A Comparison of Quality of Life and Travel-Related Factors between In-center and Satellite-Based Hemodialysis Patients

Michael J. Diamant,*† Lori Harwood,*‡ Sujana Movva,*§‖ Barbara Wilson,*‡ Larry Stitt,† Robert M. Lindsay,*§ and Louise M. Moist*†§

*Division of Nephrology, London Health Sciences Centre, London, Ontario, Canada; †Department of Epidemiology and Biostatistics, §Schulich School of Medicine and Dentistry, and ‡Arthur Labatt Family School of Nursing, University of Western Ontario, London, Ontario, Canada; and ‖Cancer Research and Treatment Center, University of New Mexico, Albuquerque, New Mexico

Background and objectives: Shorter travel times and distance to dialysis clinics have been associated with improved patient outcomes and a higher health-related quality of life (HRQOL). The objective of this study was to compare HRQOL between prevalent in-center and satellite dialysis patients, as well as compare travel-related factors that contribute to HRQOL between in-center and satellite-based patients.

Design, setting, participants, & measures: The London Health Sciences Centre is a tertiary care center with in-center and regional satellite hemodialysis units. Patients who consented and completed a questionnaire ($n = 202$) were enrolled into a cross-sectional, cohort observational study. Patients were administered the Medical Outcomes Short-Form 36 (SF-36) and the Kidney Disease Health Related Quality of Life (KDHRQOL) tool and were asked questions relating to travel to dialysis clinics.

Results: Patients who underwent dialysis in the satellites had similar demographics, comorbidities, and laboratory parameters. Patients who underwent dialysis in satellite units reported a significantly superior score on the dialysis stress domain of the KDHRQOL questionnaire. There was no significant difference between in-center and satellite patients on the basis of the SF-36. Satellite patients also reported a significantly decreased cost of transportation, a significantly increased proportion who drive themselves to clinics, and significantly decreased travel time.

Conclusions: Patients who underwent dialysis in satellite units demonstrated similar characteristics, comorbidities, surrogate outcomes, and most aspects of HRQOL. Travel time, cost, and receiving treatment in one's own community are important factors that may contribute to a trend toward higher reported HRQOL by patients in satellite dialysis units.

Clin J Am Soc Nephrol 5: 268–274, 2010. doi: 10.2215/CJN.05190709

ESRD is a burdensome chronic illness, with a treatment regimen that is quite involved. Approximately 32,000 Canadians use some form of renal replacement therapy, and approximately 16,000 are on hemodialysis (HD) (1). HD usually involves spending 4 h three times a week attached to a machine, plus the necessary time and energy required to travel to the dialysis unit. As well, many patients experience associated financial burdens and changes in family and social roles and alter their social or recreational activities as a direct result of dialysis. Many must also leave or change their employment.

For patients with ESRD, quality of life is largely determined by the patient's level of physical, mental, and social functioning in the presence of kidney disease (2). Previous literature demonstrated a decreased health-related quality of life (HRQOL or QOL) in the HD population that is consistent with the aforementioned personal challenges that are associated with the treatment regimen (3–8). Although many of the contributing factors are difficult to modify, some studies have suggested that increased patient independence and convenience of HD regimens can also lead to increases in reported QOL and improved mortality. Meers *et al.* (9) compared QOL in self-care and full-care HD patients. It was shown that self-care HD increased patient autonomy and sense of control. A recent study by Moist *et al.* (10) found that patients who traveled longer than 60 minutes to dialysis had a 20% greater risk for death compared with those who traveled ≤15 minutes. HRQOL was also significantly lower for those with longer travel times. Another Canadian study by Tonelli *et al.* (11) showed mortality associated with HD was greater among patients who lived farther from their attending nephrologist, as compared with those who lived closer.

These studies, however, limited their scope to patients who were undergoing HD at tertiary care centers. Although the models of service delivery differ, a substantial proportion of patients in North America and the United Kingdom now undergo dialysis in community-based dialysis clinics. A study by Roderick *et al.* (12) examined the organization and process of

Received July 27, 2009. Accepted November 12, 2009.

Published online ahead of print. Publication date available at www.cjasn.org.

Correspondence: Dr. Louise Moist, Room A2-338, Victoria Hospital, 850 Commissioners Road E, London, ON N6A 5W9, Canada. Phone: 519-685-8211; Fax: 519-685-8449; E-mail: louise.moist@lhsc.on.ca

ISSN: 1555-9041/502–0268

care of regional satellite units (RSUs) in England and Wales, as well as focused on the "effectiveness, acceptability, accessibility, and economic impact" of RSUs in comparison with in-hospital main renal units (MRUs). The authors concluded that many aspects of HD care were similar in both RSUs and MRUs, including most aspects of HRQOL and clinical performance; however, on questions relating to patient satisfaction with care on the Kidney Disease Quality of Life questionnaire, patients in RSUs had significantly better scores than MRU patients. The RSUs also had reduced mean travel times to dialysis, reduced dialysis adequacy as measured by the urea reduction ratio, and reduced adverse event and hospitalization rates as compared with the MRUs (12).

In the province of Ontario, dialysis services were expanded to RSUs in 1995 to improve geographic accessibility and shift patients away from the resource-strapped hospitals (1). The satellite dialysis units in the province are associated with in-center hospital HD units in a hub-and-spoke model. They are often at some distance from the main unit, where care is managed by nephrologists through regular visits and near-daily contact with the assistance of nurses *via* fax, telephone, or telehealth. Patients normally begin treatment in-center before they are eligible to transfer to an RSU. Although the characteristics and clinical outcomes of satellite patients in Ontario have been previously described (13), no comparison of outcomes in relation to in-center patients has been made in Canadian HD patients.

The primary purpose of this study was to compare the HRQOL of patients who received in-center HD with those who received HD in satellite units. The secondary objective of this study was to collect and compare patient responses to travel-related factors and issues relating to conventional HD treatment. It was hypothesized that those who received treatment in satellite units would report a significantly higher QOL.

Materials and Methods

Patient Population

This study was conducted in 2002 and at the time of this study, the London Health Sciences Centre Regional Hemodialysis Program consisted of two in-center hospital units and seven community-based satellite units situated within 20 to 180 km from the in-center units. This cohort cross-sectional study included a convenience sample of patients who were receiving long-term HD in one of the in-center HD units (ICH) and four of the RSUs. Patients were eligible when they were ≥18 yr of age, spoke English, had the capacity to provide informed consent, and had a stable dialysis condition. Patients were defined as stable when there was no nursing or physician intervention in the past 14 d. Patients who met these criteria and provided informed consent were enrolled in the study. This study was approved by the research ethics board at the University of Western Ontario.

Variables

Demographics, comorbidities, and dialysis and laboratory parameters were collected for each patient from their medical charts before administering the HRQOL questionnaires. As was used in the study by Evans *et al.* (3), a comorbidity index for which a sum of all of the aforementioned comorbid conditions of interest for each patient was calculated. Each comorbidity is given equal weighting, and thus the index scores can range from 0 to 12.

QOL Assessment

HRQOL was assessed by the administration of the MOS 36-item Short Form Health Survey (SF-36) (14) as well as the Kidney Disease Health-Related Quality of Life (KDHRQOL) questionnaire (15). The SF-36 is a generic, multidimensional instrument with eight multi-item subscales representing (*1*) physical functioning, (*2*) role-physical, (*3*) bodily pain, (*4*) general health, (*5*) vitality, (*6*) social functioning, (*7*) role-emotional, and (*8*) mental health (14). These subscales can be collapsed into physical and mental health dimensions. The SF-36 has been validated (16) in the ESRD population, and its reliability coefficients have been ≥0.80 (17).

The KDHRQOL tool is a disease-specific questionnaire (15) that has five domains: (*1*) Psychosocial stress scale, (*2*) disease stress scale, (*3*) dialysis somatic symptoms distress (or dialysis stress) scale, (*4*) fatigue rating scale, and (*5*) social-leisure activities. A higher score on the first four domains indicates a lower HRQOL, whereas a higher social-leisure activities score indicates a higher HRQOL. The reliability and validity of the questionnaire have both been previously evaluated (15,18). Along with the questionnaire, patients were asked, "How long does it take you to recover from a dialysis session?" The use of this question on conventional HD patients has been previously found to be reliable, valid, and sensitive to change (19).

In addition, patients were asked to complete a series of questions associated with dialysis care travel parameters, such as cost and travel time, and by whom they were driven to dialysis sessions. Last, satellite-based patients were also asked to answer one qualitative, open-ended short answer question: "How has the experience of having dialysis in a satellite unit impacted your life?" Responses to the open-ended question was analyzed for common themes.

Statistical Analysis

Descriptive statistics were used to summarize study participant characteristics. Unpaired t tests and χ^2 tests were used to compare baseline characteristics between in-center and satellite groups. Unpaired two-sample t tests were used to compare the SF-36 and KDHRQOL domain scores between in-center and satellite patients. Where between-group variances of the subscale scores were not the same, a Wilcoxon two-sample test was used for comparison. To address issues surrounding multiple testing, we also analyzed the subscale scores using the modified Bonferroni correction (20). For questions involving travel-related factors, Wilcoxon two-sample tests were used to compare continuous responses and χ^2 tests were used for comparing proportions. Travel time was assessed both continuously and using categories previously applied by Moist *et al.* (10). Analysis of all patient demographics, baseline covariates, and outcomes excluded patients who were missing data for these variables.

As an additional analysis, a multivariable regression analysis was conducted to compare the SF-36 and KDHRQOL scores between in-center and satellite units after adjustment for covariates that had a statistically significant association with the outcome. Covariates that were associated with HRQOL scores in the univariable model ($P = 0.05$) were included in the multivariable model. Multivariable stepwise linear regression analysis was conducted to produce a final model.

A sensitivity analysis comparing the QOL scores of RSU patients with in-center patients who had to travel >20 minutes to their dialysis clinic was also performed. This was conducted to compare RSU patients with in-center patients who were not undergoing dialysis locally but may not have the resources of a local satellite unit available to them.

All statistical analyses were performed in SAS 9.1 (SAS Institute, Cary, NC). Associations with $P < 0.05$ were considered to be statistically significant.

Results

Overall, 202 of 276 eligible patients completed the questionnaires (101 in-center, 101 in satellite clinics) for a response rate of 73.2%. Demographics and laboratory data of the nonresponders did not differ significantly from those of the participants (data not shown). Table 1 summarizes the baseline characteristics of study participants. Patients who underwent dialysis in RSUs differed from ICH patients only for access type and certain measures of dialysis adequacy and anemia management. Although it was determined that patients did not significantly differ on the basis of the cause of ESRD, a much higher proportion of patients in the in-center group had an unknown or missing cause. The percentage of missing data for each variable ranged from 0% for gender and the dialysis stress domain on the KDHRQOL questionnaire to 33.7% for the mean time to recover on the KDHRQOL. The vast majority of patient demographic and disease characteristics and QOL questionnaire domains had completion rates in excess of 90%.

SF-36

Table 2 lists the mean subscale scores for the SF-36, as well as the mean physical and mental component scores individually for satellite and in-center patients. There were no statistically significant differences in SF-36 scores between the two groups.

Kidney Disease HRQOL

Table 3 shows mean subscale scores for ICH and RSU patients on the basis of the KDHRQOL tool. Although patients in the two groups did not differ on most domains, a significantly lower mean score on the dialysis stress scale, which equates to a lower burden of dialysis stressors and a superior HRQOL, was reported by satellite patients. This association was not considered statistically significant when adjusted for multiple testing.

Multiple Regression Analysis

Only age, female gender, and diabetes status remained as covariates in the final linear regression model for both the SF-36 and the KDHRQOL scores. On the basis of the multiple linear regression analysis of SF-36 domain scores, there were no significant differences in SF-36 scores between the ICH and RSU patients, after adjustment for age, gender, and diabetes status.

On the basis of the multiple linear regression analysis of the subscale scores of the KDHRQOL questionnaire, undergoing dialysis in satellite units was found to significantly decrease the dialysis stress subscale score, on average by 0.385 ($P = 0.037$) after adjustment for age, gender, and diabetes status. This equates to a statistically significantly superior reported HRQOL for RSU patients. There were no significant differences in adjusted KDHRQOL scores between ICH and RSU patients for any other domain.

Sensitivity Analysis

Satellite-based patients demonstrated a statistically significant superior mean physical functioning score on the SF-36 compared with in-center patients (35.01 *versus* 25.50; $P = 0.025$). The mean dialysis stress scale score of the KDHRQOL questionnaire for RSU patients remained significantly lower, which translates to a lower burden of dialysis stressors ($P = 0.014$).

Travel Time

Table 4 summarizes the participants' responses to questions relating to the travel parameters associated with conventional HD therapy. There was a statistically significant difference in travel time between the two groups when analyzed categorically. Patients in satellite units also reported a significantly lower cost of transportation. The method by which patients were transported to and from their dialysis sessions differed between groups as well with a greater proportion of patients in RSUs being able to transport themselves to their dialysis appointment.

Qualitative Data

Sixty-five participants from satellite units responded to the short-answer open-ended question. Commonly reported benefits expressed were less travel time ($n = 27$), reduced driving stress ($n = 10$), the pleasant environment of the RSU and continuity with staff ($n = 18$), more time to spend with family and friends ($n = 13$), less fatigue and increased energy ($n = 10$), and decreased costs ($n = 9$). According to patient responses, issues surrounding travel, such as distance and cost, played a large role in determining their perceived QOL. For example, when describing their care at a satellite unit and the decreased amount of travel time required, one patient wrote, "It's great, I have more time to do things outside of dialysis." Others wrote, "…by being here my health has improved and given me renewed hope"; "Before all I wanted to do was come and go to sleep"; "As a result [of traveling] I have been totally, completely exhausted. I had very little energy for anything or anyone."

Discussion

It was hypothesized that patients who receive HD treatment in satellite clinics would report a superior HRQOL. In-center and satellite patients demonstrated similar demographics, comorbidities, and dialysis and laboratory parameters. Although the mean subscale and component scores did not differ significantly between the two groups on the SF-36 and most portions of the KDHRQOL questionnaire, satellite-based patients did report a significantly superior QOL score on the dialysis stress portion of the disease-specific questionnaire. This association remained after adjustment for age, gender, and diabetes status, as well as in the sensitivity analysis. It did not remain, however, after compensating for multiple testing. Patients who underwent dialysis in satellites were also found to have a decreased travel time to their clinic, which was statistically significant when analyzed categorically, and a significantly decreased weekly cost of transportation. More patients were also able to drive themselves to their dialysis clinics in the RSU group. Qualitative data collected also suggest that travel time and

Table 1. Summary and comparison of baseline demographics, ESRD cause, comorbidities, laboratory parameters, dialysis history, and access type between in-center and satellite-based study participants

Parameter	Total (n = 202)	In-center (n = 101)	Satellites (n = 101)	P (In-centre *versus* Satellite)
Age (yr; mean ± SD)	67.3 ± 13.9	68.4 ± 12.9	66.2 ± 14.9	0.276[a]
Male gender (%)	51.0	44.6	57.4	0.067[b]
Cause of ESRD (%)				0.177[c]
diabetes	40.6	38.7	42.1	
renal vascular disease	20.0	17.3	22.1	
glomerulonephritis	6.5	8.0	5.3	
polycystic kidney disease	4.7	9.3	1.1	
other	28.2	26.7	29.5	
uncertain/missing	32.0	26.0	6.0	
Comorbidities present (%)				
coronary artery disease	45.0	47.4	42.6	0.493[b]
cerebrovascular disease	28.8	32.0	25.7	0.334[b]
diabetes	35.9	34.0	37.6	0.597[b]
respiratory	22.7	22.7	22.8	0.988[b]
gastrointestinal	21.2	23.7	18.8	0.399[b]
musculoskeletal	16.7	18.6	14.9	0.484[b]
visual impairment	30.3	32.0	28.7	0.619[b]
behavioral/psychosocial	5.1	6.2	4.0	0.475[b]
cancer	14.9	14.7	14.9	0.982[b]
Nutrition indicators (mean± SD)				
albumin (g/L)	34.9 ± 4.5	34.7 ± 4.8	35.1 ± 4.2	0.561[a]
Normalized protein nitrogen appearance (g/kg per d)	1.07 ± 0.26	1.09 ± 0.28	1.05 ± 0.25	0.348[a]
Anemia management (mean± SD)				
Hb (g/L)	113.0 ± 15.6	112.9 ± 17.3	113.1 ± 13.9	0.988[d]
ferritin (μg/L)	391.1 ± 344.2	352.9 ± 353.0	427.8 ± 333.0	0.126[a]
transferrin saturation (%)	23.1 ± 15.6	24.9 ± 12.7	21.2 ± 18.2	0.035[d]
Dialysis adequacy (mean± SD)				
Kt/V	1.77 ± 0.44	1.87 ± 0.52	1.68 ± 0.34	0.018[d]
Percent reduction in blood urea concentration	72.9 ± 9.4	73.9 ± 6.8	72.1 ± 11.2	0.360[d]
Dialysis history				
Time on dialysis (mo; mean± SD)	29.8 ± 34.8	26.5 ± 34.5	33.0 ± 34.9	0.193[a]
Time at unit (mo; mean± SD)	21.3 ± 28.0	22.9 ± 30.1	19.8 ± 26.0	0.438[a]
Time on dialysis (min; mean± SD)	229.1 ± 31.1	225.1 ± 34.5	233.0 ± 27.0	0.379[d]
Access type (%)[e]				0.028[b]
fistula	44.0	35.4	52.5	
graft	15.0	13.1	16.8	
permanent catheter	39.5	49.5	29.7	
temporary line	1.5	2.0	33.3	

[a]Unpaired t test.
[b]χ^2 test for comparing proportions.
[c]Fisher exact two-tailed test.
[d]Wilcoxon two-sample test (performed when variances were not equal).
[e]Counts do not add up to 202 because of missing data.

costs are factors that are of great importance to HD patients and that undergoing dialysis in satellite units tends to have a positive impact on patients' experience.

The findings of this study correspond well with previous research that assessed the role of satellite units and travel-related factors in the perception of HD patients' health, social

Table 2. Mean ± SD SF-36 scores and comparisons between in-center and satellite-based HD patients

Parameter	In-center (n = 101)	Satellites (n = 101)	P
Physical functioning	28.5 ± 27.4	35.0 ± 29.5	0.109
Role-physical	26.3 ± 34.3	31.3 ± 36.2	0.326
Bodily pain	59.4 ± 29.9	57.7 ± 28.8	0.686
General health	43.3 ± 21.2	45.1 ± 21.8	0.553
Vitality	39.9 ± 21.7	43.6 ± 24.0	0.248
Social functioning	63.4 ± 31.6	62.5 ± 27.2	0.832
Role-emotional	58.5 ± 43.6	56.4 ± 43.1	0.732
Mental health	71.0 ± 19.4	70.2 ± 20.0	0.787
Physical component score	29.7 ± 9.9	31.9 ± 10.5	0.139
Mental component score	49.6 ± 11.5	48.8 ± 11.5	0.618

Table 3. Mean ± SD KDHRQOL tool domain scores and comparisons between in-center and satellite-based HD patients

Parameter	In-center (n = 101)	Satellites (n = 101)	P
Dialysis stress	1.59 ± 1.43	1.18 ± 1.13	0.021[a]
Fatigue rating scale	3.43 ± 2.23	3.26 ± 2.03	0.589
Disease stress	2.24 ± 1.70	1.83 ± 1.54	0.073
Psychological stress	2.08 ± 1.82	2.01 ± 1.77	0.784
Social leisure activities	1.22 ± 0.55	1.29 ± 0.55	0.357
Time to recover (min)	296.6 ± 421.4	365.8 ± 530.2	0.405

[a]Variances between groups were not the same. A Wilcoxon two-sample test reached the same conclusion (P = 0.029).

Table 4. Patient responses on questions regarding travel-related factors

Parameter	In-center (n = 101)	Satellites (n = 101)	P
Travel time (min)			
mean ± SD	81.5 ± 94.4	42.9 ± 30.9	0.461[a]
median	25.0	25.0	
Travel time (min; % yes)			<0.001
≤15	4	14	
16 to 30	19	38	
31 to 60	35	30	
≥60	34	17	
Weekly cost of transportation			
mean ± SD	42.1 ± 57.0	32.8 ± 28.8	<0.001[a]
median	60.0	30.0	
Driver (n [%])			<0.001
patient	13 (13.8)	36 (37.1)	
family/friends	36 (38.3)	38 (39.2)	
other	45 (47.9)	23 (23.7)	

[a]Wilcoxon two-sample test (performed when variances were not equal).

actualizations, and care. Moist *et al.* (10) found a significantly superior HRQOL for those with shorter travel times to their dialysis clinic. Roderick *et al.* (12) found that community-based patients reported a significantly superior satisfaction with care, whereas most other aspects of HRQOL were similar. Previous studies have also found age and gender to be factors associated with QOL scores in ESRD (21). This is the first study, however, to suggest a superior HRQOL in satellite patients on the basis of

differences in reported physical stressors that result from dialysis treatment.

Patients who underwent dialysis in satellites were largely similar to those who underwent dialysis in-center on the basis of laboratory and clinical parameters. Unlike the findings of Roderick *et al.* (12), there was no significant difference in dialysis adequacy as measured by the percentage reduction in urea between patient groups. Although satellite-based patients did demonstrate a significantly reduced dialysis dosage as measured by Kt/V, previous literature suggested that there is no clinical benefit from having an even higher dialysis dosage well above that recommended in guidelines (22).

Although the reduced mean travel time for satellite patients was not statistically significantly different than that of in-center patients when analyzed continuously, that the mean travel time for in-center patients was nearly twice that of satellite patients could be seen as a considerable difference. Furthermore, when travel time was assessed categorically, the difference was statistically significant.

That in-center and satellite patients did not differ on all domains of the HRQOL questionnaires was due to many interdependent factors. HD patients experience a high burden of illness, and thus the SF-36 scores in this group were already substantively lower than that of the general Canadian population (23). Thus, subtle differences in QOL attributable to travel time or undergoing dialysis in one's own community may not be detected on a general QOL assessment tool in a population with a heavy burden of disease. Moreover, on some SF-36 subscales, RSU patients demonstrated clinically significant improved subscale scores compared with in-center patients (24), one of which was statistically significant in the sensitivity analysis. Nevertheless, the disease-specific QOL assessment questionnaire did identify superior dialysis stress scores for satellite-based patients.

This study was not without limitations. For the purpose of this study, comorbidities were assessed on the basis of the presence or absence of disease in 12 categories. Although a crude comorbidity index was used in this study, a more developed and widely used comorbidity index would have been more useful in representing the burden of other conditions among study participants. Also, the method by which travel factors and travel time were measured has not been validated. The KDHRQOL tool administered in this study is not widely used, and thus the comparability of the results to findings from other studies that used more common kidney disease–specific QOL surveys may be limited. It should also be noted that, because of the cross-sectional nature with which HRQOL is measured, this study can provide little insight into temporal changes in HRQOL in the study population.

The mean SF-36 subscale and component scores as measured among study participants is quite similar to Canadian HD norms (25), signaling that the perceived QOL and burden of disease among study participants is representative of the Canadian HD population. This lends support to the notion that, although this study was performed at an academic center in Southwestern Ontario and its associated dialysis clinics, the results are generalizable to the Canadian HD population.

Conclusions

This study aimed to assess potential HRQOL differences between in-center and satellite-based patients and identify potential areas, specifically concerning travel-related factors, that may have a differential impact on the QOL of patients who undergo dialysis in these two settings. The findings of this study lend support to the notion that, despite demonstrating similar characteristics and surrogate outcomes as those who undergo dialysis in-center, there are indications of a higher reported QOL among satellite-based patients that requires further study.

Acknowledgments

M.J.D. was supported by the Ontario Ministry of Health and Long-Term Care, as well as Schulich School of Medicine and Dentistry at the University of Western Ontario.

Disclosures

None.

References

1. Canadian Institute for Health Information: *2007 Annual Report: Treatment of End stage Organ Failure in Canada 1996 to 2005*, Ottawa, CIHI, 2008
2. Testa MA, Simonson DC: Assessment of quality-of-life outcomes. *N Engl J Med* 334: 835–840, 1996
3. Evans RW, Manninen DL, Garrison LP Jr, Hart LG, Blagg CR, Gutman RA, Hull AR, Lowrie EG: The quality of life of patients with end-stage renal disease. *N Engl J Med* 312: 553–559, 1985
4. Merkus MP, Jager KJ, Dekker FW, Boeschoten EW, Stevens P, Krediet RT: Quality of life in patients on chronic dialysis: Self-assessment 3 months after the start of treatment. The Necosad Study Group. *Am J Kidney Dis* 29: 584–592, 1997
5. Carmichael P, Popoola J, John I, Stevens PE, Carmichael AR: Assessment of quality of life in a single centre dialysis population using the KDQOL-SF questionnaire. *Qual Life Res* 9: 195–205, 2000
6. Fukuhara S, Lopes AA, Bragg-Gresham JL, Kurokawa K, Mapes DL, Akizawa T, Bommer J, Canuad BJ, Port FK, Held PJ, Worldwide Dialysis Outcomes and Practice Patterns Study: Health-related quality of life among dialysis patients on three continents: The Dialysis Outcomes and Practice Patterns Study. *Kidney Int* 64: 1903–1910, 2003
7. Chiang CK, Peng YS, Chiang SS, Yang CS, He YH, Hung KY, Wu KD, Wu MS, Fang CC, Tsai TJ, Chen WY: Health-related quality of life of hemodialysis patients in Taiwan: A multicenter study. *Blood Purif* 22: 490–498, 2004
8. Lee AJ, Morgan CL, Conway P, Currie CJ: Characterisation and comparison of health-related quality of life for patients with renal failure. *Curr Med Res Opin* 21: 1777–1783, 2005
9. Meers C, Singer MA, Toffelmire EB, Hopman W, McMurray M, Morton AR, MacKenzie TA: Self-delivery of hemodialysis care: A therapy in itself. *Am J Kidney Dis* 27: 844–847, 1996
10. Moist LM, Bragg-Gresham JL, Pisoni RL, Saran R, Akiba T, Jacobson RH, Fukuhara S, Mapes DL, Rayner HC, Saito A, Port FK: Travel time to dialysis as a predictor of health-related quality of life, adherence, and mortality: The Dial-

ysis Outcomes and Practice Patterns Study (DOPPS). *Am J Kidney Dis* 51: 641–650, 2008
11. Tonelli M, Manns B, Culleton B, Klarenbach S, Hemmelgarn B, Wiebe N, Gill JS, Alberta Kidney Disease Network: Association between proximity to the attending nephrologist and mortality among patients receiving hemodialysis. *CMAJ* 177: 1039–1044, 2007
12. Roderick P, Nicholson T, Armitage A, Mehta R, Mullee M, Gerard K, Drey N, Feest T, Greenwood R, Lamping D, Townsend J: An evaluation of the costs, effectiveness and quality of renal replacement therapy provision in renal satellite units in England and Wales. *Health Technol Assess* 9: 1–178, 2005
13. Lindsay RM, Hux J, Holland D, Nadler S, Richardson R, Lok C, Moist L, Churchill D: An investigation of satellite hemodialysis fallbacks in the province of Ontario. *Clin J Am Soc Nephrol* 4: 603–608, 2009
14. Ware JE Jr, Sherbourne CD: The MOS 36-item short-form health survey (SF-36): I. Conceptual framework and item selection. *Med Care* 30: 473–483, 1992
15. Lindsay RM, Heidenheim AP: Measurement of quality of life in international trials involving dialysis patients and the use of recombinant human erythropoietin. In: *Clinical Applications of Erythropoietin*, edited by Bauer C, Kock K, Scigalla P, Wieczorek L, New York, Marcel Dekker, 1993, pp 181–921
16. Rettig RA, Sadler JH, Meyer KB, Wasson JH, Parkerson GR Jr, Kantz B, Hays RD, Patrick DL: Assessing health and quality of life outcomes in dialysis: A report on an Institute of Medicine workshop. *Am J Kidney Dis* 30: 140–155, 1997
17. McHorney CA, Ware JE Jr, Lu JF, Sherbourne CD: The MOS 36-item Short-Form Health Survey (SF-36): III. Tests of data quality, scaling assumptions, and reliability across diverse patient groups. *Med Care* 32: 40–66, 1994
18. Lindsay RM: Quality of life assurance in hemodialysis. In: *Quality Assurance in Dialysis*, 2nd Ed., edited by Henderson LW, Thurma RS, Norwell, MA, Kluwer Academic Publishers, 1999, pp 143–154
19. Lindsay RM, Heidenheim PA, Nesrallah G, Garg AX, Suri R, Daily Hemodialysis Study Group London Health Sciences Centre: Minutes to recovery after a hemodialysis session: A simple health-related quality of life question that is reliable, valid, and sensitive to change. *Clin J Am Soc Nephrol* 1: 952–959, 2006
20. Hochberg Y: A sharper Bonferroni procedure for multiple tests of significance. *Biometrika* 75: 800–802, 1988
21. Kimmel PL, Patel SS: Quality of life in patients with chronic kidney disease: Focus on end-stage renal disease treated with hemodialysis. *Semin Nephrol* 26: 68–79, 2006
22. Eknoyan G, Beck GJ, Cheung AK, Daugirdas JT, Greene T, Kusek JW, Allon M, Bailey J, Delmez JA, Depner TA, Dwyer JT, Levey AS, Levin NW, Milford E, Ornt B, Rocco MV, Schulman G, Schwab SJ, Teehan BP, Toto R, Hemodialysis (HEMO) Study Group: Effect of dialysis dose and membrane flux in maintenance hemodialysis. *N Engl J Med* 347: 2010–2019, 2002
23. Hopman WM, Towheed T, Anastassiades T, Tenenhouse A, Poliquin S, Berger C, Joseph L, Brown JP, Murray TM, Adachi JD, Hanley DA, Papadimitropoulos E: Canadian normative data for the SF-36 health survey. Canadian Multicentre Osteoporosis Study Research Group. *CMAJ* 163: 265–271, 2000
24. Samsa G, Edelman D, Rothman ML, Williams GR, Lipscomb J, Matchar D: Determining clinically important differences in health status measures: A general approach with illustration to the Health Utilities Index Mark II. *Pharmacoeconomics* 15: 141–155, 1999
25. Diaz-Buxo JA, Lowrie EG, Lew NL, Zhang H, Lazarus JM: Quality-of-life evaluation using Short Form 36: Comparison in hemodialysis and peritoneal dialysis patients. *Am J Kidney Dis* 35: 293–300, 2000