EFFECTS OF SELF-MONITORING AND MONETARY REWARD ON FLUID ADHERENCE AMONG ADULT HEMODIALYSIS PATIENTS

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The effects of a monetary reward and self-monitoring on reducing interdialytic weight gain (IWG) were compared for 6 hemodialysis patients in an outpatient setting. A single-subject experimental design (A-B-BC-B-BC) was used to examine each variable individually and in combination, with alternating phases to control for possible sequencing effects. Monetary reward (50 cents - $3) was administered in a titrated manner according to standardized criteria, ranging from 3 % and 4% of patients' dry weight on weekdays and weekends, respectively, to 3.5% and 4.5% for weekdays and weekends. Self-monitoring involved recording daily fluid and diet intake.

Results indicated that by the end of the treatment program, the 6 participants averaged a 14% reduction in weekday IWG and a 15.45% reduction in weekend IWG; however, due to significant variability, it cannot be concluded that the reductions are treatment effects. Four out of 6 participants reduced their average IWG for both weekends and weekdays by .75 kg (1.65 lb.). The average weekend reduction for these 4 participants was .85 kg (1.87 lbs.) while the average weekday reduction was .65 kg (1.43 lb.). All 6 participants showed reductions in weekday IWG that averaged .53 kg (1.17 lb.). However, only 2 participants demonstrated IWG reductions that could be attributable to either of the 2 treatment variables. The standardized dry weight criterion for assessing fluid adherence may have posed excessively stringent demands on participants, as only 1

of the 6 participants actually met the criterion. Future research should address the role of nonspecific treatment factors, as well as patient characteristics and responsivity to particular treatment components in an effort to identify those factors responsible for behavior change in this population.

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Over 300,000 people in the United States suffer from end-stage renal disease, a condition that is most often caused by diabetes, hypertension, and glomerulonephritis (ESRD; U. S. Renal Data System 1997 annual data). An ESRD diagnosis is made when an individual loses approximately 85 % to 90% of kidney function. Due to the failure of the kidneys to remove wastes and toxins from the blood, over 60% of these ESRD patients must depend upon hemodialysis (HD) for their survival. Treatment for ESRD is demanding and involves HD sessions three times per week, typically 4 hours per session. Although kidney transplants may prolong the lives of these patients, over 50,000 people died from ESRD in 1995 (U. S. Renal Data System 1997 annual data report).

In addition to thrice weekly dialysis sessions, HD patients must restrict the amount of fluids consumed on a daily basis. Due to the kidneys' failure to regulate the levels of phosphorus and potassium in the body, patients must also avoid foods high in potassium and take phosphorus-binding medications. Therefore, a patient’s treatment effectiveness is greatly dependent upon his or her self-management skills. Research has shown that from 60% to 80% of patients died as a direct consequence of excessive fluid intake and eating foods that were against the prescribed treatment regimen (Abram, Moore, & Westervelt, 1971; Kaplan De-Nour, & Czaczkes, 1972). This is consistent with evidence from research examining adherence to medications, where it has been estimated that in 2/3 of the 750 million prescriptions written each year there will be partial or complete nonadherence, and 33% of patients do not take medication in the prescribed manner. In addition, 70% of all patients drop out of psychotherapy after the 3rd session, and approximately 40% of hypertensive patients fail to practice relaxation exercises as prescribed (Meichenbaum & Turk, 1987). Furthermore, it has been found that long-term dietary adherence (2-5 years) can be predicted from as early as the first 20 sessions of HD (Agashua, Lyle, Livesley, Slade, Winney, & Irwin, 1981). However, not everyone is convinced of the adherence – health outcome relationship. There is contradictory evidence regarding the ability to differentiate adherers without medical complications and nonadherers with medical complications on the basis of adherence measures (Manley & Sweeney, 1986). At any rate, Turk and Meichenbaum (1991) warn researchers that strict adherence to a medical regimen may not result in predictable long-term effects.

Probably the most difficult aspect of HD patients' treatment regimen is fluid restriction because of the stress caused by the extensive behavior change required (Hoover, 1989; Rosenbaum & Ben-Ari, 1986). As a result of kidney failure many patients produce no urine; therefore, any fluids consumed are retained within the body. Short-term effects of fluid overload include nausea, dizziness, muscle cramping, shortness of breath, and exacerbated hypertension; long-term effects are congestive heart failure, pulmonary edema, accelerated disease processes, and death (Kaplan De-Nour, 1981; Tracey, Green, & McCleary, 1987).

It is no surprise, then, that the most pervasive problem with the treatment regimen is fluid nonadherence (Streltzer & Hassell, 1988). Past studies report fluid nonadherence rates of 30% to 60%, depending on the criterion used (Christensen, Benotsch, & Smith, 1997). A large, multi-treatment center study reported that 49.5% of the patients were nonadherent to fluid restrictions (Bame, Petersen, & Wray, 1993). Comparisons between U.S. HD patients and those from Sweden and Japan show that Americans have significantly lower survival rates, and that treatment nonadherence, such as missing HD sessions, is at least partially responsible for this difference (Bleyer, Hylander, Sudo, Nomoto, de la Torre, Chen, & Burkart, 1999). The authors suggested that differences in patient autonomy may be a reason for such gross nonadherence, with greater autonomy in the U.S. to make decisions regarding one's treatment, which may inadvertently prevent physicians from directly influencing decision making.

The problem of nonadherence in the medical population is frequently addressed in the research literature, yet findings are often convoluted, contradictory, and based on patient self-report (Dunbar-Jacobs, J., 1993; Meichenbaum & Turk, 1987). From the standpoint of frustrated physicians who treat HD patients: "When the care providers are convinced that the reasons for noncompliance are not ignorance or misinformation, the responsibility for adherence is on the patient" (Hoover, 1989, p. 957). From the patients' point of view, treatment adherence is a kind of double-edged sword, in that it is quite time-consuming and often only briefly delays death or serves as temporary symptom relief. Therefore, to patients, the costs of adhering to treatment may outweigh the perceived benefits (Turk & Meichenbaum, 1991). It has been suggested that patients decide to change to more adherent health behaviors based upon their perception of how the symptoms impact on their daily activities (Turk & Rudy, 1991). Interestingly, hemodialysis patients who are not candidates for kidney transplants have demonstrated greater adherence to treatment regimens (McGee, Rushe, Sheil, & Keogh, 1998).

It also has been suggested that HD patients are ideal for studying nonadherence, as the treatment is long-term and because patients typically remain at the same center with the same physician, making contact readily available (Hoover, 1989). One difficulty with research in this area is the dilemma of how to assess adherence. Meichenbaum and Turk (1987) addressed the consequences of this problem and the need for establishing a "gold standard" for adherence assessment:

> The absence of reliable, valid, clinically sensitive indices of adherence is an important problem because it can compromise clinical trials, lead to ordering of unnecessary diagnostic tests or use of alternative medications, inhibit the identification of reliable determinants, and consequently, hinder attempts to establish appropriate treatment regimens. (p. 30)

In the domain of HD treatment, researchers examining fluid adherence have employed interdialysis weight gain (IWG) as the measure of fluid intake between dialysis sessions. In attempts to rely upon measures that are least affected by factors other than the adherence behaviors of interest, biological markers (such as IWG) have been selected because they are easily calculated and reliable (Manley & Sweeney, 1986). There is evidence that the mean IWG increases during the summer months, as would be expected (Manley & Sweeney, 1986). Even so, much evidence has been established demonstrating that IWG is highly reliable, is indicative of drinking behaviors since the last HD session, and is relatively unaffected by extraneous factors (Christensen, Smith, Turner, Holman, Gregory, & Rich, 1992; Moran, Christensen & Lawton, 1997). It has also been found that IWG is not influenced by HD treatment adequacy during sessions (Kobrin, Kimmel, Simmens, & Reiss, 1991). IWG has repeatedly been shown to be unrelated to other measures of HD adherence, namely serum potassium and serum phosphorus levels which are measures of diet and medication adherence, respectively. This further validates the assertion that IWG is correlated with drinking behavior alone. Therefore, for HD patients, the most important aspect of the treatment regimen is explicit and easily measured by objective means – if the patient drinks fluid, weight is gained (Kaplan De-Nour & Czackes, 1972).

A number of psychological variables have been examined for their possible relationship with fluid nonadherence. These include demographics (Bame et al., 1993; Hartman & Becker, 1978; Meichenbaum & Turk, 1987; Morduchowicz, Sulkes, Aizic, Gabbay, Winkler, & Boner, 1993; Procci, 1978; Wolcott, Maida, Diamond, & Nissenson, 1986); social support (Christensen, Smith, Turner, Holman, Gregory, & Rich, 1992; Cummings, Becker, Kirscht, & Levin, 1982; Hartman & Becker, 1978; Reiss, Gonzales, & Kramer, 1986); internal locus of control (Blackburn, 1977; Bollin & Hart, 1982; Oldenburg, MacDonald, & Perkins, 1988; Moran et al. 1997; Poll & Kaplan De-Nour, 1980; Schneider, Friend et al., 1991; Wiebe & Christensen 1996); health beliefs (Cummings et al. 1982); personality (Wiebe & Christensen, 1997); self-efficacy (Brady, Tucker, Alfino, Tarrant, & Finlayson, 1997; Friend, Hatchett, Schneider, & Wadhwa, 1997; Rosenbaum & Ben-Ari Smira;1986); stress (Christensen, Benotsch, Wiebe, & Lawton, 1995; Everett, Brantley, Sletten, Jones, & McKnight, 1995); depression (Everett et al., 1995; Friend et al., 1997;) and body consciousness (Christensen, Wiebe, Edwards, Michels, & Lawton,1996). However, after more than 25 years of research in this area it is evident that no consensus exists. Several literature reviews have examined the relationship between various psychological factors and/or models and fluid adherence in HD patients (Hoover, 1989; Levenson & Glocheski, 1992; Sensky, 1993; Stewart, 1983).

Although much research has been conducted on psychological predictors of fluid nonadherence, there is little research on interventions to treat the problem. This is surprising considering the significance of restricted fluid intake to the survival of hemodialysis patients, as well as the magnitude of nonadherence to this restriction. Interventions to address the problem of fluid nonadherence have generally been behavioral. Since the first study in this area in 1976, there have been only 11 systematic investigations addressing interventions for fluid nonadherence in adult HD patients. These include a study that focused on fluid nonadherence in children, as well as three unpublished dissertations. There is clearly a need for further research in this area of health psychology. The following is a critical review of the research thus far.

Barnes (1976) was the first investigator to examine the effect of an intervention on fluid nonadherence in an adult HD patient. A token economy was implemented for an inpatient with severe chronic fluid overloading. The patient was able to earn points for consuming less than a prescribed limit, and extra points could be earned for less than a 1 kilogram (kg) (2.2 lb.) daily weight gain. He was allowed to exchange the points for special food and was also verbally praised by staff members for regimen adherence. Weight gain decreased to an average of 1.3 kg per day, and the patient voluntarily remained on the token economy for 6 weeks. However, no data regarding baseline IWG or specific weight gains were provided.

Hart (1979) also used token economy to treat 10 chronic fluid overloaders, and his study is the only empirical investigation to date that considered patients' dry weights when measuring fluid nonadherence. Coupons, exchanged for special food, were contingent upon meeting one of two weight gain goals: 5 coupons were given for IWG within 2% of one's dry weight, while 2 coupons were given for IWG within 5% of one's dry weight. Employing percent change statistics and mean group weight, Hart showed that the weight gains went from 167 - 168 lb. (76 kg) at baseline, to 161 - 163 lb (73 kg) post-treatment - a 3% to 3.6% reduction from baseline. No follow-up data were provided.

Magrab and Papadopoulou (1977) found that when the IWG of children, ages 11 to 18 years, were posted on charts and points were given for prizes or money, a 45% reduction in average weight gain was observed. IWG baseline average was 1 kg, and during treatment the average dropped to 0.44 kg. It is noteworthy that the investigators determined prior to the study an IWG limit of 2 lb., or 0.9 kg, which was essentially the same as the baseline average. Therefore, these participants were minimally nonadherent. There was no follow-up.

Skoutakis, Acchiardo, Martinez, Lorisch, and Wood (1978) examined the effects of pharmacist involvement on regimen adherence, including IWG. Following baseline measures, 24 HD patients met with a pharmacist two to three times per week for 4 months for information that included educational materials, consultation regarding their health, disease state, life expectancy, and written reminders for taking medications. Patients demonstrated improvements in areas that included adherence and for half of the patients randomly chosen to continue the intervention for an additional 4 months, adherence measures continued to improve. For those who did not continue the program and received only standard HD treatment, adherence returned to baseline levels. It is important to note, however, that the adherence "measures" were actually rankings of all the biochemical data into categories ranging from "excellent" to "poor." Excellent adherence was considered to be weight gains equal to or less than 0.5 kg between dialysis sessions and poor adherence described weight gains of 2.0 kg or more between sessions. This ranking system is clearly too stringent and generally inconsistent with recent studies, where typically it is considered that between-session weight gains ranging from 2.0 kg to 3.0 kg are indicative of desirable adherence.

Behavioral contracts have been somewhat effective in improving adherence to fluid regimens. Cummings, Becker, Kirscht, and Levin (1981) utilized a pretest-posttest control group design to demonstrate that patients who signed a 6-week behavioral contract, that included a family member or friend's involvement in activities, had lower mean IWG than when the contract excluded outside support. Comparison of the former intervention's effects with baseline IWG shows a 16% reduction in mean IWG, with results generally maintained at 3-month follow-up. Weekly phone calls that attempted to alter patients' health beliefs had little effect. It should be noted that the behavioral contracting intervention was actually in addition to positive consequences (state lottery tickets contingent on meeting previously agreed upon goals). Therefore, it is unclear as to which component(s) actually contributed to the observed effect. Furthermore, baseline average weight gains were based upon data from only six dialysis sessions, hardly enough to establish a stable sampling of nonadherent behavior.

Keane, Prue, and Collins (1981) employed a combination of behavioral techniques, including behavioral contracting, to demonstrate effectiveness in decreasing IWG. For the first case study, the authors implemented a contract that scheduled morning sessions (preferred by the patient) contingent upon meeting criterion 10 out of 12 consecutive sessions. This patient's baseline mean IWG was 2.15 kg over 9 weeks, and the criteria were IWG of 1.5 kg for Wednesdays and Fridays, and 2.5 kg for Mondays. The patient was an overweight (76 kg) female. Over the course of 25 sessions, staff praised the patient and engaged in increased social interactions when she met criteria, and she was taught to graph her IWG. Following implementation of the contract, her mean IWG was 1.42 kg, or a 34% reduction from baseline. IWG increased with design reversal, and again decreased to 1.45 kg when the contract was reinstated.

The second patient in the study was a male who weighed less than patient 1 (63 kg, as compared to 76 kg), but his baseline mean IWG was more severe (3.6 kg). The authors set his criteria at 3 kg on Wednesdays and Fridays, and 3.5 kg on Mondays. The implementation of a special meal contingency, staff praise and socialization with goal attainment resulted in a mean IWG of 2.7 kg, and 2.4 kg when the intervention was reinstated after reversal, or 25-33% reductions in IWG from baseline. It is unclear as to which component actually contributed to the decrease in IWG - behavioral contracting or social reinforcement or both.

Finn (1985), in an unpublished dissertation, employed a multiple baseline across participants design to examine the effects of feedback, praise, and a contracted reinforcement with 6 participants. Compared to feedback alone or in combination with praise, only 1 of the 4 participants who completed the study attained the criterion of IWG in the condition that combined all three interventions. It may be concluded that the contracted reinforcer was the variable that contributed most to the observed effects. There were no follow-up data.

Two other dissertations in the 1980's attempted to demonstrate the effectiveness of various interventions on IWG in HD patients. While details of the studies were unavailable, abstracts indicated that alternative treatments for nonadherence, such as guided imagery, were equivocally effective. While Morrissey (1985) used a pre-post experimental/control group design and found no effect of audiotapes on ability to maintain "compliance," Higgins (1985) found that a higher ability level with guided imagery was associated with a decrease in weight. Details about the research design were unavailable.

Hegel, Ayllon, Thiel, and Oulton (1992) conducted a sophisticated study to compare behavioral and cognitive approaches. Study 1 compared a traditional Health Belief Model intervention (THBM) to a behavioral intervention combined with an abbreviated version of the Health Belief Model (CHBM) that was contingent upon failure to meet contracted criteria. The THGM intervention included gathering information regarding barriers to adherence, problem solving to overcome these barriers, provision of information about negative health consequences and the benefits of good adherence, and the correction of misconceptions. This was contrasted with a behavioral intervention comprised of incentives for 24-hour weight gains of less than 2 lb., or approximately 1kg. These incentives were ranked according to preference with the top three incentives differentially provided according to three levels of criterion stringency, the most preferred incentive being given for attainment of the most stringent goal. As part of the behavioral intervention, a brief session of an abbreviated Health Belief Model (CHBM) was implemented contingent upon failure to meet the contracted minimum 24-hour IWG, and its purpose was to clarify misconceptions and provide further information.

The mean 24-hour IWG for the 4 patients during standard dialysis treatment was 1.68 kg (or approximately 3.36 kg between sessions). Although, implementation of THBM resulted in a large decrease in 24-hour IWG, results were short lived and weight gain quickly increased within one to six sessions. However, the combined reinforcement and CHBM intervention resulted in 24-hour mean IWG of 0.75 kg (1.5 kg between sessions). In order to examine maintenance of effects, at the end of this study patients were taught to monitor their own 24-hour IWG and to graph their results. During this maintenance period if a patient did not meet criterion, he was given a cueing checklist requiring him to indicate if several recommendations for limiting fluid intake were followed. Results were maintained at 2-month follow-up.

The authors then compared, in a second study, the reinforcement and CHBM components of their study 1 to examine if one or both were responsible for the observed effects. Three patients were either reinforced for meeting 24 IWG criteria or they received the contingent Health Belief Model for failure to meet criteria. In an A-B-AC-BC multiple baseline design across participants, the authors found that reinforcement alone produced a 44% decline from standard treatment, from a mean of 2.48 kg to 1.39 kg. A return to standard dialysis treatment, but with CHBM added, resulted in a deterioration trend; however, the rate of relapse was slower than with the THBM of the previous study. When reinforcement and CHBM were combined in a final phase, results showed consistent improvement, with an average 24-hour IWG of 0.99 kg. Results were maintained below criterion at 2-month follow-up.

Hegel et al. (1992) suggested that the results of their second study might have been due to sequence effects, namely that presenting reinforcement first resulted in its being more effective. In a third study, an AC-B-BC design showed that the CHBM intervention resulted in immediate 24-hour IWG decreases, with a quick deteriorating trend but a slower relapse rate. Introduction of reinforcement alone was followed by a marked drop and an improving trend. Again, when the combined intervention was introduced, the improvement trend continued. The authors suggested that the reinforcement component alone was the most effective component of the treatment program, and administration sequence had no effect on results. They also concluded that the CHBM's value may be in retarding the rate of relapse. As was posed by the authors, there remains the issue of which component of the behavioral intervention was responsible for the effects – the behavioral contract or incentive. Furthermore, as was suggested by the authors, the 2-month follow-up was probably too brief.

Mosley et al. (1993) employed contingent social reinforcement to treat fluid nonadherence in an obese female of borderline intelligence. Her 4-week baseline mean IWG was 4 kg and the IWG criterion was set at 3 kg, based upon the mean IWG for the dialysis facility where she was treated. During the first intervention the patient was shown a 20-min videotape three times for 1 week. It was also shown to all patients at the center to control for potential attention effects. Following the education intervention, social reinforcement contingent upon criterion attainment was provided for 4 weeks in the form of public posting of data graphs and staff praise. During the 4-week baseline period, the patient met the IWG criterion only 8% of the time as compared to 33% of the time following the education program, and 67% of the time during the social reinforcement phase. It was noted that she met the criterion 100% of the time during the last week of the program (social reinforcement). Results were maintained at 3- and 6-month follow-up.

Mosley et al. (1993) concluded that social reinforcement alone was most effective for decreasing IWG with this patient, without combining this intervention with behavioral contracting or token economies. However, as was suggested by Hegel et al. (1992) in their study, it is possible that the efficacy of contingent social reinforcement was influenced by the education phase presented before it. In other words, there was a possible sequence effect that was unaddressed. Although Hegel et al. (1992) found that the order of treatment presentation, namely reinforcement first, did not influence the Health Belief Model’s effectiveness, it is possible that education presented prior to social reinforcement could enhance the latter’s effectiveness. There is some evidence that education is associated with increased treatment adherence (Skoutakis et al., 1978).

While most of these interventions yielded positive results, there are criticisms of the research. Methodological problems include inadequate or no baseline data (Barnes, 1976; Cummings et al., 1981). Some investigators examined HD patients whose baseline data were within normal limits or employed IWG cut-offs that were the same as baseline data (Magrab & Papadopoulou, 1977). Other researchers categorized participants into broad categories based on composite measures of adherence and assigned labels ranging from “poor” adherence to “excellent” adherence. There is evidence that individual measures of adherence are unrelated, which casts doubt on the validity of composite measures of adherence (Sensky, Leger, & Gilmour, 1996).

Another criticism of the research is that conclusions are rather tenuous because of the arbitrary IWG cut-offs used to indicate adherence. IWG criteria varied by study and ranged from 0.5 kg to 3 kg. At least one study did not specify IWG cut-offs (Cummings et al., 1981). Hart (1979) was the only investigator to consider individual body size and weight gain tolerance. Furthermore, while absolute IWG has been found to be a reliable measure of drinking behavior (Manley & Sweeney, 1986), it may not be appropriate to use the same criterion for all participants within a study. This is because a 2-kg (approximately 4.5 lb.) weight gain for an 80-kg individual is not as significant as that for a 60-kg individual. In other words, larger patients may tolerate larger weight gain and do so without negative consequence. Therefore, Sensky (1993) suggested that rather than using arbitrary cut-off points between “low” and “high” weight gains, a fraction of ideal weight should be used.

Manley and Sweeney (1986) have also argued that cut-offs have been set impressionistically and, as a result, estimates of nonadherence have likely been artificially inflated. Few published studies have attempted to correct IWG criteria for this effect, as suggested by Manley and Sweeney (1986) and Wolcott et al. (1986). Furthermore, these cut-offs were constructed on the basis of <u>presumed</u> appropriate levels, without reference to data on the actual range and distribution, which likely results in inflated rates of nonadherence (Manley & Sweeney 1986). This might occur because there is no IWG standard set by a well-recognized authority, such as the Health Care Financing Administration (HCFA; Bame et al., 1993). Also, the opinions of physicians and nurses regarding the ideal IWG have differed even within the same treatment center (Agashua, Lyle, Livesley, Slade, Winney, & Irwine, 1981). Although various weight gain limits have been used as criteria in many studies, there is a paucity of empirical evidence demonstrating that these particular values (0.5 kg – 3 kg) result in demonstrable health complications (Manley & Sweeney, 1986).

A limitation of stringent IWG cut-offs is that a patient's body size biases the amount of fluid intake tolerated (Bame et al., 1993). Therefore, in addition to the stress of attending 4-hour HD sessions three times per week and restricting one's diet, medical staff may be imposing additional and unnecessary stress on patients by holding them to these unrealistic IWG limits (Manley & Sweeney, 1986).

A potential solution to this problem is to use an adherence measure that takes into account the individual patient's weight and what he or she can physically tolerate. Dry weight is a figure based on the body weight at which a patient begins to develop symptomatic hypotension after fluid removal or weight without any “extra” fluid on the body (Manley & Sweeney, 1986). It has been suggested that a ratio of the IWG and the patient's optimal dry weight be used instead of absolute IWG as to account for a patient’s body size (Bame et al., 1993), although support for this measure is not unanimous (Manley & Sweeney, 1986). However, dry weight ratios have been found to be highly correlated with absolute IWG, r=.80 (n=34) and, when the ratio was compared to staff ratings of patient adherence, correlations remained high, r=0.66 (n=34).

Researchers have suggested IWG of less than 3% of a patient's dry weight as a measure that would simplify, as well as standardize, the approach to fluid adherence assessment (Wolcott et al., 1986). This criterion relates IWG to individual dry body weight so that it controls for variations in body size, and is also moderate in its goal. Such a realistic goal keeps the HD patient within the boundaries of physical tolerance and health, and it is also achievable. In 1986, Wolcott et al. argued that future research should address the need for the most reliable and valid methods of adherence measurements and effective interventions based on individual factors. Research should focus upon developing individually tailored treatments that employ IWG criteria controlling for body size, and that are more likely to result in long-term effectiveness. Another advantage is improved accuracy of prevalence statistics and standardization of fluid adherence measures.

Mosley et al. (1993) observe that while evidence supports behavioral interventions for reducing IWG, these interventions typically have been treatment packages involving several components (i.e., behavioral contracting, social reinforcement, rewards, etc.) Although there have been recent attempts to disentangle treatment components most responsible for behavior change (Hegel et al., 1992; Mosley et al., 1993), Finn and Alcorn (1986) suggest that much more research still is needed to examine the efficacy of individual treatment components. Furthermore, addressing the relative merits of components requires consideration of possible sequencing effects when adding interventions. Hegel et al. (1992) were the first and, to date, the last investigators to examine that particular confound in this area of adherence research.

<u>Present Study</u>

This research has been reviewed and approved by the University of North Texas Committee for the Protection of Human Subjects. Before formal research began, and in order to examine relevant clinical issues, baseline data and 17 weeks of pilot data were gathered on a 57-year-old male who has been on dialysis for 2 ½ years. Sequential interventions implemented were: a) self-monitoring of fluid intake and diet; b) monetary rewards for taking data on a daily basis; c) monetary rewards for decreasing high sodium foods, and d) monetary rewards for meeting Monday weight gain goals. Based upon the data, these interventions collectively had an effect on the patient's adherence behavior and IWG in terms of the fluid intake amounts and decreased dietary sodium intake.

The present study investigated the sequential and additive effects of two components of a behavioral treatment package, specifically self-monitoring and monetary reward, with the goal of reducing IWG. In addition to examining the relative merit of treatment components in decreasing IWG, the present study implemented a new, standardized IWG criterion that is individualized for dry weight. The new standard, as suggested by Wolcott et al. (1986), used 3% of a patient's dry weight as the cut-off criterion for fluid adherence. However, the authors provided no details as to acceptable allowances over longer interdialysis periods (e.g., weekends). Therefore, the criterion during weekly sessions, or when there were only 2 days between HD sessions, was 3% of dry weight and the weekend weight gain criterion, or when there were 3 days between

HD sessions, was 4% of dry weight. Cut-offs based upon percentage of dry weight are more lenient for individuals with larger body weights but are slightly more stringent for smaller individuals, as compared to criteria used in other studies (2-kg weekday limit and 3-kg weekend limit).

Method

Participants

Approximately 45 potential participants at two Dallas-area HD outpatient centers, whose HD schedules coincided with that of the investigator's, were approached to volunteer for the study. Permission to view medical charts was sought from those who had been on HD for at least 6 months and to identify participants whose adherence had not improved during at least the previous 6 months. Sixteen volunteers met this criterion, and of this subgroup nine volunteers were identified as chronic fluid overloaders, operationally defined as having weight gains greater than 3% of their dry weight for weekday HD sessions and greater than 4% of their dry weight over the weekends. Three participants dropped out of the study, leaving a total of 6 participants, 4 men and 2 women. All were either on a kidney transplant list or were in the process of applying for a transplant. Their average age was 43 years and their average length of time on dialysis was 41 months. The study included 4 Caucasians, 1 Hispanic, and 1 African-American.

Dependent Measure

Interdialytic weight gain (IWG), determined by subtracting the post-dialysis weight (kg) for the previous session from the pre-dialysis weight for the current session, was the dependent measure. IWG is considered a fairly direct indication of fluid consumption since the last HD session and has been demonstrated to be a reliable measure of fluid adherence. IWG is relatively unaffected by extraneous factors such as acute medical illness (Christensen, Smith et al., 1992). Studies have shown correlations among IWG measures from 2 to 12 months to range from .57 to .78, which demonstrates the stability of IWG as a dependent variable (Lamping, Campbell, & Churchill, 1988; Rosenbaum & Ben-Ari Smira, 1986; Schneider, Friend, Whitaker, & Wadhwa, 1991).

Independent Variables

Self-monitoring. Self-monitoring alone has been shown to result in behavior change (Nelson, 1977). However, when used for the treatment of nonadherence, self-monitoring has received equivocal support with diseases such as hypertension, diabetes, obesity, smoking, anorexia, and epilepsy (Cinciripini, Kornblith, Turner, & Hersen, 1983; Epstein, 1981; Gibbered, Dunne, Handley, & Hazelman, 1970; Mullen, Simons-Morton, Ramirez, Frankowski, Green, & Mains, 1997; Nessman, Carnahan, & Nugent, 1980). Recent evidence has supported its use for maintaining long-term treatment effects (Hegel et al., 1992). In the present study, the self-monitoring component consisted of participants' collecting data daily on fluids consumed and diet intake. Personal preference determined whether data were recorded by making slashes onto pre-printed sheets supplied by the investigator, or handwritten entries (see Appendix).

Monetary rewards. Monetary rewards were scheduled for delivery in a titrated manner according to three graduated levels of IWG criteria. The most money ($3) was earned for meeting the 3% and 4% of dry weight criteria for sessions with 2 days and 3 days in between, respectively. Less money ($1.50) was earned for weight gains of 3.3%

and 4.3% of dry weight, and the least amount of money (50 cents) was earned for weight gains of 3.5% and 4.5% of dry weight. The three reward levels were used in an attempt to ensure that any improvement would be rewarded to some extent. All participants were given a schedule that described their specific cut-offs and rewards. Monetary rewards were distributed for each dialysis session (three per week); therefore, it was possible for a participant to receive a total of $9 per week if the most stringent criteria were consistently met.

Experimental Design

The design was a single subject experimental design (Hersen & Barlow, 1976). To test the efficacy of the independent variables individually and in combination, the participants were presented with an A-B-BC-B-BC design. However, because it is possible that the order in which the two independent variables were presented individually would affect the results (i.e. sequence effect), an A-C-BC-C-BC was used for half of the participants. Thus, half of the participants were asked to begin the study with self-monitoring first and the other half began the study with the monetary reward.

Procedures

Following a 6 - 9-week baseline period (depending upon the stability of the participants' baselines) during which IWG data from participants' medical charts were gathered, the clinician/investigator began meeting with each participant twice per week for approximately 50 min per session. During the first three behavior therapy sessions, the focus was on establishing rapport, gathering personal and medical histories, as well as acquiring baseline information on each patient's fluid intake, diet, and salt intake. In the third therapy session, all patients were asked to monitor their fluid and diet intake for 1 week to identify potentially problematic situations and specific drinks/foods on which to focus treatment. During this week, IWG data were collected but there were no meetings with the clinician/investigator. All participants then were shown a graph of their baseline data during the fourth therapy session, 1 week later. This session began the first 4-week treatment phase, consisting of two therapy sessions per week, in which half of the participants continued monitoring and the other half received a monetary reward for meeting criteria. It was also during the fourth therapy session that each participant was informed of the specific IWG treatment goals (based upon 3% and 4% of their dry weight for weekdays and weekends). They were given a page describing the effects of chronic fluid overload. During each therapy session throughout the study, for all 6 participants, strategies for controlling fluid intake were discussed and given as “homework” assignments. Examples of strategies included: gradually decreasing the frequency of drinks consumed on a daily basis; decreasing consumption of high-sodium foods; drinking from smaller cups; chewing gum or eating hard candy when thirsty; sucking on a lemon slice; not refilling drinking glasses; and taking medications with meals. Problem-solving strategies were discussed, situations in which participants were more likely to drink were identified, and attempts were made to rearrange the environmental contingencies. For all participants, verbal praise was given for accomplishing homework assignments, meeting goals, progress, etc., and they were shown graphs of their progress at the beginning of each phase. During monitoring phases, data regarding fluid and diet intake were discussed; any foods that contributed to an increase in IWG (high sodium, soup, etc.) were a focus of change.

During the second 4-week phase of the study, a second intervention was added to the first; i.e., participants both monitored their daily intake and received a monetary reward for meeting criteria. During the third 4-week phase the second interventions were discontinued; that is, participants were asked to either discontinue the monitoring that had been added or they were informed that the monetary reward added in the previous phase would no longer be provided. In the final 4-week phase, both interventions again were implemented together. At the final meeting, participants were shown graphs of their individual data and debriefed as to the details of the study.

Results

Treatment results are presented in three ways. First, overall results are summarized. Then commonalities across participants are reported, first for weekend data and then for weekday data. Finally, the effects of treatments on IWG of individual participants are analyzed for weekends and weekdays.

Baseline IWG

All IWG baseline data were gathered from the patients' medical records. Due to differences in the number of days between weekday and weekend HD sessions, the IWG data were separated into weekend data and weekday data, and the dry weight criteria were applied (3% between weekday sessions and 4% over the weekend). The average baseline IWG over the weekends was 5.5 kg, and the average baseline IWG between weekday sessions was 3.9 kg. Severity of nonadherence was most readily apparent in the data for the male participants (who typically weigh more), whose average baseline IWG over the weekends was 6.6 kg, and average baseline IWG during the week was 4.45 kg.

Overall Treatment Results

By the end of the treatment program, all 6 participants showed a reduction in average weekday IWG from baseline to final treatment phase (see Table 1). The IWG reductions averaged .53 kg (1.17 lb.) and individuals ranged from an average reduction of .1 kg (.22 lbs.) to 1.1 kg (2.42 lbs.). Four out of the 6 participants also reduced their average IWG for weekends. The average weekend IWG reduction for these 4 participants was .85 kg (1.87 lb.) and ranged from .5 kg (1.1 lb.) to 1.4 kg (3.1 lb.). Of the remaining 2 participants, 1 remained approximately the same from baseline to the final treatment phase for both weekend and weekday, and the other participant's results were mixed, with a gradual increase in weekend IWG (3.4 kg or 7.5 lb.). The overall reduction in IWG from baseline to final treatment phase for these 4 participants averaged .75 kg (1.65 lb.). However, despite these observed differences, significant variability in the data make it impossible to establish relationships between variables and true effects of the treatment variables.

Two variables, monitoring and monetary reward, were manipulated and compared for treatment effects, both individually and in combination. Each half of the participants were presented with one of the two variables first. Data for two of the participants showed effects of a manipulated variable for weekends, weekdays, or both. Participant 1's average weekend IWG reduction of .5 kg (1.1 lb.) (see Table 1), which was 7.6% lower than baseline, and average weekday IWG reduction of .8 kg (1.76 lb.), 17.4%

lower than baseline, were clearly related to the monitoring of daily fluid and diet intake. Participant 5's average weekend IWG reduction of .7 kg (1.54 lb.) (see Table 1), which was 21.2% lower than baseline, was related clearly to the combined treatment package of monetary reward and monitoring. However, although this participant's weekday IWG was reduced by 1.1 kg (2.42 lb.), which was 35.5% lower than baseline by the end of treatment, this reduction was not consistently related to a particular treatment variable.

Although participants 3, 4, and 6 ended the treatment program with IWG averages lower than baseline levels, these results did not relate to any specific treatment variable (see Table 2). Participant 2's average weekday IWG reduction of .5 kg (1.1 lb.) by the end of the program, which was 12% lower than baseline, also was not accounted for by any particular treatment variable, and neither was the observed increase in weekend IWG (see Table 1). A similar observed increase in participant 6's average, weekend IWG was also not related to any of the treatment variables (see Table 1). The 1-week, rapport-building phase was not consistently related to reductions in weekend IWG, and the average IWG of several participants increased during this period. However, weekday IWG reductions ranged from .2 kg - .8 kg for 4 out of 6 participants, so nonspecific treatment variables, such as attention, may have accounted for obtained reductions in weekday IWG for some participants and obtained increases in others.

Comparisons Across Participants

Weekends. During the initial rapport-establishing and history-gathering introductory sessions, 5 out of 6 participants showed increases in their weekend IWG averages over their baseline averages. These 5 participants averaged an IWG increase of approximately 20% (.92 kg or 2 lb.) (Table 3, column 1).

During the first treatment phase where each participant received one or the other treatment components, 4 out of 6 participants (1, 3, 5, and 6) had moderate to very large reductions (12.8% - 35.1%) in weekend IWG. Their average weekend IWG reduction was 1.3 kg (2.9 lb.) regardless of which treatment was in effect. Specifically, for those who monitored their fluid and diet intake, 2 out of 3 participants (1 and 3) showed moderate to very large weekend IWG decreases (13% - 35.1%). Similar effects occurred for those who received monetary rewards, with 2 out of 3 participants (5 and 6) demonstrating moderate to very large (12.8% - 25.5%) weekend IWG reductions.

The addition of a second variable (monitoring or reward) during the combination phase resulted in moderate to very large (9.5% - 26.5%) IWG reductions for 3 out of 6 participants (2, 4, and 5; see Table 3), or an average IWG reduction of .8 kg (1.76 lb.). This combination had no effect on a fourth participant (6), who maintained the very large decrease (25.5%) from the prior reward-only phase. Of the 3 participants who showed further IWG reductions in the combination phase, 2 were in the reward-first condition (participants 4 and 5).

The return to previous conditions (monitoring-only or reward-only) resulted in small to moderate (3% - 14.3%) IWG reductions for participants 1, 4, and 6, or an average IWG reduction of .5 kg (1.1 lb.). Two of the 3 participants (4 and 6) were in the reward-first condition (Table 3). The final combination phase of the study was associated with similar results as the previous combination phase, with 3 of the 6 participants (3, 4, and 5) demonstrating small to very large (4.6% - 25%) reductions in IWG, or an average IWG reduction of .9 kg (1.98 lb.) Two of the 3 participants (4 and 5) were, again, the same participants in the reward-first condition who showed decreases in the first combination phase. However, the third participant (3) to show a decrease in the final combination phase was not the same as the one who showed a decrease in the first combination phase (participant 2).

In summary, weekend IWG generally increased considerably over baseline levels during the initial information-gathering period. Introduction of either treatment variable was associated with decreases in weekend IWG for most of the participants. Adding the second variable was associated with some IWG reductions but had no systematic effect across participants, in that the effect was observed for only 2 participants. No further systematic effects of the two treatment variables were observed in weekend data across participants.

Weekdays. Contrary to the weekend IWG data, the initial rapport-establishing and history-gathering introductory sessions were associated with small reductions in weekday IWG (6.5% - 9.8%) in 3 out of the 6 participants (1, 3, and 6), or an average of .3 kg (.66 lb.) (see Table 3, column 2). A fourth patient (5) showed a large reduction in IWG (25.8%) or .8 kg (1.76 lb.) during this phase. During the first treatment phase, where each participant received either of the two components, 2 of the 6 participants (1 and 4) showed reductions in IWG, and both were moderate effects (10.2% and 16.3%). Their average IWG reduction was .45 kg (.99 lb.) regardless of order of treatment presentation. This effect was much smaller than that observed for the weekend data, where 4 participants showed moderate to very large IWG reductions after the first phase, regardless of condition. It should be noted that of the 2 participants who did show reductions in weekday IWG, 1 participant (4) never received the monetary reward during the study, as the goals were never attained. Thus, the monetary reward could not be said to have had an effect. The remaining 4 participants (2, 3, 5, and 6) showed increases in IWG that averaged 9.3% over the previous phase, or .25 kg (.55 lb.).

The addition of a second variable (either monitoring or the monetary reward) during the combination phase was accompanied by small to very large reductions in IWG (2.3% - 30%) for 4 out of the 6 patients (2, 3, 5, and 6), 2 participants from each condition (see Table 3). The average IWG reduction for these participants was .38 kg (.84 lb.). Of the 2 participants who showed increases in IWG during this phase, one showed an increase that was 36.1% and the other showed an increase that was 4.6% over the previous phase.

A return to isolated conditions (monitoring-only or reward-only) was accompanied by generally moderate IWG reductions (9.5% - 16.3%) for participants 1, 5, and 6 (see Table 3) or an average IWG of .43 kg (.95 lb.). Two out of the 3 participants belonged to the monetary reward-first condition (5 and 6). The remaining 3 participants (2, 3, and 4) showed average IWG increases of 23.4% over the previous phase, ranging from .4 kg to 1.3 kg. These results were similar to the weekend data.

The final combination phase, in which the second variable was once again added (monitoring or reward), was associated with small to very large IWG reductions (7.3% - 33.9%) for 4 out of the 6 participants (1, 2, 3, and 4), replicating overall results from the previous combination phase (see Table 3). The average IWG reduction was .88 kg (1.9 lb.). The addition of monitoring had no effect on a fifth participant (5), who maintained a moderate decrease in IWG from the previous phase, and participant 6 gained an average of .6 kg (1.32 lb.) over the previous phase's average. Of the 4 participants who showed IWG decreases, 3 were in the monitoring-first condition (1, 2, and 3). It should be noted, however, that although the overall results were similar, the participants who demonstrated IWG reductions in the final combination phase were not always the same participants who had reductions in the first combination phase (see Table 3).

In summary, weekday IWG generally decreased slightly from baseline levels during the initial information-gathering period. Introduction of either treatment variable generally had no effect on decreasing weekday IWG for most participants. Adding the second variable was associated with some IWG reductions but, similar to weekend results, there were no systematic effects across participants in that the effect was observed for only 3 participants. No further systematic effects were observed with the return to individual treatment variables alone, but the final combination phase resulted in IWG reductions for most participants. Due to enormous variability in the data, it is impossible to conclude that there was a direct relationship between the independent variables and observed effects.

Individual Analysis

Participant 1 – monitoring first. By the end of the treatment program, participant 1's average weekend IWG was .5 kg (1.1 lb.) less than baseline average and his average weekday IWG was .8 kg (1.76 lb.) less than baseline weekday IWG levels (see Table 1).

Regarding weekend IWG, this individual demonstrated a small increase (4.5% or .3 kg) during the brief information-gathering phase (Figure 1, upper graph). The introduction of the monitoring intervention was associated with a moderate drop (13%) in IWG, from an average IWG of 6.9 kg to 6.0 kg. The addition of the monetary reward contingency was associated with a moderately large (16.7%) IWG increase of 1.0 kg (2.2 lb.), and the removal of the reward contingency (return to monitoring alone) was associated with a subsequent moderate (14.3%) reduction in IWG of 1.0 kg (see Figure 1). The final combination phase resulted in a slight increase (1.7%) in IWG of .1 kg (.22 lb.). The .5 kg (1.1 lb.) reduction in the average weekend IWG at the end of treatment was associated with to the monitoring intervention.

Regarding weekday IWG, participant 1 demonstrated a small reduction in weekday IWG (6.5%) of .3 kg (.66 lb.) during the introductory phase (see Figure 1, lower graph). When monitoring was in effect, participant 1 showed a greater reduction in IWG (16.3%) or .7 kg (1.54 lb.). The addition of the monetary reward was accompanied by a very large increase in IWG (36.1%) of 1.3 kg (2.86 lb.) to a level slightly higher than baseline. Returning to monitoring alone was associated with a moderate IWG reduction (16.3%) of .8 kg (1.76 lb.). However, the introduction of the monetary reward in the final combination phase was associated with a further slight decrease in IWG (7.3%) of .3 kg (.66 lb.). At conclusion of the study, the participant’s weekday IWG was 17.4% lower than baseline and, as with weekends, monitoring is the variable that appears to account for the reduction in average IWG.

Participant 2 – monitoring first. By the end of the treatment program, participant 2 demonstrated a 54.8% increase in weekend IWG over baseline, or an average gain of 3.4 kg (7.48 lb.), but his average weekday IWG was .5 kg (1.1 lb.) less than baseline, an 11.9% decrease (see Figure 2). For weekend IWG, this participant demonstrated a large increase (24.2%) of 1.5 kg (3.3 lb.) during the brief introductory phase, followed by a further, small increase (5.2%) of .4 kg (.88 lb.) with the introduction of monitoring (Figure 2, upper graph). A moderate reduction (9.9%) of .8 kg (1.76 lbs.) in IWG was associated with the addition of the monetary reward contingency, followed by a very large increase (22.9%) of 1.6 kg (3.52 lb.) when the reward contingency was removed. The final combination phase was associated with a small IWG increase (7.9%) of .7 kg (1.54 lb.), although it was a smaller or slower increase than that which occurred during the previous monitoring-only phase.

Regarding weekday IWG results, a small increase (2.4%) of .1 kg (.22 lb.) was observed during the introductory phase, followed by a continued small increase (2.3%) of .1 kg with the introduction of monitoring (Figure 2, lower graph). The addition of the monetary reward contingency was accompanied by a small reduction in weekday IWG (2.3% or .1 kg). Removal of the reward contingency was associated with a very large IWG increase (30.2%) of 1.3 kg (2.86 lb.). However, the final combination phase resulted in a very large reduction (33.9%) in weekday IWG of 1.9 kg (4.18 lb.). It is uncertain as to why this participant's IWG worsened over the weekends but improved somewhat for the weekday HD sessions. There is some evidence that the weekday IWG reductions were attributable to the monetary reward in combination with monitoring, and its effect appeared to increase as the study progressed. For this individual, there was no evidence that either treatment variable had a systematic impact on weekend IWG.

Participant 3 – monitoring first. By the end of treatment, participant 3's average weekend IWG was 1.4 kg (3.08 lb.) less than baseline, and his weekday IWG was .3 kg (.66 lb.) less than baseline (see Figure 3). A moderate IWG increase (13.9%) of .9 kg (1.98 lb.) was observed on weekends during the brief introductory phase (Figure 3, upper graph). This individual showed a very large IWG reduction (35.1%) of 2.6 kg (5.72 lb.) following the introduction of monitoring. The addition of the monetary reward was associated with a moderate increase (14.6% or .7 kg) in IWG, followed by an even larger increase (23.6%) of 1.1 kg (2.42 lb.) when the reward contingency was removed. The final combination phase was associated with a large IWG reduction (25%) of 1.7 kg (3.74 lb.). However, since replication of the initial weekend IWG reduction during the monitoring phase was unsuccessful, it is not certain whether any specific variable was responsible for this effect.

In terms of weekday IWG, participant 3 showed a moderate reduction in IWG (9.8%) of .4 kg (.88 lb.) during the brief introductory phase, which was followed by a small increase (5.4% or .2 kg) during the monitoring phase (see Figure 3, lower graph). The addition of the monetary reward contingency was associated with a moderate reduction in IWG (10.3%) of .4 kg. These results were replicated and even stronger when the reward was removed and again added during the final combination phase. During the monitoring only phase there was a very large increase in IWG (31.4%) of 1.1 kg followed by a moderate reduction in IWG (17.4%) of 1.9 kg (4.18 lb.) during the final combination phase. For this individual, the weekday IWG reductions during the combination phase, and not the monitoring phase, were due to the effect of the monetary reward contingency.

Participant 4 – monetary reward contingency first. At the treatment program's conclusion, participant 4's average weekend IWG was .8 kg (1.76 lb.) less than baseline and his weekday IWG was .4 kg (.88 lb.) less than baseline (see Figure 4). For weekend IWG, this individual demonstrated a small decrease (2.9% or .2 kg) during the brief introductory phase followed by a moderate IWG increase (8.8%) of .6 kg (1.32 lb.) during the monetary reward contingency phase (Figure 4, upper graph). The addition of monitoring was associated with a moderate IWG reduction (9.5%) of .7 kg (1.54 lb.). Return to the previous monetary reward-only condition was accompanied by a further, small decrease (3% or .2 kg). The final combination phase was associated with an even further, small weekend IWG decrease (4.6%) of .3 kg (.66 lb.). It must be noted, however, that this participant never earned the reward offered so, in effect, the treatment variable was never introduced. A tentative conclusion is that, for this participant, monitoring fluid and diet intake was somewhat more effective in reducing weekend IWG than were nonspecific factors such as attention and instructions about how to reduce fluid intake.

During the weekday HD sessions, participant 4 maintained baseline IWG levels in the brief introductory phase, followed by moderate IWG reductions (10.2%) of .5 kg (1.1 lb.) with the introduction of the monetary reward contingency (see Figure 4, lower graph). However, it is again noted that this participant never received the monetary reward. Following the addition of monitoring, a small increase in IWG (4.6% or .2 kg) was observed with a further small IWG increase (8.7%) of .4 kg (.88 lb.) when monitoring was removed. The final combination phase was associated with a moderate IWG reduction (10%) from an average IWG of 5.0 kg to 4.5 kg. As the reward variable was never actually implemented, the monitoring variable may be compared only to general, nonspecific aspects of the treatment that all participants received. Because monitoring alone had inconsistent effects, there is no evidence that any treatment component, alone or in combination, affected Participant 4's weekday IWG.

Participant 5 – monetary reward contingency first. Participant 5 demonstrated an average weekend IWG reduction of .7 kg (1.54 lb.) from baseline by the end of the study, and an average weekday IWG reduction of 1.1 kg (2.42 lb.) from baseline (see Figure 5). For weekends, a large IWG increase (18.2%) of .6 kg (1.32 lb.) was observed during the introductory phase of the study (Figure 5, upper graph). This was followed by a moderate IWG reduction (12.8%) of .5 kg, from baseline with the introduction of the monetary reward contingency. The addition of monitoring during the combination phase was associated with a further large IWG reduction (26.5%) from an average IWG of 3.4 kg to 2.9 kg. Subsequent removal of monitoring was associated with a very large increase in IWG (32%) of .8 kg (1.76 lb.). This, again, was followed by a large weekend IWG reduction (21.2%) during the final combination phase. Although there was a moderate IWG reduction during the first reward-only phase, the IWG reductions were much larger when monitoring was added to the treatment. This effect is supported by the observation that when monitoring was removed from the combined treatment, the result was a very large increase in weekend IWG. The effect of the combined treatment was replicated and, therefore, these results indicate that the .7 kg (1.54 lb.) reduction in average weekend IWG at the end of treatment was associated with the combination of monitoring of fluid and food intake and monetary reward.

Regarding weekday IWG, participant 5 demonstrated a large reduction in weekday IWG (25.8%) or .8 kg (1.76 lb.) during the brief introductory phase of the study (see Figure 5, lower graph). The introduction of the monetary reward contingency resulted in a small increase in IWG (4.4% or .1 kg). The addition of monitoring was associated with a small reduction in IWG (4.2%) or .1 kg (.22 lb.). A further, moderate reduction in IWG (13%) or .3 kg (.66 lb.) resulted when monitoring was removed. The final combination phase had no effect on weekday IWG beyond that of the reward alone; no change in IWG was observed. Due to inconsistent results, the 1.1 kg reduction in weekday IWG by the program's end cannot be accounted for by any particular treatment variable.

<u>Participant 6 – monetary reward contingency first</u>. By the end of the treatment program, participant 6's averaged weekend IWG was .2 kg (.44 lb.) less than baseline, and her average weekday IWG was .1 kg (.22 lb.) less than baseline (see Figure 6). For weekends, this individual demonstrated a very large IWG increase (38.2%) of 1.3 kg (2.86 lb.) during the introductory phase (Figure 6, upper graph). The implementation of the monetary reward contingency was associated with a large IWG reduction (25.5%), from an average IWG of 4.7 kg to 3.5 kg. The addition of monitoring contributed nothing to the effect of reward alone, and the lower IWG achieved in the prior phase was maintained. A return to reward alone replicated previous results in that a further small

reduction in IWG (8.6% or .3 kg) was observed. The final combination phase was accompanied by a moderate increase in weekend IWG (12.5%) of .3 kg (.66 lb.).

In terms of weekday IWG, participant 6 showed a small reduction in weekday IWG (7.7%) or .2 kg during the introductory phase (see Figure 6, lower graph). Implementation of the monetary reward contingency was associated with a large increase in weekday IWG (25%) or .6 kg (1.32 lb.) The addition of monitoring was associated with a very large IWG reduction (30%), from an average IWG of 3.0 kg to 2.1 kg. Another small IWG reduction (9.5%), or .2 kg, was observed with the removal of monitoring. This was followed by an unexpected, very large increase in weekday IWG (31.6%) of .6 kg (1.32 lb.) in the final combination phase. Although participant 6's weekday IWG was 3.85% lower than baseline by the end of the program, a conclusion cannot be made regarding the variable accountable for such an effect since the observed IWG decrease associated with the combined treatment was not replicated.

In summary, two data sets (weekend and weekday IWG) were collected on each of 6 participants. Of the 12 data sets, 4 showed some consistency of results across repeated alternating conditions, and these were not the same for weekend and weekday IWG data. For Participant 1, monitoring alone was always accompanied by reductions in weekend IWG. Adding the monetary reward to monitoring was associated with reversal of these reductions. For Participant 6, the monetary reward always was associated with reductions in weekend IWG, whereas, the addition of monitoring either had no effect or was accompanied by increases in weekend IWG.

Two weekday data sets showed consistent results as well. Increases in weekday IWG for Participant 2 were consistently observed when monitoring alone was in effect. Adding the monetary reward to monitoring always was associated with reductions in weekday IWG. Participant 3 showed a similar pattern of increases in weekday IWG associated with monitoring alone and reductions in weekday IWG when the monetary reward was added to monitoring. The remaining eight data sets were inconclusive regarding systematic effects of either component alone or the two components in combination.

Standardized Dry Weight Criterion

In addition to using a percentage of a participant's dry weight as a selection procedure, 3% and 4% of dry weight for weekday and weekend HD sessions, respectively, were used to set treatment goals. Only 1 of the 6 participants (participant 6) actually reached that goal, and it was for the weekday HD sessions. It is also noteworthy that this participant was the least nonadherent of all the participants.

Discussion

The goal of this study was to begin dismantling a behavioral treatment package to examine the individual and additive effects of two treatments included in previous interventions for reducing IWG: monitoring and monetary reward contingency. Furthermore, the study sought to assess the usefulness of standardized adherence criteria based upon participants' dry weights for setting treatment goals.

Most of the 6 participants demonstrated behavior changes considered to positively impact their health. However, although the 6 participants averaged a 14% reduction in weekday IWG by the end of the study as compared to baseline levels, and 4 out of 6 participants averaged a 15.45% reduction in weekend IWG, it cannot be concluded that the independent variables were associated with any real effect due to the enormous amount of variability found in the IWG data. Therefore, it is not possible to conclude if any observed effects are real.

Results indicated that the treatment variables had different effects on weekend and weekday IWG. Within-participant replication of treatment results showed that, for one participant monitoring was effective and for another participant monetary reward was effective for reducing weekend IWG. To the investigator’s knowledge, this is the first time that such differential effects of treatment components have been observed for weekend and weekday HD sessions. That either individual component was consistently more effective on weekend IWG than the combined variables is clinically relevant, as it would be unnecessary to subject patients to complex treatment packages if only one component would effectively improve health behaviors. This is supportive of Finn and Alcorn’s (1986) suggestion that the minimal interventions required to produce behavior change should be examined and implemented. This is particularly true in the case of monitoring, which adds no financial cost to treatment implementation.

Further inconsistencies between weekend and weekday IWG were observed. While an increase in weekend IWG was accounted the information-gathering phase, a reduction in weekday IWG was associated with this phase (see Table 1). The reason for this difference is not evident, although most participants reported that it was easier to exert control over weekday drinking behaviors, which would then make it somewhat easier to intervene with nonspecific treatment variables such as attention. That there were few systematic effects of the treatment variables and that results generally were not replicated implies that a variable held constant actually may have been the effective factor for reducing IWG. Nonspecific factors such as establishing rapport, problem solving, and/or gathering information (held constant here) may be more effective than either monitoring or monetary reward alone, at least for weekday reductions for some individuals.

An additional difference between weekend and weekday IWG was that during the weekday HD sessions neither individual treatment variable, when initially introduced in isolation, was as effective in reducing IWG as during the weekend HD sessions. It should be noted that reductions in weekday IWG were observed during the rapport-establishing phase, which does not rule out the possibility that nonspecific treatment effects were associated with the decreases in weekday IWG.

It also must be noted that changing the treatment variables at arbitrary times (4 weeks per treatment phase) is inconsistent with standard behavioral research. Usually, one would continue administering a treatment until the data or behavior stabilizes, then implement a change in treatment. Such a procedure was not possible, considering the contingencies (such as time constraints) under which the experimenter was operating.

Because treatment outcomes for nonadherence in HD patients are highly individualized, the question of identifying what works for what patient warrants further research. One explanation for the observation that monitoring is effective for some and not for others is that some individuals may prefer to be unaware of their fluid intake (inclined toward "denial"). Indeed, some of the patients expressed dislike of monitoring their fluid intake and did not want to think about their intake throughout the day. However, other patients seemed to be quite interested in learning more about their own behavior and assumed an "experimenter" role in finding the best strategies to control fluid intake.

Why individual components would appear to be more effective for weekend IWG and the combination treatment would tend to be more effective for weekday IWG is not clear. This observation is counterintuitive, as participants agreed that controlling weekend fluid intake was by far the most difficult aspect of their fluid regimen, due to the longer period of time between HD sessions and the greater amount of control required. Therefore, it would seem that a combination treatment package would be needed for behavior change for weekend IWG. However, while results supporting this trend were observed, they were not replicated across participants.

An additional goal of this study was to examine the usefulness of a standardized criterion for fluid adherence, as suggested by several researchers (Manley & Sweeney, 1986; Sensky, 1993). Consistent with Keane, Prue, and Collins (1981), different criteria were assigned for weekend and weekday IWG to account for differences in time interval between HD weekday sessions and HD sessions following the weekend. Specifically, both the selection of participants and the establishment of treatment goals were based upon a proportion of each patient's dry weight: 3% of their dry weight for weekday sessions and 4% of their dry weight for weekend sessions, to allow for the extra day between HD sessions. Use of these standard criteria for selection of nonadherent participants, rather than use of arbitrary and varying criteria, would increase the internal and external validity of outcome studies. However, using these criteria to set treatment goals may not have been as beneficial as predicted because only one participant reached the treatment goal. The exception was a participant who met the goal for weekday IWG only. While it was expected to benefit larger patients who realistically could tolerate higher weight gain, most of the participants were severe fluid overloaders, and exhibited more severe overloading relative to many participants in other studies that reported baseline IWG or daily weight gains. Therefore, it is possible that for these participants treatment goals were set unreasonably high and were too difficult for them to attain. As previously stated, one participant was so severely overloaded that no approximations of the goal were ever achieved, and thus he never received the monetary reward. Clinicians interested in a data-based approach might find a potential solution to this problem by implementing a changing criterion while shaping the behavior necessary to reach a more lenient criterion, as a first step toward reaching a final treatment goal.

Research and clinical work in this area is quite complex and difficult, in large part, because of the highly individualized nature of nonadherence due to factors such as differences in life circumstances, employment, and disease comorbidity. Lack of replicable results and the differential effects observed between weekend and weekday IWG may be the result of dissimilar weekend and weekday environments and associated behavioral repertoires controlling fluid intake. For example, participants who were employed noted that their fluid intake increased over the weekends because drinks were more readily available and their activities were less structured.

Another uncontrolled variable is a patient's living situation, which may be more or less conducive to behavior change. For one unemployed participant in the present study, the prevailing reason given for nonadherence was the tempting presence of abundant drinks and high-fluid content foods, as well as a self-perceived lack of control over diet and food preparation. That the structure of a patient's home environment can influence adherence is consistent with the beneficial effect on IWG observed when several participants were hospitalized during the study.

Diseases that often accompany ESRD, such as diabetes and hypertension, make adherence and interventions additionally challenging. Two participants in the present study had insulin-dependent diabetes, and both expressed frustrations with the fluid, diet and medication requirements of ESRD that are in addition to requirements for controlling diabetes, making the entire regimen seem overwhelming. This further emphasizes the need for individualized interventions that incorporate shaping techniques to achieve long-term goals.

Unwillingness to make behavior change is a major factor in nonadherence, and interventions such as positive reinforcement may serve to enhance motivation for change. Although some theoretical models address this problem and attempt to explain why patients do not adhere to their medical regimen (e.g., Health Belief Model), HD patients have a unique reason that may undermine intervention attempts - the possibility of kidney transplantation. Three of the six participants in the present study were on the transplant list and the other three participants were in the application process. A valid question for any HD patient is, "why make difficult lifestyle changes and alter habits that have been present for most of my life if a very good possibility exists for a kidney transplant?" While there are important reasons for making these changes, namely improved health maintenance and quality of life, for many patients the long-term predicted benefits are not worth the current effort.

A strength of the current study was the attempt to bolster internal validity, by including extended pre-intervention baseline data to establish stability of nonadherent behavior, controlling for the minimum length of HD treatment history, use of a standardized criterion to select patients, and keeping nonspecific treatment variables constant for all participants throughout the study. However, the differential effects of the treatment variables for weekend and weekday IWG and the lack of replication of many of the data sets reflect the effect of uncontrolled variables. Some of these variables have already been mentioned (disease comorbidity, employment, hospitalizations, living situations). Therefore, clinicians interested in a data-based approach with this population must take into account these and other possibly uncontrollable variables.

In terms of clinical work, practitioners may have to take into consideration each patient's life circumstances and situations that prevent generalization of skills to different situations and environments. Assessment of antecedents and consequences that vary between weekdays and weekends should be considered for effective interventions and deserves the attention of future research.

In summary, while most of the participants demonstrated improvements in IWG the treatment variables responsible for the changes were not the same for all participants, suggesting the need for more attention to specific patient characteristics and responsivity to particular treatment components. Furthermore, the variability in the data precludes the possibility of stating equivocally that the changes in mean IWG were real. At this time, it may be impossible to determine the single most important treatment variable associated with adherence improvements in HD patients, but this very uncertainty provides an interesting challenge for future research in this area.

Table 1.

Differences in weekend and weekday average IWG (Kg) between baseline phase and final treatment phase. Bolded, negative numbers indicate average reductions.

Participant	Weekend	Weekday
1	**-.5**	**-.8**
2	3.4	**-.5**
3	**-1.4**	**-.3**
4	**-.8**	**-.4**
5	**-.7**	**-1.1**
6	.2	**-.1**

Table 2.

Descriptive statistics for interdialytic weight gains (IWG) of baseline and treatment phases for participants in each condition.

Participant	Weekend/Weekday (Kg)					
	Monitoring First					
	Baseline	Begin	Monitoring	M + $	M	M + $
1: M	6.6/4.6	6.9/4.3	6.0/3.6	7.0/4.9	6.0/4.1	6.1/3.8
Md	6.4/4.5	6.8/4.7	6.1/3.3	7.1/4.8	5.8/4.0	6.4/3.8
SD	.97/.87	.17/1.15	.40/1.30	.28/.52	.74/1.52	1.0/.97
2: M	6.2/4.2	7.7/4.3	8.1/4.4	7.3/4.3	8.9/5.6	9.6/3.7
Md	5.8/4.4	7.7/4.2	7.7/4.6	7.0/3.7	9.1/4.8	10.0/3.2
SD	1.65/1.05	1.0/1.43	1.22/1.98	.81/1.10	.62/1.56	1.10/.90
3: M	6.5/4.1	7.4/3.7	4.8/3.9	5.5/3.5	6.8/4.6	5.1/3.8
Md	6.4/3.9	7.4/3.0	4.5/3.8	5.3/3.5	6.1/4.7	5.3/3.4
SD	1.09/.66	2.62/2.1	1.4/.36	.93/1.19	1.18/.79	.52/1.1
	Monetary Reward First					
	Baseline	Begin	$	M + $	$	M + $
4. M	7.0/4.9	6.8/4.9	7.4/4.4	6.7/4.6	6.5/5.0	6.2/4.5
Md	7.0/5.0	6.8/4.9	7.4/4.3	6.4/4.8	6.5/4.8	6.3/4.7
SD	.63/.78	1.7/.55	.73/.53	1.1/.48	1.02/.91	.94/.56
5. M	3.3/3.1	3.9/2.3	3.4/2.4	2.5/2.3	3.3/2.0	2.6/2.0
Md	3.2/3.4	3.9/2.3	3.3/2.4	2.5/2.3	3.1/2.0	2.6/2.0
SD	.60/1.13	.71/.34	.55/1.2	.26/.48	.57/.63	.37/.78
6. M	3.4/2.6	4.7/2.4	3.5/3.0	3.5/2.1	3.2/1.9	3.6/2.5
Md	3.4/2.8	4.7/2.6	3.6/3.0	3.2/2.3	3.2/2.0	3.5/2.4
SD	.98/.91	.42/.38	1.16/.68	1.7/1.1	.30/.60	.49/.43

Table 3.

Percent change statistics of mean interdialytic weight gain (IWG) per phase. Bolded, negative percentages indicate IWG reductions from previous phase.

Participant

Monitoring First

	Weekend					Weekday				
	Rapport	M	M+$	M	M+$	Rapport	M	M+$	M	M+$
1	4.5%	**-13%**	16.7%	**-14.3%**	1.7%	**-6.5%**	**-16.3%**	36.1%	**-16.3%**	**-7.3%**
2	24.2%	5.2%	**-9.9%**	22.9%	7.9%	2.4%	2.3%	**-2.3%**	30.2%	**-33.9%**
3	13.9%	**-35.1%**	14.6%	23.6%	**-25%**	**-9.8%**	5.4%	**-10.3%**	31.4%	**-17.4%**

Reward First

	Weekend					Weekday				
	Rapport	$	$+M	$	$+M	Rapport	$	$+M	$	$+M
4	**-2.9%**	8.8%	**-9.5%**	**-3%**	**-4.6%**	0%	**-10.2%**	4.6%	8.7%	**-10%**
5	18.2%	**-12.8%**	**-26.5%**	32%	**-21.2%**	**-25.8%**	4.4%	**-4.2%**	**-13%**	0%
6	38.2%	**-25.5%**	0%	**-8.6%**	12.5%	**-7.7%**	25%	**-30%**	**-9.5%**	31.6%

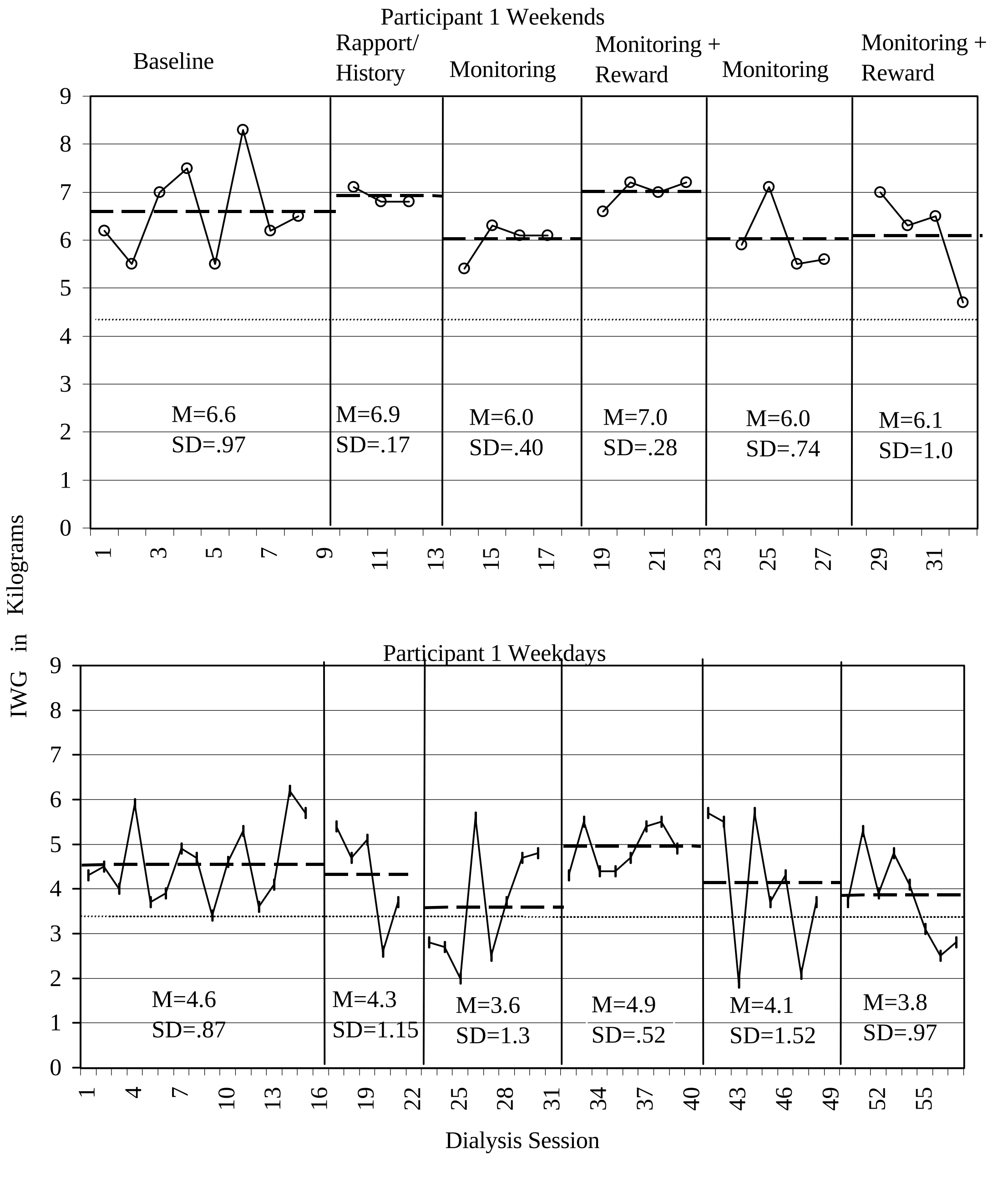

Figure 1. Participant 1's weekend and weekday weight gains since previous dialysis session (IWG). Dotted lines indicate target IWG. Bold dashed lines indicate mean IWG for each phase.

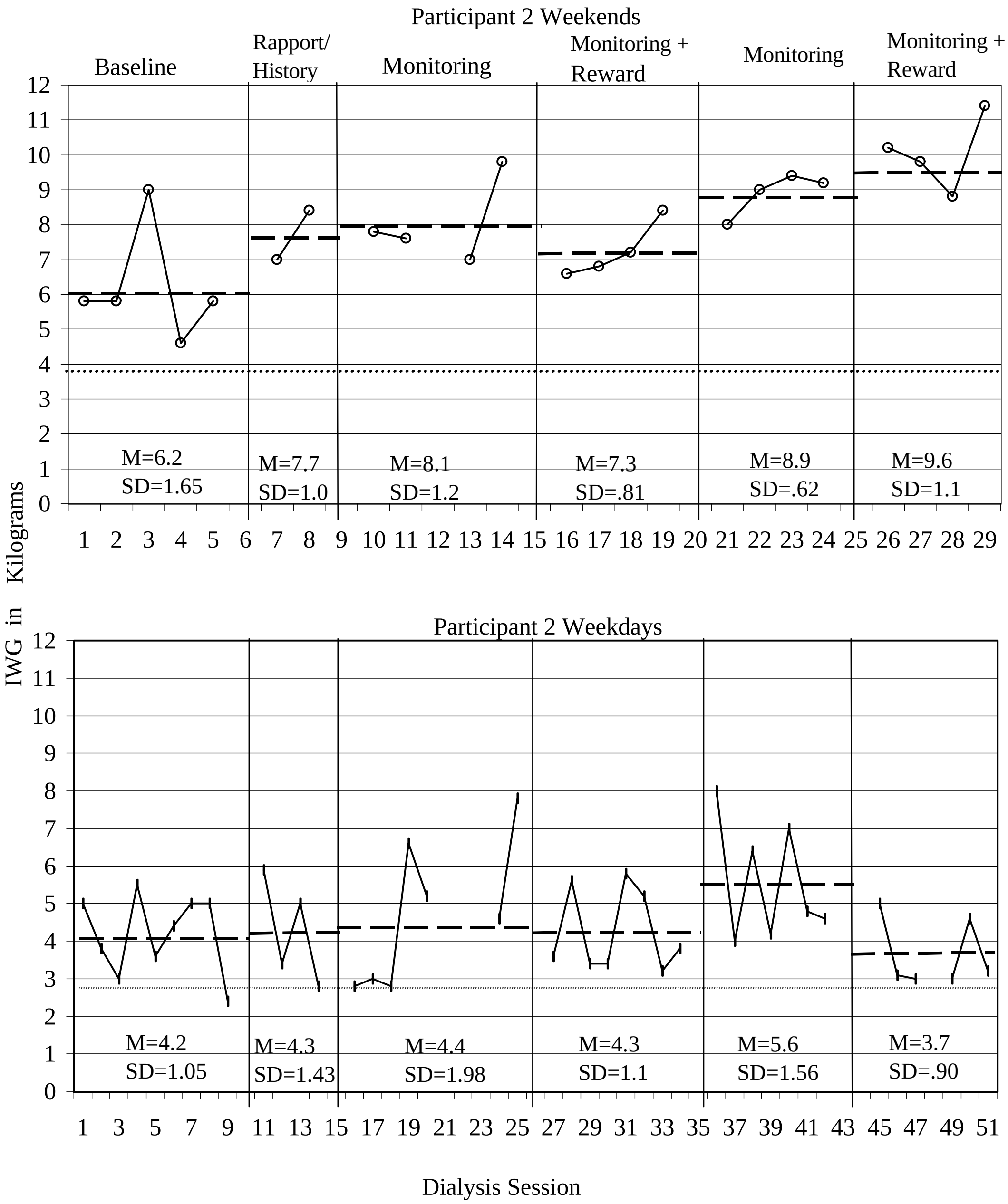

Figure 2. Participant 2's weekend and weekday weight gains since previous dialysis session (IWG). Dotted lines indicate target IWG. Bold dashed lines indicate mean IWG for each phase.

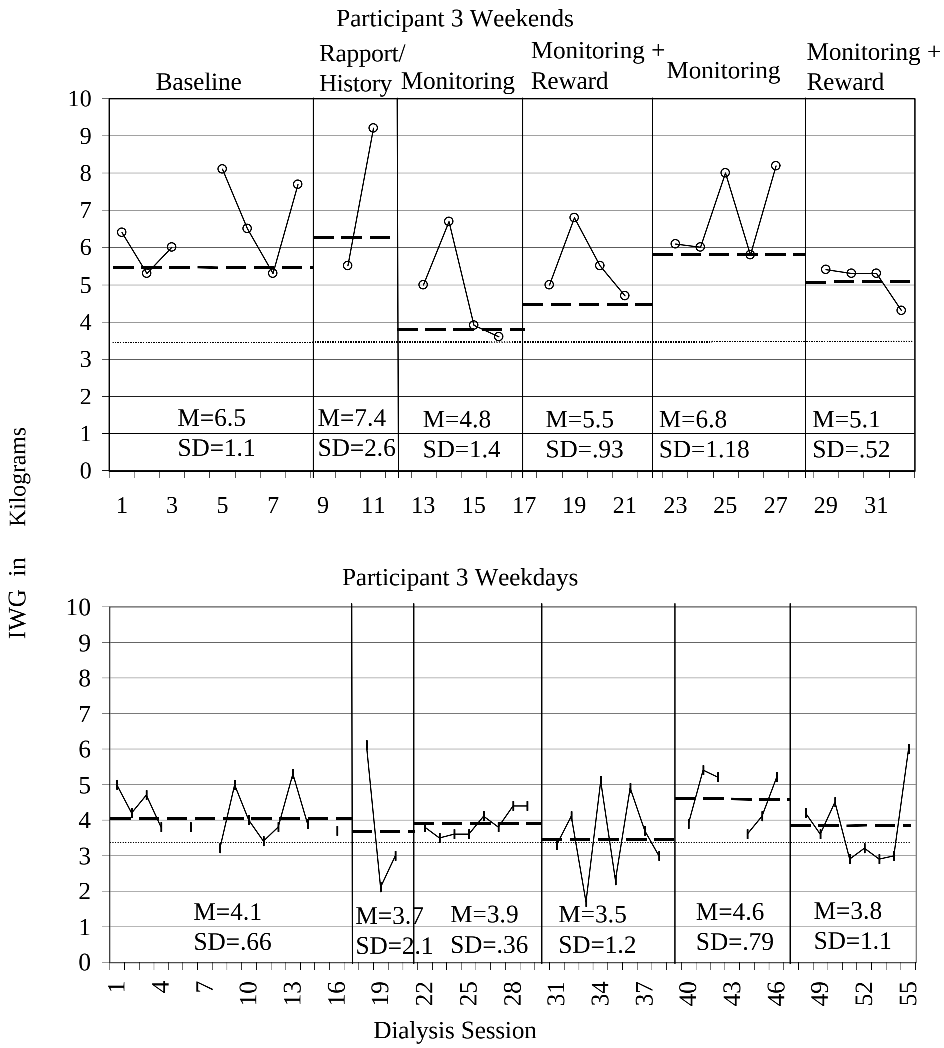

Figure 3. Participant 3's weekend and weekday weight gains since previous dialysis session (IWG).

Dotted lines indicate target IWG. Bold dashed lines indicate mean IWG for that phase.

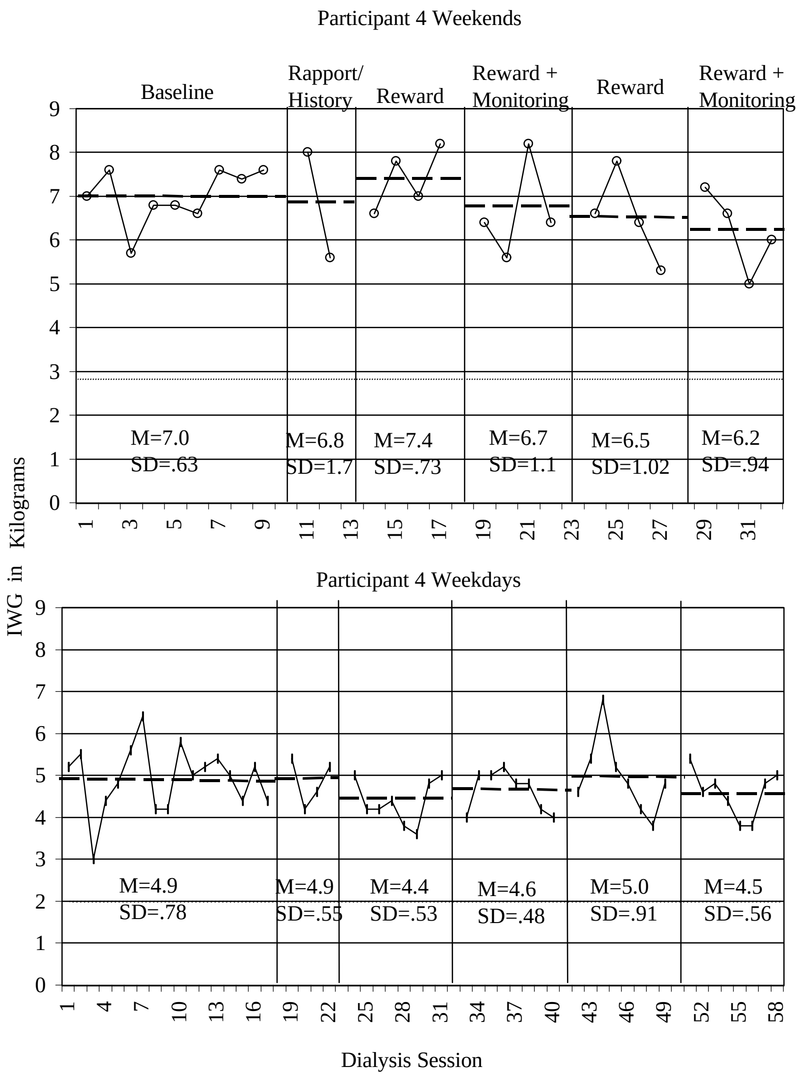

Figure 4. Participant 4's weekend and weekday weight gains since previous dialysis session (IWG). Dotted lines indicate target IWG. Bold dashed lines indicate mean IWG for each phase.

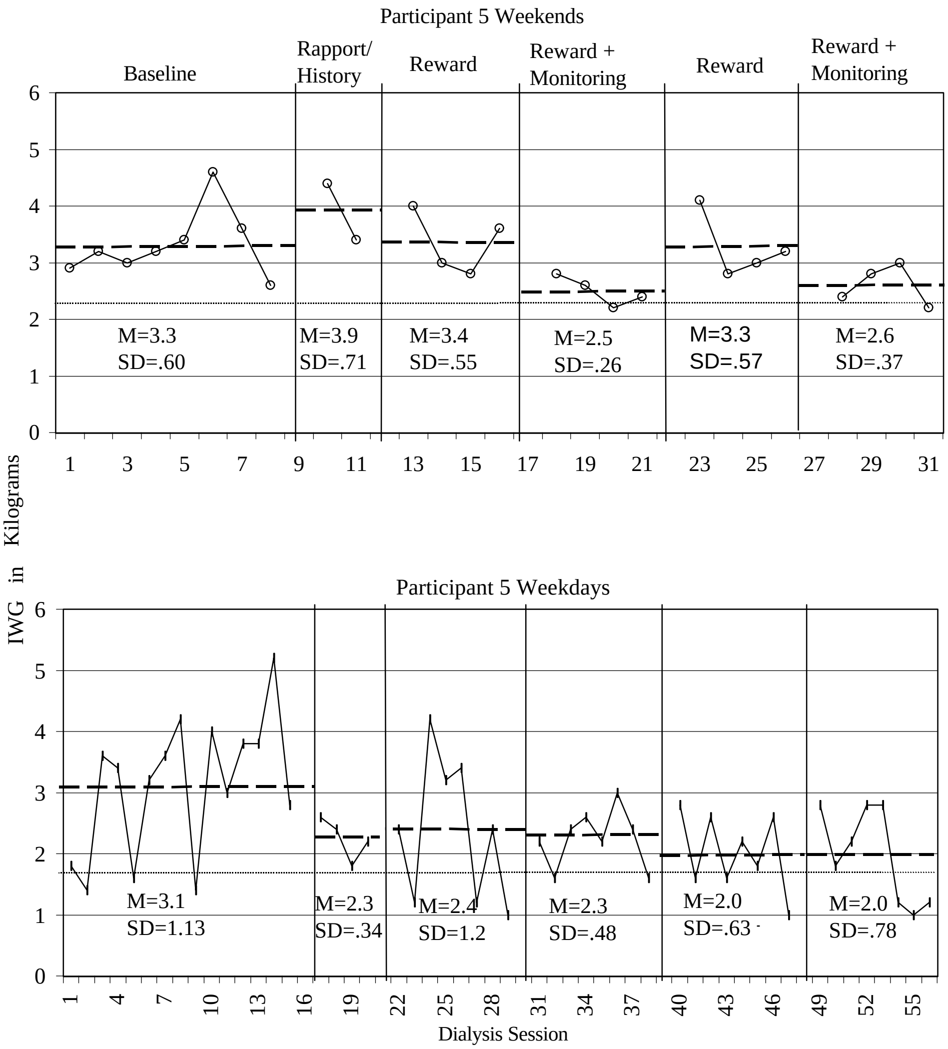

Figure 5. Participant 5's weekend and weekday weight gains since previous session (IWG). Dotted lines indicate target IWG. Bold dashed lines indicate mean IWG for

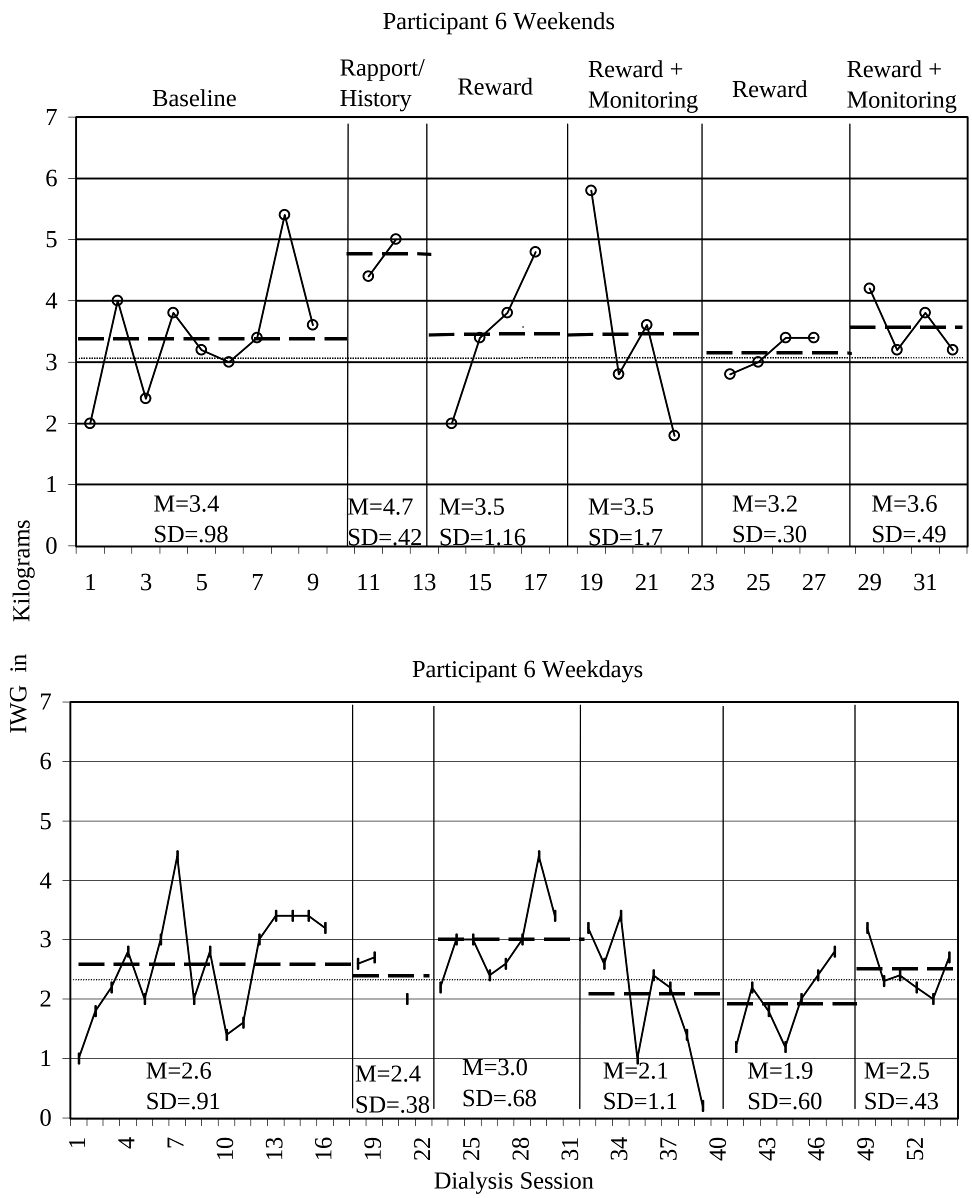

Figure 6. Participant 6's weekend and weekday weight gains since previous dialysis session (IWG).

Dotted lines indicate target IWG. Bold dashed lines indicate mean IWG for each phase.

APPENDIX

DIET MONITORING SHEETS

	Date:						
	Please record right <u>BEFORE</u> or <u>AFTER</u> each meal, drink, or snack !						
	<u>Mon.</u>	<u>Tues.</u>	<u>Wed.</u>	<u>Thurs.</u>	<u>Fri.</u>	<u>Sat.</u>	<u>Sun.</u>
<u>BEVERAGES:(***Specify amount***)</u>							
Coffee							
cola/soft drinks							
Ice							
Tea							
Lemonade							
Milk							
Water							
Grapefruit juice							
Orange juice							
prune juice							
Tomato juice							
OTHER:							
<u>BREAKFAST:</u>							
Bacon							
Bagel							
Biscuit							
Cereal							
Croissant							
Eggs							
Grits							
Hashbrowns							
Oatmeal							
Pancakes							
plain muffins							

Poptarts							
Sausage patty							
Toast							
Waffles							
OTHER:							
<u>BREADS:</u>							
breadsticks							
corn bread							
French bread							
garlic bread							
hamburger bun							
hot dog bun							
sliced bread (white, wheat)							
OTHER:							
<u>MAIN DISH:</u>							
baked chicken							
baked fish							
bar-b-que chicken/beef/pork							
beans							
burritos							
casserole							
chicken fried steak							
chili							
Chinese food							
cold cuts (pickle loaf, bologna)							
fried chicken or fish							
ham/spam							
hamburger							
hot dogs/weiners							
pasta							
pizza							
pork/pork chops							
ribs							
roast beef							
sausage (beef, polish,							

etc.)							
shrimp							
soup							
steak							
stew							
tacos							
TV dinners/frozen dinners							
OTHER:							
SIDE DISHES:							
baked potato							
broccoli							
cole slaw							
carrots							
corn							
cucumber							
french fries							
gravy or sauce							
green beans							
mashed potatoes							
mushrooms							
peas							
pickles							
potato salad							
rice							
salad							
spinach							
squash							
sweet potatoes							
tomatoes							
OTHER:							
SNACKS/DESSERTS:							
cake							
cheese							
cheesecake							
chocolate							
cookies							

cottage cheese							
crackers							
hard candy							
ice cream							
Jell-O							
jelly beans							
nuts &/or dried fruit							
pie							
popcorn							
potato chips							
pretzels							
pudding							
rice cakes							
sherbet							
yogurt							
FRUIT:							
apple							
banana							
fruit cup/fruit cocktail							
grapes							
orange							
prunes							
OTHER:							

REFERENCES

Abram, H. S., Moore, G. I., & Westervelt, F. G. (1971). Suicidal behavior in chronic dialysis patients. American Journal of Psychiatry, 149, 1624-1628.

Agashua, P. A., Lyle, R. C., Livesley, W. J., Slade, P. D., Winney, R. J., & Irwine, M. (1981). Predicting dietary noncompliance of patients on intermittent hemodialysis. Journal of Psychosomatic Research, 25, 289-301.

Bame, S. I., Petersen, N., & Wray, N. P. (1993). Variation in hemodialysis patient compliance according to demographic characteristics. Social Science and Medicine, 37, 1035-1043.

Barnes, M. R. (1976). Token economy control of fluid overload in a patient receiving hemodialysis. Journal of Behavior Therapy & Experimental Psychiatry, 7, 305-306.

Blackburn, S. L. (1977). Dietary compliance of chronic hemodialysis patients. Journal of American Dietetic Association, 70, 36-37.

Bleyer, A. J., Hylander, B., Sudo, H., Nomoto, Y., de la Torre, E., Chen, R. A., & Burkart, J. M. (1999). An international study of patient compliance with hemodialysis. Journal of the American Medical Association, 40, 1211.

Bollin, B. W., & Hart, L. K. (1982). The relationship of health belief motivations, health locus of control and health valuing to dietary compliance of hemodialysis patients. American Association of Nephrology Nurses Technical Journal, 9, 41-47.

Brady, B. A., Tucker, C. M., Alfino, P. A., Tarrant, D. G., & Finlayson, G. C. (1997). An investigation of factors associated with fluid adherence among hemodialysis patients: A self-efficacy theory based approach. Annals of Behavioral Medicine, 19, 339-343.

Christensen, A. J., Benotsch, E. G., & Smith, T. W. (1997). Determinants of regimen adherence in renal dialysis. In Gochman, D. S. (Ed.), Handbook of health behavior research (Vol.2). New York: Plenum Press.

Christensen, A. J., Benotsch, E. G., Wiebe, J. S., & Lawton, W. J. (1995). Coping with treatment-related stress: Effects on patient adherence in HD. Journal of Consulting and Clinical Psychology, 63, 454-459.

Christensen, A. J., Smith, T. W., Turner, C. W., Holman, J. M., Gregory, M. C., & Rich, M. A. (1992). Family support, physical impairment, and adherence in HD: An investigation of main and buffering effects. Journal of Behavioral Medicine, 15, 313-325.

Christensen, A. J., Wiebe, J. S., Edwards, D. L., Michels, J. D., & Lawton, W. J. (1996). Body consciousness, illness-related impairment, and patient adherence in hemodialysis. Journal of Consulting and Clinical Psychology, 64, 147-152.

Cinciripini, P. N., Kornblith, S. J., Turner, S. M., & Hersen, M. (1983). A behavioral program for the management of anorexia and bulimia. Journal of Nervous and Mental Disease, 171, 186-189.

Cummings, K. M., Becker, M. H., Kirscht, J. P., & Levin, N. W. (1981). Intervention strategies to improve compliance with medical regimens by ambulatory hemodialysis patients. Journal of Behavioral Medicine, 4, 111-127.

Cummings, K. M., Becker, M. H., Kirscht, J. P., & Levin, N. W. (1982). Psychosocial factors affecting adherence to medical regimens in a group of hemodialysis patients. Psychological Medicine, 21, 237-243.

Dunbar-Jacons, J. (1993). Contributions to patient adherence: Is it time to share the blame? Health Psychology, 12, 91-92.

Epstein, L. H. (1981). The effects of targeting improvements in urine glucose on metabolic control in children with insulin dependent diabetes. Journal of Applied Behavior Analysis, 14, 365-376.

Everett, K. D., Brantley, P. J., Sletten, C., Jones, G. N., & McKnight, G. T. (1995). The relation of stress and depression to IWG in HD patients. Behavioral Medicine, 21, 25-30.

Finn, P. E. (1985). Noncompliance to hemodialysis dietary regimens: An empirical investigation of a treatment package. Dissertation Abstracts International, 46, 299.

Finn, P. E., & Alcorn, J. D. (1986). Noncompliance to hemodialysis dietary regimens: Literature review and treatment recommendations. Rehabilitation Psychology, 31, 67-78.

Friend, R., Hatchett, L., Schneider, M. S., & Wadhwa, N. K. (1997). A comparison of attributions, health beliefs, and negative emotions as predictors of fluid adherence in renal dialysis patients: A prospective analysis. Annals of Behavioral Medicine, 19, 344-347.

Gibbered, F. B., Dunne, J. F., Handley, A. J., & Hazelman, B. L. (1970). Supervision of epileptic patients taking phenytoin. British Medical Journal, 1, 147-149.

Hart, R. R. (1979). Utilization of token economy within a chronic dialysis unit. Journal of Consulting and Clinical Psychology, 47, 646-648.

Hartman, P. E., & Becker, M. H. (1978). Noncompliance with prescribed regimens among chronic hemodialysis patients. Dialysis Transplant, 7, 978.

Hegel, M. T., Ayllon, T., Thiel, G., & Oulton, B. (1992). Improving adherence to fluid restrictions in male hemodialysis patients: A comparison of cognitive and behavioral approaches. Health Psychology, 11, 324-330.

Hersen, M., & Barlow, D. H. (1976). Single-case experimental designs: Strategies for studying behavior change. New York: Pergamon Press.

Higgins, T. E. (1985). The use of guided imagery in the control of food and liquid intake of hemodialysis patients. Dissertation Abstracts International, 46, 105.

Hoover, H. (1989). Compliance in hemodialysis patients: A review of the literature. Journal of the American Dietetic Association, 89, p.959.

Keane, T. M., Prue, D. M., & Collins, Jr., F. L. (1981). Behavioral contracting to improve dietary compliance in chronic renal dialysis patients. Behavior Therapy & Experimental Psychiatry, 12, 63-67.

Kaplan De-Nour, A. (1981). Prediction of adjustment to chronic hemodialysis. In Levy (Ed.) Psychonephrology, vol.1. New York: Plenum Publishing.

Kaplan De-Nour, A., & Czaczkes, J. W. (1972). Personality factors in chronic HD patients causing noncompliance with medical regimen. Psychosomatic Medicine, 34, 333-334.

Kobrin, S. M., Kimmel, P. L., Simmens, S. J., & Reiss, D. (1991). Behavioral and biochemical indices of compliance in hemodialysis patients. ASAIO Transactions, 37, M378-M380.

Lamping, D. K., Campbell, K. A., & Churchill, D. N. (1988). Does HD compliance show consistency and stability? Paper presentation at the 22nd Annual Meeting of the Association for the Advancement of Behavior Therapy, New York.

Levenson, J. L., & Glocheski, S. (1992). End-stage renal disease. In Stoudemire, A. (Ed.), Psychological factors affecting medical conditions. New York: Plenum Press.

Magrab, P. R., & Papadopoulou, Z. L. (1977). The effect of a token economy on dietary compliance for children on hemodialysis. Journal of Applied Behavior Analysis, 10, 573-578.

Manley, M., & Sweeny, J. (1986). Assessment of compliance in hemodialysis adaptation. Journal of Psychosomatic Research, 30, 153-161.

McGee, H.M., Rushe, H., Sheil, K., & Keogh, B. (1998). Association of psychosocial factors and dietary adherence in haemodialysis patients. British Journal of Health Psychology, 3, 97-109.

Meichenbaum, D., & Turk, D. (1987). Facilitating treatment adherence: A practitioner's guidebook. New York: Plenum Press.

Moran, P. J., Christensen, A. J., & Lawton, W. J. (1997). Social support and conscientiousness in hemodialysis adherence. Annals of Behavioral Medicine, 19, 333-338.

Morrissey, J. B. (1985). The use of guided imagery and progressive muscle relaxation in treating hemodialysis patients for dietary compliance. Dissertation Abstracts International, 46, 1530-1531.

Morduchowicz, G., Sulkes, J., Aizic, A., Gabbay, A., Winkler, J., & Boner, G. (1993). Compliance in hemodialysis patients: A multivariate regression analysis. Nephron, 64, 365-368.

Mosley, Jr., T. H., Eisen, A. R., Bruce, B. K., Brantley, P. J., & Cocke, T. B. (1993). Contingent social reinforcement for fluid compliance in a hemodialysis patient. Journal of Behavior Therapy & Experimental Psychiatry, 24, 77-81.

Mullen, P. D., Simons-Morton, D. G., Ramirez, G., Frankowski, F., Green, L. W., & Mains, D. A. (1997). A meta-analysis of trials evaluating patient education and counseling for three groups of preventive health behaviors. Patient Education and Counseling, 32, 157-173.

Nelson, R. O. (1977). Assessment and therapeutic functions of self-monitoring. In: Hersen, M., Eisler, R. M., & Miller, P. M. (Eds.). Progress in Behavior Modification, Vol.5. NY: Academic Press.

Nessman, D. G., Carnahan, J. E., & Nugent, C. A. (1980). Increasing compliance: Patient operated hypertension groups. Archives of Internal Medicine, 140, 1427-1431.

Oldenburg, B., MacDonald, G. J., & Perkins, R. J. (1988). Factors influencing excessive thirst and fluid intake in dialysis patients. <u>Dialysis and Transplantation, 17</u>, 21-40.

Poll, I. B., & Kaplan De-Nour, A. (1980). Locus of control and adjustment to chronic hemodialysis. <u>Psychological Medicine, 10</u>, 153-157.

Procci, W. R. (1978). Dietary abuse in maintenance hemodialysis patients. Psychosomatics, 19, 16-24. Rosenbaum, M., & Ben-Ari, S. K. (1986). Cognitive and personality factors in the delay of gratification of HD patients. <u>Journal of Personality and Social Psychology, 51</u>, 357-364.

Reiss, D., Gonzales, S., & Kramer, N. (1986). Family process, chronic illness, and death: On the weakness of strong bonds. <u>Archives of General Psychiatry, 43</u>, 795-804;

Rosenbaum, M., & Ben-Ari, S., K. (1986). Cognitive and personality factors in the delay of gratification of hemodialysis patients. <u>Journal of Personality and Social Psychology, 51</u>, 357-364.

Schneider, M. S., Friend, R., Whitaker, P., & Wadhwa, N. K. (1991). Fluid noncompliance and symptomatology in end-stage renal disease: Cognitive and emotional variables. <u>Health Psychology, 10</u>, 209-215.

Sensky, T. (1993). Psychosomatic aspects of end-stage renal failure. <u>Psychotherapy and Psychosomatics, 59</u>, 56-68.

Sensky, T., Leger, C., & Gilmour, S. (1996). Psychosocial and cognitive factors associated with adherence to dietary and fluid restriction regimens by people on chronic hemodialysis. <u>Psychotherapy and Psychosomatics, 65</u>, 36-42.

Skoutakis, V. A., Acchiardo, S. R., Martinez, D. R., Lorisch, D., & Wood, G. C. (1978). Role effectiveness of the pharmacist in the treatment of hemodialysis patients. American Journal of Hospital Pharmacy, 35, 62-65.

Stewart, R. S. (1983). Psychiatric issues in renal dialysis and transplantation. Hospital and Community Psychiatry, 34, 623-628.

Streltzer, J., & Hassell, L. H. (1988). Noncompliant hemodialysis patients: A biopsychosocial approach. General Hospital Psychiatry, 10, 255-259.

Tracey, H. M., Green, C., & McCleary, J. (1987). Noncompliance in hemodialysis patients as measured with the MBHI. Psychological Health, 1, 411-423.

Turk, D. C., & Meichenbaum, D. (1991). Adherence to self-care regimens: The patient's perspective. In Sweet, J. J., Rozensky, R. H., & Tovian, S. M. (Eds), Handbook of clinical psychology in medical settings. New York: Plenum Press.

Turk, D. C., & Rudy, T. E. (1991). Neglected topics in the treatment of chronic pain patients – relapse, noncompliance, and adherence enhancement. Pain, 44, 5-28.

United States Renal Data System 1997 Annual Data Report. (1997). National Institute of Diabetes and Digestive and Kidney Diseases, NIH, HHS.

Wiebe, J. S., & Christensen, A. J. (1997). Health beliefs, personality, and adherence in hemodialysis patients: An interactional perspective. Annals of Behavioral Medicine, 19, 30-35.

Wolcott, D. L., Maida, C. A., Diamond, R., & Nissenson, A. R. (1986). Treatment compliance in end-stage renal disease patients on dialysis. American Journal of Nephrology, 6, 329-33.