980s is the Medicare payment system for outpatient dialysis, which provides coverage for 83 percent of dialysis patients as a primary payer (USRDS 2014). Starting on August 1, 1983, Medicare payments to dialysis facilities were based on the composite rate system, which established prospective payment rates for dialysis and other related services. Under this system, the same prospective payment rates were used for hemodialysis and PD. Over time, however, dialysis facilities provided an expanding scope and volume of injectable drugs and laboratory tests that were paid on a fee-for service basis by Medicare. This included the injectable drug erythropoietin (EPO), an erythropoiesis stimulating agent (ESA) that was approved by the Food and Drug Administration in 1989 for treating anemia in patients with kidney disease and would later become the most expensive drug under Medicare Part B (U.S. GAO 2012). EPO and other more commonly used drugs such as injectable iron and vitamin D were found to be relatively profitable for dialysis facilities (OIG 2004, 2006), and became a growing source of dialysis facility revenues and profits. By 2007, separately billable services accounted for 35 percent of total dialysis facility payments under Medicare (Federal Register 2010). There was a tendency to use much lower levels of ESAs and other injectable ESRD drugs with PD, such that the average Medicare Allowable Payment per treatment for separately billable services was \$52 lower for PD (Federal Register 2009). These developments led to growing financial disincentives for dialysis facilities to encourage the use of PD.

In accordance with the Medicare Improvements for Patients and Providers Act of 2008 (MIPPA 2008), a new Medicare prospective payment system (PPS) was implemented in 2011 that established fixed payment rates for outpatient dialysis-related services. In implementing this reform, CMS noted goals of eliminating the incentive to overuse separately billable services and providing greater flexibility for dialysis facilities which could enhance quality of care (Federal Register 2010). The PPS established the same payment rates for hemodialysis and PD with the intent of encouraging PD as a home therapy (Federal Register 2010). Given the \$52 lower average payment per treatment with PD for separately billable services prior to the reform, which represents a potentially important source of profit with PD under a PPS that adopted the same base rate amount of \$229.63 per treatment for both modalities (Federal

Register 2010), the reform resulted in a significant shift in financial incentives regarding the use of PD.

Differences in the Use of PD

Prior to the payment reform, PD was used more frequently among patients who were younger (Kendix 1997; Winkelmayer et al. 2001; Stack 2002; Xue et al. 2002), had fewer comorbidities (Miskulin et al. 2002; Stack 2002), more favorable laboratory indicators (Xue et al. 2002), and higher levels of physical functioning (Stack 2002). As a therapy that may facilitate employment, PD was more likely to be used among patients who were employed (Stack 2002; Hirth et al. 2003).

There are also well-established differences in PD use among other patient subgroups that may indicate disparities in care. The former Institute of Medicine (IOM) defined disparities as differences in care that do not reflect clinical needs, patient preferences,¹ or the appropriateness of treatment (Institute of Medicine 2003). Patterns in the findings of previous studies of PD use point to possible disparities involving certain racial minorities and other disadvantaged subgroups. Based on multiple studies that accounted for a varying number of clinical factors, there was a consistent finding of lower PD use among non-white patients (Stack 2002) and black patients (Barker-Cummings et al. 1995; Kendix 1997; Winkelmayer et al. 2001; Xue et al. 2002) compared to white patients. A lower reported likelihood of receiving care from a nephrologist before ESRD among racial minorities (Ifudu et al. 1999; Kinchen et al. 2002) may contribute to differences in PD use by race. However, racial differences in PD use have persisted when accounting for pre-ESRD care (Winkelmayer et al. 2001; Stack 2002).

Other findings suggest potential sources of disparities in PD. PD use was higher with earlier referral to a nephrologist prior to onset of ESRD (USRDS 1997; Schmidt et al. 1998; Stack 2002; Prakash et al. 2013) and with pre-ESRD education on treatment options (Ahlmén, Carlsson, and Schönborg 1993; Prichard 1996; USRDS 1997; Golper 2001; Lacson et al. 2011). There were indications of higher PD use among patients who had higher educational attainment (Stack 2002) and who had family support or were not living alone (Stack 2002; Oliver et al. 2010; Prakash et al. 2013) and lower PD use among patients covered by Medicaid (Winkelmayer et al. 2001).

There are likely to be perceived benefits to PD in more isolated geographic areas, where patients would need to travel long distances three times per week for in-center hemodialysis. Indeed, there is evidence of higher PD

use in rural areas (O'Hare, Johansen, and Rodriguez 2006; Maripuri et al. 2012). However, PD was less likely to be offered as a treatment option by rural facilities (O'Hare, Johansen, and Rodriguez 2006; Wang et al. 2010) and by facilities in the South and Midwest relative to the Northeast (Wang et al. 2010).

Potential for Disparate Impact of the Payment Reform

There is potential for the payment reform to induce changes in provider behavior that mitigate barriers to PD. Previous research suggests that providers have an important influence on PD use. There are reports of variation in nephrologist recommendations regarding modality based on patient demographic, clinical, and social factors (Thamer et al. 2000) and in perceived PD eligibility across dialysis facilities (Blake, Quinn, and Oliver 2013). The inclination of dialysis providers to recommend PD may be influenced by their level of training and familiarity with this therapy, which has been shown to vary widely in the United States (Mehrotra et al. 2002).

The introduction of financial incentives that favor PD may lead dialysis facilities to develop additional expertise with this therapy and change the manner in which they discuss PD with patients. Such efforts could differentially benefit patient subgroups who have previously faced greater barriers in access to PD. For example, greater efforts to inform new ESRD patients about PD as a treatment option and provide related support could be especially effective for those with a lack of pre-ESRD nephrology care.

Alternatively, there may be important barriers to PD that are more difficult for dialysis providers to address. Previous studies seeking to identify specific barriers to PD found that aside from medical factors seen by the care team as likely preventing successful use of PD, patient eligibility for PD was most often limited by factors related to their physical or social environment, such as characteristics of their residence or language issues that prevented them from choosing PD (Prakash et al. 2013). If such barriers are more pronounced for certain patient subgroups, such as those who are socioeconomically disadvantaged, there may be relatively limited increases in PD use among some subgroups following the payment reform and potentially growing disparities in care.

Our research objective is to evaluate the effect of the new bundled Medicare dialysis payment system on potential disparities in the use of PD. We hypothesize that the payment reform could have either reduced or widened any existing disparities in PD use, depending on whether dialysis facilities mitigated any relevant barriers to PD. In studying the effects of the payment reform, we focused on factors previously found to be strongly associated with the use of PD

that can be used to define potential disparity groups, including patient age, race/ethnicity, pre-ESRD nephrology care, and rural/urban location.

DATA AND EMPIRICAL METHODS

Data Sources

Our primary source of dialysis patient data is the ESRD Medical Evidence Report (CMS Form 2728), which providers are required to complete for all individuals in the United States newly diagnosed with ESRD. This form includes a physician attestation that either dialysis or a kidney transplant is required to maintain life, which is used to establish entitlement for Medicare benefits. This form includes data reported at incidence of ESRD on patient demographics (date of birth, sex, race, ethnicity, residence zip code), laboratory indicators of patient severity related to renal disease (hemoglobin, serum albumin, glomerular filtration rate), primary cause of ESRD, comorbidities, body mass index (BMI), multiple indicators of functional status (described in Table 1), current and previous employment, and insurance. It also includes indicators of whether ESRD patients received care from a nephrologist or erythropoietin stimulating agents (ESAs) for treatment of anemia prior to incidence of ESRD.

Indicators of dialysis facility organizational affiliation, for-profit status, and potential excess capacity for in-center hemodialysis (number of hemodialysis patients per hemodialysis station) were defined using data from Dialysis Facility Compare (CMS 2015).

Following the methodology used by the U.S. Renal Data System (USRDS), the national ESRD patient registry, the status of each patient at 90 days following incidence was determined using a combination of CMS Form 2728, Medicare claims, the CMS-2746 Death Notification Form, and other ESRD data sources, which include the Standard Information Management System (SIMS) Events file and the Consolidated Renal Operations in a Web-enabled Network (CROWNWeb; USRDS 2015). The “anticipated long-term primary type of dialysis” among incident patients was obtained from CMS Form 2728 as a secondary outcome of interest.

Study Population

As the initial months of ESRD may represent a period of stabilization in which patients further consider their preferred treatment modality with

Table 1: Descriptive Statistics for Patients 90 Days after ESRD Incidence*

	<i>%, Prereform: 2008–2009 (N = 185,976)</i>	<i>%, Interim: 2010 (N = 96,047)</i>	<i>%, Reform: 2011–2013 (N = 289,128)</i>
Peritoneal dialysis (PD)	7.9	9.0	11.0
<i>Demographics</i>			
Sex			
Male	56.6	57.0	57.1
Female	43.4	43.0	42.9
Age			
18–39	8.0	7.7	7.5
40–64	44.4	44.2	44.7
65–74	23.5	24.1	24.6
75+	24.2	24.0	23.3
Race			
White, non-Hispanic	50.5	50.3	50.4
White, Hispanic	13.4	13.9	14.1
Black, non-Hispanic	29.7	29.2	28.8
Black, Hispanic	0.4	0.5	0.4
Asian	3.7	3.8	4.0
Pacific Islander	0.8	0.9	1.0
American Indian/Alaskan Native	1.2	1.1	1.1
Other/Multi/Missing	0.4	0.4	0.1
RUCA (Rural/Urban) category			
Urban	80.3	80.2	80.2
Large Rural	9.8	9.8	9.8
Small Rural	5.5	5.5	5.5
Isolated Rural	3.9	3.9	3.9
Unknown	0.4	0.6	0.6
Census region			
Northeast	14.1	13.3	13.4
Midwest	20.8	20.6	20.5
South	40.4	40.8	41.2
West	20.0	20.7	20.4
Puerto Rico	1.3	1.4	1.4
Unknown	3.4	3.2	3.2
<i>Clinical</i>			
BMI			
Underweight	3.5	3.2	3.1
Normal	29.5	28.6	27.8
Overweight	28.1	27.9	27.9
Obese	38.0	39.6	40.4
Missing/OOR	1.0	0.8	0.7
Pre-ESRD Nephrology Care/ESA use			
Pre-ESRD Nephrology Care Unknown*	11.9	11.7	12.1
No Pre-ESRD Nephrology Care	28.6	28.1	25.5

Continued

Table 1. *Continued*

	%, Prereform: 2008–2009 (N = 185,976)	%, Interim: 2010 (N = 96,047)	%, Reform: 2011–2013 (N = 289,128)
Pre-ESRD Nephrology Care, Prior ESA Unknown	9.9	10.9	13.1
Pre-ESRD Nephrology Care, No Prior ESA	24.1	27.1	31.9
Pre-ESRD Nephrology Care, Prior ESA	25.4	22.2	17.4
Hemoglobin			
5 to <9	24.5	26.5	30.8
9 to <10	23.3	24.1	23.5
10 to <11	21.7	21.0	18.0
11 to <12	13.4	12.0	9.4
12 to 20	8.8	7.6	6.0
Missing/OOR	8.5	8.8	12.3
Serum albumin			
1 to <3.1	32.2	30.8	29.5
3.1–3.4	16.7	16.8	16.1
>3.4, ≤5.5	27.8	27.6	26.4
Missing/OOR	23.4	24.8	28.0
Glomerular filtration rate (GFR, MDRD)			
2 to <5	7.5	7.2	8.2
5–10	39.6	38.5	39.6
>10, ≤20	45.7	46.8	45.5
Missing/OOR	7.2	7.5	6.7
Primary cause of ESRD			
Diabetes	47.2	47.5	47.9
Hypertension	29.0	29.4	30.0
Glomerulonephritis	7.8	7.4	7.3
Cystic kidney	2.2	2.0	2.0
Other urologic	0.5	0.4	0.4
Other cause	9.2	9.5	9.1
Unknown cause	3.4	3.1	2.7
Missing cause	0.8	0.7	0.7
<i>Comorbidities (not mutually exclusive)</i>			
Diabetes (not cause)	12.6	13.1	13.9
Atherosclerotic disease	20.7	20.2	17.7
Cardiac failure	31.7	31.3	29.7
Cerebrovascular disease	9.3	9.3	8.9
Peripheral vascular disease	13.5	13.3	12.0
Other cardiac	16.5	17.3	17.9
COPD	8.7	9.2	9.1
Cancer	6.9	7.1	6.8
Nonrenal congenital abnormality	0.2	0.2	0.2
Toxic nephropathy	0.4	0.4	0.4

Continued

Table 1. *Continued*

	<i>%, Prereform: 2008–2009 (N = 185,976)</i>	<i>%, Interim: 2010 (N = 96,047)</i>	<i>%, Reform: 2011–2013 (N = 289,128)</i>
Amputation	3.1	3.2	3.3
Alcohol dependence	1.4	1.5	1.4
Drug dependence	1.3	1.2	1.2
Tobacco use	6.4	6.4	6.5
<i>Functional status</i>			
Needs assistance with daily activities	10.7	11.5	11.9
Institutionalized [†]	7.0	7.4	7.4
Inability to ambulate	6.0	6.3	6.0
Inability to transfer	2.9	3.1	3.1
<i>Employment and insurance</i>			
Employment			
Current	11.6	10.9	11.1
6 months prior	19.2	18.2	17.3
Insurance category			
Employer	24.8	23.5	21.2
Traditional Medicare only	14.8	15.6	18.1
Medicaid only	11.7	12.1	11.1
Traditional Medicare and Medicaid only	11.9	12.1	13.1
Medicare advantage	6.7	7.8	8.8
Veterans	1.9	2.1	2.2
Other coverage	20.4	19.0	18.1
No coverage	7.8	7.8	7.4
Unknown	<0.1	<0.1	<0.1
<i>Facility characteristics</i>			
Facility type			
Hospital based	6.0	5.0	4.1
Hospital satellite [‡]	3.4	3.2	3.0
Nonprofit, dialysis organization	6.4	6.2	6.0
Nonprofit, independent	1.3	1.3	1.2
For profit, dialysis organization	70.3	71.3	73.6
For profit, independent	10.8	10.8	9.7
VA	0.7	0.7	0.6
Unknown	1.2	1.5	1.8
HD stations per HD patient			
Low	32.9	32.2	29.0
Medium	31.9	31.9	29.7
High	30.8	31.3	29.6
Unknown	4.5	4.6	11.7

*Includes <0.1% of patients for whom pre-ESRD nephrology care was missing; for the remaining patients, this was reported by providers as being “Unknown.”

[†]Includes assisted living, nursing home, or other institution.

[‡]Includes outpatient dialysis facilities owned and operated by a hospital but not located on the central hospital campus.

input or support from dialysis facilities, our primary analyses examined the dialysis modality being used at 90 days following incidence of ESRD. Using CMS Form 2728, we identified 655,896 individuals in the United States who were certified as requiring treatment for ESRD between January 1, 2008, and December 31, 2013, and were not identified as imminent kidney transplant recipients. We excluded 5,227 patients who were less than 18 years of age, 1,470 patients living in U.S. territories other than Puerto Rico, and 34 patients missing data on variables needed for analysis.² After excluding patients who died (50,576), recovered renal function (22,520), received a transplant (2,285), or whose status was unknown (3,710), our primary study population included 571,151 patients undergoing dialysis 90 days following incidence of ESRD. Secondary analyses examined the anticipated long-term dialysis modality for a study population of incident ESRD patients who would have less time to consider treatment options with input from dialysis facilities.

Payment Reform and Potential Disparity Groups

To study the effects of the payment reform, we identified three time periods for analysis. As the payment reform was implemented starting on January 1, 2011, we defined the 2011–2013 period as the “reform” period. Since the proposed policy was issued in the Fall of 2009 (Federal Register 2009) and the final policy was published in August 2010 (Federal Register 2010), we defined 2008–2009 as the “prereform” period and 2010 as an “interim” period when dialysis providers may have begun responding to the reform.

Patient residences were classified on a rural–urban scale by mapping the reported residence zip codes to Rural-Urban Commuting Area (RUCA) codes. These codes use the Census Bureau’s Urbanized Area and Urban Cluster definitions, along with work commuting information, to characterize areas as urban, large rural city/town, small rural town, or isolated small rural town. Using this categorization, urban areas include both core metropolitan regions and areas with at least 30 percent flow to an area with a population of at least 50,000. The subclassification of rural areas represents a continuum from areas with easy access to large cities and towns to isolated areas, as the former are likely to support many medical providers while the latter may have none. In the case of Puerto Rico, direct zip code classification was not available, so RUCA’s approximation based on census tracts was used.³

Separate indicators of pre-ESRD nephrologist care and ESA use were used to define a combined measure of pre-ESRD nephrology care.

Models and Estimation

We estimated logistic regression models of the probability of selecting PD (vs. HD). Before pooling data for the three time periods of interest, we estimated separate logistic regression models for each time period to consider the inclusion of predictor-by-time period interaction terms as control variables (see Tables S2 and S3 in Appendix SA2 for model results). Based on these results, time period interaction terms were included for census region, BMI, hemoglobin, and low HD capacity at the patient's facility, in addition to the potential disparity groups (race/ethnicity, age, rural/urban residence, and pre-ESRD nephrology care).

While aORs for the prereform period can be easily obtained by exponentiating the relevant estimated coefficient, aORs for the interim and bundle period involve multiple interaction terms. For example, "Age 65–74, prereform period" is used as the reference category for the aORs calculated for different age groups across time periods. The aOR for "Age 75 and older, reform period" is calculated by exponentiating the difference between the logits for the two categories,

$$D_{\text{Logit}} = \hat{\beta}_{\text{Age75+}} + \hat{\beta}_{\text{Reform}} + \hat{\beta}_{\text{Age75+} \times \text{Reform}} + \sum \hat{\beta}_{\text{Control} \times \text{Reform}} \bar{X}_{\text{Control, Reform}}, \quad (1)$$

where $\hat{\beta}_{\text{Control} \times \text{Reform}}$ is the estimated coefficient on the interaction term between each control variable and the reform time period, and $\bar{X}_{\text{control, reform}}$ is the mean of the control variable for patients incident during the reform period. The standard error for the logit of "Age 75 and older, reform period" is calculated as the square root of the variance of equation (1), using the estimated variance–covariance matrix for the coefficients. The confidence interval can then be calculated as

$$[\exp(D_{\text{Logit}} - 1.96 \times \text{SE}), \exp(D_{\text{Logit}} + 1.96 \times \text{SE})],$$

where D_{Logit} is defined as in equation (1), and SE is the standard error of D_{Logit} .

To aid readers, aORs and associated confidence intervals for disparity groups were calculated with values for control variables taken at their means and presented as forest plots in Figure 2.

All analyses were conducted using SAS 9.3 (SAS Institute, Inc., Cary, NC, USA).

RESULTS

Trends in the Selection of PD

The long-term trend in the selection of PD based on data published by the USRDS is shown in Figure 1 (USRDS 2014, 2015). Over a 25-year period, the selection of PD among incident patients generally declined, falling from 15.0 percent in 1983 to 6.0 percent in 2008. As of the third year of the reform in 2013, this had risen to 9.3 percent of incident patients.

Characteristics of Incident Dialysis Patients

Comparisons across the prereform, interim, and reform periods do not suggest substantive changes in overall patient case mix (Table 1). Two clinical factors with larger observed changes over time include the pre-ESRD use of ESAs and average hemoglobin values, which occurred in the context of a shift toward more conservative use of ESAs for anemia management.

Figure 1: Selection of PD among Incident U.S. Dialysis Patients, by Year of Incidence, 1983–2013 [Color figure can be viewed at wileyonlinelibrary.com]

Source: USRDS 2014 Annual Data Report, Reference Table D.1 for 1983–1996 data, USRDS 2015 Annual Data Report, Reference Table D.1 for 1997–2013 data.

PD Selection Models

The coefficient estimates from the pooled logistic regression of PD selection at 90 days after incidence are presented in Table 2. In the prereform period, a combination of prior nephrologist care and ESA use increased the odds of PD selection relative to patients with no reported care of either type. Healthier patients (as indicated by the absence of reported physical comorbidities) and those without functional status limitations tended to be more likely to select PD.

When controlling for available clinical factors, which do not include indicators of mental health conditions (e.g., dementia), younger patients were more likely to select PD. There was a lower likelihood of PD selection for black, Pacific Islander, and American Indian/Alaskan Native (AIAN) patients (relative to white patients) and for Hispanic patients. Patients living in more rural areas and patients who were employed were more likely to select PD, while patients with Medicaid insurance were less likely to select PD. Similar factors were associated with PD selection in the prereform, interim, and reform periods.

Because the coefficients on the interaction terms are not directly interpretable, aORs for the three time periods were calculated, along with their associated standard errors, and are presented in Figure 2 for potential disparity groups.

Race and Ethnicity. As shown in Figure 2, PD use at 90 days increased between the prereform and reform periods for most race/ethnicity subgroups. The estimated aOR for white non-Hispanic patients in the reform period was 1.29 ($p < .0001$ relative to the reference group of white non-Hispanic patients in the prereform period). Notably, PD use increased among most minority subgroups who were less likely to use PD prior to the reform, including black non-Hispanic patients (aOR=0.56 in the prereform period and 0.77 in the reform period, $p < .0001$), white Hispanic patients (from 0.69 to 0.96, $p < .0001$), black Hispanic patients (from 0.39 to 0.58, $p < .0001$), and Pacific Islander patients (from 0.66 to 0.93, $p < .01$). These results do not indicate large disproportionate growth in PD among these racial/ethnic minorities relative to white non-Hispanic patients.

Table 2: Estimated Logistic Regression Coefficients for PD at 90 Days after Incidence of ESRD, 2008–2013

<i>Variable</i>	<i>Estimated Coefficient</i>
Intercept	−3.0933***
Interim time period	0.1385*
Reform period	0.2551***
<i>Demographics</i>	
Female	0.1567***
Age category	
18–39	0.5629***
40–64	0.1812***
75 +	−0.4821***
75+ × Interim	0.0483
75+ × Reform	0.0792*
Race category	
American Indian/Alaskan Native(AIAN)	−0.2704**
AIAN × Interim	−0.2237
AIAN × Reform	−0.2116*
Asian	−0.0118
Asian × Interim	0.1138
Asian × Reform	0.0884
Black	−0.5818***
Black × Interim	0.0393
Black × Reform	0.0689*
Other/multiracial(O/M)	−0.1011
O/M × Interim	−0.0493
O/M × Reform	−0.4329
Pacific Islander(PI)	−0.4128***
PI × Interim	−0.0358
PI × Reform (Reference Group: White)	0.0802
Hispanic	−0.3670***
Hispanic × Interim	0.0590
Hispanic × Reform	0.0734*
Urban/Rural (RUCA) category	
Large Rural	0.2159***
Large Rural × Interim	0.0105
Large Rural × Reform	−0.0963**
Small Rural	0.3770***
Small Rural × Interim	−0.1399*
Small Rural × Reform	−0.1045*
Isolated Rural	0.5362***
Isolated Rural × Interim	−0.1146
Isolated Rural × Reform	−0.0901
RUCA unknown (Reference group: urban)	−0.0227
Census region	
Midwest	0.4023***

Continued

Table 2. *Continued*

<i>Variable</i>	<i>Estimated Coefficient</i>
Midwest × Interim	0.0673
Midwest × Reform	0.1438***
South	0.5624***
South × Interim	0.1167*
South × Reform	0.1429***
West	0.4658***
West × Interim	0.0357
West × Reform	0.1412***
U.S. Territory (Puerto Rico)	1.0209***
US Terr. × Interim	−0.2099
US Terr. × Reform	−0.3572***
Unknown (Reference group: Northeast)	0.4695***
<i>Clinical</i>	
BMI	
Underweight	−0.2608***
Underweight × Interim	−0.0247
Underweight × Reform	0.0613
Overweight	0.1050***
Obese	−0.0969***
Missing (Reference Group: Normal)	0.0209
Pre-ESRD Nephrologist Care/ESA Treatment	
Pre-ESRD Nephrology Care Unknown	−0.0579*
Pre-ESRD Nephrology Care, ESA Unknown	0.5478***
Pre-ESRD Nephrology Care, No ESA	0.9312***
Pre-ESRD Nephrology Care, ESA	1.1161***
Pre-ESRD Neph. Care, ESA, × Interim	−0.0465
Pre-ESRD Neph. Care, ESA, × Reform (Reference Group: No Pre-ESRD Nephrology Care)	−0.0525*
Primary cause of ESRD	
Diabetes	−0.4192***
Hypertension	−0.3287***
Cystic kidney	−0.2932***
Other urologic	−0.4022***
Unknown/other (Reference group: Glomerulonephritis)	−0.4987***
Hemoglobin at incidence (g/dl)	
5 to <9	−0.6373***
5 to <9 × Interim	0.0427
5 to <9 × Reform	0.1110**
9 to <10	−0.4173***
9 to <10 × Interim	0.0478
9 to <10 × Reform	0.1118***
10 to <11	−0.1748***
10 to <11 × Interim	−0.00062
10 to <11 × Reform	0.0756*

Continued

Table 2. *Continued*

<i>Variable</i>	<i>Estimated Coefficient</i>
12 to 20	0.0837**
12 to 20 × Interim	−0.0258
12 to 20 × Reform	−0.0684
Missing/out-of-range (Reference group: 11 to <12)	−0.1276***
Glomerular filtration rate at incidence	
2 to <5	−0.1393***
>10	0.1857***
Missing (Reference group: 5–10)	−0.0861***
Serum albumin	
1 to <3.1	−0.3567***
>3.4	0.4419***
Missing (Reference group: 3.1 to 3.4)	0.000437
<i>Comorbidities</i>	
Diabetes, not ESRD cause	−0.2162***
Atherosclerotic heart disease	−0.1079***
Cardiac failure	−0.3815***
Cerebrovascular disease	−0.1280***
Peripheral vascular disease	−0.0577**
Other cardiac	−0.1199***
COPD	−0.3657***
Cancer	−0.1938***
Nonrenal congenital abnormalities	0.0485
Toxic nephropathy	−0.2082*
Amputation	−0.0679
Alcohol	−0.5453***
Drug dependence	−0.6153***
Tobacco use	0.0159
<i>Functional status</i>	
Needs assistance with daily activities	−0.2961***
Institutionalized	−1.5779***
Inability to ambulate	−0.4656***
Inability to transfer	−0.1588*
<i>Employment/insurance</i>	
Currently employed	0.3319***
Employed 6 months ago	0.3104***
Insurance categories	
Any employer insurance	0.2749***
Medicare advantage	−0.0828***
Medicaid only	−0.3748***
Medicare and Medicaid only	−0.5154***
Veterans	−0.3707***
No coverage	0.2139***
Unknown/other (Reference group: Medicare only)	0.00885

Continued

Table 2. *Continued*

<i>Variable</i>	<i>Estimated Coefficient</i>
<i>Facility</i>	
Facility type	
Hospital based	0.0990***
Hospital satellite	−0.3542***
Independent, for profit	0.4241***
Dialysis organization, nonprofit	−0.0102
Independent, nonprofit	−0.0106
VA (Reference group: dialysis organization, for profit)	−0.6684***
HD stations per HD patient	
Medium	−0.0435***
Low	0.1614***
Low × Interim	−0.0384
Low × Reform	−0.0141
Unknown	0.8643***

Note. $N = 571,151$; * $p < .05$, ** $p < .01$, *** $p < .001$.

Age. There were statistically significant increases over time in PD selection for all four age groups. For the youngest age group, the estimated aOR increased from 1.76 in the prereform period to 2.27 in the reform period ($p < .0001$). For the oldest age group, the estimated aOR increased from 0.62 in the prereform period to 0.86 after the reform ($p < .0001$).

Urban/Rural. Peritoneal dialysis selection increased among patients in both urban and rural areas. The estimated aOR for patients in urban areas was 1.32 (vs. the reference group of urban areas in the prereform period; $p < .0001$). The relative increases were similarly large for all three types of rural areas (with $p < .01$ for each).

Pre-ESRD Nephrology Care. Even among patients with greater pre-ESRD nephrology care, who were substantially more likely to select PD before the reform, there were relatively large increases in PD postreform. The estimated aOR for patients receiving both pre-ESRD nephrologist care and ESA treatment for anemia increased from 3.05 in the prereform period (with no pre-ESRD nephrology care in the prereform period as the reference group) to 3.82 postreform ($p < .0001$). In comparison, among patients with no prior nephrology care, the estimated aOR in the reform period was 1.32 ($p < .0001$ vs. the reference group).

Figure 2: Adjusted Odds Ratios by Time Period for PD Selection 90 Days after Incidence of ESRD: (a) Race/Ethnicity, (b) Age Group, (c) Urban/Rural Location, and (d) Pre-ESRD Nephrology Care

(a) Race/Ethnicity

(b) Age Group

(c) Urban/Rural Location

(d) Pre-ESRD Nephrology Care

For all disparity groups under study, relatively similar patterns and trends in selection of PD as the intended modality at incidence of ESRD were observed (see the tables and Figure S1 in Appendix SA2).

DISCUSSION

In a context where the use of PD in the United States largely declined over more than a 20-year period and was low relative to many other countries, there has been a relatively sharp reversal under the recent Medicare dialysis payment reform. From 2009 to 2013, the selection of PD increased by approximately 50 percent to levels not seen since 1998. Overall, similar clinical factors are associated with PD selection following the reform. As this study demonstrates, there has been growth in PD under the new payment system among diverse subgroups of patients, including those who were identified as being less likely to select PD prior to the reform based on factors such as race and ethnicity and levels of pre-ESRD care. However, with much of the previously observed differences among these subgroups persisting in the initial years under the reform, there may be ongoing disparities in the use of PD that have largely not been addressed.

As new payment policies and other reforms have targeted improvements in overall efficiency and quality of care, there has been growing awareness of the potential implications for health disparities. Such issues have surfaced with bundled payment systems (Wang, Conroy, and Zuckerman 2009), accountable care organizations (Anderson et al. 2014), value-based purchasing programs (Casalino et al. 2007; Cheung et al. 2008; Chien, Li, and Rosenthal 2010; Joynt and Jha 2013; Ryan 2013; Damberg, Elliott, and Ewing 2015), and other payment reforms (Davitt and Kaye 2010). In these varying contexts, there is a risk of shifting resources away from providers who care for socioeconomically disadvantaged populations or otherwise creating financial pressures or constraints that may worsen health disparities.

Alternatively, there may be existing disparities that are immune to changes in payment. Based on the current study, there may be continuing disparities in access to PD that have largely been unaffected by a substantial shift in incentives, pointing to a need for other remedies. One area for further improvement involves the extent of pre-ESRD nephrology care and of patient education about available treatment options, which previous studies have identified as being strongly related to selection of PD (Diaz-Buxo 1998; Obador and Pereira 1998; Stack 2002; Mehrotra et al. 2005; Lacson et al. 2011).

The importance of these factors puts some patient subgroups at a disadvantage in considering PD. Pre-ESRD nephrology care has been reported to vary based on race (Ifudu et al. 1999; Kinchen et al. 2002; Prakash et al. 2010) and socioeconomic factors (Obialo et al. 2005; Prakash et al. 2010). As shown in the current study, limited or no pre-ESRD care continues to be reported for many dialysis patients and remains an impediment to the use of PD. New initiatives may help to overcome informational barriers to PD. For example, a Patient-centered Outcomes Research Institute (PCORI) funded project is developing a decision aid to assist patients in making a choice between PD and hemodialysis (PCORI 2015).

Even when controlling for pre-ESRD care and available socioeconomic factors, previous studies have found lower use of PD among African American patients (Barker-Cummings et al. 1995; Miskulin et al. 2002; Xue et al. 2002) and non-white patients (Stack 2002). Using a similar approach, we found continued lower use of PD among both black and Hispanic patients under the new payment system. Furthermore, these differences were not diminished among those with greater pre-ESRD care. Together, these results suggest there may be other factors contributing to racial and ethnic disparities in PD use which have previously not been well understood (Barker-Cummings et al. 1995) and have not been materially affected by the reform.

In the context of well-established patterns in PD use by patient age which may reflect a combination of clinical, social, and employment-related factors, this study demonstrates growing use of PD among older patients, including ages 75 and older. Overcoming physical and cognitive barriers to PD which have been found to be relatively common among dialysis patients (Oliver et al. 2010) and may tend to affect older patients in particular may require home care assistance or family support (Oliver et al. 2007, 2010). Such issues may limit attenuation over time of differences in PD selection by age.

Our finding of lower PD use among patients with Medicaid coverage echoes previous studies reporting an association of lower socioeconomic status with use of PD (Barker-Cummings et al. 1995; Winkelmayer et al. 2001; Stack 2002). In our study, Medicaid insurance may in part serve as a proxy for other socioeconomic factors such as education and housing, which have previously been linked to PD (Barker-Cummings et al. 1995; Stack 2002) and may improve access to this therapy. Persisting differences in PD use based on factors such as race, pre-ESRD care, and socioeconomic indicators may point to provider limitations in addressing barriers to PD in spite of the recent shift in financial incentives favoring this therapy.

As one of the limitations of this study, it is not possible for us to fully ascertain the role of patient preferences or clinical needs in explaining differences in PD selection, such that it is not clear whether all observed differences represent disparities. For example, a lower selection of PD among older patients may in part reflect weaker preferences for PD, if the findings from a study in the Netherlands (Jager et al. 2004) are also relevant in the United States. More broadly, there may be differences in patient perceptions of self-efficacy, which have been identified as potential barriers to self-dialysis in Canada (McLaughlin et al. 2003; Cafazzo et al. 2009) and may reflect patient preferences or appropriateness of treatment rather than the effects of poor provider–patient communications. As another potential limitation, recent developments other than the payment reform may have also contributed to PD growth. The introduction of the advanced chronic kidney disease education benefit under Medicare starting in 2010 may have prompted greater consideration of treatment options before ESRD among patients who were already Medicare eligible. In addition, efforts to improve pre-ESRD education about treatment options were being explored by one of the two large national dialysis organizations prior to the payment reform (Lacson et al. 2011). However, the limited uptake of this benefit to date (USRDS 2013) and growth in PD observed among patients under age 65 who would have generally not been eligible for the Medicare chronic kidney disease education benefit (unless they were disabled), as well as across broad dialysis facility ownership categories, suggests these factors were not primary drivers of the recent growth.

CONCLUSION

This study demonstrates the potential for using new payment approaches to increase the use of alternative therapies that may have advantages for some patients and promote efficiency. In the current context, the Medicare dialysis payment reform has been effective in increasing the use of PD as a home-based therapy for ESRD. Despite the expanded use of PD among diverse subgroups of patients, the continued association of factors such as black race, Hispanic ethnicity, a lack of pre-ESRD nephrology care, and Medicaid insurance with lower selection of PD under the new payment system suggests there may be ongoing disparities in access to PD that have generally not been mitigated by the reform and are likely to require separate remedies. Even with a marked change in financial incentives, there may be a continuing need for initiatives that are specifically designed to eliminate disparities in care.

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NOTES

1. This excludes certain aspects of patient preferences that may reflect disparities in care, such as an inaccurate understanding of available treatment options that resulted from poor provider–patient communications (IOM 2003).
2. These exclusion criteria are not mutually exclusive.
3. See WWAMI Rural Health Research Center (2015) for further details.

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SUPPORTING INFORMATION

Additional supporting information may be found online in the supporting information tab for this article:

Appendix SA1: Author Matrix.

Appendix SA2:

Table S1. Descriptive Statistics for Patients at Incidence of ESRD.

Table S2. Logistic Regression Results for Modality at Incidence of ESRD, by Time Period.

Table S3. Logistic Regression Results for Modality at 90 Days after Incidence of ESRD, by Time Period.

Table S4. Estimated Logistic Regression Coefficients for PD at Incidence of ESRD, 2008–2013.

Table S5. Estimated aOR's (95% Confidence Intervals) Calculated for Potential Disparity Groups, by Time Period.

Figure S1. Adjusted Odds Ratios by Time Period for PD Selection at Incidence of ESRD.