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Time-in-a-Bottle (TIAB): A Longitudinal, Correlational Study of Patterns, Potential Predictors, and Outcomes of Immunosuppressive Medication Adherence in Adult Kidney Transplant Recipients

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Owens	✓	✓		✓	✓
Coffey	✓	✓		✓	✓
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Abstract

This study examined patterns, potential predictors, and outcomes of immunosuppressive medication adherence in a convenience sample of 121 kidney transplant recipients aged 21 years or older from three kidney transplant centers using a theory-based, descriptive, correlational, longitudinal design. Electronic monitoring was conducted for 12 months using the Medication Event Monitoring System. Participants were persistent in taking their immunosuppressive medications, but execution, which includes both taking and timing, was poor. Older age was the only demographic variable associated with medication adherence ($r = 0.25$; $p = 0.005$). Of the potential predictors examined, only medication self-efficacy was associated with medication non-adherence, explaining about 9% of the variance ($r = 0.31$, $p = 0.0006$). The few poor outcomes that occurred were not significantly associated with medication non-adherence, although the small number of poor outcomes may have limited our ability to detect a link. Future research should test fully powered, theory-based, experimental interventions that include a medication self-efficacy component.

Keywords

adherence; transplant; kidney; outcomes; patient compliance

Introduction

Kidney transplantation remains the best option for adults with stage five chronic kidney disease resulting in improved quality of life, and reduced morbidity and mortality (1).

Immunosuppressive medication regimen adherence is critical for survival of the transplanted kidney (2). However, medication adherence remains a complex and elusive challenge in transplantation even with intensive pre- and post-transplant immunosuppressive medication adherence teaching and preparation (3).

In 2003, the World Health Organization determined that adherence is “the extent to which a person’s behavior (taking medications, following a recommended diet and/or executing life-style changes) corresponds with the agreed recommendations of a health care provider” (4). Non-adherence in transplantation was defined by a consensus of transplant experts as “deviation from the prescribed medication regimen sufficient to influence adversely the regimen’s intended effect” (5). Adherence to medications is complex and includes initiation (taking first medication dose), execution (extent to which actual dosing and timing corresponds to the prescribed dosing regimen), and discontinuation (stopping the medication) (6–8).

Adherence to medications in transplantation continues to fall below expectations. Dew and colleagues conducted a meta-analysis of immunosuppressive medication adherence in transplant recipients and noted those with a kidney transplant had the highest rates of poor medication adherence at 35.6 cases per 100 patient days, followed by heart at 14.5, and liver at 6.7 (9). Medication adherence rates provide little detail regarding this complex problem. Consequently, when both dosing and timing of adherence to medications are examined in kidney transplant recipients, information regarding execution becomes clearer. Adherence to medications follows a bell-shaped curve with those very adherent to dosing and timing at one end of the curve and those very non-adherent to these parameters at the other end (10). Most individuals with a kidney transplant fall somewhere in the middle with adherence to morning doses higher than evening doses.

When studied, potential predictors of adherence to immunosuppressive medications in adults with a kidney transplant have been varied. Dew and colleagues identified several weak predictors in a meta-analysis. Non-white ethnicity, poorer social support, and poorer perceived health had small effect sizes of 0.06, 0.10, and 0.15, respectively. Effect size is a statistical value that measures the strength of the relationship between 2 variables and allows comparison of across studies (11). In addition, the insufficient range of empirically examined predictor variables in the reviewed studies of adults kidney transplant recipients prevented robust meta-analysis (9).

Bandura’s Social Cognitive Theory posits that health is determined by interacting factors: personal (cognitive and affective), environmental, and behavioral which are linked to outcomes (12). This study focused on personal and behavioral factors from the theory. Self-efficacy pertains to a feeling of control that one has over the environment and behavior. Bandura notes that depression and social support are two key pathways that impact self-efficacy and consequently health behavior. The theory further suggests depression negatively influences the individual’s ability to control life stressors. Additionally, an inability to develop and maintain social support contributes to depression and lowers self-efficacy. Though outcome expectancy, or the anticipated positive outcomes of the behavior, is a component of Social Cognitive Theory, we did not include this in the model since Bandura (13) and other studies generally find that self-efficacy is a stronger predictor of behavior than outcome expectancy (14). In addition, meta-analysis has shown that providing education to patients to increase their knowledge of consequences (outcome expectancy) is a necessary but insufficient intervention for changing behavior (15).

Medication non-adherence has been previously shown to increase poor outcomes in transplantation. Among adult kidney transplant recipients, rejection, loss of the transplanted

kidney, and death are the major outcomes of non-adherence to immunosuppressive medications (16–18). Even minor deviations in adherence may lead to poor outcomes, though the dose-response of non-adherence and poor outcomes remains unclear (17, 19). Furthermore, persistent poor adherence to medications led to a \$12,840 increase in individual 3-year medical costs (20).

Patients and Methods

In light of the persistent low rates of transplant medication adherence particularly among kidney recipients and the need to expand the current body of empirical literature, the purpose of this study was to further examine the patterns, potential predictors, and outcomes of immunosuppressive medication adherence in adults with a kidney transplant. A descriptive, correlational, longitudinal design was used to conduct the study. A convenience sample of 201 adult kidney transplant recipients was recruited from three centers providing post-transplant care located in the Mid-Western and Mid-Southern United States. To examine adherence across the post-transplant trajectory, individuals varying lengths of time after transplant were included..

The sample size was based on a power analysis, which indicated 201 participants were needed for a margin of error of 5%, with 95% confidence, a true value of the proportion of medication non-adherence of $p = 0.2$, and a 25% attrition rate. Individuals meeting the following criteria were included in the sample: 1) 21 years of age or older, 2) prescribed an immunosuppressive medication taken in pill form every 12 hours, 3) ability to speak, hear, and understand English, 4) able to open a Medication Event Monitoring System cap (MEMS; MEMS Track Cap™; Aprex Corp., Union City, CA), 5) no cognitive impairment as determined by a score of 24 or above on the Mini Mental State Exam (MMSE), and 6) no other diagnoses that may shorten life span. The sample was selected to afford a broad representation from the adult kidney transplant population to enhance generalizability of the results.

Baseline measures of depression, immunosuppressive medication self-efficacy, and social support were obtained. These instruments have been described in detail in our prior work (21, 22). In brief, depressive symptoms were measured using the Beck Depression Inventory (BDI) (23). This 21 item self-administered scale assesses mood, pessimism, sense of failure, lack of satisfaction, guilty feeling, sense of punishment, self-hate, self-accusation, self-punitive wishes, crying spells, irritability, social withdrawal, indecisiveness, body image, work inhibition, sleep disturbance, fatigability, loss of appetite, weight loss, somatic preoccupation, and loss of libido. Each item is scored from 0 to 3 and then a total score is calculated. Level of depression is identified based upon the score falling into one of six categories from normal to extreme depression. The range for the entire test score is 0 to 63. Scores are usually categorized into no (0–9), mild (10–18), moderate (19–29), and severe (30–63) depressive symptoms. The BDI has high internal consistency with ranges from 0.73 to 0.92 with a mean of 0.86 and a split-half reliability co-efficient of 0.93 (23).

Medication self-efficacy was measured using the Long-Term Medication Behavior Self-Efficacy Scale (LTMBSES) (24). This 27-item self-administered scale measures an individual's confidence in taking immunosuppressive medications. The instrument assesses side effects, physical discomfort, emotional distress, distraction, and being observed. Each item is ranked on a scale from 0, meaning very little confidence, to 5 meaning quite a lot of confidence with a scale score range from 0 to 135. The LTMBSES has been used with renal, heart, and liver transplant recipients, individuals with human immunodeficiency virus, and those with hyperlipidemia. Internal consistency reliability has been report to be 0.94 (25). Generalized Estimating Equations showed the total average self-efficacy score predicted

total medication adherence ($p < 0.0001$, (26). Construct validity was determined by an area under the Receiver Operating Characteristic (ROC) curve of 0.67 indicating a significant ($p < 0.0001$) but limited predictive ability.

Social support was measured using the Social Support Appraisals Index (SSAI) (27). This is a 23-item self-administered instrument that measures the degree to which a person feels cared for, respected, and involved with family and friends. Items are scored from 1 (strongly agree) to 4 (strongly disagree). Total scores range from 23 to 92. After reversing the negatively stated items, low scores indicate high levels of support (28). The instrument has been used with adult kidney transplant recipients in three studies (22, 29, 30). Data from 10 samples indicated that the scale had good internal reliability with alpha scores ranging from 0.80 to 0.90 (27). The scale also showed stability over a 6-week interval with reliability scores of .80 (27). Convergent validity has been demonstrated with significant associations to seven other appraisal measures (31). Adequate concurrent and divergent validity with other perceived support measures were demonstrated and showed predicted associations with measures of theoretically related antecedents (support network resources) and consequences (psychological well-being). These associations were typically at least as strong as those found for other published measures of support appraisals and were consistent across samples (31).

Electronic monitoring was conducted for 12 months using the Medication Event Monitoring System (MEMS) 6 Trackcap. A 12-month period was selected because it allowed adequate time to capture patterns of behavior. Medication adherence was measured using the MEMS 6 Trackcap. This measure of medication adherence is superior in capturing both the timing and dosing history of medication adherence (32). The medication bottle cap contains microelectronics that record the date and time of each cap removal. The MEMS has a battery life of 36 months. A cumulative record of cap openings, beginning the day after the participant was instructed on use of the cap, was compiled for each subject. The MEMS cap was placed on one of the immunosuppressive medications prescribed to the participant consistent with our prior work which found adherence with one immunosuppressive medication is highly correlated with the second immunosuppressive medication (33). After retrieving the cap from the participant it was connected to a microcomputer communications port which downloaded cap data to a personal computer for decoding by the MEMS software. Since cap openings occasionally occur without drug ingestion, e.g. early removal of drug to take at a later time or demonstrating the MEMS cap to someone, the MEMS diary was also used. Participants documented the date, time, and circumstances when the MEMS cap was opened and a medication was not administered. The MEMS cap data were corrected using the MEMS diary data to increase data validity. For example, the participant may have noted in the MEMS diary that the MEMS cap was opened early to remove a medication to be taken later and on-time. The MEMS data were then corrected to eliminate the MEMS cap opening since no medication was ingested. After any necessary corrections were made, each cap removal was presumed to represent the patient ingesting one dose of the prescribed immunosuppressant.

Additional outcome data on creatinine, infection, acute and chronic rejection, graft loss, and death were collected at 12 and 24 months from medical records.

Institutional Review Board approval was obtained. Potential participants were recruited from 2005 to 2010 and enrolled in the transplant clinic by a trained research assistant (RA). After obtaining informed consent and screening for inclusion and exclusion criteria, participants completed the BDI, LTMBSES, and SSAI and received training by the RA on use of the MEMS cap and MEMS diary in the transplant clinic. A small marker was provided to participants who used pillboxes to assist them in remembering to remove a pill

from the bottle with the MEMS cap. To confirm use of the MEMS cap, participants were contacted by telephone each week by the RA during the first two weeks of using the MEMS and quarterly thereafter. The participants were asked if they had any questions or concerns about using the MEMS or the MEMS diary. Any questions or concerns were addressed by the RA at that time. Participants received a small monetary gift at the end of the study. After 12 months of using the MEMS, the participant returned the MEMS cap and diary in person or through the mail to the RA.

Data Analysis

Data were downloaded from the MEMS caps using the MEMS software and corrected using the MEMS diary by the Principal Investigator. The first 30 days of medication adherence data were deleted to decrease the likelihood that the weekly telephone calls during the first month would influence medication adherence and because prior research has shown an increase in medication adherence during the first month of MEMS use (34). To enhance data accuracy, an Excel spreadsheet was used to record the double entered data and discrepancies were corrected. A biostatistician conducted the analysis using SAS (v9.1, SAS Institute Inc., Cary, NC, USA).

Medication adherence rate calculation techniques are described in detail elsewhere (22). In brief, each morning and evening an individual received a 0.5 score if the dose of the immunosuppressive medication was taken within a 3-hour window; 0.25 if the dose of the immunosuppressive medication was not within the 3-hour window but was taken within a 12-hour window (early or late), and 0 if the dose of the immunosuppressive medication was not taken within a 12-hour window. An individual could be assigned a score of 0, 0.25, 0.50, 0.75 or 1 point each day. The participant's medication adherence score was the average score over all days that in this study, involved 11 months of MEMS use, or about 330 days.

Descriptive statistics were used to characterize the sample. Spearman's rank correlation was used due to the skewness in the data. Wilcoxon Rank Sum test was used to compare groups with and without poor outcomes. Alpha level was set at 0.05. An alpha level of 0.01 was used when multiple comparisons were made instead of the more conservative Bonferroni correction.

Findings

Figure 1 delineates study recruitment. Those who did not complete the study were significantly younger than those who did (45.54 vs. 51.12 years; $p = 0.006$) and more likely to have never married ($p = 0.005$). There were no other significant differences when examining years since transplant ($p = 0.75$), number of medications prescribed ($p = 0.60$), score on the MME ($p = 0.25$), BDI ($p = 0.20$), LTMBSES ($p = 0.55$) or SSAI ($p = 0.81$). Table 1 delineates the characteristics of the final sample. The mean age of the sample was 51.12 years ($SD = 12.35$; range 22–75). The most prevalent etiology of renal failure was hypertension (27%; 32/117) and half had no previous transplants (56%; 66/118). The time since transplant was 4.7 years ($SD = 5.56$; range 0.14–20.07).

Medication Adherence Scores and Patterns

Table 2 details the distribution of medication adherence scores of the sample. When medication adherence scores were examined, 74 of 121, or 61% had a medication adherence score lower than 0.90 and 41% lower than 0.80. Since the data were slightly skewed toward higher medication adherence scores, the median medication adherence score was more representative of the sample than the mean. The median score of 0.87 closely corresponds to the subjects taking one of the two, twice-daily prescribed immunosuppressive medications

on time and the second one late or early over the 11-month period. There was 100% persistence on this behavior in the participants completing the study.

With respect to patterns of medication adherence, we first examined distinctions among scores and found four common types of patterns as illustrated by reports of representative participants (Figure 2). The graphs show the daily medication adherence score on the vertical axis and the study day on the horizontal axis. The first participant (graph in upper left hand corner) is highly adherent with a medication adherence score of 0.99 represented by a nearly straight line across the months indicated by a score of “1” ($0.50 + 0.50 = 1$; on-time for morning dose and evening dose) most days for medication taking. The second participant (graph in upper right hand corner) is somewhat adherent, but less so than the first, with a medication adherence score of 0.70 (approximately $0.50 + 0.25 = 0.75$; either morning or evening on time with either morning or evening late or early). The third and fourth participants (graph in the lower left hand corner and lower right hand corners, respectively) are even less adherent, with medication adherence scores of 0.50 and 0.30, respectively.

Also with respect to patterns, we studied the associations between age, gender, ethnicity, marital status, employment, education, and days since transplantation (defined here as the time from transplant to the date of beginning MEMS use). We observed that older age was associated with medication adherence ($r = 0.25$; $p = 0.005$). No association was found between medication adherence scores and gender [$n=120$, $2(1) = 0.87$, $p = 0.35$], ethnicity [$n=121$, $2(2) = 7.08$, $p = 0.07$], marital status [$n=119$, $2(4) = 8.20$, $p = 0.15$], employment [$N=119$, $2(4) = 7.33$, $p=0.20$], education [$n=117$, $2(4) = 6.24$, $p = 0.18$] or days since transplantation, defined as the time since transplant to the date of beginning MEMS use ($r = -0.17$; $p = 0.067$).

Potential Predictors of Medication Adherence

When the potential predictors, long term medication self-efficacy, social support, and depression were examined, significant correlation was found between medication adherence and self-efficacy ($r = 0.31$, $p = 0.0006$) with self-efficacy explaining about 9% of the variance in medication adherence. However, medication adherence was not found to be associated with depression ($r = 0.05$, $p = 0.61$) or social support ($r = 0.03$, $p = 0.77$). The group mean self-efficacy score was high (130 on a scale of 27–135; range 81–135) while depression was low (2.50 on a scale of 0–63; range 0–17) and social support was low moderate (38 on a scale of 23–92; range 23–67).

Outcomes of Medication Adherence

At year one, there were no significant correlations between medication adherence scores and creatinine level ($r = -0.19$, $p = 0.05$), number of infections ($r = -0.04$, $p = 0.71$), acute rejections, ($r = 0.04$, $p = 0.67$), chronic rejections ($r = -0.05$, $p = 0.59$), kidney loss ($r = -0.03$, $p = 0.76$), or death ($r = -0.05$, $p = 0.59$). We had similar findings at year two, with no outcomes associated with medication adherence scores (see Table 3). In addition, no difference was found between the medication adherence scores of individuals with poor outcomes (infections, acute and chronic rejection, kidney loss, death) when compared to those without poor outcomes (Wilcoxon Rank Sum test, $z = -0.28$; $p=0.78$).

Discussion

This theory-based, descriptive, correlational, longitudinal study which examined patterns, potential predictors, and outcomes of medication adherence in a convenience sample of adult kidney transplant recipients was designed to address several key criticisms of prior

medication adherence research. Fine and colleagues in a 2009 “Non-adherence Consensus Conference Summary Report” recommended that studies examine the pharmacotherapy of persistence, or engagement in the prescribed therapy, and execution quality, or medication dosing and timing. Our study, which measured both elements, found acceptable persistence, but poor execution quality, with an alarming 61% of the participants below the medication adherence score of 0.90 over the 11 month monitoring period and 41% below 0.80. This is consistent with our prior studies which considered both taking and timing (9, 10, 21, 22). If a 0.80 medication adherence cut off is used, our findings are similar to the 36 cases per 100 patient days immunosuppressive medication non-adherence rate in kidney transplant recipients that Dew and colleagues found in a meta-analysis. However, our purpose is not to dichotomize medication adherence but instead to shed light on the patterns of immunosuppressive medication taking over time in adult kidney transplant recipients so that interventions can be crafted and tested.

The finding that increasing older adult age was correlated with medication adherence has not been consistently supported by prior evidence. Adolescent age is strongly correlated with medication non-adherence but this age group was not included in our study due to the uniqueness of this younger population (35). Prior evidence has documented that both older and younger adult kidney transplant recipients have poor medication adherence (21, 22). Dharancy and colleagues found that adult kidney transplant recipients between the ages of 46 and 65 years of age at time of transplant were more adherent than those adults transplanted at earlier ages (36). Dew’s meta-analysis did not support age as a predictor of medication adherence in adult transplant patients (9). Thus, the evidence indicates age is inconsistently correlated with medication adherence (9).

Using Bandura’s Social Cognitive theory as a guide, we found that long-term medication self-efficacy, or confidence in long-term medication taking, was a significant predictor of medication adherence. Consequently, our findings support Bandura’s model. Self-efficacy is a consistent predictor of medication adherence in both adult transplant and other chronically ill populations (2, 21, 37, 38) and thus, is a likely target for interventional studies designed to improve medication adherence. Targeting key elements for promoting self-efficacy such as mastery experiences, verbal persuasion, role modeling, and decreasing psychological arousal hold promise for improving medication adherence in kidney transplant patients (13).

Social support has been an inconsistent predictor of transplant medication non-adherence in primary research (2, 22, 39) but has been shown to have weak predictive ability in meta-analyses (poorer social support $r = 0.10$) (40). Our findings did not support the theoretical linkage of social support and medication adherence behavior. From our clinical experiences, we know that having adequate social support in place is a critical factor for joining the kidney transplant waiting list. Transplant programs routinely screen candidates for social support and exclude those with inadequate social support (41). Consequently, the high levels of social support documented in this study and others, leaves little room for variation in this predictor.

Depression has also been an inconsistent predictor of transplant medication non-adherence in primary studies (21, 42–44), but a meta-analysis in the general population has supported depression as a predictor of medication non-adherence (45). The targeted behavior was not influenced by depression as proposed in Bandura’s Social Cognitive Theory. The low levels of depression found in this sample may reflect the ability of these transplant programs in assessing and treating depression in people after transplant.

When outcomes were examined, this group of participants had very few poor outcomes when compared to national statistics. For example, in this sample, for the recipients who had

an average number of years of 4.7 since transplant, we would expect about 18 kidney failures but instead, only five occurred during the first year of the study and only three during the second year (1). Consequently, the correlation between medication non-adherence and poor outcomes cannot be adequately assessed.

This study makes an important contribution to the transplant literature in that both immunosuppressive medication adherence persistence and execution were evaluated in adult kidney transplant patients as recommended in a transplant medication adherence consensus conference summary (5). Immunosuppressive medication persistence appears to be strong in this sample, while medication dosing and timing, i.e., execution, remains problematic. With 61% of the participants have both taking and timing problems (medication adherence score less than 0.90), we must use appropriate and valid medication adherence assessment tools in clinical practice. These tools should include both taking and timing assessment (46, 47) If medication nonadherence is identified, sharing medication taking and timing pattern reports with patients presents a unique opportunity to guide behavioral interventions to improve medication adherence. Providing medication taking, dosing, and timing feedback during a home or clinic visit may offer an objective and effective starting point to begin productive and objective, problem-solving conversations between patient and provider (48). In a meta-analysis, electronic monitoring feedback as an intervention was effective in improving medication adherence in 77.8% (12 of 18) of the examined studies (49). Medication adherence pattern information has the potential to contribute to implementation of behavior-changing interventions at the level of the individual's environment, unlike prior studies which focus on rates of medication taking, dosing, and holidays which fail to provide the detail needed to formulate specific interventions (16, 50).

Although clinically desirable, and sometimes necessary, social support and depression treatment as a focus for immunosuppressive medication adherence interventions may not prove broadly fruitful. Instead, strengthening and maintaining long-term medication self-efficacy as a medication adherence intervention shows promise. De Geest and colleagues piloted a self-efficacy intervention in a small group of adult kidney transplant recipients (51). Though underpowered to detect a statistically significant difference, there was a greater improvement in medication adherence in the group that received the educational-behavioral intervention which included a self-efficacy approach including reviewing electronic monitoring medication taking reports for problem detection, proxy goal setting, and targeted feedback. Additionally, focusing on linking medication taking and refill ordering with regularly occurring routines that occur in a person's daily system of living has also shown promise as in intervention to improve immunosuppressive medication adherence (48). Finally, a meta-analysis of medication intervention components suggests that medication packaging, dose-modification, one-page succinct written instructions, stimuli to take medications every time, and self-monitoring with side effect management are effective interventions for improving medication adherence (15). Ineffective components include disease and drug education, tailored interventions, a professional medication review, and any general type of written instructions (52).

Additional study contributions and strengths include a study sample from three transplant centers that is comparable to the adult United States kidney transplant population which is 39.2% female (our sample was 37%), 26% Black (our sample was 30%), and 23.5% with hypertension as disease etiology (our sample was 27%), and 88% with no previous transplant (our sample was slightly lower at 56%). Consequently, this sample is representative of gender, Black race, and those with hypertension as the disease etiology of kidney failure in the United States kidney transplant population (1).

Use of electronic monitoring, which is a valid and reliable measure of medication taking, is also a notable methodological component and strength of this study. Electronic monitoring is superior to other direct (observation, serum blood levels) and indirect (self-report, collateral report, pharmacy refill records, pill counts) measures of medication taking due to its ability to document the dynamic nature of medication dosing and timing (53).

Furthermore, this is one of the few studies that monitored medication adherence for an nearly a year. It is possible that monitoring for this length of time provides a superior representation of actual medication taking than the typical measured time periods of 3 months or 6 months found in most research studies.

This study also has several limitations. We had an over-representation of Caucasians of 68% (United States kidney transplant population is 52.2%) which could limit generalizability to this group. We recognize that there is a group of individuals who choose not to participate in our study either through declining to participate or dropping out of the study. Consequently, we do not have information about their medication adherence. Those who did not join the study were younger than those who completed the study which could have biased the findings toward older adults. However, those who did participate have patterns of non-adherence that do invite interventions for improvement. Additionally, this study was underpowered for measuring outcomes but not under powered for measuring potential predictors.

Conclusion

We urgently need effective medication adherence interventions and this study provides further guidance for developing such approaches. Future research should further test theory-based, fully-powered, experimental interventions that include an immunosuppressive medication adherence self-efficacy enhancing component. Transplant programs should continue to screen for and treat depression in transplant candidates and recipients. Additionally, social support should be evaluated pre-transplant and nurtured after transplant. Additional components should include one page succinct written medication adherence instructions, dose modification, a stimulus to take medications every time, special packaging, self-monitoring (e.g. blood pressure, weight, urine output), side effect management with electronic monitoring feedback to provide data for patients to track their medication taking progress. We can reduce costs (e.g. emergency room visits, hospitalizations, and return to dialysis) and make additional kidneys available for transplant through decreasing kidney loss and resulting re-transplantation by improving interventions to decrease transplant complications due to medication non-adherence.

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Figure 1.
Study Recruitment

Figure 2.
Medication Adherence Score (Dosing and Timing) Patterns

Table 1

Demographic Characteristics of the Sample *

Demographic Factor	Demographic Detail	N	Percent
Sex	Male	76	63
	Female	44	37
Education Level	High School/Some High School	52	44
	Some College/ College Graduate	66	56
Ethnicity	Caucasian	81	68
	African American	36	30
	Other	3	2
Marital Status	Married	76	64
	Divorced	16	13
	Never Married/Widowed/Separated	27	23
Employment Status	Disabled	55	46
	Full Time	28	24
	Part Time	13	11
	Unemployed/Retired/Student/Homemaker	23	19
Type of Transplant	Deceased Donor	97	80
	Living Related/Un-related Donor	24	20

Note:

* Sample with useable MEMS data; totals do not always equal 121 due to missing data.

Table 2

Medication Adherence Scores (N=121)

Medication adherence score	N	Percent
1.0-.90	47	38.84
.89-.80	24	19.83
.79-.70	21	17.36
.69-.60	15	12.40
.59-.50	9	7.44
.49-.40	2	1.65
.39-.30	3	2.48
< .30	0	0

Table 3

Outcomes of the Sample (N=121)

Outcomes	Year 1	Year 2
Infection (Number and range)	25 (0–5)	24 (0–3)
1 infection	13	21
2 infections	3	0
3 infections	0	1
4 infections	1	0
Acute Rejection (Number and range)	3 (0–2)	3 (0–1)
1 acute rejection	1	3
2 acute rejections	2	0
Chronic Rejection (Number and range)	6 (0–2)	3 (0–1)
1 chronic rejection	5	3
2 chronic rejections	1	0
Kidney Loss (Number)	5	3
Death	1	0