End-Stage Renal Disease–Associated Managed Care Costs Among Patients With and Without Diabetes

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OBJECTIVE — To examine the direct costs of care before and after onset of end-stage renal disease (ESRD) for patients with and without diabetes based on analyses of retrospective healthcare claims data.

RESEARCH DESIGN AND METHODS — Patients with onset of ESRD between January 1998 though June 2002 were identified based on use of dialysis, renal transplantation, or other ESRD-related services. Continuous health plan enrollment ≥12 months before and ≥1 month after ESRD onset was required. The costs calculated include both observed and adjusted estimates; the latter were calculated using generalized linear models, controlling for demographic and clinical characteristics, "onset" period, and duration of follow-up. Analyses focus on the diabetic ESRD patient and include a comparison with ESRD patients without diabetes.

RESULTS — The study included 2,020 patients with diabetes and 2,170 without diabetes; 63% of patients were >50 years of age. Average costs were relatively stable before ESRD ($1,535 to $4,357 for diabetes, $1,082 to $2,447 for no diabetes) but more than doubled in the month preceding onset ($9,152 and $8,211, respectively). Postonset, average monthly per-patient costs escalated sharply in the 1st month ($26,507 and $26,789), declined steadily through month 6, and remained flat but elevated thereafter. Adjusted annual costs per patient pre- and postonset of ESRD were significantly higher for diabetes ($P < 0.0001$); annual costs were 69% ($38,041 vs. $22,538) and 79% ($96,014 vs. $53,653) higher pre- and postonset, respectively.

CONCLUSIONS — The economic burden of ESRD in the year after onset is substantial, particularly among patients with diabetes.

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Over the past 2 decades, both the incidence and prevalence of end-stage renal disease (ESRD) have continually increased (1–4). Between 1980 and 2001, incidence increased fourfold from 82 to 334 per million of the total population, while prevalence increased fivefold from 271 to 1,400 per million. Much of this increase in ESRD prevalence and incidence may be attributed to diabetes, specifically diabetic nephropathy, which is the leading cause of ESRD in the U.S. (2). The increase in the prevalence and incidence of ESRD caused by other conditions, including hypertension, glomerulonephritis, and cystic kidney disease, were much lower than that caused by diabetes. Between 1982 and 1992, the prevalence of diabetes as the underlying cause of ESRD increased from 27 to 36%; between 1994 and 1999, 40% of all new ESRD cases occurred among individuals with diabetes (2,3).

In addition to the clinical burden, preventing or delaying the onset of ESRD also becomes especially crucial in the context of the economic impact on the healthcare system. ESRD patients constitute one-half of 1% of Medicare beneficiaries but account for 5% of Medicare program expenditures. In 1999, ~350,000 people in the U.S. suffered from ESRD, resulting in a cost of $12.7 billion to the Medicare ESRD program (2). However, these costs are expected to increase to $28 billion per year by 2010 (5).

Cost containment policies undertaken by the Health Care Financing Administration (now known as the Centers for Medicare & Medicaid Services) have included shifting ESRD program costs to the private sector. Under the Medicare-as-secondary-payer (MSP) policy, health plans whose beneficiaries experience kidney failure are required to be the primary payer for the first 30 months of care (6). The MSP period of 30 months and the increasing incidence of ESRD have substantial budget implications for managed care organizations, particularly because costs immediately after ESRD onset are known to be very high (7). To fully understand the magnitude of these cost implications, and since diabetes, with its increasing incidence, is the major underlying cause of ESRD, a study was conducted to examine direct costs before and after ESRD onset among patients with and without diabetes using medical and pharmacy claims data from a national database.

RESEARCH DESIGN AND METHODS

— Medical and pharmaceutical claims were obtained from the PharMetrics Patient-Centric Database for January 1997 through December 2002. This retrospective database includes fully adjudicated claims from 61 health plans across the U.S. Patients in the database are representative of the national commercially insured population on a variety of demographic measures, including geographic region, age, sex, and plan type. The

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Abbreviations: CPT, Common Procedure Terminology; ESRD, end-stage renal disease; GPI, generic product identifier; MSP, Medicare as secondary payer; POS, place of service.
A table elsewhere in this issue shows conventional and Système International (SI) units and conversion factors for many substances.

data are also longitudinal, with an average member enrollment time of 2 years. Inpatient and outpatient diagnoses (International Classification of Diseases [ICD]-9-CM format), procedures (Common Procedure Terminology [CPT]-4 and Health Care Financing Administrators Common Procedure Coding System [HCPCS] formats), as well as standard and mail order prescription records are included in the dataset. Reimbursed payments and charged amounts are available for all services rendered, as well as dates of service for all claims. Additional data elements include demographic variables (e.g., age, sex, geographic region), plan type (e.g., HMO, PPO), payer type (e.g., commercial, self-pay), provider specialty, and start and stop dates for plan enrollment.

Patients were included if they had evidence of dialysis, renal transplantation, or other ESRD-related services (see APPENDIX for specific ICD-9 CM and CPT-4 codes) between 1 January 1998 and 30 June 2002. Patients were also required to have a minimum of 12 months of continuous enrollment in a health plan before and at least 1 month after the date of ESRD onset. All patients with at least 1 month of plan enrollment post-ESRD onset were included for the entire 12-month follow-up period (including those who disenrolled, died, or survived).

Patients were excluded if the claims of interest were indicative of acute renal failure or short-term dialysis, i.e., dialysis in months 1, 2, and/or 3 and no dialysis or kidney transplant in subsequent months. Other exclusion criteria included patients aged 65 years or older who were not enrolled in a Medicare Risk plan (as full utilization and cost data were not available) as well as patients from health plans not providing claims data for 12 months following the patient's index date, i.e., to allow for full follow-up if the patient survived and remained enrolled.

Adjustment for possible informative censoring due to death was done by including in the models the indicator of death and time to death variables (8). Because the database does not provide an indicator of death for privacy reasons, a "proxy" procedure was used to identify such individuals in the postonset period. This procedure included the examination of all postonset utilization on a month-to-month basis for every patient. Patients with <12 months of claims activity and an event likely to have been fatal (e.g., cardiac arrest, resuscitation, or hospitalization; see APPENDIX) during the last month in which medical and pharmacy claims were available were assumed to have died. Figure 1 depicts patient selection and classification into either survived, died, or censored categories (n = 1,849, 1,266, and 1,075, respectively). All medical and pharmaceutical claims spanning the period from 1 January 1997 to 31 December 2002 were then extracted for each eligible patient.

Patients were then stratified based on whether they had diabetes before ESRD onset. Patients were considered to have diabetes based on the presence of one or more provider or facility claims with a diagnosis of diabetes (ICD-9-CM 250.xx) and/or one or more reimbursed pharmacy claims for antihyperglycemic medication (insulin and all oral forms) in the 12 months before new onset of ESRD. (Note: patients were excluded from the nondiabetic group if they had the first evidence of diabetes following ESRD onset only.)

In addition to patient demographic and clinical characteristics and comorbidity profile pre-ESRD onset (low, levels 0–3; medium, levels 4–6; and high, levels ≥7 as defined by the Charlson Comorbidity Index score) (9), utilization and costs of all inpatient, outpatient, and pharmacy services were examined for both the pre- and postonset periods. Measures of interest included the frequency of hospitalization and corresponding days in the hospital, the number of physician, emergency room, hospital outpatient, and home health visits, laboratory tests, outpatient pharmacy claims (retail and mail order), and all other ancillary services. These measures were separated into three mutually exclusive categories pertaining to renal-related, cardiovascular-related, and all other care based on coded diagnoses and procedures available on these claims (see APPENDIX for ICD-9-CM, CPT-4, place of service [POS], revenue center, and generic product identifier [GPI] drug codes).

Analyses

Direct costs (health plan reimbursements) for all services were calculated separately for the 12-month pre- and postonset periods. Average per-patient costs from preonset to follow-up were estimated on a monthly and annual basis. Overall monthly and annual costs were expressed in 2002 dollars and were adjusted using the medical care component of the U.S. Consumer Price Index (U.S. Bureau of Labor Statistics, 2003).

The results were stratified according to the presence or absence of diabetes. Among those with diabetes, further stratifications were based on age (<65 years vs. ≥65 years) and membership in a more stringently managed health plan type (i.e., HMO vs. PPO/POS or other).

Descriptive analyses were performed to estimate average monthly per-patient costs for each of the three major service categories and in total. These unadjusted results focused attention only on those deemed to have survived and died postonset and did not include those who were censored.

Adjusted cost estimates were derived using generalized linear models with a γ distribution and log-link function (10), which provided the ability to *1*) group event times into discrete interval lengths to estimate mean costs directly from pre- to postonset periods; *2*) account for differential follow-up duration; and *3*) account for the expected high correlation of costs in the pre- and postonset periods using the generalized estimating equations approach (11). A separate model was developed to estimate renal-related, cardiovascular-related, and all other related costs and total cost.

Covariates in the total cost model included age (<21, 21–34, 35–49, 50–64, and ≥65 years), sex, geographic region (Northeast, South, Midwest, and West), health plan type (HMO, PPO/POS, and other), time period (pre- vs. postonset), preonset resource utilization, presence of diabetes, death, presence of other comorbidities (i.e., coronary artery disease, hypertension, and neuropathy), and concomitant medication use (i.e., albuterol, antifungals, antiviral cytomegalovirus agents, hematopoietic agents, immunosuppressants, mineralocorticoids, phosphate-binding agents, sulfa methoxazole plus trimethoprime, α-1 blockers, α-2 blockers, anticoagulants, angiotensin receptor blockers, β-blockers, calcium channel blockers, combination antihypertensives, diuretics, platelet aggregation inhibitors, and thombolytics). Annualized mean cost estimates derived from the model were compared across pre- and postonset ESRD periods. The resulting scaled deviance (DEV) divided by the degrees of freedom (d.f.) (DEV/d.f. = 1.23) indicated a good

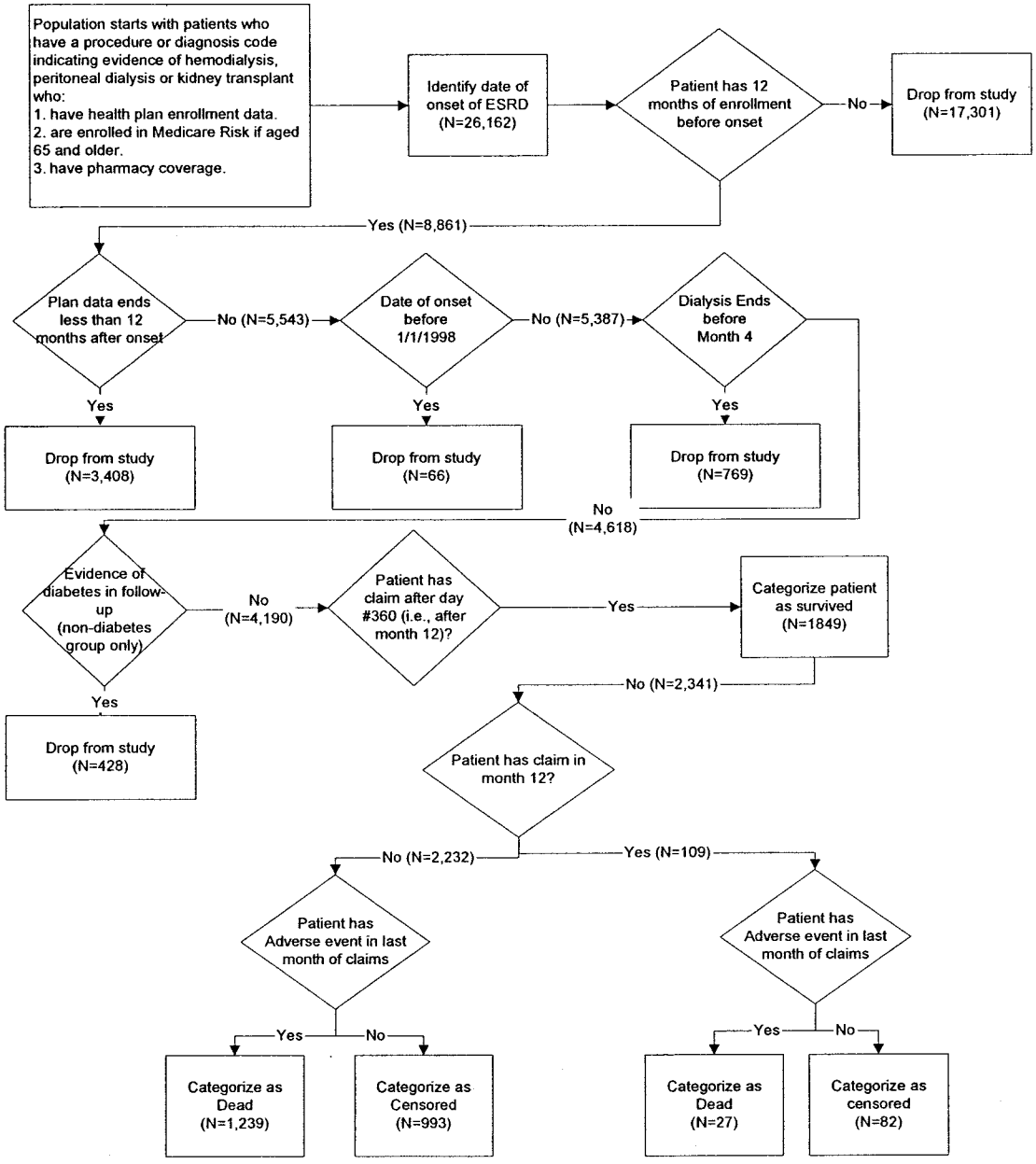

Figure 1—*Flowchart of ESRD sample selection.*

model fit. All analyses were conducted using SAS software, version 8.2.

RESULTS

Patient population

Patients with diabetes (n = 2,020) were older than those without diabetes (n = 2,170) (mean ± SD age 58.0 ± 14.0 vs. 50.5 ± 19.8 years for diabetes vs. no diabetes, respectively) (Table 1). Approximately 25% of patients in the sample were ≥65 years of age (30.2 vs. 22.5% for diabetes vs. no diabetes, respectively; $P <$ 0.0001). Almost two-thirds (59.4%) belonged to an HMO (65.8 vs. 53.5% for diabetes vs. no diabetes, respectively; $P <$ 0.0001). Patient severity defined by the Charlson Comorbidity Index Score was higher on average in the diabetes group (54.6 vs. 21.1% and 22.8 vs. 6.4% in the medium and high categories, respectively, $P < 0.0001$). Diabetic patients also had related reported complications and comorbidities including nephropathy (44.6%), neuropathy (28.5%), and retinopathy (35.6%). Other reported prevalent conditions were hypertension (81.0 vs. 55.3% for diabetes vs. no diabetes, respectively; $P < 0.0001$) and hyperlipidemia (37.3 vs. 20.7%; $P < 0.0001$). Finally, nephrologists (63.5 vs. 48.4%) represented the most frequently seen specialty by patients at the time of ESRD onset.

Monthly cost trends

Mean monthly costs were relatively stable before ESRD (range $1,535–$4,357 among patients with diabetes and

Table 1—*Patient characteristics by presence of diabetes*

	Overall	Diabetes	No diabetes	*P* value
Total	4,190 (100.0)	2,020 (100.0)	2,170 (100.0)	
Age (years)				
<21	199 (4.7)	24 (1.2)	175 (8.1)	<0.0001
21–34	320 (7.6)	70 (3.5)	250 (11.5)	
35–49	1,032 (24.6)	426 (21.1)	606 (27.9)	
50–64	1,539 (36.7)	889 (44.0)	650 (30.0)	
≥65	1,100 (26.3)	611 (30.2)	489 (22.5)	
Sex				
Female	1,893 (45.2)	914 (45.2)	979 (45.1)	0.9315
Male	2,297 (54.8)	1,106 (54.8)	1,191 (54.9)	
Complication				
CAD	82 (2.0)	61 (3.0)	21 (1.0)	<0.0001
Hyperlipidemia	1,203 (28.7)	754 (37.3)	449 (20.7)	<0.0001
Hypertension	2,837 (67.7)	1,636 (81.0)	1,201 (55.3)	<0.0001
Nephopathy	900 (21.5)	900 (44.6)	0 (0.0)	<0.0001
Neuropathy	661 (15.8)	576 (28.5)	85 (3.9)	<0.0001
Obesity	18 (0.4)	12 (0.6)	6 (0.3)	0.1163
Retinopathy	734 (17.5)	719 (35.6)	15 (0.7)	<0.0001
Plan type				
HMO	2,490 (59.4)	1,330 (65.8)	1,160 (53.5)	<0.0001
PPO/POS/other	1,700 (40.6)	690 (34.2)	1,010 (46.5)	
Physician specialty				
Endocrinologist	11 (0.3)	9 (0.4)	2 (0.1)	<0.0001
FP/GP	130 (3.1)	57 (2.8)	73 (3.4)	
Internal medicine	159 (3.8)	78 (3.9)	81 (3.7)	
Nephrologist	2,333 (55.7)	1,283 (63.5)	1,050 (48.4)	
Pediatrician	30 (0.7)	2 (0.1)	28 (1.3)	
Other	1,527 (36.4)	591 (29.3)	936 (43.1)	
Severity*				
Low (0–3)	2,030 (48.4)	457 (22.6)	1,573 (72.5)	<0.0001
Medium (4–6)	1,561 (37.3)	1,103 (54.6)	458 (21.1)	
High (≥7)	599 (14.3)	461 (22.8)	139 (6.4)	

Data are *n* (%). *Based on the Charlson Index.

$1,083–$2,447 for no diabetes) but more than doubled in the month immediately preceding onset ($9,152 and $8,211 for diabetes vs. no diabetes, respectively) (Table 2). After ESRD onset, the average monthly per-patient cost escalated sharply in the 1st month of onset and was quite similar for those with and without diabetes ($26,507 and $26,789); costs then declined steadily through month 6 and remained relatively stable but elevated thereafter ($3,748–$5,295 for diabetes and $2,025–$2,720 for no diabetes).

Costs were primarily manifested in renal- and cardiovascular-related services and were most pronounced in the pre- and postonset periods immediately adjacent to ESRD onset. Among those with diabetes, renal-related costs increased from an average of $590 in month 12 before onset to $20,436 immediately after onset. Cardiovascular-related costs among patients with diabetes increased from $678 in month 12 before onset to $3,504 and $5,532 in the month immediately before and following onset, respectively. Similar trends were seen among those without diabetes.

Among patients with diabetes, monthly costs did not differ substantially by age in the preonset period. However, total follow-up costs were higher among patients <65 years of age. This may be due to the restrictive payment mechanisms used in Medicare Risk plans where patients may in fact have more payment responsibility or uncompensated care than those in standard commercial offerings. Not surprisingly, patients enrolled in HMO products incurred 15–25% lower costs in both the pre- and postonset periods compared with those in less stringently controlled managed plans.

Cost estimates

Observed and adjusted annual cost estimates for ESRD patients were estimated for both patients with and without diabetes. Total observed cost more than doubled among both those with (from $36,554 to $86,081) and without (from $22,881 to $57,249) diabetes from pre- to postonset of ESRD. Annual renal-related costs increased nearly fivefold among those with diabetes (from $14,738 to $69,439) and sixfold among those without diabetes (from $7,493 to $43,076) from the pre- to postonset periods, respectively. Costs for cardiovascular care declined among those with diabetes (from $13,746 to $11,665), and costs for all other care declined among both groups.

Adjusted annual per-patient cost increased by ~150% (from $38,041 to $96,014) among those with diabetes and 140% (from $22,538 to $53,653) among those without diabetes from pre- to postonset of ESRD. Adjusted annual costs of renal-related services more than quintupled (from $15,442 to $80,414 and from $7,678 to $37,712 among those with and without diabetes, respectively; $P < 0.0001$), whereas adjusted cardiovascular-related costs decreased slightly (from $16,031 to $14,624 and from $9,906 to $8,523; $P < 0.0001$), and the costs of all other services decreased by nearly 40% (from $8,118 to $5,321 and from $6,368 to $3,936; $P = 0.6871$).

Adjusted total annual costs per patient pre- and postonset of ESRD were significantly higher ($P < 0.0001$) among those with diabetes as compared with those without diabetes. Total annual costs were 69% higher ($38,041 vs. $22,538 for diabetes vs. no diabetes, respectively) in the preonset period and 79% higher ($96,014 vs. $53,653 for diabetes vs. no diabetes, respectively) in the postonset period compared with those without diabetes.

CONCLUSIONS — Overall, findings from this study suggest that the onset of ESRD represents an extremely costly event regardless of whether the patient has diabetes. We observed a twofold or higher increase in total annual costs of care among both groups of patients after disease onset, with the highest costs being incurred shortly after ESRD treatment is

Table 2—*Monthly costs by category for patients with and without diabetes*

Diabetes												
Preonset period	**Month −1**	**Month −2**	**Month −3**	**Month −4**	**Month −5**	**Month −6**	**Month −7**	**Month −8**	**Month −9**	**Month −10**	**Month −11**	**Month −12**
Renal-related treatment	$4,712	$1,570	$1,186	$1,013	$1,320	$810	$503	$553	$558	$521	$441	$590
Cardiovascular-related treatment	$3,504	$1,896	$1,753	$1,168	$1,169	$602	$761	$761	$971	$616	$514	$678
All other treatment	$936	$891	$914	$704	$799	$547	$786	$593	$543	$582	$580	$477
Total	$9,152	$4,357	$3,853	$2,885	$3,288	$1,960	$2,050	$1,906	$2,072	$1,719	$1,535	$1,745
Postonset period	**Month +1**	**Month +2**	**Month +3**	**Month +4**	**Month +5**	**Month +6**	**Month +7**	**Month +8**	**Month +9**	**Month +10**	**Month +11**	**Month +12**
Renal-related treatment	$20,436	$10,321	$6,213	$6,282	$5,286	$4,889	$4,424	$4,203	$3,943	$3,597	$3,599	$3,270
Cardiovascular-related treatment	$5,532	$2,325	$1,262	$898	$938	$415	$419	$403	$262	$267	$283	$179
All other treatment	$539	$414	$534	$604	$449	$418	$452	$389	$384	$477	$369	$300
Total	$26,507	$13,060	$8,009	$7,784	$6,672	$5,722	$5,295	$4,995	$4,589	$4,341	$4,251	$3,748
No diabetes												
Preonset period	**Month −1**	**Month −2**	**Month −3**	**Month −4**	**Month −5**	**Month −6**	**Month −7**	**Month −8**	**Month −9**	**Month −10**	**Month −11**	**Month −12**
Renal-related treatment	$4,196	$723	$545	$408	$324	$364	$296	$248	$275	$238	$442	$258
Cardiovascular-related treatment	$3,098	$1,098	$805	$629	$507	$459	$448	$470	$391	$758	$440	$473
All other treatment	$917	$626	$872	$858	$527	$512	$448	$365	$448	$369	$397	$352
Total	$8,211	$2,447	$2,222	$1,895	$1,357	$1,335	$1,192	$1,082	$1,114	$1,364	$1,278	$1,083
Postonset period	**Month +1**	**Month +2**	**Month +3**	**Month +4**	**Month +5**	**Month +6**	**Month +7**	**Month +8**	**Month +9**	**Month +10**	**Month +11**	**Month +12**
Renal-related treatment	$19,874	$6,270	$3,993	$3,293	$2,795	$1,718	$2,146	$1,541	$1,705	$1,571	$1,553	$1,698
Cardiovascular-related treatment	$6,373	$1,683	$879	$315	$613	$376	$253	$266	$239	$209	$435	$221
All other treatment	$543	$468	$448	$378	$390	$352	$320	$264	$266	$245	$253	$223
Total	$26,789	$8,420	$5,320	$3,986	$3,798	$2,446	$2,720	$2,070	$2,209	$2,025	$2,241	$2,143

initiated. Because commercial insurers are currently responsible for the care of ESRD patients for nearly 3 years after onset, our findings indicate that they will also incur the bulk of ESRD-related costs for these patients because costs will likely have flattened to lower levels among patients surviving long enough to be transitioned to the Medicare ESRD program.

It is also of interest that, in a population receiving ESRD treatment, the amount of direct medical costs approximately attributable to diabetes is substantial. The total adjusted costs in the 24-month period of pre- and post-ESRD onset were 76% higher among ESRD patients with diabetes ($134,054) compared with those without diabetes ($76,192). After adjustment for differences between groups with ESRD, the change in costs from pre- to post-ESRD onset was nearly twice as high among those with diabetes and was mostly attributed to outpatient costs (adjusted change in mean costs from pre- to postonset $57,973 for those with diabetes and $31,115 for those without diabetes); in other words, nearly one-half of the costs of ESRD are driven by the presence of diabetes. This emphasizes the importance of interventions among patients with diabetic nephropathy to prevent or delay progression to ESRD.

We found that ESRD patients with diabetes were older than those without diabetes. However, age was not a significant predictor of costs, and it is likely that the variance associated with age alone could be explained by other age-related factors such as diabetes complications and comorbidities.

The cost of ESRD-related treatment appears to be higher for those <65 years of age versus older individuals. However, our sample was restricted to include only elderly patients enrolled in a Medicare Risk plan. These patients may differ in certain respects from the overall U.S. elderly population (e.g., demographics and severity) and may have a "capped" benefit structure. Therefore, cost estimates in this group may not be truly representative of all elderly individuals at risk of ESRD.

As the data source includes health plans, it is conceivable that data on ESRD-related comorbidities/complications may not have been consistently reported. However, the underreporting of diagnoses did

not likely affect our total cost estimates, i.e., ESRD related and unrelated.

Costs were categorized as renal related, cardiovascular related, or other based on a hierarchy. Consequently, costs were not partitioned among the three categories within an individual claim. True differentiation by type of costs for a single encounter is difficult; as such, this study focused on total costs in a new-onset ESRD population rather than attribution of costs.

In addition, as with most observational studies, we cannot rule out the possibility that selection bias, i.e., differences in severity and/or progression of disease, may have influenced our comparisons of those with and without diabetes with ESRD. Nevertheless, observed differences in cost persisted when analyses controlled for between-group differences, suggesting that any selection bias would likely affect only the magnitude (and not the direction) of our findings. We also used a proxy indicator to account for mortality in this analysis, which may be subject to misclassification error. Although this is true, it is important to note that the proxy 1-year mortality rate observed in our sample was 30.2%, which is similar to 1-year mortality rates (16–26%) for incident ESRD reported elsewhere (12).

In this study, annualized per-patient costs for those who developed ESRD were substantial particularly among patients with diabetes (i.e., >$90,000 for patients with diabetes and >$50,000 for patients without diabetes, respectively, during the 1st year of treatment). Prior studies have reported 1-year costs among those with ESRD ranging from $50,000 to $64,500 (2,13,14). However, none of those studies examined ESRD-associated costs in a managed care setting for patients with diabetes compared with those without diabetes. The findings of our study have substantial implications for managed care because the rising prevalence of diabetes and diabetic nephropathy could impose an increasing economic burden from ESRD in the coming years.

APPENDIX

Patient selection criteria

New-onset ESRD using CPT and ICD-9 procedure codes consisting of:

- ESRD services (CPT 90921 and 90925 [>20 years of age only])
- Dialysis treatments (CPT 90935–90947, 99512, and 99559)
- Renal transplant (CPT 50360 and 50365)
- ESRD-related procedures (ICD-9 V42.0, V56.0, V56.8, 39.95, 54.98, and 55.69)

Identification of events likely to be fatal in last month of claim activity:

- Hospitalization
- Emergency room: POS code 23, revenue center codes 450–459, CPT-4 99281–99288, or revenue center code 981
- Ambulance service: revenue center codes 540–549 or CPT-4 99289–99290
- Resuscitation: CPT-4 92950
- Defibrillation: CPT-4 92960 and 92961
- Cardiac arrest/failure: ICD-9 410.9
- Death: CPT 95824 (cerebral death)
- Injections given to stimulate heart: Adrenalin (epinephrine) J0170 and Lidocaine J2000
- Kidney transplant failure/rejection: ICD-9 996.81
- Transplanted organ failure (nonspecific): ICD-9 996.80
- Cardiac complications: ICD-9 997.1

Type of service designation

***1*) Renal-related treatments.**

- ICD-9-CM 250.4x, 271.4, 581.81, 582.9, 583.81, 584.xx-586.xx, 587, 588.x, 593.x, 403.x1, 404.x2, 404.x3, 405.01, 405.11, 405.91, 996.73, 996.81, V42.0, V56.0, V56.8, and dialysis/transplant codes cited above
- CPT-4 36145, 36800, 36810, 36815, 36831, 36832, 36833, 49420, 49421, 50360–50365, 75790, 78725, 82040, 8204278725, 82043, 82044, 82040, 82042, 82565, 82570–82575, 82668, 82043, 82044, 82565–82575, 82668, 84520–84525, 84540–84545, 90921–90925, 90935–90944, 90945–90999, 93990, 99512, 99559, A4650-A4932, C1037, C1152, C1750, C1752, C1881, E1500, E1520, E1530, E1540, E1592, E1594, E1630, E1637, E1638, E1639, E1649, E1699, G0159, G0257, S9339, and dialysis/transplant codes cited above
- GPI therapeutic drug class codes 2220*, 48*, 7910*, 5280002010*, 5280007010*, 8210*, 8220*, 8230*, 824010*, 8299*, 9940*, 994500*, 44201010* (include only route = inhalation), 11*, 1220*, and 16990002*

***2*) Cardiovascular-related treatments.**

- ICD-9-CM 272.xx, 391.xx-392.xx, 393.xx-398.xx, 401.xx, 402.xx, 403.x0, 404.x0, 404.x1, 405.09, 405.19, 405.99, and 410.xx-459.xx
- CPT-4 33200–33208, 33210–33211, 33212–33214, 33216–33217, 33503–33505, 33510–33516, 33517–33530, 33533–33536, 35600, 78414 –78459, 78466 –78499, 82550 –82552, 78460 –78465, 78460–78465, 80061, 80076, 82247–82252, 82465, 83718–83721, 84075–84080, 84132–84133, 84155, 84450–84460, 84478, 92980–92998, 93015–93018, 90924, 93224–93237, 93303–93308, 93312–93317, 93320–93325, 93350, 93542–93543, 93545, 93571–93572, 93660, and all other codes not listed between 92950–93799
- GPI therapeutic drug class codes 31*, 33*, 34*, 3610*, 3615*, 36202005*, 36202030*, 36202040*, 362010*, 3,640*, 36202010*, 36202020*, 36203010*, 36203010*, 36203020*, 36203030*, 36203040*, 36203050*, 3699*, 37*, 39*, 83*, 8515*, and 8560*

***3*) All other treatments: claims not included in categories *1* or *2* above.**

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