Published in final edited form as:

Clin Exp Nephrol. 2018 August ; 22(4): 947–956. doi:10.1007/s10157-017-1512-8.

PATIENT KNOWLEDGE AND ADHERENCE TO MAINTENANCE HEMODIALYSIS:

An International Comparison Study

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Abstract

Background—Non-adherence to hemodialysis (HD) is associated with increased morbidity and mortality. In this cross-sectional study, we compared correlates and rates of non-adherence between the U.S. and Japan to determine if differences in patient knowledge about HD might account for international variation in adherence.

Methods—We evaluated 100 U.S. and 116 Japanese patients on maintenance HD. Patient knowledge was scored based on the identification of their vascular access, dry weight, cause of kidney disease, and 3 phosphorus and potassium rich foods. Patients were considered non-adherent if they missed >3% of HD sessions in 3 months.

Results—23% of the U.S. and none of the Japanese patients were non-adherent. Using logistic regression, we found that in the U.S. non-adherence was more common in black patients [Odds ratio (OR), 3.98; 95% confidence interval (CI), 1.42–11.22], while high school graduates (OR,

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Compliance with ethical standards

Conflict of interest: The authors have declared that no conflict of interest exists.

Ethical approval: This study was approved by the Mount Sinai Beth Israel Institutional Review Board (approval #222-12) and the Tama Medical Center Research Ethics Committee (approval #42) and was carried out in accordance with The Code of Ethics of the World Medical Association (Declaration of Helsinki).

Informed consent: Informed consent was obtained from all individual participants included in the study.

0.20; 95% CI, 0.05–0.81) and those on the transplant waiting list (OR, 0.25; 95% CI, 0.083–0.72) were less likely to miss their treatments. There was no significant association between knowledge and non-adherence in the U.S. However, Japanese patients had significantly higher levels of HD knowledge than U.S. patients after adjusting for age ($p<0.001$).

Conclusion—Age-adjusted HD knowledge was higher and non-adherence rates were lower in Japan vs. the U.S. However, because of the unexpected finding of 100% adherence in Japan, we were unable to formally test whether knowledge was significantly associated with adherence across both countries. Further research is needed to understand the reasons behind the higher non-adherence rates in the U.S.

Keywords

adherence; hemodialysis; patient knowledge; international

Introduction

Hemodialysis (HD) is a life-saving procedure for patients with end-stage kidney disease (ESKD). However, some patients skip dialysis sessions, which puts them at an increased risk of hospitalization and death [1–3]. Improved adherence to prescribed dialysis may decrease morbidity and mortality, but this goal cannot be achieved without each patient's better understanding of and motivation for HD treatment.

During the 2012 Hurricane Sandy disaster in New York City (NYC), stranded patients presented to our emergency room at Beth Israel Medical Center (now Mount Sinai Beth Israel [MSBI]) requesting urgent HD [4]. However, most had no knowledge of their HD prescription, dialysis physician's names, target weights, Hepatitis B status, or comorbid diseases, complicating the triage process [5]. This experience made us aware of the large gap between what patients actually know and what physicians expect them to know in the United States. Japanese nephrologists noted that after the Great East Japan Earthquake and Tsunami in 2011 inadequate understanding of dialysis needs was also an issue, but mainly for older dialysis patients.

Both Japan and the U.S. governments provide ESKD patients with access to long-term life-saving renal replacement therapy. However, Japan's dialysis patients have a much higher rate of survival: unadjusted 5-year survival was 60% in Japan but only 39% in the U.S. for patients who started dialysis in 2004–2008 [6]. Different practice patterns between the U.S. and Japan may in part account for the observed mortality difference, including shorter treatment times, more frequent use of tunneled catheters, and staffing of dialysis units with more technicians rather than nurses in the United States [7]. It may also be due to a higher rate of non-adherence to HD in the U.S. The Dialysis Outcomes and Practice Patterns Study (DOPPS) found that the 7.9% of U.S. patients skipped one or more HD sessions/month compared with only 0.6% in Japan [1]. It is unclear if a difference in patient knowledge about HD may contribute to differences in outcomes because international comparisons of patient knowledge have not been well studied to date. To bridge this gap, we compared levels of patient knowledge about HD as well as other correlates and rates of non-adherence

between the U.S. and Japan in this cross-sectional study to determine if differences in knowledge might account for international variation in adherence.

Materials and Methods

Design and Setting

We conducted this international cross-sectional study at outpatient-based hemodialysis centers in the U.S. (1 center in NYC) and Japan (3 centers in Tokyo with different owners/providers) from March 2013 to November 2013. After written informed consent was obtained, data were collected using both patient interviews and chart review. Data collection procedures were performed under the same conditions using the same instruments in the respective language of each country. This study was reviewed and approved by the Mount Sinai Beth Israel Institutional Review Board and the Tama Medical Center Research Ethics Committee.

Study Population

We recruited patients in-person from the participating dialysis centers during their HD treatments. All study patients were 18 years of age or older, spoke English or Japanese fluently, and had been on in-center chronic HD treatment three times a week for at least 3 months. Patients with neurocognitive impairments were excluded.

In total, 226 patients were enrolled in this study (Figure 1). In the U.S., of the 134 patients screened, 26 did not meet the eligibility criteria and 8 declined to participate. In Japan, all of the 116 patients who were screened were eligible and participated.

Patient Interviews

Patients participated in 1:1 in-person structured interviews during their HD treatment. The interview guide was developed specifically for this study (Supplemental Table S1). It assessed 4 domains:

1. sociodemographic factors such as race/ethnicity, marital status, level of education, occupation, smoking status, living situation, and meal preparation;
2. history of kidney disease, including number of years treated for chronic kidney disease (CKD), CKD etiology, transplant waiting list status, number of times seen by a dietician or nephrologists in the past three months, and medication adherence;
3. knowledge of HD, including vascular access, dry weight, cause of kidney disease, and 3 phosphorus and potassium rich foods, with scores ranging from 0 (low) to 5 (high) (Table 1);
4. thoughts on HD treatments, including their major concerns and the level of satisfaction with their overall dialysis treatment. Patients were asked the open-ended question, "What is your major concern during the hemodialysis treatment?" If the patient could not come up with any answer, examples of muscle cramping, blood pressure change, back pain, headache, being bored,

itchiness, and pain at vascular access site, were presented to the patient. Multiple answers were allowed. Patients rated their satisfaction on a scale from 1 (low) to 10 (high).

Chart Review

Demographic and dialysis-related data were extracted from the patients' medical records. Information collected included age, sex, comorbid conditions, number of missed HD sessions in the last 3 months, HD vintage, primary renal disease, dry weight, interdialytic weight gain, length of prescribed HD treatment, and laboratory values (dialysis adequacy expressed as Kt/V, blood urea nitrogen (BUN), hemoglobin, transferrin saturation, calcium, phosphorus, parathyroid hormone, potassium, and albumin). Because of the difference in each facility's clinical system, blood was drawn before the first dialysis of the week (Monday or Tuesday) at HD centers in Japan and before the mid-week dialysis (Wednesday or Thursday) in the U.S.

Assessment of Dialysis Adherence

Attendance records were reviewed for each patient. Patients were considered non-adherent if they skipped more than 3% of their scheduled dialysis sessions in a 3 month period, as defined in previous studies [8]. We excluded sessions missed due to scheduled vacations or doctor's appointments if patients had arranged in advance to make-up that session at a different facility or on a different day. We also excluded HD treatments that occurred during hospitalizations.

Statistical Analysis

We assessed differences in participant characteristics between the two countries and adherent vs. non-adherent U.S. patients using t-tests for normally distributed continuous variables, and Mann-Whitney tests for non-normally distributed continuous variables, and χ^2 tests for categorical variables. Continuous data are reported as mean $\pm$ standard deviation if normal and as median and interquartile range (IQR) if not. Categorical data are reported as frequencies and percentages. Because age was correlated with knowledge score and the Japanese population was significantly older than the U.S. population, we used linear regression to estimate both unadjusted and age-adjusted associations between country (Japan vs. U.S.) and knowledge score.

In the U.S. subsample, logistic regression was used to identify correlates of non-adherence. The association of total knowledge score with non-adherence was explored using multivariable logistic regression models adjusting for variables which were identified in univariate analysis to be significantly correlated with non-adherence. Similar multi-variable analyses were done to assess the association between black race and non-adherence as well. Statistical analyses were performed using the statistical software packages SAS University Edition (SAS Institute, Cary, NC, USA). For all analyses, p value of <0.05 was considered statistically significant.

Results

Patient Characteristics

Patient characteristics are shown in Table 2. Japanese patients were significantly older than U.S. patients, with a mean age of 66 vs. 57. They also were more likely to be married, living with their families, and have meals cooked by their families than U.S. patients. However, only 81% of Japanese patients completed high school, while 91% of U.S. patients were high school graduates. Japanese patients were both on HD and had known CKD prior to HD about 2–3 years longer than U.S. patients, but were less likely to be waitlisted for transplant despite being seen 6 times more frequently by physicians than the U.S. patients. Compared to their U.S. counterparts, Japanese patients weighed less, had a higher percent weight gain, and longer treatment times. Although they had slightly lower hemoglobin and albumin levels than U.S. patients, Japanese patients also had lower phosphorus and parathyroid hormone (PTH) levels. There were no differences in Kt/V or potassium level between the 2 countries.

In terms of treatment adherence, none of the Japanese patients but 23% of U.S. patients were non-adherent. Among the patients who were non-adherent, the median number of missed dialysis sessions over 3 months was 5 (IQR 3 – 9). We reported the characteristics of the U.S. patients by their adherence status in Table 2. Non-adherent U.S. patients were more likely to be black, have lower educational backgrounds, and have longer treatment lengths than adherent U.S. patients, but were less likely to be on the transplant waiting list. However, there were no statistically significant differences in laboratory results between adherent and non-adherent patients.

Patient knowledge about HD

The scores for each knowledge question as well as the total knowledge score are listed in Table 3. While the vast majority of patients knew their vascular access, only 65% of U.S. patients knew their dry weight compared to 81% of Japanese patients. Only two thirds of patients knew the cause of their kidney disease, only half could name 3 or more potassium rich foods, and less than half could name 3 or more phosphorus rich foods.

In unadjusted analyses, the only significant difference in knowledge between the two countries was that Japanese patients were more likely to know their dry weight (Table 4). However, in both countries the total knowledge score was inversely correlated with age ($\beta = -0.05$, $p = <0.001$ in Japan, $\beta = -0.05$, $p = <0.001$ in U.S.) as shown in Supplemental Figure S1. Since the Japanese subsample was significantly older than the U.S. subsample, we adjusted the scores for age. After age adjustment, U.S. patients were still significantly less likely to know their dry weight, but they were also less likely to be knowledgeable about phosphorus rich foods and to have lower total knowledge scores (Table 4).

Correlates of non-adherence in U.S. patients

We identified various correlates of non-adherence in the U.S. population (Figure 2). In unadjusted analyses, black patients were nearly 4 times more likely to be non-adherent than non-black patients (OR 3.98, 95% CI: 1.42 to 11.22), while high school graduates (OR 0.20, 95% CI: 0.05 to 0.81) and patients on the transplant waiting list (OR 0.24; 95% CI: 0.083 to

0.72) were less likely to be non-adherent. Black race remained significantly correlated with non-adherence after adjusting for each of the following variables: age, high school education, HD session length, and transplant waitlist status (Table 5). Other sociodemographic factors, dialysis-related characteristics, laboratory results, and satisfaction score were not significantly related to non-adherence. Likewise, none of the knowledge scores were associated with non-adherence even after adjusting for various potential confounders (Table 6).

Comparison of satisfaction and concerns between Japan and U.S. patients

Scores for satisfaction with dialysis treatments were higher in the U.S. (median 9.0, IQR: 8.0–10.0) compared to Japan (median 8.0, IQR: 7.0–10.0) (Table 3). There was no difference in satisfaction between adherent and non-adherent U.S. patients.

Major patient concerns regarding HD treatments are listed in Table 7. The most common concern was “blood pressure change during HD” in Japan (reported by 41% of patients) and “muscle cramps” in the U.S. (reported by 43% of patients). In the U.S. cohort, a higher percentage of non-adherent patients complained of any type of physical symptoms, such as muscle cramps, pains, and itching, compared to adherent patients (74% vs. 55%), but the difference was not statistically significant. Physical symptoms were the main concern for more than half of both Japanese and U.S. patients (53% and 59%, respectively).

Discussion

In this study, we compared levels of dialysis-related patient knowledge and non-adherence to HD treatments between patients on chronic HD in Japan and the United States. We found that non-adherence was more common in the U.S. even though the U.S. cohort had a higher educational background and was more satisfied with their HD treatments than the Japanese cohort. The Japanese population had stronger social support (as measured by marital status, living situation, and meal preparation) and a higher total knowledge score after age adjustment. While this suggests that increased knowledge about HD may contribute to Japan’s higher rates of adherence, we were unable to formally test this hypothesis because there were no non-adherent Japanese patients.

Within the U.S., however, HD-related knowledge scores did not differ between non-adherent and adherent U.S. patients even though lower educational background was a risk factor for non-adherence. Our finding of no association between knowledge and adherence concurs with a similar report which showed that knowledge of dietary restrictions were not predictive of dietary compliance in HD patients [9]. Our result suggests that it might be the socio-economic factors associated with lower educational background, such as low income, rather than low levels of HD-related knowledge, that is driving treatment non-adherence in less educated U.S. patients. For instance, patients with lower educational backgrounds might be more likely to have part-time jobs with erratic schedules leading to missed dialysis sessions despite a high level of knowledge about their disease. Another potential explanation for our result is that our knowledge questions did not accurately assess the overall amount of knowledge that patients possessed. Notably, an Iranian study of 58 hemodialysis patients

showing that educational interventions for HD patients improved both knowledge and adherence scores used different measures to assess both knowledge and adherence [10].

Still, the large gap between what patients understand about their kidney disease and what physicians expect them to know is striking. Wright et al. surveyed 401 patients in a U.S. CKD clinic and found that more than a third of the participants did not know that the kidney makes urine, or that they had CKD [11]. Disease-related knowledge was also limited in many of the patients in both countries in our study even though all of them visit HD centers thrice weekly and have had many interactions with doctors, nurses, and dieticians for years. We cannot expect patients to effectively manage their health without a clear understanding of their disease. Although lack of knowledge did not associate with treatment non-adherence in the U.S. in this study, it may still affect other important outcomes not measured in this study, like hospitalization and mortality rates.

Non-adherence was more common among black patients, which was consistent with previous large-scale studies [1–3, 8]. Though it is known that low socioeconomic status contributes to the high incidence and prevalence of ESKD among ethnic minorities [12], its role in dialysis adherence has not been clearly defined [2]. We found that black race was a risk factor for non-adherence independent of education level. This suggests that low socioeconomic status may not be the major cause of non-adherence in black patients. In addition, the fact that adjusting for transplant waitlist status did not appreciably change the risk of non-adherence implies that lack of access to healthcare is not the factor driving non-adherence in this group of patients since being waitlisted for transplanted is tightly correlated with better access to care. We speculate that cultural differences in attitude towards HD may play a role in adherence. A single-center study of 77 patients showed that white patients on HD had more positive attitudes towards medication compliance than did African American patients on HD [13]. There may be similar differences in patient perceptions and attitudes about HD between races.

Likewise, cultural differences between Japan and the U.S. may explain why all of the Japanese patients were adherent. Japanese patients had stronger social support, and this family support might be contributing to Japanese patients' positive attitudes towards, and thus adherence to dialysis. In addition, compared to the U.S., Japan is racially and culturally homogeneous. This might make it easier for Japanese health care providers to address adherence issues since they share the same cultural background as their patients.

Unique aspects of the Japanese medical system may also promote adherence among its patients. For instance, one of the HD centers in Tokyo has an online system where each patient can access his or her laboratory results, latest dialysis prescription, and current medication list. Being exposed to their own medical information repeatedly could have motivated those patients to learn more about HD, track their progress, and attend all of their treatment sessions. Another systematic difference between two countries is that Japanese patients at the same HD center are managed by one physician who is almost always present at the HD center, while most U.S. patients have different physicians who are only intermittently available during the patients' treatments. This difference may influence patients' perceptions of being monitored closely, which could impact their motivation to

show up for their treatments. Interestingly, though, satisfaction scores were higher in the U.S. than in Japan. This may reflect cultural differences in how patients rate satisfaction in both countries, or it may simply mean that satisfaction is not related to adherence.

There are several limitations to this study. First, this is a cross-sectional study and causality cannot be inferred. There is a lack of generalizability due to the small number of facilities in a single geographic area of each country (1 in NYC and 3 in Tokyo) and limited diversity (only English or Japanese speaking patients were enrolled). We also excluded patients with cognitive impairment, which may be a contributing factor to adherence. We did not have detailed socioeconomic data, such as income or type of health insurance. The timing of the blood draw was also different between two countries; Monday or Tuesday in Japanese facilities and Wednesday or Thursday in the U.S. facility. Thus, the true differences of serum potassium and phosphorus between two groups might have been masked. The questionnaire and knowledge score were developed specifically for this study, and were not validated. We also did not have the power to adjust for multiple potential confounders in the same model or to test for effect modification. Finally, we were unable to formally test whether a difference in patient knowledge between the two countries accounted for the difference in non-adherence rates because there were no non-adherent Japanese patients. These limitations should be weighed against the strengths of this study, which include the international comparison of adherence and knowledge in a relatively large sample.

In conclusion, we found that non-adherence to HD was more common and age-adjusted levels of patient knowledge about HD were lower in the US than in Japan. Although this may hint that differences in knowledge might explain the variance in adherence seen between the countries, we could not statistically prove our hypothesis because of the 100% adherence rate among the Japanese patients. There are likely many other cultural factors that affect adherence as well. Further qualitative studies are needed to better understand the reasons behind the higher non-adherence rates in the U.S.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

JIS is supported by grant K23DK103972 from the National Institute of Diabetes, Digestive, and Kidney Diseases (NIDDK, Bethesda, MA, USA). KNM and JIS are supported by a generous gift honoring the life and work of nephrologist Henry Shavelle, MD. We thank Shin Miyata and Erik Lum for reviewing earlier drafts of this manuscript.

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Fig 1.
Flow diagram of participant selection.

Fig. 2.
Correlates of non-adherence to hemodialysis treatments in U.S. patients

Table 1

Assessment of patient knowledge about hemodialysis

Question	Prompt	1 point	0 points
1. "What type of vascular access do you use for dialysis?"	If unable to answer, patients were given the options of arteriovenous (AV) fistula, AV graft, or tunneled catheter.	Correct answer	Incorrect answer or no answer
2. "Do you know your dry weight?"		Within 2 kg of the prescribed dry weight	All other answers
3. "Do you know which medical problem caused your kidney failure?"		Correct answer. If a patient answered "I don't know," and the original cause was documented as unclear etiology, the answer was scored as 1	Incorrect answer or no answer
4. "Please list potassium rich foods, as many as possible."		Answer which contains 3 or more potassium rich foods	Answer of two or fewer potassium rich foods
5. "Please list phosphorus rich foods as many as possible."		Answer which contains 3 or more phosphorus rich foods	Answer of two or fewer phosphorus rich foods

The total score was a sum of each question's score. Scores ranged from 0 to 5.

Table 2

Characteristics of patients on maintenance hemodialysis in the U.S. and Japan

	Overall			U.S. subgroup		
	Japan (n=116)	US (n=100)	P Value	non-adherent* (n=23)	adherent (n=77)	P Value
Sociodemographics						
Age (years)	66 ± 11	57 ± 14	<0.001	55 ± 14	58 ± 14	0.31
Men, n (%)	66 (57)	72 (72)	0.02	16 (70)	56 (77)	0.77
Race/ethnicity, n (%)			<0.001			0.06
White	0	12 (12)		1 (4)	11 (14)	
Black	0	49 (49)		17 (73)	32 (42)	
Hispanic	0	36 (36)		5 (22)	31 (40)	
Asian	116 (100)	3 (3)		0	3 (4)	
Comorbidities, n (%)						
Diabetes	44 (38)	33 (33)	0.45	4 (17)	29 (38)	0.07
Hypertension	97 (83)	95 (95)	0.008	20 (87)	75 (97)	0.04
Dyslipidemia	31 (27)	40 (40)	0.04	8 (35)	32 (42)	0.56
Coronary artery disease	38 (33)	33 (33)	0.97	6 (26)	27 (35)	0.42
Cerebrovascular accident	17 (15)	10 (10)	0.30	5 (22)	5 (6)	0.03
Pulmonary disease	0 (0)	11 (11)	<0.001	3 (13)	8 (10)	0.72
HIV/AIDS	0 (0)	17 (17)	<0.001	3 (13)	14 (18)	0.56
Kidney transplant	0 (0)	7 (7)	0.004	2 (9)	5 (6)	0.71
Married, n (%)	80 (69)	34 (34)	<0.001	8 (35)	26 (34)	0.93
High school graduate, n (%)	92 (81, n=113)	91 (91)	0.04	18 (78)	73 (94)	0.02
Working, n (%)	19 (16)	11 (11)	0.25	1 (4)	10 (13)	0.45
Smoker, n (%)	12 (10)	26 (26)	0.002	9 (33)	17 (23)	0.10
Living situation, n (%)	(n=114)		<0.001			0.12
Alone	22 (19)	32 (32)		8 (23)	24 (31)	
With Family	92 (81)	59 (59)		12 (52)	47 (61)	
Nursing home	0 (0)	7 (7)		1 (4)	6 (8)	
Shelter	0 (0)	2 (2)		2 (9)	0 (0)	

	Overall			U.S. subgroup		
	Japan (n=116)	US (n=100)	P Value	non-adherent* (n=23)	adherent (n=77)	P Value
Meal preparation, n (%)		(n=96)	<0.001			0.25
Cooked by myself	43 (37)	44 (45)		10 (43)	34 (44)	
Cooked by family	53 (46)	28 (29)		5 (22)	23 (30)	
Cooked by home aid	2 (2)	10 (10)		1 (4)	9 (12)	
Served at facility	0 (0)	7 (7)		3 (13)	4 (5)	
Eat at restaurants or buy cooked foods	14 (12)	6 (6)		3 (13)	3 (4)	
Meal delivery service	4 (3)	1 (1)		1 (4)	0 (0)	
<u>Dialysis-related characteristics</u>						
Non-adherent to HD, n (%)	0 (0)	23 (23)	N/A			
HD vintage (years)	5.0 [2.0–10.0]	3.0 [1.0–6.5]	0.002	2.0 [1.0–6.0]	4.0 [1.0–4.0]	0.49
CKD length by self-report (years)	4.0 [1.0–12.0]	1.0 [0–2.0]	<0.001	1.0 [0–2.0]	1.0 [0–2.0]	0.86
Primary renal disease, n (%)			<0.001			0.25
Diabetes	41 (35)	27 (27)		3 (13)	24 (31)	
Hypertension	20 (17)	37 (37)		11 (48)	26 (34)	
Polycystic kidney disease	10 (9)	4 (4)		0 (0)	4 (5)	
HIV	0 (0)	17 (17)		4 (17)	13 (17)	
Glomerulonephritis	31 (27)	6 (6)		1 (4)	5 (6)	
Others	13 (11)	9 (9)		4 (17)	5 (6)	
Dry Weight (kg)	55.6±12.1	76.9±21.3	<0.001	81.0±22.6	75.7±20.9	0.30
% Weight Gain (%)	4.1 [3.1–5.2]	2.6 [2.0–3.1]	<0.001	3.0 [2.1–3.3]	2.6 [2.0–3.0]	0.26
Treatment length (hours)	4.00 [4.0–4.0]	3.75 [3.5–4.0]	0.001	4.0 [3.5–4.0]	3.75 [3.3–4.0]	0.03
Transplant waitlist, n (%)	10 (8.6)	46 (46)	<0.001	5 (22)	41 (53)	0.01
Number of seeing a dietitian in 3 months (self-report)	1.0 [0–2.0]	3.0 [3.0–12.0]	<0.001	3.0 [2.0–12.0]	4.0 [3.0–12.0]	0.62
Number of seeing a doctor in 3 months (self-report)	36.0 [12.0–36.0]	6.0 [3.0–12.0]	<0.001	6.0 [1.0–12.0]	6.0 [3.0–12.0]	0.55
Number of missed medication in 1 week (self-report)	0 [0–0.25]	0 [0–1.0]	0.84	0 [0–0]	0 [0–1.0]	0.05
<u>Laboratory results</u>						
Kt/v	1.43±0.27	1.40±0.19	0.32	1.37±0.19	1.41±0.19	0.30
BUN (mg/dL)	62.8±14.3	58.7±14.2	0.04	55.8±13.6	59.6±14.3	0.27
Hb (g/dL)	10.7±1.2	11.1±1.33	0.007	10.8±1.1	11.2±1.4	0.18

	Overall			U.S. subgroup		
	Japan (n=116)	US (n=100)	P Value	non-adherent* (n=23)	adherent (n=77)	P Value
TSAT (%)	25 [18–32]	31 [25–41]	<0.001	30 [26–40]	31 [24–41]	0.92
Ca (mg/dL)	8.7±0.7	8.9±0.7	0.03	8.8±0.7	9.0±0.6	0.43
Phos (P) (mg/dL)	4.9±1.1	5.5±1.3	<0.001	5.8±1.5	5.3±1.2	0.13
PTH (pg/ml)	105 [49–206]	541 [366–1064]	<0.001	513 [402–1112]	542 [363–1019]	0.49
Potassium (K) (mEq/L)	4.95±0.64	4.79±0.63	0.06	4.6 [4.4–5.1]	4.8 [4.3–5.2]	0.98
Albumin (g/dL)	3.58±0.43	4.04±0.39	<0.001	3.96±0.30	4.07±0.41	0.22

Normally distributed variables are listed as means +/- SD and non-normally distributed variables as listed as median [IQR]

CKD = chronic kidney disease, HD = hemodialysis, PTH = parathyroid hormone, TSAT = transferrin saturation

* Patients were considered non-adherent if they missed more than 3% of this dialysis sessions in a three month period.

[†] Higher scores indicate more knowledge or satisfaction.

Table 3

Dialysis-related patient knowledge and satisfaction in the U.S. and Japan

	Overall		US subgroup		P Value
	Japan (n=116)	US (n=100)	non-adherent (n=23)	adherent (n=77)	
<u>HD Knowledge</u>					
1 Know vascular access (%)	94 (81)	84 (84)	22 (95)	62 (80)	0.11
2 Know dry weight (%)	94 (81)	65 (65)	18 (78)	47 (61)	0.13
3 Know CKD cause (%)	69 (59)	61 (61)	14 (60)	47 (61)	0.99
4 Know 3 K rich foods (%)	58 (50)	51 (51)	10 (43)	41 (53)	0.41
5 Know 3 P rich foods (%)	51 (44)	35 (35)	9 (39)	26 (33)	0.64
Total score (0–5)*	3.0 [2.0–4.0]	3.0 [2.0–4.0]	3.17±1.27	2.89±1.33	0.38
<u>Satisfaction</u>					
Satisfaction score (1–10)	8.0 [7.0–10.0]	9.0 [8.0–10.0]	9.0 [7.0–10.0]	9.0 [8.0–10.0]	0.26

Table 4Associations of country with patient knowledge scores (Japan vs. U.S.)^{*}

Score	Unadjusted		Adjusted for age	
	Coefficient (β)	P value	Coefficient (β)	P value
1. Know vascular access	−0.03	0.57	0.04	0.41
2. Know dry weight	0.16	0.01	0.25	<0.001
3. Know CKD cause	−0.02	0.82	0.06	0.33
4. Know 3 K rich foods	−0.01	0.88	0.07	0.30
5. Know 3 P rich foods	0.09	0.18	0.21	<0.01
Total score	0.06	0.64	0.35	0.01

^{*} Positive coefficients indicate that Japanese patients on average had higher scores than U.S. patients.

Table 5

Association between black race and non-adherence to hemodialysis treatment in U.S. patients

	OR	95% CI
Univariate OR	3.98	1.42 – 11.20
Adjusted for age	3.82	1.35 – 10.82
Adjusted for high school education	4.71	1.55 – 14.29
Adjusted for treatment length	3.35	1.16 – 9.70
Adjusted for transplant waitlist status	4.05	1.39 – 11.80

CI= confidence interval. OR=odds ratio

Table 6

Association between total knowledge score and non-adherence to hemodialysis treatment in U.S. patients

	OR	95% CI
Univariate OR	1.18	0.82 – 1.71
Adjusted for age	1.09	0.71 – 1.03
Adjusted for ethnicity	1.17	0.80 – 1.72
Adjusted for high school education	1.27	0.85 – 1.88
Adjusted for treatment length	1.14	0.78 – 1.66
Adjusted for transplant waitlist status	1.40	0.93 – 2.11

CI= confidence interval. OR=odds ratio

Table 7

Patient satisfaction and major concerns regarding hemodialysis treatments

	Japan (n=116)	U.S. (n=100)	
		Non-adherent (n=23)	Adherent (n=77)
<u>Satisfaction Score</u> *	8.0 [7.0–10.0]	9.0 [7.0–10.0]	9.0 [8.0–10.0]
<u>Concerns</u>			
Blood pressure change	48 (41.3%)	4 (17%)	22 (29%)
Muscle cramp	23 (19.8%)	13 (57%)	30 (39%)
Bored during treatment	9 (7.8%)	3 (13%)	5 (6%)
Itchiness	13 (11.2%)	3 (13%)	1 (1%)
Back pain	20 (17.2%)	1 (4%)	1 (1%)
Fistula pain	10 (8.6%)	0	3 (4%)
Headache	7 (6.0%)	0	7 (9%)
Fistula trouble	1 (0.8%)	0	1 (1%)
None	23 (19.8%)	1 (4%)	11 (14%)
Others	HD during natural disasters; 3 (2.6%) carpal tunnel syndrome; 1 (0.8%) dizziness; 1 (0.8%) busy; 1 (0.8%) tennis elbow; 1 (0.8%) foot pain; 1 (0.8%) amyloidosis; 1 (0.8%) constipation; 1 (0.8%) hand pain; 1 (0.8%)	fear of heart attack; 1 (4%) restlessness; 1 (4%) chest pain; 1 (4%)	pain at tunneled catheter; 1 (1%) uncomfortable chair; 1 (1%) death; 1 (1%) high PTH; 1 (1%) infection; 1 (1%) nausea; 1 (1%) stress; 1 (1%) fatigue; 1 (1%) numbness; 1 (1%) CHF; 1 (1%) poor wifi; 1 (1%)

CHF=congestive heart failure, PTH=parathyroid hormone

* Higher scores indicate more satisfaction.