Frequency of Patient–Physician Contact and Patient Outcomes in Hemodialysis Care

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Abstract. There is little evidence supporting the widespread belief that regular patient–physician contact in chronic disease management leads to better patient outcomes. The objective of this study was to examine the relationship of the frequency of patient–physician contact with several patient outcomes in a prospective cohort study begun in 1995 of incident hemodialysis patients treated at 75 US dialysis clinics. Average frequency of patient–physician contact at each clinic was determined by clinic survey (*low*, monthly or less frequent; *intermediate*, between monthly and weekly; *high*, more than weekly). The authors used logistic, Poisson, and Cox proportional hazards regression analyses to assess the relationship between contact and satisfaction, quality of life, patient adherence, hospitalizations, and mortality. Of 735 hemodialysis patients, 14.3% were treated at clinics with high frequency of contact, 65.2% intermediate, and 20.5% low. Patients treated at clinics reporting less frequent physician contact had lower odds of rating the frequency at which they saw a nephrologist excellent (low: adjusted OR = 0.39, 95% CI, 0.23–0.67; intermediate: adjusted OR = 0.57, 95% CI, 0.37–0.87; reference, high) and greater odds of nonadherence (low: adjusted OR = 2.89, 95% CI, 1.01–8.29; intermediate: adjusted OR = 1.58, 95% CI, 0.78–3.19). However, patient survival did not vary by frequency of physician contact (low: adjusted RH = 0.87, 95% CI, 0.53–1.44; intermediate: adjusted RH = 1.33, 95% CI, 0.82–2.13), nor did patients' overall ratings of care, hospitalization rates, or quality of life measures. Although less frequent patient–physician contact was associated with lower patient satisfaction with that contact and patient nonadherence, it was not associated with several other outcomes of care. Future studies are needed to assess the individual frequency and nature of physician contact over time, including total time spent with the patient and quality of the interaction, to guide the provision of patient-centered and cost-effective care.

It is commonly believed that more frequent patient–physician contact in chronic disease management may be associated with better patient outcomes. More frequent contact may allow for more engagement of physicians with patients, more opportunities for new medical problems to be detected, closer monitoring of treatment regimens, and more opportunities for discovery of complications that might compromise long-term outcomes. Despite these beliefs, evidence of an association between physician contact and patient outcomes is lacking. The issue is important for several reasons. Patients desire greater interaction with their physicians, and greater interaction is often perceived to be associated with the provision of more patient-centered care (1,2). Also, additional time spent with patients involves greater physician resources but, depending on the nature of reimbursement polices, may not necessarily provide greater physician compensation. For example, when physicians are reimbursed on a capitated *versus* a fee-for-service basis, there is little financial incentive to spend more time with patients.

The care of hemodialysis patients, in which frequent visits to a healthcare facility are necessary for ongoing care and for which physicians receive a capitated payment, provides an interesting setting to address this question. In fact, it has been postulated that physician contact during dialysis treatments provided by a team of health professionals may vary and that more physician contact may result in better outcomes for end-stage renal disease (ESRD) patients (3,4). A study of dialysis clinics in the southeastern United States found that decreased frequency of physician supervision of care was significantly associated with increased mortality in dialysis patients (5), whereas earlier work suggested that other staffing patterns might be associated with patient mortality (6). We

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therefore conducted a national study to examine whether the amount of patient–physician contact in hemodialysis care is associated with patient outcomes, including satisfaction with care, quality of life, patient adherence, hospitalizations, and mortality.

Materials and Methods

Study Design

Our study design was a national cohort study, the ESRD Quality (EQUAL) study, of hemodialysis patients cared for at 75 not-for-profit, free-standing outpatient dialysis clinics in the United States. The cohort was assembled from the Choices for Healthy Outcomes in Caring for End-Stage Renal Disease (CHOICE) study (7) in which 1041 incident dialysis patients were enrolled in the study at 81 dialysis clinics in 19 states between October 1995 and June 1998. The CHOICE study was based on a collaborative relationship between Johns Hopkins University and Dialysis Clinics, Inc. (DCI, Nashville, TN; $n = 79$), New Haven CAPD (New Haven, CT; $n = 1$), and St. Raphael's Hospital (New Haven, CT; $n = 1$). To be eligible, patients had to be more than 18 yr of age and speak either English or Spanish. Median time from dialysis initiation to enrollment was 45 d, with 98% enrolling within 4 mo of initial dialysis. Informed consent was obtained from each patient. Institutional review boards for the Johns Hopkins University School of Medicine and clinical centers approved the study protocol.

Data Collection

A questionnaire was administered to medical directors or head nurses at the 81 participating clinics in October 1998 to ascertain the independent variable for this study. The questionnaire asked about each clinic's customary practice with regard to the frequency of patient–physician contact during hemodialysis treatments. The item consisted of the question "How often does a physician visit each patient while on hemodialysis?" and the response categories "Every treatment," "Weekly," "Monthly," "Every two months," "Every three months or longer," and "Other, please specify." Seventy-five (DCI, $n = 74$; St. Raphael's Hospital, $n = 1$) of 81 clinics (94%) responded to this questionnaire item. Responses to this question (including "Other") were collapsed into three categories: high frequency (every treatment or more than once a week), intermediate frequency (weekly or more than once a month), and low frequency (monthly or less often) and linked by clinic to relevant patient-level data.

Outcome variables were taken from several sources. Both patient satisfaction ratings and quality of life measures were taken from baseline (median of 45 d on dialysis) and follow-up (at 1 and 2 yr after enrollment) self-report questionnaires (8). For satisfaction, the item specifically related to the frequency of nephrologist visits asked "How satisfied are you with how often the nephrologist sees you?" In addition, patients were asked about their views of their overall care in two ways: "How would you rate the quality of care you have received as a dialysis patient, overall?" and "Would you recommend your dialysis center to a friend or relative who needs dialysis?" Patients responded on a five-point scale with categories of excellent/definitely yes, very good/probably yes, good/not sure, fair/probably not, or poor/definitely not. For quality of life assessment, mental and physical health status were assessed using the mental component summary (MCS) and physical component summary (PCS) scores from the Medical Outcomes Study Short Form 36 (9). Patient adherence to dialysis treatment was based on data from dialysis treatment records on the frequency of skipped treatments. Patients were considered nonadherent if they missed >3% of all their dialysis sessions for reasons other than planned absence, inability to dialyze, or hospitalization. We obtained hospitalization data from Center for Medicare & Medicaid Services (CMS), which was available through November 1998 (median follow-up, 1.4 yr). Finally, mortality information was ascertained from clinic report and the CMS. Follow-up continued until death, transplantation, loss to follow-up, or the last follow-up date of June 2002 (average follow-up, 2.5 yr).

In addition to the independent variables and outcome variables, we collected extensive individual-level data on demographic, laboratory, and clinical characteristics. Data regarding patient demographics (age, gender, and race), socioeconomic status (education, employment, and marital status), and distance to the dialysis unit were collected from a baseline self-report questionnaire. Laboratory values (albumin, creatinine, and hematocrit) and height and weight (used to calculate body mass index [BMI]) were obtained from clinic records or from the CMS Medical Evidence report (CMS Form 2728). Dialysis dose (Kt/V) was calculated from clinic-supplied values of blood urea nitrogen, pre- and post-dialysis weight, and dialysis duration using the Daugirdas formula (10). Comorbidity was assessed using the Index of Coexistent Disease (ICED), the composite integer score of which ranges from 0–3 (with 3 as the highest severity level), as a measure of both the presence and severity of comorbid conditions (11–14). Both the ICED and health status were measured at baseline and at 1 and 2 yr of follow-up.

Statistical Analyses

We first compared individual-level patient characteristics by frequency of patient–physician contact using Pearson χ^2 tests for categorical variables and ANOVA for continuous variables. Patient questionnaire items regarding satisfaction were dichotomized by the highest rating *versus* any other rating. Similarly, MCS and PCS scores were dichotomized by previously reported means for these scores in patients undergoing hemodialysis (15, 16)—48 for MCS and 33 for PCS, on a 100-point scale. In bivariate analyses, for each item we compared crude percentages of highest satisfaction ratings and of MCS and PCS scores above the population mean (at 1 yr) according to clinic practice of patient–physician contact. We used generalized estimating equations with a logit link to examine the presence, magnitude, strength, and independence of an association between clinic frequency of patient–physician contact and satisfaction and quality of life measures. Odds ratios for highest rating *versus* any other rating and MCS/PCS score above the mean *versus* below the mean by clinic frequency of patient–physician contact were generated both without and with adjustment. Baseline, 1-yr, and 2-yr values for ICED, MCS, and PCS were used in longitudinal models. Logistic regression models were used to determine the relationship between frequency of contact and patient adherence to dialysis treatment. Odds ratios represent the odds of being nonadherent *versus* odds of being adherent. Hospitalization rates were compared among the contact frequency groups with Poisson regression, which accounts for both number of hospitalizations and time at risk. Finally, we assessed individual cumulative mortality by frequency of clinic practice of patient–physician contact by calculating overall crude mortality rates at the average follow-up (2.5 yr) and using Kaplan-Meier methods. We were able to detect differences of 14% and 17% in mortality between the high-frequency and intermediate- and low-frequency contact groups, respectively, at 80% power. We used Cox proportional hazards models to assess the strength and independence of an association between frequency of patient–physician contact and death. We calculated both unadjusted and adjusted relative hazards for mortality by frequency of contact using time from first dialysis to death or censoring (at transplant, loss

to follow-up, or closeout) as the survival time variable. The proportional hazards assumption was not violated in either unadjusted or adjusted models ($P > 0.20$ for both, global test of Schoenfeld residuals). Variables chosen for adjustment (race, ICED, age at enrollment, and albumin level at first dialysis) in the regression models were based on either their demonstration to be confounders or prior evidence of their association with survival. Time-varying ICED (baseline, 1-yr, and 2-yr scores) was used for adjustment in the models. Dialysis dose, BMI, hemoglobin, and patient adherence were also considered for adjustment, as prior research (17–19) has shown associations of these variables with survival. However, adding these variables did not change our hazard estimates in magnitude or significance.

Patients at the same clinic cannot reasonably be considered independent observations (20). We accounted for this consideration (STATA option CLUSTER) by obtaining robust variance-covariance matrix estimates in all Cox proportional hazards and logistic regression models (21, 22). For the binary outcomes (23), we also ran random-effects logistic regressions grouped by clinic cluster. For Cox regressions, frailty models (similar to random-effects models) were also tested (24). Because the results were so similar to those from models with no accounting for clustering and to those with robust variance estimates, we present the robust variance models.

Because data elements were missing for some participants, we addressed the possibility that missing independent variables could influence our results by performing regression analyses that included missing variables as dummy variables and separate analyses in which missing data were replaced using multiple imputation methods. Both approaches yielded similar results in magnitude of estimates and statistical significance to analyses that were based on only nonmissing data. Thus, we present results excluding records with missing values. All analyses were performed using STATA v. 7.

Results

Patients and Their Characteristics

A total of 735 incident in-center hemodialysis patients (96% of the 767 incident hemodialysis patients in the CHOICE study) treated at 75 clinics (93% of the 81 not-for-profit clinics in the CHOICE study) for whom we had information on frequency of physician contact were included in our analyses. Patients at the six clinics for which no data on frequency of patient–physician contact were available were more likely to be younger, less educated, and unmarried; to have fewer comorbid conditions; to have a shorter interval from first dialysis to enrollment; and to have lower Kt/V and higher creatinine values than their counterparts at facilities that provided this information.

For patients included in the analysis, many of the characteristics did not differ significantly by frequency of contact (Table 1). However, a significantly higher proportion of white and unemployed (including retired) patients received visits at a clinic with a practice of less frequent contact. Those receiving care at clinics with least frequent contact also had lower Kt/V and hematocrit values and had a longer time from first dialysis to enrollment than those in the more frequent groups. The most common group (intermediate frequency) had the oldest patients, but this result was not statistically significant.

Additionally, we looked at several clinic-level variables by frequency of contact. Several measures of clinic size—number of HD patients, number of HD shifts per week, patient:nurse ratio, and patient:technician ratio—differed significantly by frequency of contact, with those patients being treated at larger clinics being more likely to be in the intermediate frequency group. The intermediate group also had less frequent nurse manager rounds, compared with the low and high groups. The patients at clinics with high frequency of contact were significantly less likely to be at a clinic where many patients were on the transplant wait-list. Finally, frequency of contact did not vary significantly by the number of years the clinic had been in operation (Table 1).

Association of Frequency of Patient–Physician Contact with Patient Satisfaction

The proportions of patients reporting excellent satisfaction ratings for how often they are seen by the nephrologist reported at 1 yr (Table 2) are similar to baseline reports (high, 36%; intermediate, 23%; low, 15%). Also at 1 yr of follow-up, 51% of patients rated the overall quality of care they have received as a dialysis patient as excellent and 73% of patients stated they would definitely recommend their dialysis center to a friend or relative who needed dialysis. In both unadjusted and adjusted longitudinal analyses, there was no association at follow-up between the clinic practice of frequency of patient–physician contact and ratings for the two measures of overall quality of care, but decreasing frequency of physician contact was significantly associated with decreased odds of excellent ratings for how often patients saw the nephrologist (Table 2). With regard to willingness to recommend a center, there was a trend (not statistically significant) toward higher ratings in the less *versus* more frequent patient–physician contact groups. In stratified models, there was a trend toward greater impact of low-frequency clinic practice of physician contact on patient views of how often the nephrologist saw them, of their overall quality of care, and of recommending the center among older (age > 65 yr) and sicker (ICED $= 3$) patients, compared with their younger and healthier counterparts; however, this trend was not statistically significant. There were no differences in the association of frequency of patient–physician contact with patient views by either race or diabetic status. Ordinal regression using all five response categories of patient satisfaction rather than dichotomized categories showed no differences in significance or magnitude of the odds ratios.

Association of Frequency of Patient–Physician Contact with Quality of Life

Roughly half of our cohort had 1-yr follow-up MCS and PCS scores above the population mean (15) for patients undergoing hemodialysis (Table 2). Longitudinal analyses showed that although PCS was not associated with frequency of contact, the intermediate frequency group was marginally significantly more likely than the high frequency group to have MCS above the mean. The same association was seen with low *versus* high frequency, but it was not statistically significant.

Table 1. Baseline characteristics of patients by clinic practice of the frequency of patient-physician contact

Characteristic	Frequency of Patient-Physician Contact at Clinic[a]			Overall	*P*
	High Frequency	Intermediate Frequency	Low Frequency		
No. (%) of patients	105 (14.3%)	479 (65.2%)	151 (20.5%)	735 (100%)	—
No. (%) of clinics	8 (10.7%)	53 (70.7%)	14 (18.7%)	75 (100%)	—
Patient-level characteristics					
Demographic					
Age at enrollment ($n = 735$)[c]	57.8 ± 14.5	60.1 ± 14.6	58.8 ± 14.8	59.5 ± 14.6	0.271
Gender ($n = 735$)[b]					
female	53 (50.5%)	223 (46.6%)	60 (39.7%)	336 (45.7%)	0.195
male	52 (49.5%)	256 (53.4%)	91 (60.3%)	399 (54.3%)	
race ($n = 735$)[b]					
white	56 (53.3%)	310 (64.7%)	97 (64.2%)	463 (63.0%)	
black	46 (43.8%)	139 (29.0%)	49 (32.5%)	234 (31.8%)	**0.027**
other	3 (2.9%)	30 (6.3%)	5 (3.3%)	38 (5.2%)	
education ($n = 708$)[b]					
not a high school graduate	37 (36.3%)	159 (34.6%)	37 (25.2%)	233 (32.9%)	0.077
high school graduate	65 (63.7%)	300 (65.4%)	110 (74.8%)	475 (67.1%)	
marital status ($n = 728$)[b]					
not currently married	52 (50.0%)	213 (44.9%)	73 (48.7%)	338 (46.4%)	0.533
currently married	52 (50.0%)	261 (55.1%)	77 (51.3%)	390 (53.6%)	
employment status ($n = 734$)[b]					
not employed	89 (84.8%)	445 (92.9%)	136 (90.7%)	670 (91.3%)	**0.027**
employed	16 (15.2%)	34 (7.1%)	14 (9.3%)	64 (8.7%)	
distance from clinic ($n = 702$)[b]					
<30 miles	86 (86.9%)	426 (92.2%)	133 (94.3%)	645 (91.9%)	0.104
≥30 miles	13 (13.1%)	36 (7.8%)	8 (5.7%)	57 (8.1%)	
Clinical					
baseline ICED ($n = 734$)[b]					
≤1	32 (30.5%)	151 (31.6%)	36 (23.8%)	219 (29.8%)	
2	45 (42.9%)	174 (36.4%)	63 (42.0%)	282 (38.4%)	0.287
3	28 (26.7%)	153 (32.0%)	52 (34.4%)	233 (31.7%)	
baseline MCS score ($n = 618$)[c]	44.1 ± 11.0	46.9 ± 11.9	46.2 ± 11.1	46.3 ± 11.7	0.125
baseline PCS score ($n = 618$)[c]	33.6 ± 10.1	32.3 ± 10.3	30.9 ± 9.3	32.2 ± 10.1	0.167
body mass index ($n = 688$)[c]	28.0 ± 7.4	27.0 ± 7.1	27.7 ± 6.5	27.3 ± 7.0	0.370
mean Kt/V ($n = 574$)[c]	1.28 ± 0.27	1.28 ± 0.31	1.19 ± 0.27	1.27 ± 0.30	**0.025**
time from first dialysis to enrollment, days ($n = 734$)[c]	52.9 ± 26.6	52.6 ± 33.0	59.8 ± 30.7	54.1 ± 31.7	**0.047**
Laboratory					
albumin at 1st dialysis, g/dl ($n = 727$)[c]	3.47 ± 0.53	3.51 ± 0.44	3.48 ± 0.50	3.50 ± 0.47	0.732
mean creatinine, mg/dl ($n = 715$)[c]	7.5 ± 2.0	7.1 ± 2.5	7.5 ± 2.5	7.2 ± 2.5	0.072
mean hematocrit, % ($n = 712$)[c]	32.7 ± 3.4	31.8 ± 3.7	31.5 ± 4.0	32.0 ± 3.8	**0.043**
Clinic-level factors					
number of HD patients[b]					
<5	15 (12.6%)	308 (55.9%)	54 (28.1%)	377 (43.7%)	**<0.001**
≥5	104 (87.4%)	243 (44.1%)	138 (71.9%)	485 (56.3%)	
number of HD shifts/week[b]					
≤12	65 (54.6%)	336 (56.9%)	149 (77.6%)	550 (61.0%)	**<0.001**
>12	54 (45.4%)	255 (43.2%)	43 (22.4%)	352 (39.0%)	
patient:nurse ratio[c]					
≤3	40 (36.7%)	334 (56.5%)	44 (22.9%)	418 (46.9%)	**<0.001**
>3	69 (63.3%)	257 (43.5%)	148 (77.1%)	474 (53.1%)	
patient:technician ratio[b]					
≤3	35 (33.7%)	301 (64.9%)	37 (20.0%)	373 (49.5%)	**<0.001**
>3	69 (66.4%)	163 (35.1%)	148 (80.0%)	380 (50.5%)	
nurse manager rounds[b]					
none	68 (57.1%)	225 (38.1%)	90 (46.9%)	383 (42.5%)	
weekly	35 (29.4%)	183 (31.0%)	41 (21.4%)	259 (28.7%)	**<0.001**
daily/twice a week	16 (13.5%)	183 (31.0%)	61 (31.8%)	260 (28.8%)	
number of years in operation[b]					
≤10	48 (40.3%)	292 (50.2%)	98 (51.0%)	438 (49.0%)	0.122
>10	71 (59.7%)	290 (49.8%)	94 (49.0%)	455 (51.0%)	

[a] High, every treatment/more than weekly; Intermediate, weekly/more than monthly; Low, monthly or less.
[b] *P*-values obtained from Pearson χ^2 test. Significant *P*-values are in boldface type.
[c] Shown are means (± SD). *P*-values obtained from ANOVA. Significant *P*-values are in boldface type.

Table 2. Association over time of clinic practice of the frequency of patient-physician contact with patient outcomes[a]

Outcome	Crude %	Unadjusted Result	Adjusted[b] Result
Mortality[c]	% Dead	RH (95% CI)	RH (95% CI)
high frequency (n = 105)	19%	1.00 (ref.)	1.00 (ref.)
intermediate frequency (n = 479)	27%	1.54 (0.88–2.70)	1.33 (0.82–2.14)
low frequency (n = 151)	24%	1.13 (0.60–2.13)	0.87 (0.53–1.44)
Hospitalization	Rate per 1000 pt-yrs	IRR (95% CI)	IRR (95% CI)
high frequency (n = 105)	1345	1.00 (ref.)	1.00 (ref.)
intermediate frequency (n = 479)	1454	1.07 (0.76–1.51)	1.03 (0.75–1.42)
low frequency (n = 151)	1108	0.83 (0.55–1.25)	0.73 (0.50–1.05)
Patient adherence to dialysis treatment	% Nonadherent	OR (95% CI)	OR (95% CI)
high frequency (n = 105)	6%	1.00 (ref.)	1.00 (ref.)
intermediate frequency (n = 479)	8%	1.45 (0.61–3.43)	1.58 (0.78–3.19)
low frequency (n = 151)	14%	**2.67 (1.04–6.84)**	**2.89 (1.01–8.29)**
Quality of life: MCS[d]	% above Mean	OR (95% CI)	OR (95% CI)
high frequency (n = 67)	51%	1.00 (ref.)	1.00 (ref.)
intermediate frequency (n = 338)	60%	**1.52 (1.03–2.24)**	1.46 (0.99–2.15)
low frequency (n = 125)	55%	1.36 (0.87–2.14)	1.32 (0.84–2.08)
Quality of life: PCS[d]	% above Mean	OR (95% CI)	OR (95% CI)
high frequency (n = 67)	52%	1.00 (ref.)	1.00 (ref.)
intermediate frequency (n = 338)	51%	0.96 (0.65–1.42)	1.00 (0.66–1.52)
low frequency (n = 125)	42%	0.68 (0.42–1.08)	0.69 (0.42–1.12)
Satisfaction: how often nephrologist sees you[d]	% Excellent	OR (95% CI)	OR (95% CI)
high frequency (n = 65)	25%	1.00 (ref.)	1.00 (ref.)
intermediate frequency (n = 309)	20%	**0.59 (0.40–0.89)**	**0.57 (0.37–0.87)**
low frequency (n = 107)	18%	**0.41 (0.24–0.68)**	**0.39 (0.23–0.67)**
Satisfaction: overall quality of care[d]	% Excellent	OR (95% CI)	OR (95% CI)
high frequency (n = 71)	47%	1.00 (ref.)	1.00 (ref.)
intermediate frequency (n = 315)	40%	0.88 (0.58–1.32)	0.88 (0.57–1.35)
low frequency (n = 107)	49%	1.04 (0.65–1.66)	1.07 (0.66–1.74)
Satisfaction: willingness to recommend center[d]	% Definitely Yes	OR (95% CI)	OR (95% CI)
high frequency (n = 70)	61%	1.00 (ref.)	1.00 (ref.)
intermediate frequency (n = 315)	59%	1.11 (0.72–1.71)	1.08 (0.70–1.66)
low frequency (n = 108)	68%	1.35 (0.81–2.26)	1.42 (0.84–2.38)

[a] RH, relative hazard; IRR, incidence rate ratio; OR, odds ratio. Significant values are in boldface type.

[b] Adjustment was for the following variables: mortality, age at enrollment, race, time-varying ICED (baseline, 1-year, and 2-year values, where available), and albumin at first dialysis; hospitalizations, age at enrollment, race, baseline ICED, and albumin at first dialysis; adherence, age at enrollment, race, current smoking, baseline ICED, albumin at first dialysis, and baseline creatinine; quality of life, age at enrollment, gender, race, education, time-varying ICED, albumin at first dialysis, baseline creatinine, and baseline hematocrit; satisfaction, age at enrollment, race, education, time-varying ICED, MCS, and PCS, marital status, employment status, distance from center, and time from first dialysis to enrollment.

[c] Crude mortality is at mean follow-up (2.5 yr).

[d] Values for n and percentages are at 1 yr; odds ratios are from longitudinal models incorporating baseline, 1- and 2-yr values.

Association of Frequency of Patient–Physician Contact with Patient Adherence

Crude nonadherence to dialysis treatment was highest in the low physician contact frequency group (Table 2). Both unadjusted and adjusted logistic regression showed increased odds of being nonadherent in the less frequent groups relative to the high frequency groups, but the association was only statistically significant in the low frequency group.

Association of Frequency of Patient–Physician Contact with Hospitalization

Crude hospitalization rates were lowest in the low contact frequency group (Table 2). However, incidence rate ratios obtained from Poisson regression were not statistically significant. There appears to be no association between frequency of contact and hospitalization, although there is a slight trend toward lower hospitalization rates in the lowest frequency group, relative to high frequency.

Association of Frequency of Patient–Physician Contact with Mortality

The crude mortality rates at the average follow-up of 2.5 yr were lowest in the high frequency group and highest in the intermediate frequency group (Table 2); however, the cumulative mortality incidence curves (Figure 1) were not significantly different by log-rank test (P = 0.121). The adjusted

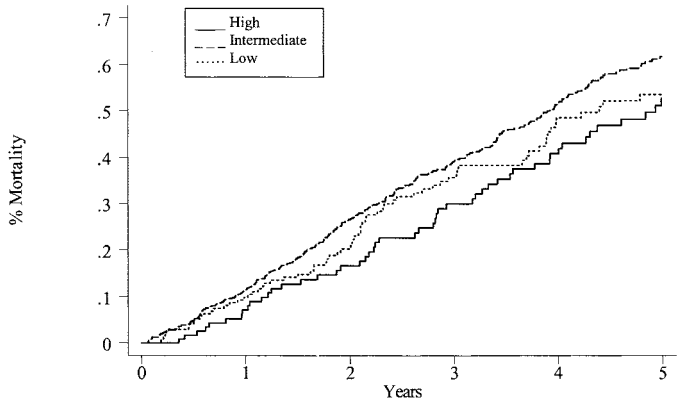

Figure 1. Cumulative mortality by clinic frequency of patient–physician contact. High, more than weekly; intermediate, weekly or more than monthly; low, monthly or less often ($P = 0.121$).

relative hazard of death for the low frequency group and intermediate frequency groups relative to the reference group, high frequency, was not statistically significantly different from one (Table 2). In Cox models that followed up to 1, 2, 3, 4, and 5 yr post-enrollment, no differences in cumulative mortality were seen, and the association of frequency of patient–physician contact with mortality was not substantially changed from that obtained with complete follow-up in any of these models. In stratified models, there were no differences in the impact of the clinic practice of frequency of patient–physician contact by age, race, diabetic status, or ICED. Using the largest (intermediate) group as reference showed a decreased risk for both the high and low frequency groups (statistically significant for the low frequency group), and dichotomizing the frequency into high *versus* intermediate/low showed no significant association in Cox models (RH = 1.20, 95% CI, 0.75–1.91). Finally, we also looked at Cox models adjusted for possible clinic-level confounders (see *Patient Characteristics*). It should be noted that using transplant rather than death as the outcome showed that those in the less frequent categories were significantly more likely to leave the study due to a transplant (low: RH = 2.69, 95% CI, 1.87–3.88; intermediate: RH = 3.03, 95% CI, 2.11–4.37). No other clinic-level variable changed the mortality results substantially. The addition of adherence as a possible confounder did not change the results appreciably. Also, the addition of available maintenance phase (6-mo) data on nutrition (albumin), anemia control (hemoglobin), and dose to the model did not affect the results. Finally, analyses removing the portion of the cohort who were censored before the survey was performed showed similar results (low: RH = 1.04, 95% CI, 0.76–1.41; intermediate: RH = 1.29, 95% CI, 0.86–1.94).

Discussion

This study suggests that patients with chronic kidney disease who were treated at hemodialysis clinics with a practice of less patient–physician contact were less satisfied with how often they saw their nephrologist and were more likely to be nonadherent to their dialysis treatment. However, a clinic practice of less frequent patient–physician contact was not associated with increased hospitalizations or mortality, worse quality of life, worse overall views of the quality of dialysis care, or less willingness by patients to recommend their center to a family member or friend.

These results have important implications for the division of labor among teams of health professionals in the delivery of chronic illness care in general, and in chronic kidney disease in particular. First, the finding that patients recognize less physician contact when it occurs and that they desire more contact indicates that they do not deem current exposure to physicians as the most optimal or patient-centered practice (2). By definition, patient-centered care is health care that is congruent with and responsive to patients' values, needs, and preferences. However, although patients at clinics with practices of less patient–physician contact had lower satisfaction with the frequency of contact, overall views of their care were not negatively affected by the clinic practice of less frequent physician contact. More patient–physician contact, while desirable, may not be as important to patients as other considerations in their care (25).

Second, we found that less frequent physician contact was associated with patient nonadherence. Physician contact may encourage patients to adhere to treatment regimens. Although it is possible that nonadherent patients seek facilities that provide less frequent physician contact, we believe this explanation is unlikely.

Third, we did not observe an association between less frequent patient–physician contact and increased mortality. Similarly, no association was seen between physician contact and hospitalization rate, a more intermediate outcome. Even with consideration of the results on nonadherence, there was no effect of patient–physician contact on mortality or hospitalization. Also, although those with the most frequent contact had better Kt/V and hematocrit values, Kt/V and hematocrit themselves were not related to either hospitalizations or mortality in this cohort. The lack of an association between mortality or hospitalizations and frequency of physician contact does not mean that this contact is either unnecessary or unimportant. The nature of the contact (*e.g.*, data gathering, relationship and partnership building, and counseling) during encounters may be just as important as the frequency of contact (26). Additionally, the amount of other non–face-to-face time physicians spend on behalf of individual patients is likely to be important to overall outcomes. Physicians, including nephrologists in dialysis units, are engaged in a number of activities on behalf of individual patients that could affect patient care (*e.g.*, overseeing care plans and communicating with other health professionals such as other physicians, nurses, nutritionists, and technicians) even though such activities may not include face-to-face time with patients. The range of physician work includes pre-encounter activities on behalf of patients (*e.g.*, reviewing medical records), activities during the encounter (*e.g.*, history-taking, physical examination, explaining diagnoses, and treatment options), and post-visit activities (*e.g.*, record documentation and communication with family members for future ongoing care). Of course, some physicians may perform

pre- and post-visit activities during face-to-face encounter time. Nephrologists also perform an executive function, orchestrating and coordinating the various components of care. In fact, our results of no effect of frequency of "clinic-averaged" (*i.e.*, not individual-level) physician contact on death outcomes suggest that rigid standards for face-to-face time or indiscriminate cutbacks in frequency of visits might not be in the best interest of promoting the most effective care. Physician flexibility to make individual judgments about when face-to-face time is needed may promote optimal outcomes. Indeed, other health professionals (*e.g.*, nurses, dietitians, social workers, or pharmacists) may serve to extend the capacity of busy physicians to manage a large number of complex patients, especially where workforce shortages exist (27–36). Indeed, it has been shown that satisfaction with being seen by nurse practitioners is quite high (37,38).

Fourth, although patients would probably be more satisfied with an arrangement in which they saw more of their physician, their overall views of their care indicate that they may recognize that contact with a physician whose time is more limited than other health professionals is reasonable within the constraints of our current healthcare system. In fact, patients themselves are increasingly being asked to take more responsibility for their health care and health outcomes (39,40). Physicians spending more face-to-face time with patients is inherently more expensive. Effectiveness of deploying labor resources in this way should be investigated.

In this study, comorbidity, as measured by the ICED, was not associated with frequency of physician contact. Although the ICED is an improvement on measurement of comorbidity and has been validated (14,41), it does not include some measures of overall health status. The ICED assesses the functional status of a patient but may not address all the reasons why physicians would want to see patients more frequently. Thus, we cannot entirely rule out a relationship between unmeasured comorbidity and frequency of physician contact.

Other possible limitations of this study deserve mention. First, as indicated above, our data reflect the frequency but not the length or nature of the patient–physician contact (*e.g.*, the relative amounts of time that a nephrologist spends on technical *versus* interpersonal aspects of care). For example, actions that physicians take during contact, such as dose and dry weight changes, inspection of vascular access, and investigations of comorbid disease status might be more relevant to patient outcome. It is important to note that two important parameters monitored by the nephrologist—dose and hematocrit—that might affect mortality were better in the higher frequency groups relative to the low frequency groups in our cohort, although they did not affect the results when tested as adjusters in our models. It has been suggested that the frequency of patient–physician contact may not be as important for patient outcomes as the quality or the length of the health system encounter (3), for which we do not have data. In fact, although those who were treated at clinics in which physicians see their patients at every treatment were most satisfied with how often they saw their physician, only one quarter of them found this highest rate to be excellent at 1 yr (Table 2). Also, data concerning facility processes were collected from the clinic medical directors or head nurses, whom we thought could accurately report the frequency of physician contact in their clinic. However, the fact remains that our measure of clinic practice of patient–physician contact reflects practice patterns in general and not the experience of individual study participants. The validity of the clinic report, however, is supported by the strong correlation between this measure and the patients' views of the frequency with which they were being seen by the nephrologist, determined independently by patient questionnaire. The timing of assessment represents another limitation: although we had an incident cohort with varying enrollment dates, the exposure variable was assessed cross-sectionally after the enrollment period, and thus the exposure variable's association with some outcomes, such as hospitalizations, may be attenuated. Another possible limitation is that the level of physician contact at the facilities we studied may not be entirely reflective of the pattern nationally, which may be less or more intensive. Also, selection bias is always an important consideration in an observational study such as this one.

Despite collection of and adjustment with extensive data on determinants of patient outcomes, residual confounding due to lack of data on variables for which we could not account may still exist. For example, a more remote clinic (*i.e.*, more distant from a medical center) may receive fewer visits or less attention from a physician. Also, although we examined patient: personnel ratios and nurse manager rounds, we do not have optimal measures of how often and in what way other staff, including physician extenders such as nurse practitioners and physician assistants, are used in the care of patients, which may be related to how often a physician is seen. The amount of turnover among dialysis center staff and the staff's experience might affect the amount of physician oversight at a clinic. We examined the years a clinic had been in operation, which may be considered a measure of clinic experience, but this does not always reflect staff experience, especially if there is high turnover. Another potentially confounding variable with regard to patient satisfaction is *a priori* patient expectation of how much physician face-to-face time there will be during treatment. Also, there were missing questionnaire data: 1-yr follow-up data for quality of life and satisfaction outcomes were more likely to be missing for those in the high-frequency contact group.

In conclusion, this study provides an important examination of the proposed relationship between increased frequency of patient–physician contact and better patient outcomes. Clinic practice of less frequent physician contact was associated with lower satisfaction with how often patients saw their physician and lower patient adherence, but it was not associated with better overall satisfaction with care, quality of life, hospitalization rates, or mortality. Although this preliminary evidence is illuminating, it should not be used to change current clinical policies. Rather, future work is needed to explore the precise nature of physician contact that is most beneficial to patient health in chronic kidney disease care.

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