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Health Care Providers' Support of Patients' Autonomy, Phosphate Medication Adherence, Race and Gender in End Stage Renal Disease

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Abstract

This study was designed to assess dialysis subjects' perceived autonomy support association with phosphate binder medication adherence, race and gender. A multi-site cross-sectional study was conducted among 377 dialysis subjects. The Health Care Climate (HCC) Questionnaire assessed subjects' perception of their providers' autonomy support for phosphate binder use, and adherence was assessed by the self-reported Morisky Medication Adherence Scale (MMAS). Serum phosphorus was obtained from the medical record. Regression models were used to examine independent factors of medication adherence, serum phosphorus, and differences by race and gender. Non-white HCC scores were consistently lower compared with white subjects' scores. No differences were observed by gender. Reported phosphate binder adherence was associated with HCC score, and also with phosphorus control. No significant association was found between HCC score and serum phosphorus. Autonomy support, especially in non-white end stage renal disease subjects, may be an appropriate target for culturally informed strategies to optimize mineral bone health.

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Conflict of Interest

The authors declare that they have no conflict of interest.

Human and Animal Rights and Informed Consent

All procedures used in this study conform to the ethical standards of the institutional review board of all the three sites. The procedures followed were also in accordance with the Helsinki Declaration of 1975 (revised in 2000). Written informed consent was obtained from all the subjects prior to their participation in this study.

Keywords

autonomy support; self-determination theory; medication adherence; bone mineral disorder; dialysis; race; gender

Introduction

Phosphate retention is a common hallmark of end stage renal disease (ESRD) because subjects are unable to excrete excess phosphate in their urine. This inability to remove phosphate causes hyperphosphatemia, which leads to the syndrome of mineral and bone disorder (MBD) characterized by a wide range of pathologic manifestations including osteitis fibrosa cystica, brown tumors, bone pain and pathologic fractures (Slatopolsky, Gonzalez, & Martin, 2003). It also results in significant increases in cardiovascular and all-cause mortality risk in ESRD reflective of its role in promoting vascular calcification (Giachelli, 2009; Tentori et al., 2008). The primary management of ESRD-MBD includes dialysis, a low phosphorus diet and medications known as phosphate binders. These medications form the cornerstone of therapy and their use is associated with a survival benefit among subjects receiving dialysis (Lopes et al., 2012). However, medication non-adherence permeates this patient population with rates as high as 75% (Karamanidou et al., 2008). Known modifiable psychosocial factors have been largely implicated but still do not sufficiently explain the non-adherence burden.

The availability of different types of phosphate binders with unique side effects and tolerability has been shown to affect adherence (Arenas et al., 2010) and thus promotes the need for patient-centered care and shared-decision making that is a priority in the effective management of patients with kidney disease (Cavanaugh, 2015). This approach aligns patients' values to their choice of medications by taking into account medication side effects, diet-based therapy as well as guided meal-based dose adjustments. It requires the examination of unique psychosocial factors, such as autonomy support, to potentially explain current gaps in knowledge of the unacceptably high non-adherence to prescribed therapy in chronic disease conditions especially those requiring a high level of self-care such as diabetes (Raaijmakers et al., 2015; Williams, Freedman, & Deci, 1998).

Autonomy support specifically refers to subjects' perception that their healthcare providers support their self-care choices and actions. It has been linked to positive outcomes in tobacco cessation (Williams et al., 2006) and drug rehabilitation programs (Zeldman, Ryan, & Fiscella, 2004), and has also been shown to correlate specifically with improved medication adherence in chronic disease care including diabetes (Raaijmakers et al., 2014; Williams et al., 1998; Williams, Lynch, & Glasgow, 2007; Williams et al., 2009; Williams et al., 2005; Williams et al., 2004), hypertension (Williams et al., 1998) and HIV (Kennedy, Goggin, & Nollen, 2004). Previous researchers have effectively explained these associations using self-determination theory, a theory of human behavior, which is used to distinguish autonomous from controlled behavior.

Self-determination theory (SDT) includes three important variables: autonomy support, autonomous regulation and perceived competence (Deci & Ryan, 2012). Autonomy is the

central concept in SDT and is important for effective change. It is also emphasized in the approach used in motivational interviewing which is a patient-centered approach to increasing autonomy (Deci & Ryan, 2012; Miller & Rollnick, 2012). It has been shown that the perception of autonomy support facilitates autonomous self-regulation of medication adherence (Williams et al., 1998). Improvement in autonomy support following motivational interviewing was assessed in one small study among dialysis subjects. The observed trend toward improvement in autonomy support was associated with positive outcomes on dialysis attendance, frequency of shortened treatment, and phosphorus and albumin levels (Russell et al., 2011). That study, however, was limited by a small sample size and was not designed to evaluate the association between autonomy support, phosphate binder adherence and serum phosphorus control.

Racial and ethnic disparities in the incidence, prevalence and treatment of ESRD are well established (Norris & Agodoa, 2005). Disparities specific to outcomes in mineral bone disorder have also been demonstrated with non-Whites developing MBD earlier and with greater severity (Gutierrez et al., 2008). Racial disparities have also been observed related to medication adherence, and African American Medicare recipients reported less medication adherence than Whites even after adjusting for health literacy, depression, and social support (Gerber et al., 2010). However, critical gaps still exist in our understanding of determinants of these racial disparities, specifically for medication adherence in ESRD.

Furthermore, gender may play a significant role in influencing self-care and medication adherence. It has been shown that women with a longer duration of Type 1 diabetes have poorer perceptions of autonomy support from their providers and poorer dietary self-care (Austin et al., 2011). Effect modification by gender specific to medication use and adherence has been explored in subjects with chronic conditions (Manteuffel et al., 2014), but this was limited to pharmacy and medical claims data (i.e., billing codes that health care providers submit to payers) from adults with prescription benefits and did not examine potential mechanisms to explain the observed gender disparities.

Correlates of socioeconomic status such as health literacy (Adams et al., 2013; Curtis et al., 2012); educational level (Xu et al., 2012) and health insurance status (Penson et al., 2001) could be significant factors influencing subjects' perception of providers' autonomy support but are yet to be evaluated with respect to phosphate binder medication adherence. Dialysis modality could also be an important factor affecting subjects' perception of providers' autonomy support and it is plausible that subjects receiving peritoneal dialysis (PD) could be more autonomous since it is a self-delivered therapy. This has been demonstrated in prior research on dialysis subjects (Stack, 2002) but has not been evaluated in the context of adherence to phosphate binder therapy.

The objective of this study was to characterize ESRD subjects' perception of their providers' autonomy support related to phosphate binders and its association with self-reported medication adherence, and also phosphorus control. We hypothesized that ESRD subjects with higher autonomy support scores would have higher medication adherence scores and lower serum phosphorus levels. We also hypothesized that higher perceived autonomy

support will be associated with stronger association of medication adherence and serum phosphorus in females compared to males and in Whites compared to non-Whites.

Methods

Design, Participants, and Setting

This multi-site cross-sectional study enrolled adult dialysis subjects from eight dialysis units affiliated with either academic medical centers or a not-for-profit health care organization from 2012 to 2015. The sites included Vanderbilt University Medical Center (VUMC - Nashville, TN), Henry Ford Hospital (HFH - Detroit, MI) and CentraCare Health (Alexandria, Brainerd, Little Falls, and St. Cloud, MN). Subjects were approached in three dialysis clinics affiliated with VUMC, one clinic associated with HFH, and four clinics affiliated with CentraCare Health.

Institutional review board (IRB) approval was obtained from the respective IRB of each of the sites. Signed, informed consent was obtained from all participants, which included permission to access protected health information in their medical records. Eligibility criteria included age 18 years or older, and a current prescription for phosphate binder medications. Exclusion criteria included significant cognitive or visual impairment, no current phosphate binder medication prescription and inability to communicate in English. There were two subsets of subjects recruited from the clinics affiliated with VUMC. One of the subsets included baseline data from subjects enrolled in a concurrent interventional study. An additional exclusion criterion in this subset was a MMAS score greater than 6.

Measures

Data collection was conducted during face-to-face interviews while the subjects were undergoing their dialysis treatment or at a time not during dialysis if preferred by the subject. These surveys were completed in less than 45 minutes.

The perception of dialysis subjects' autonomy support from their healthcare providers was evaluated using a version of the Health Care Climate (HCC) scale (Williams et al., 1996) (Table 1). We used the 6-item adapted version of the HCC scale (Williams, Freedman, et al., 1998) that had a Cronbach's α of 0.93 in a recent study conducted by Shumway et al. (2015). Our adaptation of the HCC scale assesses the perception of providers' autonomy support specific to phosphate binder medications. Items were oriented to phosphate binders such as the provision of choices and options related to phosphate binder use and confidence in ability to make changes with regards to their use. It is a summated rating scale with scale responses ranging from 1 (*not at all true*) to 7 (*very true*). In this study, the total HCC score was divided by 6 to give a mean scale score that could range from 1 to 7. Cronbach's α of the HCC in our study was 0.90.

The dependent variable was self-reported phosphate binder medication adherence assessed using the Morisky Medication Adherence Scale (MMAS) (Morisky et al., 2008). This is a widely used self-reported scale for medication adherence that has been previously adapted for phosphorus control (Joson et al., 2015; Umeukeje et al., 2015). Previous studies suggested that high, medium and low adherence are described by MMAS scores of 8, 6 to 7,

and < 6 respectively. This 8-item summated rating scale demonstrated good internal consistency (Cronbach's $\alpha = 0.83$) and good concurrent and predictive validity in assessing medication adherence in subjects with chronic diseases, such as hypertension (Morisky et al., 2008).

A secondary dependent variable was the subjects' serum phosphorus level. In dialysis subjects, serum phosphorus levels are evaluated each month. The subject's most recent serum phosphorus level closest to the date of the survey was abstracted from the electronic medical record.

Demographics including age, gender, race, educational level, health literacy, and access to private health insurance were also evaluated. In this study, health literacy was evaluated with one of two measures, either the short form of the test of functional health literacy in adults (S-TOFHLA) (Baker et al., 1999) or the Brief Health Literacy Screen (BHLS) (Cavanaugh et al., 2015). The S-TOFHLA which had a Cronbach's α of 0.95 in our study is a 7-minute timed test of 36 items with a possible score range from 0 to 36. An S-TOFHLA score of 22 or lower was considered lower health literacy (i.e. $< 9^{\text{th}}$ grade level). The BHLS, with a Cronbach's α of 0.72 in our study, has been shown to be a valid 3-item assessment of subjective health literacy in subjects receiving dialysis. The BHLS scores can range from 3 to 15, with scores of 9 or lower defined as lower health literacy.

Statistical Analyses

Demographic variables were coded in categories. Dialysis type was comprised of four different groups: in-center hemodialysis; nocturnal in-center hemodialysis; peritoneal dialysis and home hemodialysis. Educational level was dichotomously coded (less than or equal to a high school education versus greater than a high school education). Subjects' health insurance status was also dichotomously coded (lack of private health insurance versus having private health insurance).

Analyses were performed using Stata 13.1 (Stata Corp, College Station, Texas). Results are presented as either means and standard deviations (SD) for continuous variables or proportions for categorical variables. A higher perception of providers' autonomy support was attributed to the maximum score of 7 on the HCC while a lower perception of providers' support for autonomy was attributed to mean item scores less than 7. This dichotomization of HCC facilitates further description of HCC and has also been done by other researchers using a different categorization scheme (Lee & Lin, 2010). A similar dichotomous categorization has been utilized in studies assessing different psychosocial factors in kidney patients (Umeukeje et al., 2015; Wright Nunes et al., 2011). Key patient characteristics were compared according to lower HCC versus higher HCC group using two-sample t tests or chi-squared tests as appropriate.

Differences by race across HCC total score and individual HCC items were analyzed using two-sample t tests and plotted graphically. Evidence of interaction by race and gender for HCC score was examined. This was performed using a regression analysis that included a model with an interaction covariate for race and gender. Linear regression analyses were performed to ascertain factors that were associated with phosphate binder adherence and

also separately serum phosphorus control. These analyses were repeated with adjustment for key potential confounders including age, gender, race, study site, dialysis modality and type of health insurance. Exploratory stratification analyses of differences in association of HCC scores and phosphorus control by race and gender were also performed.

Results

A total of 377 subjects across the different sites completed the study. There were 266 potential subjects screened at VUMC out of which 214 completed the study; 109 potential subjects were screened at HFH out of which 100 completed the study; and 149 potential subjects were screened at CentraCare Health out of which 63 completed the study. Sixty-four potential subjects across all sites declined participation while 83 persons were excluded because they were non-English speaking or had some cognitive or visual impairment. Subject recruitment details are summarized in Figure 1.

The average age of the subjects was 55 years (SD 15.3), 49% were men and 63% were non-White. Most of the subjects (79%) received hemodialysis. Lower health literacy was found in 28% of the subjects, and 47% reported having high school education or less. Twenty-seven percent of the subjects had private health insurance, and only 3% of the subjects reported having excellent or very good health. The mean (SD) MMAS score was 4.8 (2.1), and the mean (SD) serum phosphorus level was 5.5 (1.6) mg/dL. Details of key subject characteristics are provided in Table 2.

Health Care Climate Scores

The range of HCC scores in our study was 1–7, with a mean (SD) HCC score of 5.5 (1.5).. Analyses of the individual items on the HCC scale showed a range of mean (SD) scores from [5.1 (2.1) - HCC1] to [6.1 (1.5) - HCC5] (Table 1).

The maximum HCC score of 7 was reported by 24% of the subjects. There were no statistically significant differences in age amongst subjects with higher versus lower HCC scores. Subjects with higher HCC scores were less likely to be in-center hemodialysis subjects (72% vs. 82%; $p = 0.04$). There were no observed significant differences in the proportion of subjects with low health literacy or education level by HCC category. Subjects with private health insurance were more likely to be in the higher HCC score group than the lower HCC score group (40% vs. 22%; $p < 0.01$) and there were significant differences in HCC scores by site (Table 2).

Provider autonomy support scores did not differ by gender (5.5 (1.54) in males versus 5.6 (1.49) in females; $p = 0.75$); however, the mean overall HCC score differed significantly by race with a score of 5.9 (1.3) for whites versus 5.3 (1.6) for non-whites ($p = 0.001$) (Table 1; Figure 2). The observed differences in mean HCC score by race persisted in most of the individual HCC item scores (Table 1; Figure 2). Similar mean scores for the fifth HCC item asking about perceptions of the encouragement of questions by subjects to providers were observed across both race (Table 1; Figure 2) and also by gender groups (Table 1)..

HCC Scores and Medication Adherence

The mean (SD) self-reported phosphate binder medication adherence score was 4.8 (2.1), and this was positively associated with HCC score in unadjusted linear regression analysis (β [95% CI]: 0.19 [0.05–0.33]; $p = 0.008$). The mean medication adherence score for the subjects in the higher HCC score group was significantly higher than that of the subjects in the lower HCC score group [5.4(1.8) vs. 4.6(2.2); $p < 0.01$). This association was even stronger after the analysis adjusting for age, race, gender, study site, dialysis modality, and type of insurance β [95% CI]: 0.24 [0.10–0.38]; $p = 0.001$) (Table 3).

HCC scores, Medication Adherence, and Phosphorus Control

The mean (SD) serum phosphorus level for all subjects was 5.5 mg/dL (1.6 mg/dL), representing that many achieved target phosphorus levels with the upper limit often identified as 5.5 mg/dL ("K/DOQI clinical practice guidelines for bone metabolism and disease in chronic kidney disease," 2003). In a linear regression analysis, medication adherence was strongly associated with serum phosphorus level (β [95% CI]: -0.15 [-0.23 – -0.07]; $p < 0.001$) even after adjusting for age, gender, race, study site, private insurance, dialysis type and HCC score (β [95% CI]: -0.11 [-0.19 – -0.03]; $p < 0.001$) (Table 3). However, HCC score was not significantly associated with serum phosphorus level in this study sample. *A priori* exploratory analyses did not find differences in the association of HCC scores and phosphorus control stratified by race or by gender.

Discussion

In this study, dialysis subjects' perception of their providers' autonomy support for phosphate binders was found to be associated with better self-reported phosphate binder medication adherence. In turn, self-reported phosphate binder medication adherence was strongly correlated with serum phosphorus control. We also demonstrated significant differences in dialysis subjects' perception of providers' autonomy support by race but not by gender, suggesting that interventions to improve subjects' perception of providers' autonomy support may need to be culturally sensitive to be most effective.

An understanding of self-determination theory leads to the appreciation that autonomy support facilitates positive health outcomes by facilitating autonomous regulation and perceived competence (Levesque et al., 2007; Williams et al., 2002). The construct of autonomy support has been linked to improved glycemic control in diabetic subjects (Williams et al., 1998; Williams et al., 2007; Williams et al., 2009; Williams et al., 2005; Williams et al., 2004) and improved medication adherence in adult outpatients with chronic diseases such as hypertension, hyperthyroidism, menopausal symptoms, arthritis and seizure disorders (Williams et al., 1998). The perception of autonomy support from providers has, at times, been termed patient empowerment, which has been linked to improved outcomes for dialysis patients (McCarley, 2009; Schatell & Witten, 2005; Tsay & Hung, 2004). One noteworthy finding that emerged from a qualitative study of subjects receiving dialysis for an average of 21 years is that their transformation into comprehensive, active managers of their disease had been a critical element of their success in handling this chronic condition (Curtin et al., 2002). Furthermore, research has shown an association between higher patient

autonomy and improved survival and higher transplantation rates among new dialysis patients in the United States (Stack & Martin, 2005).

Determinants of higher HCC scores include race, dialysis modality and type of health insurance. The most common dialysis modalities are hemodialysis, which is most often performed in dialysis centers, and peritoneal dialysis, which is a treatment that is performed by the patient at home. Guided by our data, we suggest that subjects receiving in-center hemodialysis may feel less autonomy support from their providers compared to those receiving peritoneal dialysis. Even though we had an overrepresentation of subjects on hemodialysis in our study compared to those on peritoneal dialysis, our finding of greater perceived autonomy support among patients on peritoneal dialysis is consistent with research showing that subjects receiving peritoneal dialysis are more often autonomous (Stack, 2002). Because peritoneal dialysis is a self-delivered therapy, it is conceivable that subjects receiving PD may be more autonomous and/or more likely to have a robust support network to ensure appropriate execution of the therapy. Informed by our results, we also suggest that those subjects who have private health insurance may have a higher perception of autonomy support from their providers compared to those without private insurance. Having private health insurance could be regarded as an indirect reflection of the subjects' higher socioeconomic status or their employment status, which has been associated with higher health-related quality of life (Penson et al., 2001) and which could plausibly influence providers' expectations of independence and autonomous decision-making among subjects. However, other correlates of socioeconomic status such as health literacy (Adams et al., 2013; Curtis et al., 2012) and educational level (Xu et al., 2012) did not have any relationship with autonomy support in our study.

We suggest that Whites may feel more autonomy support from their providers compared to non-Whites, based on our study findings. Whites not only reported higher HCC scores overall compared to non-White dialysis subjects, but they also had higher HCC scores on nearly all of the individual items. This may be partly explained by the existence of higher race-discordance in dialysis provider-patient relationships among non-White dialysis subjects in this sample. It has been previously reported that subjects who are managed by providers of the same race perceive their providers' decision-making styles as more participatory (Cooper et al., 2003; Cooper-Patrick et al., 1999; Johnson et al., 2004). Perceived personal similarity has also been linked with higher rates of intention to adhere, trust and patient satisfaction (Street et al., 2008). Patient-physician communication during medical visits has been found to be different in Whites compared to non-Whites, and it has been suggested that White physicians engage in less patient-centered communication and are more verbally dominant in their interactions with non-White subjects (Johnson et al., 2004).

Surprisingly, gender was not associated with HCC scores among our sample of dialysis subjects. In contrast to the influence of race on the association between patient-provider concordance and patient outcomes, it has been reported that gender concordance between providers and patients is not consistently correlated with providers' participatory decision-making styles (Cooper-Patrick et al., 1999). Also, consistent with our study findings, other research findings have shown that the motivational framework of self-determination theory

is specifically invariant across gender (Gillison, Standage, & Skevington, 2006; Standage, Duda, & Ntoumanis, 2005)

The strong association between dialysis subjects' perception of providers' autonomy support and phosphate binder medication adherence is consistent with data from other studies that show a strong association between autonomy support and medication adherence in subjects with chronic conditions other than kidney disease (Williams et al., 2007; Williams et al., 2009; Williams et al., 1998; Williams et al., 2006). This is an important finding among dialysis subjects, and it supports the notion that a collaborative care model centered on understanding dialysis subjects' perceptions may lead to improvements in medication adherence (Zullig, Peterson, & Bosworth, 2013). However, to our knowledge, our study is the first to specifically evaluate the direct association between autonomy support and phosphate binder adherence in dialysis subjects.

Guided by our study findings, we highlight the importance of behavioral interventions such as motivational interviewing, which is designed to empower dialysis subjects to self-manage their care (McCarley, 2009; Protheroe et al., 2008). A small study conducted among dialysis subjects was done using a pretest-posttest design to examine the influence of a motivational interviewing intervention on improvement in autonomy support and non-adherence measures including missed and shortened dialysis treatments, interdialytic weight gain, and serum phosphorus and albumin levels (Russell et al., 2011). Results from that study showed a trend toward improvement in autonomy support following the motivational interviewing intervention and improvement in all the non-adherence measures examined, with the exception of interdialytic weight gain. Based on our findings, and in conjunction with the Russell et al. study, we suggest that motivational interviewing targeting perceptions of provider autonomy support may be an important pathway to optimize phosphate binder medication adherence.

In the current study we did not observe an association between HCC scores and serum phosphorus level. There are several potential explanations for this finding. First, serum phosphorus level is highly variable among subjects with kidney disease (Kestenbaum et al., 2005; Wang et al., 2013). A longitudinal study with several assessments over time may minimize the effect of this variation, and inform the achievement of phosphorus control as well as factors related to sustained control over time, similar to studies of diabetes control. Secondly, serum phosphorus control in dialysis subjects involves additional actions including adherence to the dialysis prescription and a diet low in phosphorus. Our study did not include an assessment of diet or dialysis attendance adherence on serum phosphorus control. Each of these factors may also be influenced by a subject's overall perception of their providers' autonomy support and introduce potential residual confounding related to associations with serum phosphorus.

The cross-sectional nature of our study design further limits our ability to evaluate causality. In addition, the use of a self-report measure of phosphate binder adherence is a possible limitation because it increases the chances of recall and information bias. However, the possibility of recall bias is low because phosphate binders are taken several times daily with minimal adjustment in the prescription itself. Furthermore, the Morisky Medication

Adherence Scale has demonstrated excellent reliability and validity (Morisky et al., 2008). We acknowledge the fact that we included a subset of subjects with lower MMAS score which could potentially impact our data analysis, however, even when we excluded those subjects from our analyses, our main findings remained unchanged. We also acknowledge that we had a small proportion of subjects on peritoneal dialysis in our study, which limits our ability to make meaningful comparison between subjects on peritoneal dialysis versus those on hemodialysis. However, we included dialysis modality in our adjusted analysis to account for any possible residual confounding by dialysis modality. Lastly, our study sample is derived from several dialysis clinics affiliated with three different sites and is comprised of subjects with comparable age to other prevalent ESRD subjects in the US, but because our sample had a lower proportion of males and a greater proportion of non-Whites compared to other ESRD patients in the US population (National Institutes of Health, 2015), our results may not necessarily be generalizable to patients seen in other practice settings.

Use of the adapted HCC scale in the clinical setting is practical and can guide patient self-management. It may also stimulate improved patient-centered communication by simply “using the right words” (Epstein, 2013). It may have the greatest utility among non-White dialysis subjects who are known to have an increased prevalence and severity of bone mineral disorder (Gutierrez et al., 2008; Kalantar-Zadeh et al., 2010), less adherence to medications than Whites even after adjusting for significant confounders (Charles et al., 2003; Gerber et al., 2010; Shenolikar et al., 2006), and less perceived autonomy support. Efforts to improve phosphate binder adherence would likely be positively enhanced by greater competence on the part of physicians and other members of the health care team in patient-centered, culturally sensitive communications with subjects, especially those diverse racial and ethnic backgrounds (Powe, 2008).

Based on our findings in this novel study, we highlight the correlation between autonomy support and phosphate binder medication adherence, as well as the correlation between medication adherence and phosphorus control in dialysis subjects. Furthermore, we demonstrate that non-White dialysis subjects perceive less autonomy support from their providers than Whites. In our efforts to improve the low rate of adherence to phosphate binders in dialysis subjects, these findings set the stage for the design of successful behavioral interventions, such as motivational interviewing, to improve autonomy support, phosphate binder adherence and overall self-care especially among vulnerable non-White dialysis subjects.

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Figure 1.
Study flow diagram.

Figure 2.
HCC items and overall score by race.

Table 1

Health Care Climate (HCC) Scale Items

Item #	Statement	Male Mean (SD)	Female Mean (SD)	White Mean (SD)	Non-white Mean (SD)	Overall Mean (SD)
HCC1	I feel that my dialysis health care providers have given me choices and options about taking my phosphate binders.	5.2 (2.1)	5.0 (2.2)	5.7 (1.6)	4.8 (2.3)	5.1 (2.1)
HCC2	I feel my dialysis health care providers understand how I see things with respect to taking my phosphate binders.	5.3 (2.0)	5.4 (1.9)	5.8 (1.6)	5.1 (2.0)	5.3 (1.9)
HCC3	My dialysis health care providers show confidence in my ability to make changes regarding my phosphate binder use.	5.6 (1.7)	5.8 (1.7)	5.9 (1.5)	5.7 (1.8)	5.7 (1.7)
HCC4	My dialysis health care providers listen to how I would like to do things regarding my phosphate binder use.	5.4 (1.8)	5.6 (1.8)	5.8 (1.6)	5.3 (1.9)	5.5 (1.8)
HCC5	My dialysis health care providers encourage me to ask questions about my phosphate binder use.	6.1 (1.5)	6.1 (1.4)	6.1 (1.3)	6.1 (1.5)	6.1 (1.5)
HCC6	My dialysis health care providers try to understand how I see things about my phosphate binder use before suggesting any changes.	5.5 (1.9)	5.4 (1.9)	5.8 (1.7)	5.2 (2.0)	5.5 (1.9)
Total HCC		5.5 (1.5)	5.6 (1.5)	5.9 (1.3)	5.3 (1.6)	5.5 (1.5)

Table 2

Patient Characteristics for Total Sample and by Health Care Climate Scale Score Categories

Variables	All subjects	Lower HCC score N=287 (76%)	Higher HCC score N=89 (24%)	p-value
Demographics				
Age (mean, SD)	55 (15.3)	55 (15.5)	56 (14.9)	0.55
% Male	49 (n = 183)	49 (n = 141)	47 (n = 42)	0.75
% Non-white	63 (n = 238)	67 (n = 191)	53 (n = 47)	0.02
% In-center hemodialysis	79 (n = 296)	82 (n = 232)	72 (n = 64)	0.04
% Low health literacy	22 (n = 82)	24 (n = 68)	16 (n = 14)	0.11
% High school education or less	47 (n = 178)	50 (n = 132)	52 (n = 46)	0.35
% Private health insurance	27 (n = 100)	22 (n = 64)	40 (n = 36)	0.001
% Subject enrollment per site				<0.001
• Vanderbilt University Medical Center	57 (n = 214)	53 (n = 151)	71 (n = 63)	
• Henry Ford Hospital	26 (n = 99)	33 (n = 96)	3 (n = 3)	
• CentraCare Health (MN)	17 (n = 63)	14 (n = 40)	26 (n = 23)	
Outcomes				
Medication adherence (mean, SD) (range = 0 to 8)	4.8 (2.1)	4.6 (2.2)	5.4 (1.8)	0.002
Serum phosphorus (mean, SD)	5.5 (1.6)	5.4 (1.6)	5.7 (1.7)	0.19

Note: HCC = Health Care Climate Scale; MN=Minnesota

Table 3

Adjusted Regression Coefficients for Medication Adherence and Phosphorus Control

Variable	Medication adherence (N = 372)		Phosphorus control (N = 370)	
	β (95% CI)	p-value	β (95% CI)	p-value
HCC score	0.24 (0.10 – 0.38)	0.001	0.08 (–0.04–0.19)	0.18
Age	0.03 (0.02 – 0.05)	<0.001	–0.03 (–0.04–0.02)	<0.001
Race (Ref: white)	0.04 (–0.41 – 0.50)	0.85	–0.64 (–0.99–0.27)	0.001
Site	0.09 (–0.20 – 0.38)	0.60	–0.12 (–0.34–0.11)	0.32
Gender (Ref: female)	–0.28 (–0.70 – 0.13)	0.18	–0.03 (–0.35–0.29)	0.87
Private insurance	–0.18 (–0.66 – 0.30)	0.46	0.26 (–0.11–0.63)	0.17
Dialysis modality (Ref: Peritoneal dialysis)	0.16 (–0.47 – 0.80)	0.61	0.08 (–0.41–0.57)	0.32
Medication adherence score			–0.11 (–0.19–0.03)	0.007

Note: HCC = Health Care Climate Scale.