Global ESRD Costs Associated with a Short Daily Hemodialysis Program in the United States

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In spite of the growing evidence that daily hemodialysis (DHD) improves clinical outcomes and quality of life, the additional dialysis costs are not currently reimbursed in the United States. Nor have there been reports of the effects of DHD on end-stage renal disease (ESRD) global costs, which would help predict the financial impact of DHD on the ESRD program. Since 1996, 22 patients (20 in-center, 2 home) have switched from conventional thrice-weekly dialysis to short, daily dialysis with six treatments per week. Eighteen patients started for medical indications, and four started for nonmedical reasons. Causes of ESRD were the following: diabetes mellitus (6), hypertension (4), glomerulonephritis (6), hereditary (2), and other (4). Mean age was 56 ± 16 years. Patients had an average of 3.3 major comorbidities. Weekly conventional HD dialysis times were divided into six DHD treatments, each 2.0 ± 0.3 hours. Weekly Kt/V remained unchanged. Twenty-two patients were followed on DHD for 220 patient-months: 7 patients died after 1.8 ± 1.3 months, 2 were transplanted at 4.3 ± 3.2 months, and 2 discontinued DHD at 3.6 ± 4.8 months. Eleven patients remain on DHD at 17.4 ± 8.3 months. Actual costs per extra dialysis session are as follows: $14.30 for supplies and $3.20 for labor for setup/cleanup time (15 minutes at $12.80/hour). Annualized DHD savings are based on comparison of doses of epoetin alpha (Epogen) and blood pressure medication at the start and after 12 months of DHD. Hospitalization rates include all enrolled patients, comparing rates for the 12 months prior to DHD with the first year on DHD, or annualized rates for those on DHD less than one year. Cost assumptions are $9/1000 U Epogen, $1/blood pressure pill, and $1200/per day of hospitalization. Extra transportation costs were covered by the patients. No increased access problems were observed. For patients on short DHD longer than 12 months, supply and labor costs increased to $2733/patient/year; however, Epogen use was reduced 55%, and blood pressure medications were reduced 40%. For all patients who switched to DHD, hospitalization rates were reduced 24%. This resulted in a net savings of about $4241/patient/ year after 12 months on DHD. Overall ESRD costs were substantially decreased on DHD. These cost savings must be passed on to providers before DHD becomes more widely available.

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Introduction

There have been recent reports from several countries that daily hemodialysis (DHD) improves clinical outcomes and quality of life [1–6]. In the United States, the increased dialysis costs associated with DHD currently are not reimbursed. There have not been, however, any reports of the effects of DHD on end-stage renal disease (ESRD) global costs, which would allow assessment of the potential financial impact of DHD on the ESRD program.

In October 1996, El Camino Dialysis Services started a short DHD (sDHD) program. El Camino Hospital, a nonprofit community hospital in Mountain View, California, was willing to underwrite the additional unreimbursed treatments. In order to provide the benefit for those most in need, this new modality was initially offered only to patients who were failing on thrice-weekly conventional hemodialysis, a population we hypothesized would benefit most from DHD as a form of "rescue therapy."

Because the patients in greatest medical need were dialyzing in-center, we chose the sDHD protocol, as described by Buoncristiani *et al.* [2], rather than the slow nocturnal daily dialysis regimen reported from Toronto [7]. This report describes the effect of sDHD on overall ESRD costs in our study.

Materials and methods

Patient selection

The goal of participant recruitment was to have approximately 10–15 patients on sDHD at any time. All patients receiving in-center or home hemodialysis through El Camino Dialysis Services (approximately 400 patients) were screened for medical indications for sDHD. Patients were advised of the potential benefits and risks of sDHD and asked to commit to the study for no less than 3 months. The study protocol was evaluated and approved by the Institutional Review Board at El Camino Hospital. Written informed consent was obtained from patients prior to participation in the study.

Criteria for patient selection included current dialysis three times a week in-center or home hemodialysis for at least one month, a willingness to reuse dialyzers if in-center, adequate blood access, compliance with treatment protocols, and indication for daily hemodialysis.

Initially, we selected patients based on medical needs for switching to DHD, such as difficulty during the time between dialysis sessions, inability to tolerate the prescribed dialysis time, inability to control blood pressure, or malnutrition with failure to thrive. Shortly after starting, however, we added two nonmedical criteria: the desire to improve general well-being and the desire to improve the dialysis schedule for work or family.

Study protocol

This was a longitudinal prospective study, with each patient serving as his/her own historical control. For patients adequately dialyzed three times a week, the weekly dialysis time was kept the same, but was divided equally into six treatments per week. All other aspects of their treatment were unchanged, such as dialyzer type, blood and dialysate flow rates, adherence to dialysis unit protocols, as well as clinical management by their own attending nephrologist.

The minimum prescribed Kt/V on sDHD was 0.66/treatment, or 3.96/week. The minimum delivered Kt/V on sDHD was 0.60/treatment, or 3.60/week.

The following baseline data were gathered for each patient at the time of enrollment in the study: the number of hospitalization days and admissions for the 12 months prior to starting DHD, the history of the patient's blood access, and laboratory data for the 3 months prior to starting DHD; each patient also completed the Kidney Disease Quality of Life (KDQOL) questionnaire, version 1.2.

During the study, kinetic modeling and laboratory testing were repeated monthly, except for intact parathyroid hormone levels, which were done quarterly. KDQOL was readministered 3 months after starting DHD, then yearly on the patient's anniversary of starting DHD.

Hospitalization rates were monitored. For the patients who were on DHD less than one year, the hospitalization rate during the time on DHD was annualized.

Financial information was analyzed 6 months after the beginning of the study and repeated yearly thereafter. The financial data collected included the costs for all supplies and labor required for each additional treatment. In addition, acquisition costs of Epogen and estimations of daily hospital charges were updated yearly.

Transportation costs, which were covered by the patient, were not included in our financial analysis. All the study patients drove themselves or were driven by family members; therefore, there were no increased costs to third party transportation agencies. We did not evaluate any change in financial status resulting from change in employment status or productivity.

Statistical analysis

Values are expressed as mean±SD. Student's paired *t*-test was used for comparison of the differences. A *p* value under 0.05 was considered statistically significant, and a *p* value under 0.01 was considered highly significant.

Results

Over a 28-month period, we enrolled 22 patients for a cumulative observation time of 220 patient-months. There were 14 males and 8 females. Average age was 56 ± 16 years. Causes of ESRD were diabetes mellitus type I or II ($n = 6$), glomerulonephritis ($n = 6$), hypertension ($n = 4$), hereditary ($n = 2$), and other ($n = 4$). The patients had an average of 3.3 major comorbid conditions in addition to ESRD.

Patient course

Eleven patients remain on sDHD (17.4 ± 8.3 months). Of the other 11 patients no longer on DHD, 2 were transplanted (4.3 ± 3.2 months), 2 discontinued (3.6 ± 4.8 months), and 7 died (1.8 ± 1.3 months). Of the two who discontinued the DHD program, one patient stopped after one week for an acute psychiatric decompensation. The other had continuation of recurring blood access infections which antedated DHD and switched to peritoneal dialysis. No patient who switched voluntarily chose to return to conventional hemodialysis.

Clinical outcomes

Clinical results have been reported in more detail elsewhere [4,8]. As other investigators have reported [2,3,5], we also found improved blood pressure control with fewer blood pressure medications, stable hematocrit with reduced Epogen requirements, and highly significant improvements in quality of life measurements using the KDQOL questionnaire. There were no apparent excess blood access problems in this patient population.

The economics of sDHD

As shown in Table I, after one year on DHD the Epogen dose decreased from 18.7 ± 18.3 kU to 8.5 ± 10.3 kU per patient per treatment, representing a 55% reduction from the baseline dose. Although not statistically significant, this represents cost savings of $4612/patient/year, based on Epogen acquisition costs of $9/1000 U. The average number of blood pressure pills dropped from 15.4 ± 16.0 to 9.2 ± 13.0 pills/patient/week

TABLE I Additional costs and savings associated with our sDHD program. Comparisons are per patient, conventional thrice-weekly dialysis versus twelfth month on sDHD (1998)

	Pre DHD	*12 mo. sDHD*	*Savings/yr*
Extra supply cost/week	N/A	($42.90)	($2231)
Extra labor cost/week	N/A	($9.60)	($502)
Epogen (1000 U/week)	18.7±18.3	8.5±10.3[a]	$4612
No. of blood pressure pills/ patient/week	15.4±16.0	9.2±13.0[b]	$322
Hospital days/patient/yr	7.9±9.5	6.2±9.3[b]	$2040
Total savings			$4241

sDHD = short daily hemodialysis.
[a] $p = 0.02$.
[b] p = NS.

after one year on DHD. This 40% reduction in blood pressure medication, for the same level of blood pressure control, represents savings of approximately $322/patient/year, based on acquisition cost assumptions of $1/pill.

Hospitalization days for all enrolled patients decreased from 7.9 days/patient/year for the 12 months prior to DHD to 6.2 days/patient/year in the first year of DHD.

The supply costs for each additional DHD treatment (the fourth, fifth, and sixth treatment each week) averaged $14.30 per treatment. This included all additional costs associated with dialyzer use: tubing, dialysate, syringes, needles and routine items such as saline, local anesthetics, disinfectants, and tape. Medications such as Epogen and calcitriol were continued on the three times per week schedule and, therefore, did not add to the supply or labor costs.

There was no net change in either patient or staffing schedules because the weekly dialysis time for sDHD was unchanged, and the number of study patients was small. The extra work associated with the additional "put-ons" and take-offs" required for sDHD was absorbed by the existing staff. In a larger sDHD program, at some point this additional labor would result in increased labor costs. We estimate that the three extra treatments (fourth, fifth, and sixth) per week each require an additional 15 minutes of labor. The local average pay scale for patient care technicians is $12.80/hour. The additional 15 minutes would thus cost an additional $3.20/ extra treatment, or $9.60/week.

The additional cost for each sDHD patient was approximately $2733/patient/year for increased direct supply and labor costs (Table I), where the total weekly dialysis time on sDHD was kept unchanged from the thrice-weekly schedule. Short daily hemodialysis resulted in net savings of $4241/ patient/year after 12 months, based on cost savings from decreased use of Epogen, blood pressure medication, and hospitalization.

Discussion

Although the clinical superiority of DHD over conventional hemodialysis is increasingly being reported, the financial impact of more frequent dialysis sessions has not been described. This study shows that sDHD is a highly cost-effective treatment option with improved clinical outcomes. The overall costs are reduced as a result of decreased need for Epogen, blood pressure medication, and hospitalization, despite the additional costs associated with the extra dialysis treatments.

In spite of the fact that patients feel significantly better, clinical outcomes are improved, and global costs are reduced, DHD will not be more widely utilized within the current reimbursement structure because of financial disincentives. Relatively few ESRD patients in the United States are fully capitated for their medical care. For the vast majority of their patients, dialysis organizations starting DHD programs now incur the increased costs of the additional treatments, but do not reap the benefits of the decreased global costs. The benefits of decreased costs accrue to the payer, not to the provider, in any such setting. In addition to providing the additional treatments for which they do not get paid, a dialysis provider would also receive less revenue for Epogen, since its dosing requirement decreases. Therefore, DHD is not a viable alternative under the present reimbursement structure in the United States.

For DHD to become more widespread, one of two things needs to occur. One, the payment of more ESRD care must be capitated, which is occurring very slowly under managed care in the United States. If dialysis providers were to be at risk for the ESRD global costs, then the potential cost savings would be an important incentive to develop and expand DHD programs. Once such programs are available, nephrologists will then be able to prescribe this modality according to the clinical needs of their patients rather than be limited by the existing financial disincentives. DHD may contribute an additional competitive margin for providers who share in the cost savings.

Two, in the absence of increased capitation, there must be additional payment to the provider to offset the additional expenses associated with DHD. Increased reimbursement for DHD is indicated insofar as patients experience substantial clinical improvements not achievable through conventional hemodialysis. In our opinion, this is analogous to Epogen, which received additional reimbursement for the striking benefits it brought to anemic dialysis patients. It would be in the payers' interest to increase the payment to support expansion of DHD services, since it lowers their overall ESRD costs and at the same time improves clinical outcomes and quality of life.

One simple solution to cover the additional expenses of DHD is to provide a fourth payment per week for those patients who dialyze more than three times a week. As long as the total weekly dialysis time is held constant, one additional treatment payment should cover the costs of four, five, or six treatments per week. If the expenses associated with the additional treatments are managed very carefully, the fourth reimbursement may contribute to the provider's margin. In this way, the provider could potentially share in the payer's cost savings even without increased capitation. Medicare is the principal payer for the ESRD program, and this company often sets the reimbursement policy adopted by other payers of ESRD care. If Medicare were to include coverage of a fourth treatment per week, this would allow expansion of DHD throughout the United States according to its clinical benefits.

In the future, technological advances will also affect the additional costs associated with DHD. Improved automated systems can reuse more of the disposable supplies and possibly decrease the amount of labor and supervision required per treatment, thereby reducing both the supply and labor costs.

Conclusion

Daily hemodialysis benefits patients by improving their clinical outcomes and quality of life. Daily hemodialysis benefits payers by decreasing ESRD global costs. However, DHD will not become more widespread until the financial disincentives to the dialysis providers are removed.

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