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Hospital Utilization among Chronic Dialysis Patients

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Abstract. Factors driving inpatient and outpatient utilization were studied among patients who began dialysis for chronic renal failure at the New England Medical Center (NEMC) between 1992 and 1997. Clinical, laboratory, and hospital resource utilization data were obtained from patient records and electronic databases. There were 2.2 hospitalizations and 14.8 hospital days per patient year at risk (PYAR). The number of hospitalizations and hospital days per PYAR were higher in the first 3 mo of initiating dialysis (4.3 and 28.3, respectively) compared to after 3 mo (1.9 and 12.9, respectively). Factors associated with increased risk of hospital days within the first 3 mo included non-health maintenance organization insurance, ischemic heart disease, late referral to the nephrologist, and use of temporary vascular access for the first dialysis. Patients with ischemic heart disease and who received dialysis during the years 1992–1994 compared with 1996–1997 had an increased risk of hospital days after 3 mo of initiating dialysis. There were 16.6 outpatient visits per PYAR, with significant differences in utilization between the first 3 mo and after 3 mo of initiating dialysis. Thus, hospital utilization was significantly higher in the first 3 mo compared to after 3 mo, and factors associated with hospital utilization depended on duration of dialysis. In particular, delayed referral to the nephrologist and lack of permanent vascular access were independently associated with increased risk of hospital utilization in the first 3 mo of dialysis. Greater attention to timely referral to the nephrologist and timely placement of vascular access could result in reduced utilization and cost savings.

The number of patients with end-stage renal disease (ESRD) is increasing. There were 260,151 patients with ESRD in the United States during 1996, which represents a doubling of the population prevalence in a decade (1). A significant proportion of health care resources is expended on the care of patients with ESRD (2–4). Indeed, ESRD patients account for only 0.5% of the Medicare pool, but the ESRD program consumes 5% of total Medicare expenses (5). Although the cost of caring for each individual dialysis patient has decreased in real dollars over the years, the total cost of ESRD care has doubled in the last 4 yr, from $7.2 billion in 1992 to more than $14.5 billion in 1996, and is expected to reach $20 billion in 2000 (1,6).

Because of growing pressure to contain health care costs in the United States, the Health Care Financing Administration (HCFA) modified the ESRD program by extending the primary payor status of non-Medicare insurers from 18 to 30 mo, and has begun a demonstration project to examine the feasibility of capitating reimbursements for ESRD services (7). The capitation rates for this project were based on cost estimates developed by private corporations and the U.S. Renal Data System (USRDS). Concurrently, private payors reduced reimbursements for dialysis and instituted full-risk capitated ESRD contracts. The central theme of these efforts is to control costs by restricting utilization. Inpatient hospital care accounts for 41% of ESRD cost (8) and hence is a prime target for cost containment. A thorough understanding of the factors that affect hospital utilization is critical if payors and providers are to establish fair capitated rates. Unfortunately, the majority of previous studies on this subject have been handicapped by the absence of data on one or more of the following: non-Medicare patients, outpatient utilization, utilization in the first 3 mo after initiation of renal replacement therapy, and pre-ESRD care.

We examined the patterns of inpatient and outpatient utilization among patients who began dialysis for chronic renal failure at the New England Medical Center between 1992 and 1997, demographic and clinical correlates of utilization, and the relationship of utilization with referral pattern, type of vascular access, and insurance at initiation of dialysis.

Materials and Methods

Patient Population

The study population consisted of patients (at least 18 yr old) who began dialysis for chronic renal failure at the New England Medical Center (NEMC) and its affiliated dialysis facility, Dialysis Clinic, Inc. (DCI), Boston, Massachusetts, between October 1, 1992 and December 31, 1997, and who received all outpatient and inpatient medical care at NEMC. Patients were identified using records of the annual dialysis facility survey, and by review of individual hospital and dialysis charts.

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Clinical and Laboratory Information

Clinical and laboratory data at the initiation of dialysis were extracted from the patient records and electronic databases of NEMC and DCI using a standardized form. Information collected included age, gender, race, insurance status, cause of ESRD, comorbid conditions, date of first visit to the nephrologist and first dialysis, laboratory values obtained within 24 h before initiation of chronic dialysis, pre-ESRD erythropoietin use, presence and type of vascular access used for the first dialysis, initial dialysis modality (hemodialysis [HD] *versus* peritoneal dialysis [PD]), predicted GFR, and hospital utilization. GFR was predicted using the equation derived from the Modification of Diet in Renal Disease Study, which is based on age, gender, race, blood urea nitrogen, serum albumin, and serum creatinine (9). Comorbidities recorded included ischemic heart disease (IHD), congestive heart failure (CHF), arrthymias, cerebrovascular disease, peripheral vascular disease (PVD), malignancy, and hepatobiliary/gastrointestinal disease.

Resource utilization information was obtained from the financial and clinical electronic databases of NEMC, and included the number of outpatient visits, number and duration of hospitalizations, and reason for each hospitalization. Hospitalizations in rehabilitation facilities were not recorded, as most of them were at facilities other than NEMC. The reason for hospitalization was ascertained from the discharge summary and was classified as one of the following: (*1*) cardiovascular; (*2*) dialysis access-related (placement of vascular access, thrombolytic therapy, treatment of infection, placement of peritoneal dialysis catheters, peritonitis, and other catheter-related complications); (*3*) infection unrelated to dialysis access; (*4*) gastrointestinal; and (*5*) other. Hospitalization data from the financial and clinical databases were compared, and discrepancies were resolved by individual chart review. The overall agreement between the two sources was 96%.

Definitions and Data Categorization

Patient age was categorized as 18 to 40, 41 to 64, 65 to 74, or ≥75 yr. Race was categorized as Caucasian or non-Caucasian (African-American and Asian). Cause of ESRD was classified as diabetes mellitus (DM) or non-DM. Insurance status at the initiation of dialysis was classified as private (private, fee-for-service), health maintenance organization (HMO), Medicare, or Medicaid. Patients with both private insurance and Medicare were classified as private, and patients with both HMO insurance and Medicare were classified as HMO. Patients were classified as early referral (ER) if their first encounter with a nephrologist occurred 4 mo or more before initiation of dialysis. Patients referred within 4 mo of starting dialysis were classified as late referral (LR). A patient was considered to have a functioning permanent vascular access for the first dialysis if an arteriovenous (AV) fistula or AV graft was used for the first dialysis; otherwise, the patient was labeled as requiring temporary vascular access. Late initiation of dialysis was defined as initiation of dialysis at a predicted GFR <5 ml/min per 1.73 m^2. Hypoalbuminemia was defined as serum albumin <3.5 g/dl, and severe anemia was defined as hematocrit <28%. Dialysis modality was defined using the "60-day rule" described by the USRDS. This rule requires that a patient be on the new modality for at least 60 d before it is considered to be a change in modality (1). Thus, for a PD patient who developed peritonitis and required HD for 30 d before returning to PD, hospital utilization during this period was ascribed to PD rather than HD.

Number of hospitalizations, hospital days, and outpatient visits were calculated per patient year at risk (PYAR). Days at risk were calculated from the date of start of dialysis until death, renal transplantation, transfer out of the dialysis unit, or end of study period (December 31, 1997), whichever occurred earlier. For number of hospitalizations and outpatient visits, days spent in the hospital were excluded from the days at risk.

Statistical Analyses

Analyses were performed using Poisson regression to examine the association between demographic, clinical, and laboratory variables at initiation of dialysis, and each of the following resource utilization outcomes: (*1*) number of hospitalizations per PYAR; (*2*) number of hospital days per PYAR; and (*3*) number of outpatient visits per PYAR. The analyses were performed for the entire study period and were stratified by the following time periods: first 3 mo of dialysis and after 3 mo following the initiation of dialysis. The Spearman coefficient was used to examine the correlation between the number of hospitalizations and the number of hospital days.

Three multivariate models (first 3 mo, after 3 mo, and overall) were constructed for each of the resource utilization outcomes in the manner described below. We used Poisson log linear regression with a quasi-likelihood approach to control for overdispersion. For each model, the independent variables included *a priori* selected variables (age, gender, race, and cause of ESRD) and all additional variables that had a univariate association with the resource utilization outcome with a probability value <0.10. The two final time-stratified models (first 3 mo and after 3 mo) for each resource utilization outcome included the variables that demonstrated an adjusted $P < 0.05$ in any of the three exploratory models and the *a priori* selected variables. Finally, two additional variables of interest—timing of referral to the nephrologist and type of initial vascular access—were examined in the final models, although they did not reach statistical significance in the exploratory models. Consequent to the inclusion of vascular access, patients with PD as initial modality were excluded. The goodness of fit of the multivariate models was assessed by ascertaining that the scaled deviance divided by the degree of freedom was close to 1 and by examining calibration plots. Statistical analyses were performed using SAS version 6.12 (SAS Institute, Inc., Cary, NC).

Poisson regression was the preferred statistical method for our data, as hospital utilization events are multiple, repetitive, and occurring at random, and this technique corrects for heterogeneity and dispersion of data as well as adjusts for varying days at risk (10). The appropriateness of the Poisson model was confirmed by the lack of significant differences between the observed number of hospitalizations and hospital days per PYAR and the numbers predicted with the Poisson models (data not shown).

Results

Patient Characteristics

Information regarding timing of referral and complete hospitalization data were available on 152 of the 155 patients who began dialysis at NEMC between 1992 and 1997. Of these, 104 (68%) were early referrals to the nephrologist, 18 (12%) were late referrals due to irreversible acute renal failure (ARF), and the remaining 29 (20%) were late referrals for reasons other than ARF. Irreversible ARF generally occurs in the hospital setting and is an unavoidable cause of late referral. Because the ARF population would not yield information on modifiable pre-ESRD factors associated with utilization, these patients were excluded from the analysis. Patients with no insurance were also excluded because there were too few for meaningful analysis ($n = 6$, 4.5%). Thus, the final study population consisted of 128 patients: 99 early referrals and 29 non-ARF late referrals. Mean follow-up of the patients was 670 d (median 487 d).

The mean age of the patients was 56 yr, 52% were Caucasian, and 52% were female. Sixty-four percent had IHD, 70% had CHF, 28% had PVD, 11% had liver disease, and 7.5% had a malignancy before initiation of dialysis. Eighty-four percent of patients began ESRD treatment on HD, and of those, 25% had a functioning permanent vascular access for the first dialysis. A detailed description of the patient cohort, the factors associated with late referral to the nephrologist, and the pre-ESRD consequences of late referral has been published previously (11).

Causes of Hospital Utilization

Figure 1, A and B, shows the distribution of causes of hospitalization and hospital days for the first 3 mo and after the first 3 mo following the initiation of dialysis. Dialysis access-related events were the most common cause of hospitalization, particularly during the first 3 mo. Overall, dialysis access-related events accounted for 36% of hospitalizations, cardiovascular diseases for 22%, gastrointestinal diseases for 11%, infections unrelated to access for 10%, and other causes for 22%. Although dialysis access-related events were the leading causes of hospitalization, cardiovascular disease accounted for a slightly higher proportion of hospital days than dialysis access events (27% *versus* 25%).

Relationship between Number of Hospitalizations and Hospital Days

The relationship between number of hospitalizations and hospital days was strong ($r = 0.94$, $P = 0.001$). Because the number of hospital days is a more precise indicator of resource utilization, the subsequent presentation of results is primarily restricted to the analysis of hospital days.

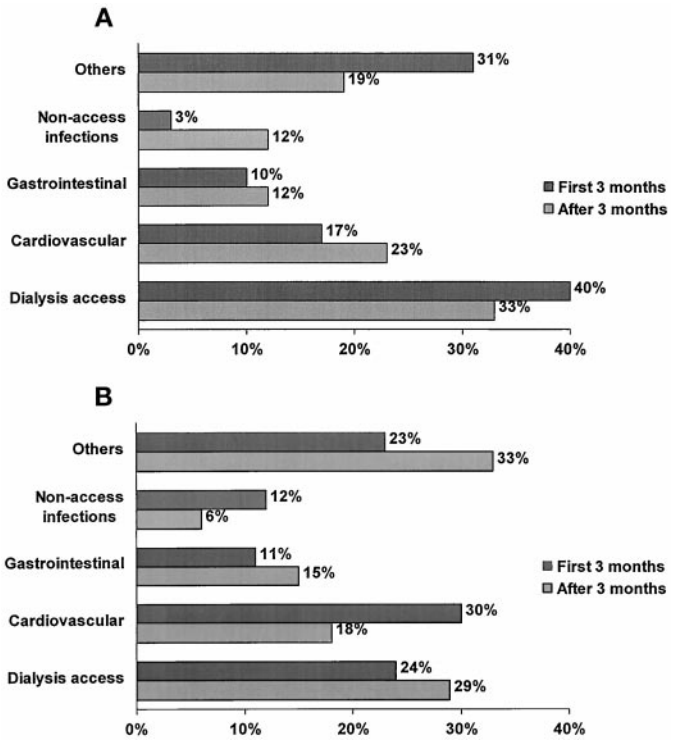

Figure 1. (A) Causes of inpatient utilization (hospitalizations). (B) Causes of inpatient utilization (hospital days).

Factors Associated with Hospital Utilization

Univariate Analysis. Patients had an average of 2.2 hospitalizations and spent 14.9 d in the hospital per year at risk. The number of hospital days per PYAR was significantly higher among diabetic patients, non-Caucasians, patients who received dialysis during the years 1992–1994, and patients with hypoalbuminemia, IHD, PVD, and CHF.

The number of hospitalizations (4.3 *versus* 1.9; $P < 0.001$) and of hospital days (28.3 *versus* 12.9; $P < 0.001$) was significantly higher in the first 3 mo than after the first 3 mo following the initiation of dialysis (Table 1). During the first 3 mo of dialysis, the number of hospital days per PYAR was significantly higher among patients with non-HMO insurance, temporary vascular access for the first dialysis, hypoalbuminemia, and IHD. The number of hospital days per PYAR during the first 3 mo was also higher among patients referred late to the nephrologist compared to those referred early (42.4 *versus* 24.4, $P = 0.06$). After the first 3 mo following initiation of dialysis, the number of hospital days per PYAR was significantly higher among patients with diabetes, patients who received dialysis during the years 1992–1994, and patients with hypoalbuminemia, IHD, and PVD.

Multivariate Analysis. In the multivariate model (Table 2), the relative risk (RR) of hospital utilization during the first 3 mo of dialysis was significantly higher among patients with non-HMO insurance (RR 9.9; 95% confidence interval [CI], 2.3 to 42.1), IHD (RR 1.7; 95% CI, 1.0 to 2.8), late referral to the nephrologist (RR 2.0; 95% CI, 1.2 to 3.4), and temporary vascular access for the first dialysis (RR 1.9; 95% CI, 1.2 to 2.9). The relative risk of hospital utilization after the first 3 mo of dialysis was significantly higher among patients with IHD (RR 1.8; 95% CI, 1.0 to 3.3) and patients who received dialysis during the years 1992–1994 (RR 2.4; 95% CI, 1.3 to 4.4).

Factors Associated with Outpatient Utilization

Univariate Analysis. There were 16.6 outpatient visits per PYAR. The number of outpatient visits (20.5 *versus* 16.1; $P < 0.02$) was significantly higher in the first 3 mo than after the first 3 mo. The number of outpatient visits per PYAR did not change over the 5-yr period. Outpatient utilization in the first 3 mo was significantly higher among patients with temporary vascular access for the first dialysis. After 3 mo following the initiation of dialysis, outpatient utilization was significantly higher among patients with diabetes as cause of ESRD. The number of outpatient visits differed significantly among the four age groups in both time periods (Table 1).

Multivariate Analysis. The adjusted relative risk of outpatient utilization during the first 3 mo of dialysis was significantly higher among patients aged 18 to 44 yr compared to those >75 yr old (RR 1.8; 95% CI, 1.1 to 2.8), Caucasians (RR 1.4; 95% CI, 1.1 to 1.8), diabetic patients (RR 1.5; 95% CI, 1.1 to 2.0), late referrals (RR 1.4; 95% CI, 1.1 to 2.0), and among patients who required temporary vascular access for the first dialysis (RR 1.4; 95% CI, 1.0 to 1.8). The adjusted relative risk

Table 1. Univariate analyses: inpatient and outpatient utilization per patient-year at risk[a]

Variable	First 3 Months			After 3 Months			Overall		
	Hospital Days	Hospitali-zations	Outpatient Visits	Hospital Days	Hospitali-zations	Outpatient Visits	Hospital Days	Hospitali-zations	Outpatient Visits
Overall	28.3	4.3	20.5	12.9	1.9	16.1	14.9	2.2	16.6
Age (yr)									
18 to 44	3.2	3.2	29.0[b]	6.2	1.8	14.4[c]	7.0	1.9	16.8
45 to 64	25.6	3.9	21.1	14.9	2.0	19.9	16.2	2.2	19.6
65 to 75	36.0	4.5	16.5	17.5	2.1	13.9	20.1	2.4	15.7
>75	39.0	6.1	15.9	9.6	1.6	9.8	14.1	2.3	11.0
Gender									
female	31.9	4.4	19.2	14.5	2.1	14.8	16.6	2.4	15.3
male	24.0	4.2	22.1	1.0	1.5	17.9	12.4	1.9	18.6
Race									
Caucasian	34.6	4.9	22.0	16.7	1.8	18.1	19.6[b]	2.3	18.8
non-Caucasian	21.3	3.7	18.9	10.2	2.0	15.6	11.4	2.2	15.8
Cause of ESRD									
diabetes mellitus	38.9	5.3	23.7	18.8[b]	2.6[b]	21.4[c]	21.8[b]	3.0[b]	21.7[c]
non-diabetes mellitus	22.7	3.8	18.9	10.5	1.6	13.9	12.0	1.9	14.5
Insurance									
non-HMO	33.8[c]	4.9[b]	21.4	14.0	2.0	15.6	16.5	2.4	16.3
HMO	6.7	2.1	17.4	7.3	1.2	18.1	7.3	1.4	18.0
First vascular access									
permanent	22.7[b]	4.4	17.4[b]	12.1	2.0	15.2	13.7	2.4	15.5
temporary	41.9	5.2	24.5	14.6	1.8	15.5	16.4	2.1	16.4
Years of dialysis									
10/92 to 9/94	37.4	5.1	20.2	26.0[d]	2.3	16.5	29.2[d]	3.1	17.5
10/94 to 9/96	20.1	3.2	22.8	9.3	1.6	16.4	10.4	1.8	17.0
10/96 to 12/97	25.0	4.5	17.6	11.6	2.0	15.5	12.8	2.2	15.7
Modality of dialysis									
peritoneal dialysis	15.5	2.5	22.6	14.2	2.5	18.3	12.3	2.5	16.0
hemodialysis	30.7	4.7	20.1	12.6	1.7	15.3	15.8	2.1	18.7
Timing of referral									
early	24.4	4.2	21.1	11.9	1.9	16.1	13.6	2.2	16.8
late	42.4	4.8	18.2	16.2	2.0	15.9	19.6	2.4	16.2
Serum albumin (g/dl)									
<3.5	36.0[b]	4.8	20.5	16.5[b]	2.4[b]	16.7	19.2[b]	2.7[b]	17.2
3.5 and high	17.6	3.9	20.7	8.7	1.3	14.9	9.8	1.6	15.6
Hematocrit (%)									
>28	28.7	4.9	19.5	13.7	2.0	17.0	15.7	2.4	17.3
<28	28.4	3.5	22.2	11.5	1.8	14.9	13.6	2.0	15.7
GFR at initiation of dialysis									
>5 ml/min per 1.73 m^2	31.4	4.8	21.6	14.0	2.0	16.1	16.4	2.3	16.9
<5 ml/min per 1.73 m^2	21.0	3.2	17.6	10.6	1.6	15.4	11.9	1.8	15.6
EPO use									
yes	22.6	3.6	16.2[b]	14.5	1.8	15.4	15.7	2.0	15.5
no	31.7	4.7	22.9	12.3	2.0	16.4	14.7	2.3	17.2
Ischemic heart disease									
no	18.4[d]	3.7	19.6	9.1[d]	1.5[d]	15.9	10.2[d]	1.8[d]	16.5
yes	46.8	5.5	21.3	23.2	2.9	16.8	27.1	3.3	17.3
Congestive heart failure									
no	23.1	4.3	21.1	9.6	1.6	15.1	11.3[b]	1.9	15.8
yes	34.2	4.3	20.3	16.6	2.3	17.3	18.9	2.5	17.7

Table 1 continues

Table 1.—Continued

Variable	First 3 Months			After 3 Months			Overall		
	Hospital Days	Hospitali-zations	Outpatient Visits	Hospital Days	Hospitali-zations	Outpatient Visits	Hospital Days	Hospitali-zations	Outpatient Visits
Peripheral vascular disease									
no	23.1	3.8	20.2	9.9[c]	1.7[b]	15.7	11.6[d]	1.9[b]	16.2
yes	43.2	5.7	22.3	22.9	2.1	17.6	25.9	3.1	18.3
Hepatic disease									
no	29.4	4.3	20.7	12.6	1.7[b]	15.8	14.7	2.1[b]	16.4
yes	22.0	4.7	20.8	15.6	3.1	18.5	16.7	3.4	18.8

[a] Results are given as number of days in the hospital, number of hospitalizations, and number of outpatient visits per patient-year at risk. ESRD, end-stage renal disease; HMO, health maintenance organization; EPO, erythropoietin.
[b] $P < 0.05$.
[c] $P < 0.01$.
[d] $P < 0.001$.

Table 2. Factors associated with hospital utilization (hospital days per patient-year at risk)[a]

Variable	First 3 Months		After 3 Months	
	Relative Risk	95% Confidence Interval	Relative Risk	95% Confidence Interval
Age (yr)				
18 to 44	0.4	0.2 to 1.0	0.6	0.2 to 1.7
45 to 64	0.5	0.3 to 1.0	1.0	0.5 to 2.1
65 to 75	0.5	0.3 to 1.0	0.9	0.4 to 1.8
>75 (ref)	1.0		1.0	
Female gender (ref = male)	0.9	0.6 to 1.5	1.5	0.8 to 2.7
Diabetes mellitus[b] (ref = non-diabetes mellitus)	1.6	1.0 to 2.7	1.5	0.9 to 2.7
Insurance				
non-HMO (ref = HMO)	9.9	2.3 to 42.1	1.3	0.5 to 3.3
Ischemic heart disease present (ref = absent)	1.7	1.0 to 2.8	1.8	1.0 to 3.3
Year of dialysis				
10/92 to 9/94	1.6	0.9 to 2.8	2.4	1.3 to 4.4
10/94 to 9/96	1.3	0.7 to 2.5	0.8	0.5 to 1.5
10/96 to 9/98 (ref)	1.0			
Late referral (ref = early)	2.0	1.2 to 3.4	1.0	0.5 to 1.9
Temporary access for first dialysis (ref = permanent)	1.9	1.2 to 2.9	1.4	0.8 to 2.4

[a] Multivariate model adjusted for the interaction between race and severe anemia.
[b] Diabetes mellitus as a cause of ESRD.

of outpatient utilization after the first 3 mo of dialysis was significantly higher among patients younger than 75 yr (RR 1.7; 95% CI, 1.2 to 2.1) and patients with diabetes (RR 1.7; 95% CI, 1.4 to 2.1).

Discussion

Overall, dialysis patients at the New England Medical Center had an average of 2.2 hospitalizations and 14.8 hospital days per year at risk. The number of hospitalizations and hospital days per PYAR was higher in the first 3 mo of initiation of dialysis than after 3 mo. Although the number of hospitalizations per PYAR after the first 3 mo was similar to that reported by the USRDS during a similar time period (1.9 at NEMC *versus* 2.0 by USRDS), the number of hospital days per PYAR was lower (12.9 at NEMC *versus* 15 by USRDS) (1). Some of the discrepancies between our results and those of the USRDS may be explained by: (*1*) rehabilitation facility admissions not being included in our study; (*2*) the high regional presence of managed care organizations, which restrict inpatient utilization; and (*3*) different regional practice patterns. Indeed, data from the USRDS support differing practice patterns. Compared to the national average, incident hemodialysis patients in ESRD Network 1 (Network of New England) are less likely to have an arteriovenous graft than a fistula (odds ratio 0.20; CI, 0.14 to 0.28) (12). Similarly, Standardized Hospitalization Ratio, a measure of ESRD patient hospitalization experience, has been reported to vary from state to

state ranging from 0.72 to 1.29 (1). Associated comorbid conditions are an unlikely explanation for the lower utilization in our study, since 67, 50, and 28% of NEMC patients had IHD, CHF, and PVD, respectively, which represent a higher prevalence than that reported for the U.S. ESRD population (13).

Few studies have evaluated the factors associated with increased hospital utilization (14–16), and, to our knowledge, none has reported on inpatient or outpatient utilization in the first 3 mo following initiation of dialysis. Rocco *et al.* (16) described factors associated with increased hospital utilization among incident dialysis patients in Network 6 during the years 1989–1993. Low serum albumin, increasing age, decreased activity score, white race, diabetes, smoking, CHF, PVD, and absence of hypertension were significantly associated with an increased number of hospital days per PYAR. This was the first comprehensive analysis of risk factors for hospital utilization, but it has some limitations. The analysis excluded more than 50% of the patients, notably those who did not have any admissions, and hospital utilization data were limited to patients on Medicare.

In contrast, our study included patients with no hospitalizations and almost all forms of insurance, and explored factors associated with inpatient as well as outpatient utilization. Furthermore, an analysis stratified by time since starting dialysis was performed, because we thought it likely that factors associated with hospital utilization among chronic dialysis patients change over time. We chose the cutoff of 3 mo because there is little published information on resource utilization by U.S. ESRD patients during the first 3 mo of chronic dialysis. The much higher inpatient utilization observed during the first 3 mo among our patients has several explanations: many patients with advanced uremia are very ill, most do not have permanent vascular access, and stabilization of dialysis management and comorbid conditions has not yet occurred.

Insurance by HMOs was associated with lower inpatient utilization in the first 3 mo compared to non-HMO insurance. This may reflect the HMO strategy of restricting provider and hospital expenditures to promote savings (17). Indeed, Gold *et al.* (18) surveyed the arrangements managed care plans make with physicians. More than half of the HMOs reported adjusting payments according to utilization and cost patterns. Studies attempting to evaluate whether lower inpatient utilization among patients insured with HMOs is the result of better economic management or is at the cost of patient outcomes have shown conflicting results. Ware and colleagues (19) compared the physical and mental health outcomes of chronically ill patients treated during 1986–1990 in HMOs and fee-for-service (FFS) systems. Elderly, poor, and chronically ill patients had worse physical health outcomes in HMOs than in FFS systems. Angus and colleagues (20) described no difference in the length of stay in the intensive care unit or mortality between patients insured with HMOs and patients with other insurance. Kreindel and colleagues (21) found no significant difference in the hospital stay and short-term mortality between patients with managed care insurance and patients with non-managed care insurance. To the best of our knowledge, there is no published information or data comparing insurance status and outcome among chronic dialysis patients. Clearly, additional studies are needed to resolve this complex issue.

Delayed referral of patients with chronic renal failure to the nephrologist has been reported to be associated with a greater likelihood of prolonged hospitalization around the time of initiation of dialysis (22–24). However, these analyses did not adjust for factors that could potentially affect inpatient utilization. In our analysis, which adjusted for age, gender, race, cause of ESRD, insurance status, and presence of IHD, patients referred late to the nephrologist had a higher risk of hospital days per PYAR during the initial 3 mo of dialysis. This suggests that early referral may reduce early hospital utilization, perhaps by facilitating timely placement of a permanent access and appropriate management of anemia, hypertension, secondary hyperparathyroidism, and other comorbid conditions.

Access-related diagnoses are an important cause of inpatient utilization among dialysis patients, accounting for 25 to 31% of hospitalizations in previous reports (14,25). Furthermore, it appears that hospitalizations related to vascular access are increasing in the United States (26). Thirty-six percent of all hospitalizations and 25% of hospital days in our study were access-related. We studied the effect of requiring temporary vascular access for the first hemodialysis treatment on inpatient and outpatient utilization. Adjusted for demographic characteristics, cause of ESRD, and IHD, patients requiring temporary vascular access for the first dialysis had a higher risk for hospital days in the first 3 mo of dialysis compared to those who had a functioning permanent vascular access. Similarly, use of temporary vascular access for the first dialysis was associated with an increased risk of outpatient visits in the first 3 mo of dialysis. Placement of a permanent vascular access before initiation of dialysis may result in more effective hospital resource utilization and thus may decrease the cost of care of patients with ESRD.

Patients on dialysis not only have higher inpatient utilization compared to patients without chronic renal failure, but also higher outpatient utilization. According to the National Ambulatory Medical Care Survey, in 1996 the overall rate of office visits to a physician was 2.8 per person (27). This is in sharp contrast to 16.6 visits per PYAR among patients in our cohort. The inclusion of outpatient procedures and some short-stay ($<$24 h) hospitalizations in outpatient utilization may in part explain this discrepancy. In addition, patients with ESRD have a high incidence of cardiovascular and other complications prompting visits to other specialists. Nephrology encounters do not account for a large proportion of outpatient visits at our institution because most patients are seen during dialysis sessions without a separate outpatient encounter. However, this practice may vary by institution as some nephrologists schedule outpatient visits with their chronic dialysis patients. Younger patients had higher outpatient utilization. This is to be expected, because they are less likely to require hospitalization for procedures and complications. The higher outpatient utilization associated with diabetes as a cause of ESRD is probably related to comorbidities and complications of diabetes.

There are several potential limitations of this study. (*1*) These results are from a single center in a state that has a substantial presence of HMOs, and hence may not be gener-

alizable. (*2*) Hospitalizations for rehabilitation were not reported, and hence we may have underestimated utilization. (*3*) Some of the 24-h admissions were considered outpatient visits by the hospital accounting system. (*4*) There may be other patient-, physician-, and treatment-related factors that could affect hospital utilization which were not reported in the study.

In summary, our study provides a comprehensive analysis of inpatient and outpatient utilization among patients with ESRD at a single center. Our results indicate that: (*1*) hospital utilization is significantly higher in the first 3 mo of dialysis than thereafter; (*2*) factors associated with hospital utilization are different in these two time periods; (*3*) absence of a permanent vascular access and delayed nephrology referral are independently associated with higher hospital utilization in the first 3 mo of dialysis; and (*4*) insurance by an HMO is associated with lower inpatient utilization. Our results point toward certain areas of potential intervention that may be targeted for quality improvement, such as timely placement of permanent vascular access and early nephrology referral. Further study of the impact of improved pre-ESRD management on patient morbidity and hospital utilization is needed.

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