Effect of Insurance on Prescription Drug Use by ESRD Beneficiaries

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In this article the author reviews the prescription drug coverage policy in the Medicare End Stage Renal Disease (ESRD) program and examines the relationship between secondary insurance status and the number of medications prescribed for dialysis patients who had Medicare as their primary payer. Negative binomial models were used to examine this relationship. Findings in this study indicate that the number of secondary payers has a significant impact on the number of prescription drugs received by Medicare ESRD patients. Further research is needed to determine whether Medicare beneficiaries without secondary insurance are obtaining fewer prescriptions than needed or if those with greater coverage are obtaining more than needed.

INTRODUCTION

Prescription drug coverage in Medicare is a popular request among the elderly. To date, most outpatient prescription drugs have not been included as a Medicare benefit because of concern over increasing program expenditures as a result of such coverage. Several studies (Mueller, Schur, and O'Connell, 1997; Stuart and Grana, 1998) have found that elderly persons with secondary insurance (e.g., insurance other than Medicare) are more likely to take medications. However, the relationship between secondary insurance status and medication use among enrollees in the Medicare ESRD program remains an unexplored issue. Because of the complexity of permanent renal failure and the combination of multiple comorbidities in this population, most ESRD beneficiaries are on several medications (St Peter, Clark, and Levos, 1998). Therefore, difficulties in meeting their medication needs may be especially detrimental to this group of patients.

In this article I examine medication use in the Medicare ESRD program from two aspects. First, I review the current Medicare outpatient prescription drug coverage policy and discuss problems associated with that policy. Second, I explore the relationship between secondary insurance status and medication use among ESRD beneficiaries on dialysis for whom Medicare was primary payer.

BACKGROUND

Medicare ESRD Program

Medicare started its ESRD program in 1973 as a result of the 1972 Social Security Amendments. The purpose of this program is to save the lives of persons with permanent kidney failure by covering dialysis or renal transplantation. ESRD, like age or disability status in Social Security, makes a person eligible for Medicare, if he or she has paid into the Social Security system for a certain period of time or is the dependent

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of someone who has paid into the system for that period. Any person who meets the Social Security eligibility requirement and whose loss of kidney function is certified by a physician as irreversible is eligible for Part A and Part B of Medicare. Soon after this program became effective, Medicare felt the financial burden of this program as a result of increasing enrollment size. In less than 3 years, program costs and enrollment both doubled (Rettig, 1976).

Compared with non-ESRD Medicare, the ESRD program is not only more expensive in terms of per capita expenditure but also in terms of total expenditures. According to a recent publication by HCFA (Health Care Financing Administration, 1995) that identified three groups of high-cost users of Medicare services, ESRD beneficiaries topped the list, followed by non-ESRD beneficiaries who had died or were hospitalized during the reporting year. In 1995 the point prevalence of ESRD was approximately 257,000 persons, an increase of 285 percent since 1980; total Medicare spending in 1995 was $9.74 billion (Health Care Financing Administration, 1996; Held et al., 1997). Both the cost and the incidence of ESRD have been increasing over the past decade. Per capita Medicare expenditures for ESRD patients were $35,154 in 1995, more than seven times the $4,976 figure for aged Medicare beneficiaries (Health Care Financing Administration, 1997). Even though spending for the ESRD program remains a small percentage of total Medicare spending at 5.8 percent of all payments, policymakers have been increasingly concerned about cost containment and quality of care for this population (Health Care Financing Administration, 1997).

Prescription Drug Coverage

Currently only two independent categories of outpatient prescription drugs are covered in the Medicare ESRD program. One is immunosuppressant drugs for patients with a renal transplantation. The other is erythropoietin (EPO), which is used to treat anemia in dialysis patients. The composite rate, HCFA's outpatient dialysis reimbursement mechanism, covers medications that can be bundled with outpatient dialysis services, for example, injectable medications administered during dialysis.

Medicare eligibility continues for 3 years after a successful kidney transplant, and the patient must remain on immunosuppressants for the duration of his or her life to avoid graft failure. In response to the 1986 Omnibus Budget Reconciliation Act (OBRA), Medicare began covering immunosuppressants for 1 year following a transplant. A 1994 study (United States Renal Data System, 1994) estimated that Medicare's costs in the 3-year post-transplant period were three times higher for patients who experienced graft failure than for patients who had a successful graft, and the cost of a return to dialysis caused by graft failure was approximately eight times the cost of immunosuppressant drugs. The law then extended the duration of immunosuppressant coverage, on a phase-in basis over a period of 4 years, so that, as of January 1, 1998, immunosuppressant coverage was extended for the full 36 months of Medicare eligibility after a successful transplant.

The termination of both Medicare and immunosuppressant coverage after 3 years jeopardizes the health of patients who have received transplants and who do not have

other insurance to cover drug costs. Ironically, if the patient's graft fails as a result of inability to pay for immunosuppressants, the return to maintenance dialysis makes the patient again eligible for Medicare through the ESRD program. Moreover, given the long waiting list for transplantation and extremely scarce supply of kidneys, the current Medicare policy provides only a short-term solution to this excess demand problem. Eventually when patients who have received transplants experience graft failure as a result of losing coverage for immunosuppressant drugs, they may return to the waiting list.

Another problem with the current reimbursement policy regarding immunosuppressant drugs is the change of immunosuppression regimens over the past few years. Between 1988 and 1994, the majority of transplant patients received either a double therapy composed of cyclosporine and prednisone or a triple therapy of cyclosporine, azathioprine, and prednisone. After 1995 another triple therapy (cyclosporine, mycophenolate mefetil [MMF], and prednisone) became more common (Katznelson and Cecka, 1996). Though the new immunosuppressive drugs tend to be more effective in reducing the risk of acute rejection and complications caused by infection or adverse reaction, they are also more expensive. For example, the estimated annual cost of azathioprine was approximately $1,000, whereas the annual cost of MMF was more than $6,000 in 1995 dollars (Sullivan et al., 1997). Therefore when transplant recipients lose prescription drug coverage, it becomes even more financially burdensome to pay for their maintenance immunosuppression.

Medicare coverage of EPO began June 1, 1989, almost immediately following its approval by the Food and Drug Administration. Because of the nature of renal failure and the dialysis process, ESRD patients on dialysis are particularly susceptible to anemia. Traditional therapy for the condition consisted of transfusions of packed red cells on an as-needed basis. Androgen therapy has also been used but not as routinely because of its limited efficacy and other concerns (Watson, 1989). The 1989 introduction of EPO, a genetically engineered hormone that raises patients' hematocrit level by stimulating red blood cell production (Erslev, 1991), provided a superior alternative.

HCFA began its EPO coverage by paying dialysis facilities $40 per EPO treatment for any dose up to 9,999 units and an additional $30 for any dose of 10,000 units or higher (Rettig and Levinsky, 1991). However, this payment method was criticized because it could create financial incentives for dialysis facilities to administer a lower dosage of EPO and thereby profit (Office of Inspector General, 1990). The payment mechanism for EPO was changed to $11 per 1,000 units in July 1991. In addition, Medicare coverage of EPO was initially limited to in-center hemodialysis patients but was extended to home-dialysis patients in July 1991. The rate was decreased to $10 per 1,000 units in OBRA 93. The estimated monthly average cost of EPO per patient was $420 in 1989 dollars, and more than 90 percent of patients remained on EPO for at least 6 months (Powe, Eggers, and Johnson, 1994).

Despite the coverage of EPO for dialysis patients and immunosuppressant drugs for transplant patients, a major concern of the Medicare prescription drug policy is whether the current coverage meets the medication needs in this population. Because of the complexity of permanent renal failure, ESRD patients consume more medications than other Medicare beneficiaries. Several studies have examined medication use in dialysis patients. Anderson (1982) surveyed more than 1,000 medical records of dialysis patients

and concluded that a mean of 7.7 medications were prescribed. Grabe et al. (1997) used pharmacy data from a single dialysis center and found the mean number of medications prescribed to the prevalent dialysis patients was 10.9. A recent study by the USRDS (1998) found that the median number of medications for patients who were on dialysis in 1993 was nine. Pollack and Pesce (1990) found that from 1978 to 1989, the average number of medications administered per patient increased by nearly ninefold, excluding EPO. However, no study has examined the impact of insurance status on medication use in dialysis patients. Given that Medicare only covered two categories of outpatient prescription drugs (e.g., a maximum number of five medications if an ESRD beneficiary used EPO and a quadruple immunosuppressive therapy), it is important to understand to what extent medication needs were met by secondary payers and whether the lack of secondary insurance could put Medicare ESRD patients in a more disadvantaged situation.

DATA AND METHODS

Data

This study uses the Dialysis Morbidity and Mortality Study (DMMS) waves III and IV data collected by the USRDS to examine the relationship between insurance coverage and medication use in ESRD beneficiaries. The USRDS is a national data system that collects, analyzes, and distributes information on the incidence, prevalence, treatment, morbidity, and mortality of ESRD in the United States (United States Renal Data System, 1998). The data consist of several files containing clinical, demographic, and claims information for most ESRD patients. The DMMS is a special study to collect demographic, comorbidity, laboratory, treatment, socioeconomic, and insurance information for a large random sample of dialysis patients (United States Renal Data System, 1998).

The DMMS study contains four "waves" of data collection over a 3-year period. This study uses waves III and IV of the DMMS for the empirical analysis. Waves III and IV are prospective studies of a random sample of ESRD patients receiving in-center hemodialysis on December 31, 1993; data collection was completed during 1997. Each wave includes more than 5,000 patients. A special feature of waves III and IV is that extensive medication use information was collected, including identification of medications, dose, and frequency for up to 22 medications. Information was also collected on primary and secondary insurance status of several payers, including Blue Cross, other private insurance, health maintenance organizations (HMOs), Medicare, Medicare-pending, Medicaid, Department of Veterans Affairs (VA), no insurance, self-pay, and other insurance. Because this study focuses on the relationship between secondary insurance status and medication use among Medicare ESRD beneficiaries, patients were excluded from this study if their primary payer was not Medicare or if their insurance information was missing.

Methods

Medication use can be influenced by many factors. Patients' demographic characteristics and socioeconomic status, in particular age and insurance coverage, may be associated with medication use. Health factors, for example, history of diabetes, may also affect the number of medications. Because of the nature of kidney failure, several health problems, such as diabetes, hypertension, glomerulonephritis, are

especially common in this group of patients. To examine the impact of secondary insurance status on the number of medications among Medicare ESRD beneficiaries, while controlling for other factors that may also affect medication use, the following regression model is used:

$$M_i = \beta_0 + \beta' X_i + \gamma' SI_i + \varepsilon_i \qquad (1)$$

where M_i represents the number of medications prescribed for beneficiary *i*.

X_i in equation (1) is a vector of explanatory variables, including patients' demographic and socioeconomic characteristics, primary cause of ESRD, health status, medical history, and dialysis history. Specifically, age is categorized into four ranges: under 25 years, 25-44 years, 45-64 years, and over 64 years. Three binary variables are used to represent these age categories in the regression model, using persons over age 64 as the reference group. Race is grouped into white, black, Asian, Native American, and other, with white as the reference group. In addition Hispanic ethnicity is included as a binary variable. Gender is characterized as a binary variable, using female as the reference group. Education is classified into four levels: less than high school, high school graduate, some college, and college graduate (reference group). Other socioeconomic variables include living arrangement and marital status. Primary disease leading to ESRD includes the following causes: diabetes, hypertension, glomerulonephritis, polycystic kidney disease, and other. In the regression model, four binary variables are used to represent this information, using diabetes as the reference group. Three activity of daily living (ADL) variables (independent eating, walking, and transferring) are used to characterize the current health status. Several variables are used to describe medical history, including history of smoking, heart disease, and cerebrovascular disease. In addition 16 binary variables[1] are used to represent the ESRD network, using network 18 (Southern California) as the reference group. The network variables are included to capture possible regional variations in prescription patterns. SI_i are binary variables indicating either the number or types of secondary payer beneficiary *i* had in addition to Medicare. β_0, β, γ are regression parameters, and ε_i is the error term.

Conclusions from an ordinary least squares (OLS) estimation based on equation (1) may be misleading, as the dependent variables are not continuous. To estimate the number of medications, two count data models are used in this study (Winkelmann, 1994). The first count data model is the Poisson regression model, and the second is the negative binomial regression model. Equation (2) illustrates the likelihood specification of the Poisson model:

$$f(M_i) = e^{\beta_0 + \beta' X_i + \gamma' SI_i} \qquad (2)$$

The main criticism of the Poisson model is the overdispersion problem as a result of the equal mean and variance assumption underlying the Poisson distribution. Alternatively the negative binomial model adopts more general functional forms to estimate count data (Hausman, Hall, and Griliches, 1984). Denote $Z_i = \beta_0 + \beta' X_i + \gamma' SI_i$ and α as a shape parameter, the likelihood in the negative binomial model is:

$$f(M_i|\mu_i) = \frac{1}{\Gamma(M_i + 1)} (\mu_i Z_i)^{M_i} e^{-\mu_i Z_i} \qquad (3)$$

[1] Because of sample problems, no information from network 10 has been used in the USRDS special studies; therefore only 16 (rather than 17) binary variables are included in the analysis.

Table 1

Distribution of Payment Sources

Source	All ESRD Patients (*N* = 10,214)		Medicare ESRD Patients[1] (*N* = 8,136)
	Primary Payer	Secondary Payer[2]	Secondary Payer[2]
	Percent		
Total	100.0	113.0	113.0
Blue Cross	2.6	15.1	18.5
Other Private Insurance	3.6	16.1	19.6
HMO[3]	2.2	2.9	3.4
Medicare	79.7	9.4	—
Medicare Pending	0.1	1.0	—
Medicaid	6.0	29.9	36.4
VA	0.4	0.4	0.4
No Insurance	3.8	—	—
Self-Pay	0.1	1.1	—
Other Insurance	1.7	17.1	18.7
No Secondary Insurance[4]	—	20.2	16.2

[1] ESRD patients with Medicare as the primary payer.

[2] Because an ESRD patient can have more than 1 secondary payer, percentages in the secondary payer columns sum to more than 100.0.

[3] Although HMOs are entities that receive payment from payers such as Medicare and other insurance, in the Dialysis Morbidity and Mortality Study waves III and IV, "HMO" was listed as a payer type. It is not clear what proportion of the ESRD patients for whom HMO is given as a payment source are really covered by Medicare or some other insurance. At present, Medicare ESRD patients cannot enroll in HMOs, but if they develop ESRD after enrollment, they may remain enrolled.

[4] No secondary insurance is an aggregate of no insurance and self-pay.

NOTES: ESRD is end stage renal disease. HMO is health maintenance organization. VA is Department of Veterans Affairs.

SOURCE: United States Renal Disease System; data analysis by Shih, Y.C.T., 1999.

where μ_i follows a gamma distribution.

Specifically, $h(\mu_i) = \frac{1}{\Gamma(\alpha)}\mu_i^{\alpha - 1}e^{-\mu_i}$. Both Poisson and the negative binomial models are estimated using maximum-likelihood method. If α, the shape parameter, is significantly different from zero, then the Poisson model is not an appropriate model in this case.

DESCRIPTIVE STATISTICS

Sources of Insurance

Table 1 summarizes the distribution of insurance sources among the ESRD population, as categorized in DMMS waves III and IV. Medicare was the sole or primary source of payment for 79.7 percent, and Medicaid ranked second as the sole or primary source of payment for 6.0 percent. Other payers (e.g., Blue Cross, HMOs, other private or public insurance, or VA), in aggregate, were primary for 10.5 percent. Only 3.9 percent had no insurance or were self-pay patients.

Because the law requires that employer group health plans remain the primary payer for a certain duration for persons who have that coverage at the time they become eligible for Medicare because of ESRD, 9.4 percent of ESRD patients have Medicare functioning as a secondary payer. Of the patients who had Medicare as a primary payer, 83.8 percent had a secondary payer.

Patient Characteristics

Table 2 summarizes characteristics of the Medicare ESRD beneficiaries in waves III and IV. The average age was 62.22 years. More than one-half (51.99 percent) of the Medicare ESRD patients were white, and more than one-third (41.03 percent) of the patients were black. In addition, when focusing solely on Hispanic ethnicity, 12.27 percent were Hispanic. Approximately one-

Table 2

Characteristics of Medicare ESRD Dialysis Patients

Characteristic	*N* = 7,887[1]
Age in Years (Standard Deviation)	62.22 (19.97)
Race	
White	51.99
Black	41.03
Asian	1.94
Native American	1.44
Other	3.60
Ethnicity	
Hispanic	12.27
Gender	
Male	50.31
Socioeconomic Status	
Live Alone	19.09
Married	46.94
Education Level	
Less Than 12 Years	39.01
High School Graduate	29.39
Some College	9.62
College Graduate	21.98
Insurance Source	
Medicare Only	14.96
Medicare Plus 1 Secondary Insurance Carrier	72.88
More Than 1 Secondary Insurance Carrier	12.16
ESRD Network	
1 (01 CT) Network of New England	4.06
2 (02 NY) Network of New York	6.06
3 (03 NJ) Trans-Atlantic R.C.	6.07
4 (04 PA) ESRD Network Org. #4	6.26
5 (05 VA) Mid Atlantic R.C.	6.10
6 (06 NC) Southeastern Kidney Council	9.57
7 (07 FL) ESRD Network of Florida	5.85
8 (08 MS) Network 8	6.71
9 (09 IN) Tri-State R.N.	7.85
10 (10 IL) Renal Network of Illinois	0.00
11 (11 MN) Renal Network of Upper Midwest	5.52
12 (12 MO) ESRD Network 12	4.20
13 (13 OK) ESRD Network 13	4.69
14 (14 TX) Network of Texas	9.21
15 (15 CO) Inter-Mountain ESRD Network	3.58
16 (16 WA) Northwest Renal Network	2.38
17 (17 N-CA) Trans-Pacific ESRD Network	4.87
18 (18 S-CA) Southern California Network	7.02
Primary Cause of ESRD	
Diabetes	34.33
Hypertension	29.99
Glomerulonephritis	11.59
Polycystic Kidney Disease	3.83
Other	20.26
Activity of Daily Living	
Eat Independently	95.04
Walk Without Assistance	65.92
Independent Transferring	79.76

See notes at end of table.

Table 2—continued

Characteristics of Medicare ESRD Dialysis Patients

Characteristic	*N* = 7,887[1]
Medical History	
Smoke	53.18
Coronary Heart Disease (CHD) or Coronary Artery Disease (CAD)	44.40
Cerebrovascular Disease	14.85
Peripheral Vascular Disease	24.53
Heart Disease Other Than CAD or CHD	43.86
Diabetes	41.59
Lung Disease	10.78
Cancer	9.43
AIDS Status	0.54
Had Previous Transplant	6.55
Years of Dialysis (Standard Deviation)	7.36 (3.79)

[1] A total of 249 observations with negative age or dialysis history were deleted.

NOTES: ESRD is end stage renal disease. AIDS is acquired immunodeficiency syndrome.

SOURCE: United States Renal Disease System; data analysis by Shih, Y.C.T., 1999.

half (50.31 percent) of this population was male, 19.09 percent lived alone, and 46.94 percent were married. The majority of patients had educational levels less than high school (39.01 percent), followed by high school graduates (29.39 percent), college graduates (21.98 percent), and some college (9.62 percent). In addition, these Medicare primary ESRD patients were not evenly distributed across the ESRD network. Networks 6 and 14 had the largest number of ESRD beneficiaries (9.57 percent and 9.21 percent, respectively), whereas networks 15 and 16 had the fewest (3.58 percent and 2.38 percent, respectively).

In terms of primary disease leading to ESRD, the leading cause was diabetes (34.33 percent), followed by hypertension (29.99 percent). Statistics of medical history variables showed that 44.4 percent of Medicare ESRD beneficiaries had a history of coronary heart disease (CHD) or coronary artery disease (CAD). For history of cerebrovascular disease, peripheral vascular disease, heart diseases other than CHD and CAD, diabetes, lung disease, and cancer, the percentages were 14.85, 24.53, 43.86, 41.59, 10.78, and 9.43 percent, respectively. That is, the most common medical problems in this group were heart problems and diabetes. Among this population, 6.55 percent had a transplant before December 1993. Because waves III and IV collected data only for ESRD patients who underwent in-center hemodialysis in December 1993, patients with a history of transplant were those who had experienced graft failure and resumed dialysis. Lastly, the average dialysis history was 7.36 years.

Patient Characteristics by Secondary Payer Status

Table 3 describes patient characteristics by the number of secondary payers. In general, several differences were observed among Medicare primary ESRD patients. Older patients and white persons were more likely to have more than one payer. A reversed pattern was observed in the proportion of black persons. The proportion of Hispanic people decreased as the number of secondary payers increased. Also, the proportion of males decreased for those with at least one secondary payer.

Compared with patients without any secondary payer, those with at least one secondary payer were more likely to live alone or to have a history of heart disease (including CHD or CAD, cerebrovascular, or peripheral vascular disease), lung disease, or cancer, and less likely to have either dia-

Table 3

Patient Characteristics, by Number of Secondary Payer

Characteristic	Number of Secondary Payers		
	None (*N* = 1,180)	1 (*N* = 5,748)	More Than 1 (*N* = 959)
Age in Years (Standard Deviation)	59.66 (18.85)	62.58 (20.19)	63.18 (19.82)
Race			
White	46.70	53.06	52.00
Black	45.59	39.82	42.65
Asian	1.19	2.12	1.78
Native American	1.69	1.36	1.69
Other	4.83	3.64	1.88
Ethnicity			
Hispanic	17.63	11.67	9.28
Gender			
Male	54.75	49.48	49.84
Socioeconomic Status			
Live Alone	18.73	18.89	20.75
Married	48.31	46.59	47.34
Education Level			
Less Than 12 Years	41.19	38.05	42.13
High School Graduate	26.70	30.25	27.53
Some College	9.66	9.69	9.18
College Graduate	22.45	22.01	21.16
ESRD Network			
1 (01 CT) Network of New England	2.12	4.87	1.56
2 (02 NY) Network of New York	2.63	7.01	4.59
3 (03 NJ) Trans-Atlantic R.C.	11.27	5.33	4.07
4 (04 PA) ESRD Network Org. #4	4.41	5.85	11.05
5 (05 VA) Mid Atlantic R.C.	3.56	5.67	11.78
6 (06 NC) Southeastern Kidney Council	14.32	9.12	6.47
7 (07 FL) ESRD Network of Florida	8.22	5.81	3.13
8 (08 MS) Network 8	8.73	5.90	9.07
9 (09 IN) Tri-State R.N.	5.00	8.58	6.99
10 (10 IL) Renal Network of Illinois	0.00	0.00	0.00
11 (11 MN) Renal Network of Upper Midwest	3.56	5.46	8.24
12 (12 MO) ESRD Network 12	1.44	4.02	8.65
13 (13 OK) ESRD Network 13	7.03	4.52	2.82
14 (14 TX) Network of Texas	15.68	7.76	9.91
15 (15 CO) Inter-Mountain ESRD Network	3.22	3.62	3.75
16 (16 WA) Northwest Renal Network	2.46	2.59	1.04
17 (17 N-CA) Trans-Pacific ESRD Network	1.86	5.71	3.55
18 (18 S-CA) Southern California Network	4.49	8.18	3.33
Primary Cause of ESRD			
Diabetes	34.82	34.39	33.48
Hypertension	32.80	29.40	30.03
Glomerulonephritis	10.00	11.93	11.47
Polycystic Kidney Disease	2.80	4.12	3.33
Other	19.58	20.16	21.69
Activity of Daily Living			
Eat Independently	93.56	95.46	94.37
Walk Without Assistance	69.07	65.59	64.03
Independent Transferring	76.53	80.76	77.79

See notes at end of table.

Table 3—continued

Patient Characteristics, by Number of Secondary Payer

Characteristic	Number of Secondary Payers		
	None (*N* = 1,180)	1 (*N* = 5,748)	More Than 1 (*N* = 959)
Medical History			
Smoke	56.53	52.52	52.97
Coronary Heart Disease (CHD) or Coronary Artery Disease (CAD)	38.31	45.06	47.97
Cerebrovascular Disease	11.95	15.15	16.58
Peripheral Vascular Disease	21.19	24.95	26.17
Heart Disease Other Than CHD or CAD	41.53	43.70	47.65
Diabetes	41.95	41.68	40.56
Lung Disease	8.81	11.24	10.43
Cancer	6.78	9.88	10.01
AIDS Status	1.02	0.005	0.005
Years of Dialysis (Standard Deviation)	7.08 (3.50)	7.37 (3.85)	7.66 (3.73)

NOTES: ESRD is end stage renal disease. AIDS is acquired immunodeficiency syndrome.

SOURCE: United States Renal Disease System; data analysis by Shih, Y.C.T., 1999.

betes or hypertension as the primary cause of ESRD, to be able to walk without assistance, or to have a history of smoking. In addition, wide regional variations were observed. The three ESRD networks with the highest percentages of ESRD patients without any secondary payer were networks 3, 6, and 14; for those with one secondary payer, networks 6, 9, 18; and for those with more than one secondary payer, networks 4, 5, and 8. This may be related to variations in regional programs supporting or sponsoring ESRD patients.

Number of Medications

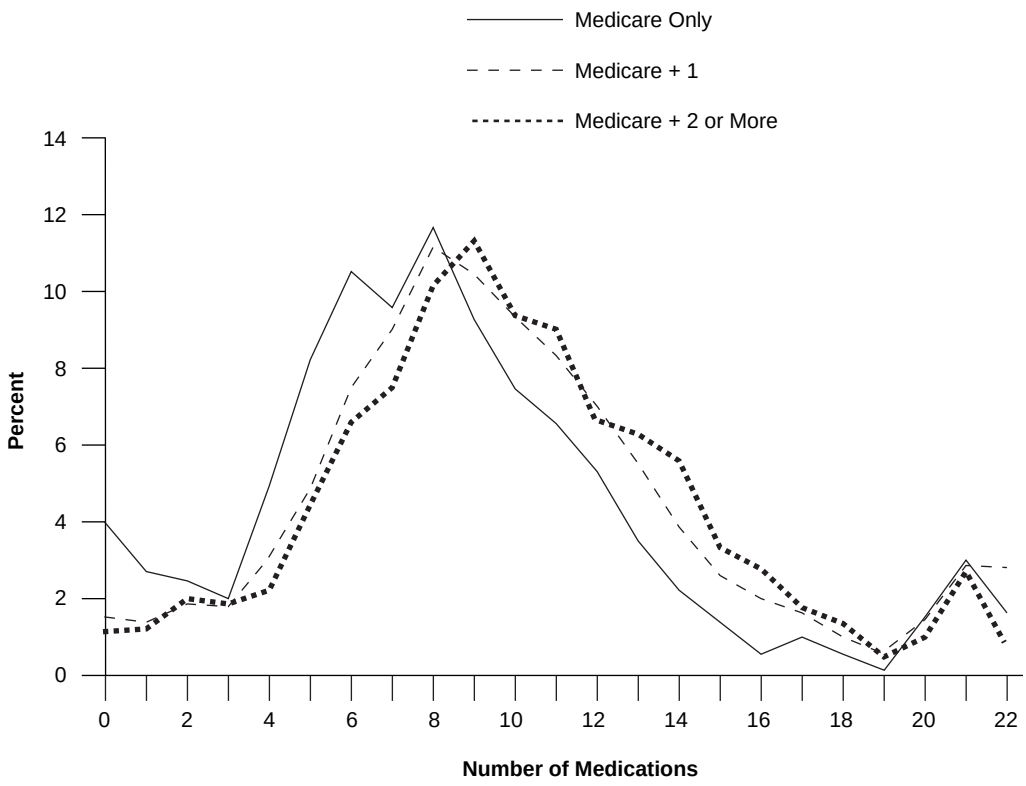
Figure 1 illustrates the relationship between number of medications and number of secondary insurance carriers a Medicare primary ESRD beneficiary had. The secondary insurance is classified into three categories: Medicare-only (no secondary insurance), Medicare + one (had one insurance carrier in addition to Medicare), and Medicare + two or more (had more than one insurance carrier in addition to Medicare). As shown in Figure 1, the distribution of number of medications shifted toward the right (i.e., more medications) as the number of secondary payers increased. This pattern indicates that lack of secondary insurance may have a negative impact on the number of prescription drugs for Medicare ESRD beneficiaries.

Similar information is presented in Table 4, where the mean and median number of medications were calculated by the number of secondary insurance carriers that Medicare ESRD beneficiaries had. Overall, the mean number of medications prescribed for this group was 8.96 medications, and the median was 9 medications.[2] In terms of secondary payers, 15.4 percent of these patients had Medicare as the only payer, 72.6 percent had one secondary insurance carrier, 11.7 percent had two, and 0.33 percent had three. On average, patients with Medicare as the only payer had 8.55 (median = 8) medications, compared with 9.75 (median = 9), 10.08 (median = 10), and 10.11 (median = 10) for those with one, two, and three secondary insurance carriers, respectively. That is, as the number of secondary insurance carriers increased, the mean and median number

[2] Note that because of the differences in sample exclusion criteria, the number of medications used by dialysis patients estimated from this study may be different from that in the USRDS report (United States Renal Data System, 1998). The latter study excludes from its analysis patients who were under 15 years of age, were on home hemodialysis, or had a previous transplant, whereas this study excludes patients whose primary payer is not Medicare and those whose insurance information is missing. A total of 928 (8.3 percent) observations were deleted as a result of missing insurance information.

Figure 1

Number of Medications, by Presence of Secondary Insurance



SOURCE: United States Renal Disease System; data analysis by Shih, Y.C.T., 1999.

of medications increased as well. To what extent this positive relationship is "contaminated" by factors other than insurance status is examined in the following section.

ANALYTICAL RESULTS

Table 5 reports estimates from the negative binomial model. Overall, regression coefficients have the same directions in the OLS, Poisson, and negative binomial models (not shown), but are different in their significance in explaining the number of medications. Note that the estimates reported in Table 5 are the estimated coefficients in the likelihood function (equation 3) and therefore cannot be explained as "marginal effects on the number of medications" as in the OLS model. For example, the estimated parameter 0.083 associated with the "one secondary payer" variable is interpreted as "holding other things constant, a Medicare ESRD beneficiary with one secondary insurance carrier was prescribed 1.0865 (=exp(0.083)) times more medications than one without any secondary insurance." The low R^2 value (0.06) in the OLS model (not shown) suggests a poor fit of the linear least-square model. On the other hand, the extremely high goodness-of-fit χ^2 value (16,323) (not shown) raises concerns that the Poisson model may be an inappropriate model specification. In addition, the likelihood ratio test based on α (the shape parameter) shows that α was significantly different

Table 4

Number of Medications and Number of Secondary Payers

Number of Secondary Payers	Percent Distribution	Number of Medications		
		Mean	Standard Deviation	Median
All	100.0	8.96	5.07	9
0	15.4	8.55	4.85	8
1	72.6	9.75	4.58	9
2	11.7	10.08	4.49	10
3	0.3	10.11	4.09	10

SOURCE: United States Renal Disease System; data analysis by Shih, Y.C.T., 1999.

from zero, which confirms that the Poisson model is not appropriate in this case. Because the negative binomial model appears to be superior to the OLS and Poisson models, discussions of regression results are based on the negative binomial regression model.

Two models are used to capture secondary payer status. The first uses the number of secondary payers (e.g., none, one, and more than one). The second model describes secondary payer status by types of secondary payer, that is, whether ESRD patients had Blue Cross, other private insurance, HMOs, Medicaid, VA, or other insurance as their secondary payer. Notice that the binary variables used to represent different types of secondary payers were not mutually exclusive because one person may have more than one secondary payer.

Table 5 describes the first model. It shows that number of secondary payers has a significant effect on the number of medications prescribed. Compared with Medicare ESRD beneficiaries who had no secondary insurance, those with one secondary insurance carrier had 1.087 (i.e., exp(0.083)) times more prescription medications, whereas those with more than one secondary insurance carrier had 1.103 (= exp(0.098)) times more medications. Compared with elderly ESRD beneficiaries, patients who were under age 25 had fewer medications, and those 25-44 and 45-64 years had more medications. However, this relationship was significant for the group age 45-64 only. Number of medications prescribed was significantly lower for males and Hispanic persons, but differences between white persons and all other races were not significant. In addition, living arrangement, education level, and marital status had no significant impact on the number of medications prescribed.

The number of medications prescribed increased slightly but significantly with years of dialysis. Among the three ADL variables, ability to eat independently correlated significantly with more medications, but independent walking and transferring did not have a significant impact on the number of medications. Compared with Medicare ESRD beneficiaries with diabetes as the primary cause of ESRD, those whose primary cause was hypertension, polycystic kidney disease, or glomerulonephritis had a lower number of medications, though these relationships were not significant. Among the medical history variables, positive and significant associations were observed for those with a history of CHD or CAD, cerebrovascular disease, diabetes, and lung disease. And compared with Medicare ESRD beneficiaries in network 18 (Southern California), those in networks 9 (Tri-State), 12 (Missouri), and 17 (Trans-Pacific) had a significantly higher number of medications, and those in network 3 (Trans-Atlantic) had a significantly lower number. This finding suggests that there were variations in prescription patterns across regions.

Table 5

Coefficient Estimates for Negative Binomial Models of Number of Medications

Patient Characteristic	Model Including Number of Secondary Payers	Model Including Type of Secondary Payer
1 Secondary Payer	*0.083	—
More Than 1 Secondary Payer	*0.098	—
Blue Cross	—	*0.065
Other Private Insurance	—	*0.061
Health Maintenance Organization	—	*0.063
Medicaid	—	*0.072
Department of Veterans Affairs	—	*0.193
Other Insurance	—	0.019
Age ≤ 24 Years	-0.017	-0.017
Age 25-44 Years	0.04	0.036
Age 45-64 Years	*0.046	*0.043
Male	*-0.061	*-0.061
Black	-0.032	*-0.034
Asian	-0.058	-0.060
Native American	-0.024	-0.020
Other Race	0.032	0.033
Hispanic Ethnicity	*-0.078	*-0.080
Live Alone	-0.013	-0.013
Less than High School Education	-0.031	*-0.034
High School Education	-0.035	*-0.036
Some College Education	0.023	0.023
Married	-0.001	-0.002
Dialysis History	*0.007	*0.007
Independent Eating	*0.077	*0.078
Independent Walking	-0.01	-0.009
Independent Transfer	-0.009	-0.008
Hypertension	-0.01	-0.011
Polycystic Kidney Disease	-0.048	-0.047
Glomerulonephritis	-0.012	-0.011
Other Causes	0.001	0.001
Smoking	0.006	0.005
CHD or CAD	*0.071	*0.072
Cerebrovascular Disease	*0.054	*0.054
Peripheral Vascular Disease	0.017	0.017
Heart (Other than CHD or CAD)	0.028	*0.028
History of Diabetes	*0.099	*0.098
History of Lung Disease	*0.061	*0.061
History of Cancer	-0.006	-0.005
History of Transplant	-0.019	-0.008
ESRD Network 1	0.027	0.028
ESRD Network 2	0.017	0.013
ESRD Network 3	*-0.078	*-0.079
ESRD Network 4	0.047	0.050
ESRD Network 5	0.044	0.046
ESRD Network 6	-0.039	-0.042
ESRD Network 7	0.017	0.017
ESRD Network 8	0.007	0.004
ESRD Network 9	*0.082	*0.078
ESRD Network 11	0.061	*0.060
ESRD Network 12	*0.137	*0.136
ESRD Network 13	-0.012	-0.016
ESRD Network 14	-0.001	0.0002
ESRD Network 15	-0.031	-0.027
ESRD Network 16	0.01	0.011
ESRD Network 17	*0.101	*0.103
Constant	*2.021	*2.038
α	**-2.250	***-2.251

* Statistically significant at the 5-percent level.

**Significant from likelihood ratio test, i.e., $X^2(1) = 2314.49$, P = 0.000.

*** Significant from likelihood ratio test, i.e. $X^2(1) = 2311.64$, P = 0.000.

NOTES: CHD is coronary heart disease. CAD is coronary artery disease. ESRD is end stage renal disease.

SOURCE: United States Renal Disease System; data analysis by Shih, Y.C.T., 1999.

Type of secondary payer, on the other hand, did not appear to have an impact on the number of medications prescribed. In general, having Blue Cross, other private insurance, HMOs, Medicaid, or VA as secondary payer had a positive association with the number of medications prescribed. Though the estimated parameters indicated that such association was strongest for VA and Medicaid, differences between either VA or Medicaid and other secondary payers were not statistically significant. Table 5 also shows that other explanatory variables in the second model had similar magnitude as in the first model. The only difference was that several variables, for example, being black, having less than high school education, having a high school education, or having CHD or CAD, became statistically significant in the second model.

DISCUSSIONS AND DIRECTIONS FOR RESEARCH

Findings in this study indicate that the number of secondary payers has a significant impact on the number of prescription drugs received by Medicare ESRD patients. Not only do those with at least one secondary payer have more medications, the number of medications prescribed also increases as the number of secondary insurance carriers increases. In fact, a close examination of the estimated regression coefficients shows that the two variables representing secondary insurance status were among the top five variables that had the largest impact on the number of medications.[3] This study also finds that the impact on the number of prescription drugs did not vary across types of secondary payers.

[3] The five most influential explanatory variables in the negative binomial regression models are: (1) ESRD network 12, (2) history of diabetes, (3) had more than one secondary payer, (4) had one secondary payer, and (5) ESRD network 9, respectively.

The positive association between the number of secondary payers and the number of medications implies that Medicare ESRD beneficiaries with Medicare as the only insurance carrier may not receive a sufficient number of medications. Alternatively, one could apply the moral-hazard theory and argue that beneficiaries with more than one insurance carrier may receive more than the necessary number of prescription drugs because insurance can create incentives to overutilize for consumers and/or overprescribe for providers (Manning et al., 1987). Another explanation for this positive relationship is that the purchase of secondary insurance is motivated by the need for prescription drug coverage. Whether Medicare beneficiaries without secondary payers are obtaining fewer prescriptions than needed or those with greater coverage are obtaining more than needed is a topic to be explored by future research.

However, medication information included in this study must be interpreted with caution. It reflects the medications prescribed by physicians and filled by beneficiaries, rather than the number of medications consumed by beneficiaries. These two numbers may differ because of factors such as non-compliance. Also, in the data collection process, a maximum of 22 drugs was collected. As a result, findings from this study may underestimate the actual number of medications prescribed and either overestimate or underestimate the actual number of medications consumed.

Several issues related to medication use in ESRD beneficiaries but not fully addressed in this study are discussed in the next section.

Prescription Drugs Used by Dialysis Patients

In a recent USRDS study (United States Renal Data System, 1998), medications used by hemodialysis patients were com-

pared with those used by peritoneal dialysis patients. Based on this USRDS study, the following medications were commonly prescribed to ESRD patients: (1) antihypertensives, such as calcium channel blockers, angiotensen-converting enzyme inhibitors, beta blockers, central alpha–2 receptor agonists, peripheral alpha–1 receptor blockers for hypertensive dialysis patients; (2) cardiovascular medications such as nitrate, digoxin, and lipid-lowering agents; (3) EPO and iron for anemic dialysis patients; (4) endocrine/hormonal agents, including insulin and oral hypoglycemics for diabetic patients, estrogen for postmenopausal dialysis patients, and thyroid; (5) nutrition supplements such as calcium, vitamins, and vitamin D analogs; and (6) other medications, including gastrointestinal agents, analgesics, antithrombotic agents, and psychiatric medications. Because relative to ESRD patients with at least one secondary payer, a slightly higher proportion of those without any secondary payer had diabetes or hypertension as the primary cause of ESRD, the negative association between number of secondary payers and number of medications may present access problems to hypertensive and diabetic medications for these patients. In addition, the higher proportion of heart disease among ESRD patients with at least one secondary payer implies that access to cardiovascular medication may be less problematic for those with secondary insurance.

Medication Use and Health Outcomes

The relationship between number of prescription medications filled or consumed and health outcomes among Medicare ESRD beneficiaries was not addressed in this study but should be explored in future research. The extensive medication and clinical information (such as serum albumin and hematocrit level) provided in waves III and IV allows the examination of this relationship. However, because the causal relationship between medication use and health outcomes can go in both directions, researchers need to be aware of the endogeneity problem when studying this issue.

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