Original Investigation

Factors Associated With Discontinuation of Home Hemodialysis

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Rebecca Kurnik Seshasai, MD,[1] Nandita Mitra, PhD,[2] C. Michael Chaknos, MD,[3] Jiaqi Li, MS,[2] Christopher Wirtalla, BA,[4] Dan Negoianu, MD,[3] Joel D. Glickman, MD,[3] and Laura M. Dember, MD[3]

Background: Home hemodialysis (HHD) is associated with improved clinical and quality-of-life outcomes compared to in-center hemodialysis, but remains an underused modality in the United States. Discontinuation from HHD therapy may be an important contributor to the low use of this modality. This study aimed to describe the rate and timing of HHD therapy discontinuation, or technique failure, and identify contributing factors.

Study Design: Retrospective cohort study.

Setting & Participants: Using data from a large dialysis provider, we identified a nationally representative cohort of patients who initiated HHD therapy from 2007 to 2009 (N = 2,840).

Factors: Demographics, end-stage renal disease duration, kidney transplant listing status, comorbid conditions, level of urbanization or rurality based on residence zip code, socioeconomic status based on residence zip code, and dialysis facility factors.

Outcomes: Discontinuation from HHD therapy, defined as 60 or more days with no HHD treatments.

Measurements: Competing-risk models were used to produce cumulative incidence plots and identify sociodemographic and clinical variables associated with HHD therapy discontinuation. Transplantation and death were treated as competing risks for HHD therapy discontinuation.

Results: The 1-year incidence of discontinuation was 24.9%, and the 1-year mortality estimate was 7.6%. Median end-stage renal disease duration prior to initiating HHD therapy was 2.1 years. Diabetes and smoking/alcohol/drug use were associated with increased risk for HHD discontinuation (HRs of 1.34 [95% CI, 1.07-1.68] and 1.34 [95% CI, 1.01-1.78], respectively). Listing for kidney transplantation and rural residence (rural-urban commuting area ≥ 7) were associated with decreased risk for HHD therapy discontinuation (HRs of 0.73 [95% CI, 0.61-0.87] and 0.78 [95% CI, 0.59-1.02], respectively).

Limitations: Limited to variables available within the DaVita dialysis and US Renal Data System data sets.

Conclusions: A substantial proportion of patients discontinue HHD therapy within the first 12 months of use of the modality. Patients with diabetes, substance use, nonlisting for kidney transplantation, and urban residence are at greater risk for discontinuation. Targeting high-risk patients for increased support from clinical teams is a potential strategy for reducing HHD therapy discontinuation and increasing technique survival.
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INDEX WORDS: Hemodialysis; home dialysis; home hemodialysis (HHD); discontinuation; technique failure; technique survival; end-stage renal disease (ESRD); renal replacement therapy (RRT); RRT modality; US Renal Data System (USRDS).

Approximately 450,000 people in the United States are treated with maintenance dialysis for end-stage renal disease (ESRD) and about 90% receive thrice-weekly in-center hemodialysis.[1] Although dialysis is life-saving, the mortality rate is 6.1 to 7.8 times greater for dialysis patients than for age-matched Medicare

beneficiaries, the hospitalization rate is 1.73 admissions per patient-year, and quality of life and functional status are low.[2,3] An interest in alternative dialysis modalities to combat these poor outcomes has led to a recent increased focus on home hemodialysis (HHD).

Accumulating evidence suggests that more frequent dialysis, which is usually performed at home, has benefits for blood pressure, mineral metabolism, cardiovascular-related hospitalization rates, quality of

life, and survival compared with conventional thrice-weekly dialysis.[4-16] However, despite these potential advantages, HHD remains underused in the United States.[17] Low use can stem both from low rates of initiation and high rates of discontinuation of the modality. Reasons identified for low HHD use include lack of patient awareness of home modalities, lack of physician experience prescribing the modality, and patient fear of self-cannulation and complications in the home,[17-21] all of which lead to low HHD therapy initiation rates. A less recognized contributor to low HHD use is discontinuation of HHD therapy with transfer to another dialysis modality.[22,23] Discontinuation of HHD therapy, also referred to as technique failure, is reported to occur at rates as high as 20% to 25% within the first year of HHD in the United States and can have a deleterious impact on both facilities and patients given the large upfront costs, personnel time, and patient and family commitment required for HHD training and initiation.[4,12,24,25]

In this study using a large national cohort, we aimed to estimate the rate and timing of discontinuation from HHD therapy and identify patient and dialysis facility factors associated with discontinuation. Understanding the contributors to HHD therapy discontinuation could facilitate the development and targeting of interventions to reduce its occurrence, improve HHD modality selection, and target high-risk patients for increased support to reduce HHD therapy discontinuation.

METHODS

Study Cohort

The cohort comprised all adult patients who initiated HHD therapy at DaVita dialysis facilities in the United States during the 3-year period from January 1, 2007, to December 31, 2009. Most patients were using NxStage equipment and performing short daily hemodialysis treatments. The DaVita data set included dates of HHD service and, when applicable, the dialysis modality preceding and following HHD. The HHD therapy initiation date indicated the first day that the patient dialyzed at home and excluded dates of HHD training. We excluded 399 patients who were already using HHD prior to January 1, 2007, to restrict the analyses to incident HHD patients. We also excluded 141 individuals who initiated HHD therapy after November 1, 2009, the date at which we censored individuals still using HHD. We excluded 137 patients who had an isolated HHD episode of less than 10 days, making the assumption that these were erroneous classifications and did not represent an actual HHD experience because it is unlikely that a patient who completed the requisite 4 to 6 weeks of training without discontinuation would discontinue within the first few treatments at home. Finally, we excluded 5 patients who were younger than 18 years. Our final study cohort comprised 2,840 patients.

The DaVita data set was linked to the US Renal Data Systems (USRDS) database by the USRDS Coordinating Center in Minneapolis, MN, under a data use agreement between the USRDS and researchers at the University of Pennsylvania. Almost all (99.8%) records were linked to patients in the USRDS database. We received a file linking the DaVita identification number with the USRDS

identification number, but with personal identifiers removed. The study was approved by the University of Pennsylvania Institutional Review Board (protocol number 817208), with a waiver of informed consent due to the de-identified nature of the data.

Data Elements

For each patient, we obtained age, race, ethnicity, sex, primary cause of ESRD, ESRD duration, and kidney transplant listing status from the USRDS Standard Analysis Files. Kidney transplant waiting list status was defined at the time of HHD therapy initiation. We identified comorbid conditions, including hypertension, diabetes, peripheral vascular disease, heart disease, cerebrovascular disease, congestive heart failure, cancer, chronic obstructive pulmonary disease, inability to ambulate or transfer, and substance use at the time of starting dialysis (which included smoking, alcohol, and drug use) from the most recent Medical Evidence Report form (Centers for Medicare & Medicaid Services form CMS-2728).

Dialysis facility variables were obtained from the USRDS facility files from January 1, 2007, through December 31, 2008. Information from the 2000 US Census was used to define median household income quartiles based on residence zip codes and defined in ascending order: quartile 1 is the lowest income, and quartile 4 is the highest income. The level of urbanization or rurality of residence zip code was categorized using the US Department of Agriculture rural-urban commuting area (RUCA) designation. RUCA codes are based on sizes of cities and towns and the commuting patterns from the 2000 US Census data and defined on a scale from 1 to 10.6 (1, least rural; 10.6, most rural). A file linking RUCA code to zip code is available from the University of Washington Rural Health Research Center. We defined rural as RUCA ≥ 7 to increase the sensitivity of the designation.[26,27]

Facility-level variables were examined in the subset of patients for whom they were available (n = 2,055). Variables included the number of HHD patients in a facility, ratio of HHD patients to total number of patients in the facility, ratio of HHD patients to total number of home dialysis patients (HHD plus peritoneal dialysis patients), in-center census and number of in-center hemodialysis stations as 2 indicators of facility size, and years of Medicare certification.

Outcomes

The primary outcome was discontinuation from HHD therapy. Discontinuation was defined as a change in dialysis modality after initiating HHD therapy. A patient was considered to have discontinued if there were no HHD treatments for a 60-day period. Intervals of no HHD treatments that were shorter than 60 days were collapsed because we assumed that these gaps in treatment were not true discontinuations but instead were interruptions for hospitalizations or brief periods of in-center dialysis for travel or administration of intravenous antibiotics. If a patient returned to HHD therapy after more than 60 days, we included only the first episode of HHD. Dates of kidney transplantation and death were obtained from the USRDS transplantation and death files, respectively. If kidney transplantation or death occurred within 30 days of the last HHD treatment, the event was classified as a transplantation or death rather than as HHD therapy discontinuation. Patients were followed up from initiation of HHD until HHD therapy discontinuation, kidney transplantation, death, or November 1, 2009, at 60 days before the end of the data set.

Statistical Analysis

Descriptive statistics were used to describe baseline characteristics of the cohort. Continuous variables are presented as either mean ± standard deviation or median with interquartile range. Column percentages are listed for categorical variables. Diabetes, inability to ambulate or transfer, and smoking/alcohol/drug use