Length of Stay and Costs for Hospitalized Hemodialysis Patients: Nephrologists *versus* Internists

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Abstract. The high cost of hospitalization for hemodialysis patients has become a major health care issue. To address this issue, length of hospital stay and costs for these patients were compared with services covered by nephrologists and services covered by internists. Hemodialysis patients ($n = 161$) were prospectively admitted 219 times on alternate days to services covered by nephrologists or by internists from July 1995 to March 1996. Admissions to nonmedical services and admissions for overnight observation were excluded. Length of stay, costs, and risk-adjusted predicted length of stay and costs, as well as the number of consultations were compared between services, using Wilcoxon rank sum tests. Readmissions and deaths were compared using χ^2 tests. Mean length of stay for admissions to the nephrology service ($n = 114$) was 6.3 days compared with 8.1 days for admissions to internal medicine services ($n = 105$) ($P = 0.017$). The predicted length of stay was similar. Mean overall cost for admissions under the care of nephrologists was \$7,925 *versus* \$10,773 under the care of internists ($P = 0.101$). The internal medicine service averaged 1.5 consultations *versus* 0.5 consultations for the nephrology service ($P = 0.001$). The risk of readmission was 24% for nephrologists and 30% for internists ($P = 0.328$). Death within 90 days of discharge was 12% for the nephrology group and 22% for the internal medicine group ($P = 0.07$). The length of stay was significantly shorter for hemodialysis patients under the care of nephrologists compared with internists. The average total costs and risk of readmissions tended to be lower for nephrologists. If these results are corroborated, the care of hemodialysis patients by the nephrologist could diminish the overall expense of the ESRD program.

Since its inception in 1973, the end-stage renal disease (ESRD) program has experienced rapid growth. Americans have had near-universal access to renal replacement therapy (RRT). In 1973, approximately 10,000 individuals were receiving RRT. By 1996, more than 250,000 individuals were receiving some form of RRT, the most common of which was hemodialysis (1).

During this period, health care costs have risen steadily. Since 1960, the rate of increase in costs has been greater than the rate of the Consumer Price Index (2). The ESRD program has become particularly expensive. Annual Medicare expenditures exceeded \$10 billion since 1996 (3). ESRD beneficiaries accounted for 0.5% of the total Medicare population, yet received 5% of all Medicare expenditures (4). Annual expenditures per beneficiary ranged from \$36,000 for those 24 yr old and younger to \$51,000 for those 75 yr and older (4). Inpatient expenditures accounted for approximately 45% of total program expenditures (4).

Physician-generated costs may be responsible for some of the rise in health care costs. Physician charges directly accounted for 21% of all health care expenses, and physicians' actions indirectly accounted for 71% of all expenses (2), and have a multiplier effect (5).

Patients receiving RRT, especially those receiving chronic hemodialysis, are often hospitalized with general medical problems. Hospitalization of patients on hemodialysis is disproportionately costly. The indications for hospitalization usually reflect the patients' comorbid conditions, such as coronary artery disease, diabetes mellitus, and cerebrovascular disease. Physicians trained in internal medicine or family practice may be able to manage these individuals, with nephrology consultation as needed. Nonspecialists are generally thought to use fewer resources than specialists (6–10), even when controlling for the severity of illness in patient populations (9,10). Therefore, some have speculated that costs may be reduced by placing such patients under the care of generalists instead of nephrology specialists. However, few data are available to support this claim in chronic hemodialysis patients (11).

We therefore conducted a study to examine the length of stay and costs in the management of hemodialysis patients who were hospitalized for a variety of medical problems. Our primary goal was to determine whether hemodialysis patients admitted to the University of North Carolina (UNC) Hospitals under the direct care of nephrologists had differences in length of stay and hospital costs when compared with hemodialysis patients placed under the care of non-nephrologist internists. A secondary goal of the study was to compare the rehospitaliza-

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tion risk among these patients. Death within 90 days of discharge was also examined.

Materials and Methods

Patient Selection

All adult patients on chronic hemodialysis who were admitted to medical services at UNC Hospitals between July 1995 and March 1996 were eligible for inclusion in the study. Patients who were hospitalized during the study period for initiation of chronic hemodialysis were also eligible for entry into the study. Patients were excluded if they were admitted to any surgical service, any obstetrics or gynecological service, any psychiatric service, or any inpatient rehabilitation service. Admissions for shunt placement and modification, as routine policy at UNC Hospitals, were considered surgical, and thus were excluded from the present study. Admissions for management of catheter-related infections were eligible for inclusion in the study. Patients who were transferred from one service to another were excluded, as were patients who were admitted for overnight observation (less than 24 h).

Enrollment

The University of North Carolina Hospitals is one contiguous structure located in Chapel Hill, North Carolina. As a tertiary care center, it has a variety of general and specialty medical inpatient services. At the time of this study, some specialty medical services were open to patient admissions on alternate days only. General medicine services admitted specialty patients on the days that the specialty services were closed for admissions. The alternate-day admission program has been in effect since 1992. Attending physicians within each division were assigned to cover their inpatient service for one calendar month at a time. The sequence of rotation of faculty members through an inpatient service was left to the discretion of each division.

A previous review of hospital admissions revealed that hemodialysis patients were hospitalized an average of 3 days more on internal medicine services than on the nephrology service. Before the start of the present study, we estimated that a sample size of 172 to 212 admissions would be needed to detect a difference of 3 days, with a two-sided P value of 0.05. We then estimated the number of months necessary to accumulate the appropriate number of admissions.

Throughout the study period, hemodialysis patients were prospectively and consecutively admitted on alternate days to services attended by either internal medicine physicians or by nephrologists. The decision to admit a particular patient was generally made by either a nephrologist at a dialysis unit or an attending physician in the Emergency Department at UNC Hospitals. Whenever hemodialysis patients were admitted to general medical services, a nephrology consultation was obtained. None of the patients was aware of the study during the months that data were being accrued. One of the authors (R.J.F.) was aware of the study. No other physician from the internal medicine or nephrology services was aware of the study during the time of data accrual.

An individual patient could be included in the study more than once if he or she was hospitalized more than once. This was not considered a violation of the rules of independence because readmission to a different service or the same service was not contingent on the previous admission. A readmission was defined as a repeat admission of eligible patients during the study period. Readmissions were counted only if they met the same inclusion criteria for admission into the study. The risk of readmission was calculated during the study period only.

Data Extraction and Retrieval

Demographic information, length of stay, costs, number of consultations, and diagnostic related group (DRG) codes were obtained from the hospital's master file of discharges on all patients who received hemodialysis during their hospital stay. From this master list, all patients who received hemodialysis for acute renal failure were excluded; the other patients were screened for eligibility according to the criteria described previously. DRG codes were assigned by trained hospital coders.

Length of stay was calculated as the number of days in the hospital. Costs were calculated by the hospital's Cost Accounting/Decision Support System. This system identified the variable and fixed cost components of major activities and services and aggregated them into an activity-based cost. The costs were not adjusted insurance charges or fees collected. Predicted length of stay and predicted costs were calculated using the risk adjustment method developed by the University Health System Consortium (12). This method used a combination of DRG codes and the Sachs Complications Profiler (13), in conjunction with data on specific patient characteristics (age, gender, urgency of admission, payor class), to construct regression models that assign predicted values for length of stay and costs for individuals at the time of admission (12). The Continuous Quality Improvement Department of UNC Hospitals provided the required data to the University Health System Consortium, which computes predicted values for length of stay and costs on all admissions to UNC Hospitals.

Information on duration of dialysis, cause of ESRD, and death outcomes was obtained from the UNC Hospitals medical record and, when necessary, by contacting each patient's outpatient hemodialysis unit. The Social Security Death Index was searched for death information on the patients who were lost to follow-up within 90 days of hospital discharge (http://www.ancestry.com).

Statistical Analyses

Continuity-adjusted χ^2 tests were used to compare categorical variables of interest between the group of patients under the care of nephrologists and the group under the care of internists. Wilcoxon rank sum tests were used to compare numerical variables, including length of stay, overall costs, cost categories, average costs per day, and number of consultations. Mean values, medians, and interquartile ranges are reported. These analyses were performed with and without data from the month of January 1996, because one of the study authors (R.J.F.) was covering the nephrology service at that time. These analyses were also performed with and without the inclusion of admissions to the intensive care units. Because of the significant difference between the internal medicine and nephrology groups in the baseline variables age and unknown cause of ESRD, the mean and median age of patients was calculated for individuals with the unknown cause of ESRD and for individuals with all of the other causes of ESRD.

The cumulative incidence of readmission to UNC Hospitals was calculated during the study period only. The cumulative incidence of death was calculated for individuals for up to 90 days after the conclusion of the study. The relative risks of readmission and of death, along with 95% confidence intervals, were quantified for each group. Risks were compared using χ^2 analysis.

Results

There were a total of 219 admissions (161 individual patients) during the study period. Seventy-three percent of patients had a single hospitalization, while 21% had two, and

approximately 2% (three patients) had at least four hospitalizations. Twenty-three of the admissions were to the intensive care units.

Table 1 shows the demographic characteristics of the patients who were included in the study. Gender and race of the patients did not vary significantly between the two services. The predominance of blacks in our study (62% of the nephrology service admissions and 66% of the internal medicine service admissions) is representative of the ESRD dialysis population in North Carolina (62% of the prevalent RRT population in North Carolina is black [14]). The patients admitted to the nephrology service were significantly older than the patients admitted to the internal medicine service ($P = 0.005$). There was a slightly greater percentage of women than men admitted to the nephrology service (women = 56% *versus* men = 44%), but the difference was not statistically significant. There were no statistical differences between the two services in the duration of dialysis before admission or in the number of patients starting dialysis within 90 days of admission. Additionally, the distribution of diabetic patients at the time of hospitalization was similar between the two groups.

The cause of renal failure was statistically different between the two groups. Thirty-eight percent of individuals admitted to an internal medicine service were reported to have an unknown cause of ESRD, compared with 11% of those admitted to the nephrology service (Table 1). Subsequent analysis revealed that when the focus was limited to admissions of patients already on chronic hemodialysis before hospitalization, there was no statistical difference in the causes of ESRD reported for each group ($P = 0.161$). However, when the analysis was limited to admission of patients with chronic renal failure who were initiating hemodialysis when they were admitted, the difference in the number of unknown causes of ESRD reported by the two groups remained statistically significant (internal medicine = 60% *versus* nephrology = 14%). The average age and median age of patients also varied by assigned cause of ESRD. Individuals with an unknown cause of ESRD had a mean and median age of 50 and 45 yr, respectively. Individuals with the other four causes of ESRD had a mean and median age of 55 and 56 yr, respectively.

The distribution of DRG codes of the patients was not statistically different between nephrologist and internists ($P = 0.822$). Cardiovascular, peripheral vascular, and renal-related events were the most common DRG codes assigned to admissions for this population of hemodialysis patients. Admitting diagnoses, according to general categories of the assigned DRG code, are shown in Table 2.

The average length of stay for hemodialysis patients under the care of nephrologists was 6.3 days, compared with 8.1 days for internists with nephrology consultation (Table 3). This difference in length of stay was statistically significant ($P = 0.017$). There was no statistical difference in predicted days of hospital stay between the two groups (6.9 days for the nephrology group *versus* 7.6 days for the internal medicine group; $P = 0.378$) (Table 3).

The average total cost per admission was $2,848 more for hemodialysis patients admitted to an internal medicine service than for those admitted to the nephrology service (Table 3). This difference in cost trended toward statistical significance ($P = 0.101$). Predicted overall cost was not different between

Table 1. Summary of patient characteristics by service[a]

Variable	Nephrology (Total $n = 114$)	Internal Medicine (Total $n = 105$)	P Value
Gender			
male	50 (44)	52 (50)	0.401
female	64 (56)	53 (50)	
Race			
black	71 (62)	70 (67)	0.823[b]
white	36 (32)	30 (29)	
other	7 (6)	5 (4)	
Mean age (yr)	57 ± 16	50 ± 16	0.005
Mean time on dialysis (mo)	24 ± 33	23 ± 34	0.888
No. starting dialysis within 90 d prior to admission	43 (39)	26 (28)	0.085
No. with diabetes mellitus	41 (41)	44 (39)	0.753
ESRD cause			
hypertension	42 (37)	20 (19)	0.001[b]
diabetes mellitus	36 (32)	30 (29)	
glomerulonephritis	15 (13)	4 (4)	
other[c]	8 (7)	11 (10)	
unknown	13 (11)	40 (38)	

[a] Results are given as n (%) or mean ± SD. ESRD, end-stage renal disease.
[b] The P value is the probability that the distribution across all categories of race or cause of ESRD is the same between the two services.
[c] Other causes include interstitial disease, HIV, amyloidosis, multiple myeloma, sickle cell disease, and Alport's syndrome.

Table 2. Reason for admissions by service[a]

Diagnosis	Nephrology (Total $n = 114$)	Internal Medicine (Total $n = 105$)
Cardiovascular or peripheral vascular	36 (33)	29 (28)
Kidney related/renal failure	25 (22)	19 (18)
Infections	19 (17)	21 (20)
Gastrointestinal	9 (8)	9 (9)
Neurologic or psychologic	2 (2)	5 (5)
Respiratory	3 (3)	2 (2)
Musculoskeletal	4 (4)	3 (3)
Diabetes mellitus	5 (4)	3 (3)
Hematologic	1 (1)	3 (3)
Miscellaneous[b]	6 (5)	6 (6)
Unknown	4 (4)	4 (4)

[a] Data are categorized using diagnostic related group (DRG) codes. Results are given as *n* (%). There were no differences in admission diagnosis categories between the two services ($P = 0.822$). This *P* value is calculated by combining the following small categories: miscellaneous, neurologic or psychologic, respiratory, musculoskeletal, and hematologic. Column percentages do not add up to 100 because of rounding.

[b] Miscellaneous reasons for admission include operation procedures for injuries; skin ulcers; inborn errors of metabolism; and hernia, anal, or stomal procedures.

the two groups (Table 3). For certain categories of hospital cost—routine and pharmacy—the average amount was statistically higher for the admissions to internal medicine services compared with admissions to the nephrology service (Table 3). There were no statistical differences in costs in the other categories, including diagnostic tests, dialysis, laboratory, respiratory therapy, procedures, and supplies. Average overall costs per day were not different between services for total costs ($P = 0.446$; Table 4).

The risk of readmissions was not significantly different between the two groups, although the incidence was slightly lower among nephrologists (24%) than internists (30%) ($P = 0.328$). There was no statistical difference in mortality rates within 90 days after discharge between services. Twelve percent of patients from the nephrology service *versus* 22% of patients from the internal medicine service died within 90 days of discharge, resulting in a relative risk of death of 1.76 (95% confidence interval, 0.94 to 3.30; $P = 0.182$).

The number of consultations obtained by either nephrologists or internists differed significantly. On average, the nephrology service obtained 0.5 consultations per admission *versus* 1.5 for the internal medicine services ($P = 0.001$). The difference in the average length of stay did not change with the exclusion of data from the month of January. The differences also did not change with the exclusion of admissions to the intensive care units ($n = 23$).

Discussion

In this prospective analysis of 161 patients admitted a total of 219 times, we observed that the length of stay for hemodialysis patients differed by the medical service in which they received care. Individuals admitted to a nephrology service, on average, were hospitalized 2 days fewer than individuals admitted to an internal medicine service. Overall, costs per hospitalization tended to be less on the nephrology service than on the internal medicine service. Average costs per day did not differ by service. These observations suggest that the difference in the length of stay between the two services was the driving force for the overall cost difference. Importantly, the risk of readmission or death did not differ between the two groups, despite a shorter length of stay and lower costs.

The potential explanations of these findings are likely structural and multifaceted. First, nephrologists are the primary care providers for chronic hemodialysis patients at UNC Hospitals. As such, they see these patients frequently (3 times per week for outpatient hemodialysis sessions) and are responsible for providing continuity of care. Often, the high frequency of patient-physician encounters allows nephrologists to initiate care before a patient's hospitalization. On the other hand, an attending internist in this study is likely to have seen an individual patient for the first time during a hospitalization.

Second, the nephrologists have a better opportunity to ensure follow-up after discharge because they are likely to see their patients at the hemodialysis center. Thus, they may be able to shift some of the management to the outpatient setting. The internist has no such built-in mechanism to ensure follow-up. As a result, internists may be inclined to keep patients hospitalized until all necessary studies can be performed. The outpatient hemodialysis clinic structure allows for continuity of care and has advantages for both patients and physicians. In other medical fields, continuity of care has been shown to improve outcomes (15,16).

Third, the consultative process is inherently inefficient. In our study, anytime a patient was admitted to an internal medicine service, nephrology consultation was obtained. There is inherent delay from the time an individual is admitted to the time a consultation is called. Furthermore, there is also an inherent lag from the time recommendations of nephrology

Table 3. Comparison of length of hospital stay and costs for hemodialysis patients cared for by nephrologists ($n = 111$) and internists ($n = 102$)[a]

Variable	Nephrology (Total $n = 114$)	Internal Medicine (Total $n = 105$)	*P* Value
Days of hospital stay	6.3, 4.0 (2 to 8)	8.1, 6.0 (4 to 9)	0.017
Predicted days of hospital stay	6.9, 5.9 (4.5 to 8.1)	7.6, 6.1 (4.7 to 9.6)	0.378
Total cost of stay	$7,925, $6,138 ($3,342 to 10,125)	$10,773, $6,836 ($4,023 to 11,239)	0.101
Predicted cost of hospital stay	$8,712, $7,252 ($5,107 to 10,772)	$10,183, $7,633 ($5,287 to 12,872)	0.269
Cost categories			
diagnostic tests	$1,162, $692 ($104 to 1,467)	$1,031, $459 ($72 to 1,428)	0.572
dialysis	$1,076, $802 ($535 to 1,448)	$1,411, $995 ($535 to 1,590)	0.185
laboratory	$974, $622 ($327 to 1,152)	$1,551, $837 ($440 to 1,503)	0.093
routine costs[b]	$2,569, $1,814 ($911 to 3,239)	$3,452, $2,316 ($1,360 to 3,837)	0.010
pharmacy	$736, $492 ($278 to 819)	$1,177, $701 ($405 to 1,081)	0.008
respiratory therapy	$82, $26 ($0 to 97)	$125, $26 ($0 to 108)	0.365
procedures	$119, $0 ($0 to 80)	$54, $0 ($0 to 0)	0.446
supplies	$196, $72 ($19 to 174)	$243, $54 ($25 to 186)	0.769

[a] Results are given as mean, median (first and third data quartiles).
[b] Routine costs include costs from the floor where the patient is physically located.

consultants are made to the time these recommendations are adopted. The formulation and execution of care plans are undoubtedly less time-consuming with only an attending physician involved than when care must be coordinated among attending and consulting physicians.

Finally, inherent differences in training between nephrologists and internists may partially explain the observations. Currently, board eligibility and certification in nephrology require 2 yr of subspecialty training after 3 yr of internal medicine. During the additional years of training, nephrologists are exposed to a myriad of medical problems that hemodialysis patients encounter. It is clear from studies in other medical fields that specialists have a greater knowledge base about their fields than generalists do (17,18). This greater knowledge may translate into greater efficiency (19,20), and possibly better outcomes (20–22).

It is unlikely that the difference in the length of stay was due to differences in case severity of patients. DRG codes were used in place of direct measurements of case severity. Comparison of the DRG codes did not reveal any statistically significant differences between the groups of patients admitted to either the nephrology or internal medicine services. There were also no differences between the services in predicted length of stay and predicted costs, indicating an equitable distribution of patient risks in the two services. In addition, the variables of gender, race, prevalence of diabetes, and the time on dialysis were similar between services. Furthermore, admissions that may have skewed the results—those requiring surgical intervention or rehabilitation, transfers from medical and surgical services, and overnight observations—were excluded from this study.

The statistically significant difference in the assigned cause of ESRD by type of medical service is noteworthy. Subgroup analysis revealed that this difference was driven largely by the frequency with which the cause was reported as unknown, especially for individuals initiating hemodialysis during a hospital admission. Generally, cause was assigned as a best guess on the basis of a patient's clinical presentation. Few patients had biopsy-proven diagnoses. When a patient was admitted to the internal medicine service, the primary cause of ESRD was assigned by the nephrologist on the consultation service. When a patient was admitted to the nephrology service, the cause was assigned by the attending nephrologist covering the service. It was unclear why the observed difference in the labeled cause of ESRD was seen. It is unlikely that this observed difference biased the results. One could postulate that assigning an indi-

Table 4. Comparison of average hospital costs per day for hemodialysis patients cared for by nephrologists ($n = 114$) and internists ($n = 105$)[a]

Variable	Nephrology (Total $n = 114$)	Internal Medicine (Total $n = 105$)	P Value
Overall cost per day	\$1,302, \$1,228 (\$1,013 to 1,534)	\$1,262, \$1,155 (\$954 to 1,486)	0.446
Diagnostic tests	\$177, \$102 (\$34 to 235)	\$116, \$73 (\$19 to 168)	0.033
Dialysis	\$196, \$150 (\$129 to 222)	\$183, \$144 (\$107 to 199)	0.400
Laboratory	\$166, \$132 (\$89 to 202)	\$180, \$132 (\$81 to 220)	0.900
Routine costs[b]	\$394, \$453 (\$340 to 453)	\$411, \$453 (\$367 to 468)	0.030
Respiratory therapy	\$15, \$4 (\$0 to 15)	\$11, \$6 (\$0 to 19)	0.461
Pharmacy	\$112, \$106 (\$81 to 142)	\$131, \$113 (\$89 to 161)	0.076
Procedures	\$18, \$0 (\$0 to 8)	\$10, \$0 (\$0 to 0)	0.506
Supplies	\$32, \$12 (\$6 to 30)	\$21, \$11 (\$5 to 26)	0.525

[a] Results are given as mean, median (first and third data quartile).
[b] Routine costs include costs from the floor where the patient is physically located.

vidual the diagnosis of "unknown" would result in a greater diagnostic workup, and thus a longer length of stay. Although there were no estimates of the number of diagnostic tests obtained, the average daily costs for diagnostic tests were similar for both the nephrology and the internal medicine groups. Despite a greater number of unknowns on the internal medicine group, the workup for the unknowns was not greater. Therefore, it is unlikely that difference in the distribution of unknowns biased the observed difference in the length of stay in favor of the nephrologists.

Additional subgroup analysis also revealed that the variables age and unknown cause of ESRD may be codependent. The median age of individuals with the unknown diagnosis was 45 yr *versus* 56 yr for individuals with the other four diagnoses. The mean age for individuals with an unknown cause was 50 yr *versus* 55 yr for individuals with the other four assigned causes ($P = 0.055$). Although it is impossible to establish cause and effect for these two variables, this finding helps to explain observed statistically significant differences in these two variables between the internal medicine and nephrology groups. We do not know the reason for the greater distribution of individuals with the unknown diagnosis in the internal medicine group than in the nephrology group.

The observed difference in the average number of consultations between the nephrology and internal medicine service was approximately 1 (nephrology = 0.5, internal medicine = 1.5). This difference can be accounted for by the routine policy at our institution of obtaining nephrology consultations whenever a hemodialysis patient is admitted to the internal medicine service.

There were some limitations to this study. First, the analysis was primarily powered to show a difference in length of stay of approximately 3 days. Despite a sample size of more than 200 admissions, the study did not have the statistical power to detect statistically significant differences in average costs of less than \$3000 or in risks of readmission less than 10%. Interestingly, both parameters are clinically significant and tend to favor the nephrology group. Extrapolating the observed differences over a longer follow-up period than that of the current study would likely make them statistically significant.

Second, we did not explicitly measure disease severity of admissions. However, comparisons of DRG codes, predicted length of stay, predicted costs, and baseline demographic/comorbid characteristics were not significantly different between the medical services. Age, a crude measure of severity, was actually biased in favor of the group of patients admitted to the internal medicine group. Furthermore, the method of enrollment improved the possibility of baseline similarity of the two groups. Participants were admitted consecutively onto either service on an alternate-day basis.

Third, we could not make specific comparisons of the quality of care received by patients hospitalized to either type of medical service. However, we were able to analyze risk of rehospitalization. The risk of readmission was not statistically different between the two groups. It is reassuring that the risk of readmission was not higher for nephrologists than internists, despite the shorter length of stay.

Importantly, there was no difference in mortality rates at 90 d between the two groups. Additional studies will be required to measure quality of care outcomes. Also, because the

training experience of internists likely varies by hospital and region, we cannot generalize the results of the study to other hospitals. This type of analysis would need to be repeated in other hospitals or in a multicenter fashion throughout the United States.

Comparisons with other studies are difficult because there have been no published reports directly comparing nephrologists with internists. Previous analyses have focused on provider alternatives to physicians (23,24) or on generalists as alternatives to specialists (6–10,19,20,25–28). The majority of specialty comparison studies suggest that generalists use fewer resources than specialists (6–10), even when controlling for the severity of illness in the patient populations (9,10). However, specialists may be more efficient than generalists (19,20,28), as appears to be the case in this study. Policymakers are calling for expanding the role of primary care physicians to help curb costs (29–31). However, it is likely that generalists are unable to contain costs for specific populations of patients.

In summary, the length of stay was reduced for hospitalized dialysis patients admitted by nephrologists than by internists. The average costs tended to be lower for the nephrologists. Furthermore, the risk of readmission was not higher for the nephrologists' patients, despite a lower length of stay. With hospitalization rates increasing for chronic hemodialysis patients (1) and given the expected global capitation, there is a strong impetus for delineating pathways for providing effective *and* efficient health care to these patients.

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