Adherence to HIV Medications: Utility of the Theory of Self-Determination

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The utility of self-determination theory in predicting adherence to antiviral therapy (ART) was investigated in 205 HIV+ (85% male) patients. Participants completed brief structured adherence interviews and measures of perceived autonomy support, autonomous motivation, and perceived competence, specific to ART. Adherence measures included percentage of doses administered and precision of dose scheduling. As hypothesized, greater autonomy support predicted greater autonomous motivation for adherence, which predicted adherence through an indirect relationship mediated by perceived competence. Autonomy support from health care providers was most predictive of autonomous motivation. Psychological distress also contributed to the variance in adherence. Study results demonstrate the importance of psychological factors in predicting ART adherence, and emphasize the role of internal motivations and competencies.

KEY WORDS: adherence; ART; autonomous motivation; autonomy support; self-determination theory.

INTRODUCTION

For many, adherence to prescription medications is critical for maintaining or improving health status. This is particularly true for persons living with HIV, as adherence to HIV medications predicts both health status and future success with antiviral therapies (ART; Ho et al., 1995). The introduction of combination therapies in the treatment of HIV has contributed to a number of celebrated successes for individuals coping with HIV. Strict adherence to ART has been associated with decreased viral load, improved immune functioning, decreased mortality (Bangsberg et al., 2000; Cameron et al., 1998; Kelly, Otto-Salaj, Sikkema, Pinkerton, & Bloom, 1998; Saag et al., 2002; Staszewski et al., 1999) and increased quality of life (Swindells et al., 1999). The value of these medications cannot be underestimated in maintaining current and future health status. However, despite the apparent necessity for

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strict adherence to treatment with ART medications, such adherence is not easily achieved.

Problems With Adherence to HIV Medications

Strict adherence to ART regimens is relatively rare. For example, a study of 134 patients on combination therapy found that 30% had missed at least one dose in the past 3 days (Dunbar-Jacob, Burke, & Puczynski, 1995). A more recent study of 3788 men and women undergoing antiretroviral therapy found mean adherence rates of 36% over the course of a year (Becker, Dezil, Burtcel, Kawabata, & Hodder, 2002). Measures of adherence to strict dosing schedules depict an even bleaker picture with an average adherence rate of only 27% (Kastrissios et al., 1998). Adherence to HIV medications involves considerable adjustments to one's daily schedule as well as tolerance for many undesirable side effects. In fact, combination therapy has been described as possibly the most rigorous, demanding, and unforgiving treatment ever prescribed (Rabkin & Chesney, 1999). Individuals who participate in ART cite a number of factors that interfere with adherence, particularly with respect to dosing schedules and side effects associated with ART.

Combination therapy requires adherence to a complex dosing schedule that frequently interferes with many aspects of patients' lives. Patients must adapt both waking and sleeping hours, as well as their eating patterns to match the schedule that their ART regimens mandate. Some medications require careful attention to dietary intake including fat content of meals, whereas others require increased water intake (Chesney, Morin, & Sherr, 2000). Many patients also are challenged with integrating additional medications into their dosing schedule for the treatment of other conditions such as diabetes or hepatitis, or for coping with the undesirable side effects of ART itself. Not surprisingly, adherence decreases as the number of pills taken per day, number of doses taken per day, and length of time one has been on treatment increase (Maggiolo et al., 2002; Paterson et al., 2000). Adherence is also inversely related to the degree to which the regime interferes with individuals' daily routine (Mehta, Moore, & Graham, 1997). HIV medications are associated with a number of undesirable side effects including nausea, vomiting, diarrhea, and fatigue, as well as longer term effects including oral numbness, persistent metallic taste, cardiovascular problems, lipid redistribution, and neuropathy (Chesney et al., 2000). Unlike treatments for other illnesses, ART medications do not provide negative reinforcement in the form of relief, and in fact, are more likely to contribute to greater discomfort. In some cases, the severity of medication side effects discourages patients from taking the medications altogether.

Predicting Adherence to Art

Demographic and External Variables

Adherence to HIV medications also has been associated with a number of demographic variables. Mehta et al. (1997) report that adherence to medications increases with age, with the exception of the elderly who are less likely to adhere. Women tend

to adhere better, with the exception of those with child care commitments. Adherence typically is poorer among African Americans as well as individuals with low income, low-educational attainment, lack of medical insurance, and unstable or low-income housing (Mehta). Individuals undergoing antiviral therapies list a number of external barriers that contribute to nonadherence, including the cost of the medications, lack of transportation for obtaining medications, lack of child care, and lack of a primary care physician. Adherence also declines when illness becomes severe (Mehta).

Psychosocial Variables

Individuals on ART report a number of psychosocial barriers to adherence. Psychological distress has been identified as a risk factor for poor adherence to medical regimes (Dunbar-Jacob et al., 1995), including adherence to ART (Chesney et al., 2000). ART adherence is lower for those with psychiatric illness (Chesney et al., 2000; Magura, Laudet, Mahmood, Rosenblum, & Knight, 2002), and those reporting alcohol and drug use (Friedland & Williams, 1999). Depressed mood has repeatedly been associated with poorer adherence to ART (e.g., Catz, Kelly, Bogart, Benotsch, & McAuliffe, 2000; Chesney et al., 2000; Safren et al., 2001) as has a general pessimism about the future (Roberts & Mann, 2000). High scores on the Tension-Anxiety subscale of the Profile of Mood States (POMS) have also been associated with poorer adherence (Molassiotis et al., 2002). Unlike some health behaviors in which adherence is associated with elevated mood (e.g., physical activity), adherence to ART is not associated with improvements in mood (Lyketsos & Treisman, 2001).

Beliefs about the medications themselves also play a role in adherence. Patients who report low confidence in the efficacy of the medications and perceive minimal benefits resulting from ART are less likely to be adherent (Mehta et al., 1997). Lack of faith in the medications, combined with a poor outlook for the future, often leaves little motivation for adherence to prescribed pharmacotherapy. Adherence to ART medications also is predicted by perceived competence for taking medications as prescribed (Catz et al., 2000; Tuldra et al., 2000), as well as acceptance of one's seropositive status (Mehta).

Many patients report difficulty meeting the demands of family and/or work while maintaining their ART regime. As is the case with many individuals who take regular prescription medications, those with greater social support typically report greater adherence to HIV medications. Catz et al. (2000) reported a positive association between social support and adherence, though half of their sample also reported a reluctance to share their condition with others. Thus many of the individuals coping with this disease are likely to miss out on the positive effects of social support due to their unwillingness to disclose health status. Unlike previously studied health behaviors, patients' reluctance to disclose may force them to rely more heavily upon their own personal motivations rather than upon the support of others.

Applying Self-Determination Theory

Sikkema and Kelly (1996) suggest that adherence to HIV medications is likely to improve if patients take an active role in planning their treatment with their

physician by communicating their beliefs about treatment and conceivably empowering themselves to make their own choices regarding their health care. Attitudes towards adherence are likely to improve if the individual feels that he or she is freely choosing to participate in drug therapy at his or her own volition, and because it is important to him or her. This notion of patient autonomy and its role in predicting health behaviors is described by Williams, Frankel, Campbell, and Deci (2000) in the theory of self-determination (SDT).

SDT centers around the role of autonomous motivation, (originally termed autonomous regulation), which opposes the perception of undue pressure and obedience to medical authority. Rather, treatment decisions and associated behaviors are viewed as falling within the patient's domain. Individuals who regulate their behavior autonomously choose to do so because of the personal importance of the behavior for their health (Williams, Deci, & Ryan, 1998).

According to SDT (Williams et al. 2000), autonomous motivation is predicted by autonomy support, or perceived support from others for making autonomous decisions with regard to a particular health behavior (Williams, Rodin, Ryan, & Grolnick, 1998). SDT also suggests that the relationship between autonomous motivation and the behavior of interest (e.g., cigarette smoking), is mediated by perceived competence for the behavior. This construct, likened to self-efficacy, is defined by Williams and colleagues as an individual's confidence in his or her ability to carry out the behavior (i.e., stop smoking).

SDT has demonstrated predictive validity in a number of studies of health behaviors including smoking cessation (Williams, Cox, Kouides, & Deci, 1999; Williams, Gagne, Ryan, & Deci, 2002), substance abuse (Ryan, Plant, & O'Malley, 1995), and weight loss (Williams, Grow, Freedman, Ryan, & Deci, 1996). Williams, Freedman, and Deci (1998) investigated the role of self-determination theory in predicting adherence to diabetic medications over a 12-month period. The authors reported a significant association between perceived competence and adherence to diabetic medications, as well as a significant association between autonomous motivation and perceived competence. Autonomous motivation was associated with autonomy support, as predicted.

Williams, Rodin, et al. (1998) investigated the role of health care providers in supporting the autonomous motivation of their patients with a variety of medical disorders (e.g., hypertension, menopausal symptoms, and hyperthyroidism) using their measure of autonomy support known as the Health Care Climate Questionnaire (HCCQ). Results demonstrated that health care providers could foster autonomous motivation in their patients by conveying an understanding of the individual's choices and encouraging behaviors that coincide with his or her value system. Perceived support for patients' autonomy predicted autonomous motivation, which in turn predicted adherence to medications. Although providing evidence for the importance of provider support for autonomy, this study did not examine adherence to ART, specifically.

Given the range of health behaviors to which SDT has been successfully applied, it is reasonable to assume that this theory might also predict adherence to HIV therapy. Autonomous motivation may be especially important in this context, as many individuals choose not to disclose their HIV+ status to all in their social support

network, and therefore must rely heavily upon internal motivation to comply with these difficult regimes. For patients living with HIV, perceived competence (i.e., self-efficacy for adherence) has been shown to be predictive of better ART adherence (Mehta et al., 1997; Molassiotis et al., 2002), however its association to autonomy support and autonomous motivation has not been fully explored.

Health care providers are also thought to play a central role in providing support for adherence to ART. And for some patients, providers may be the only people with whom the patient discusses his or her antiviral regimen. Indeed, patients report that a lack of support from their physicians, and/or "undue pressure" from others hinder motivation for adherence (Mehta et al., 1997; Roberts & Mann, 2000). A study by Bakken et al. (2000) investigated the role of the patient-provider relationship using a 13-item measure of engagement with health care providers to predict antiviral adherence. This study demonstrated the importance of patient perceptions of their relationship with their provider (e.g., "My provider cares about me") in predicting adherence to HIV medications, however it did not specifically investigate adherence to ART.

Evidence from qualitative studies of HIV positive individuals suggests that adherence may be influenced not only by health care providers, but also by members of the individual's social network who are aware of patients' HIV+ status (Roberts & Mann, 2000). Although health care providers play a central role in deciding upon appropriate treatment, properly informed friends and family may play a greater role in supporting daily adherence. The effect of such relationships in supporting (or discouraging) autonomous motivation and adherence is not known. The relative influence of friends, family members, and health care providers on adherence to ART also has not been investigated.

The purpose of this study was to apply SDT to ART adherence with the goal of providing a theoretical framework for improving adherence interventions in the future. Unlike variables that are more determined (i.e., medication history and pharmacological properties), autonomy support, autonomous motivation and perceived competence are more amenable to intervention and may therefore offer more promise for influencing ART adherence. Thus, autonomy support, autonomous motivation, and perceived competence were examined along with traditional predictors (i.e., psychological distress, physical symptoms, and demographics) in a sample of HIV positive persons who had followed an antiviral regime for at least 4 months. It was expected that autonomous motivation would be higher for individuals who report greater autonomy support. In turn, individuals high in autonomous motivation were expected to report greater perceived competence to adhere, and those with greater perceived competence would demonstrate better adherence. Thus, autonomous motivation was expected to mediate the relationship between autonomy support and perceived competence, and perceived competence was expected to mediate the relationship between autonomous motivation and ART adherence (see Fig. 1).
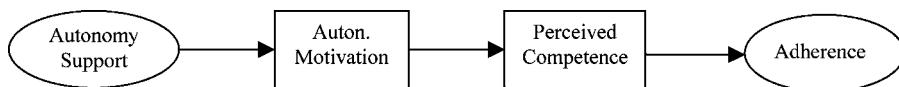

Fig. 1. Hypothesized model of adherence.

METHOD

Participants

Participants were recruited from four clinics that provide medical services for patients with HIV in a large Midwestern city. Eligible patients included those ≥18 years old who had been taking antiviral medications for at least 4 months and were capable of providing informed consent. Participants who were not independently responsible for taking their medications (i.e., prisoners, residents of assisted living facilities) were excluded. Ninety percent of those invited to participate completed the study. Information from four participants was discarded due to incomplete data ($n = 3$) or a doctor-prescribed drug holiday ($n = 1$).

The remaining 201 participants in the study sample were 85% male, 14% female, and 1% transgender, ranging in age from 18 to 66 years with a mean age of 40. Sixty-one percent of participants identified as gay/lesbian, 28% heterosexual, and 10% as bisexual. The majority of the participants (55%) were Caucasian, 38% were African American, and 5% were Hispanic. Remaining participants were Native American or Biracial. With regard to education, 86% had completed high school or equivalent, though 57% were unemployed. Fifty-one percent received Social Security Disability Insurance. The majority of participants reported little to no use of alcohol (55%) or recreational drugs (78%). Less than one third of participants (31%) had children.

Measures

Measures included five pencil-and-paper measures and a structured interview describing adherence to HIV medications over the past 3 days. The written questionnaires included background information, experiences with HIV medications, current symptoms, autonomous motivation, and autonomy support.

Background Information

Participants reported demographic information, medical history surrounding HIV status and treatment (including current CD4 count and viral load), and current substance use.

Autonomy Support

Support for autonomy surrounding HIV medications was assessed using the Health Care Climate Questionnaire (HCCQ; Williams et al., 1996) which measures perceived support from health care providers for adherence to specific health behaviors. The 6-item questionnaire was modified for the purpose of this study to address adherence to HIV medications specifically. Additional items also were added to address other sources of autonomy support including perceived support from friends and family. Participants respond to 14 statements describing perceived support from health care providers, friends, and family (e.g., "My family understands how I see my HIV treatment") using a 7-point Likert-type scale (αs = .94 to .96). Participants

who had not shared their HIV status with friends or family entered "0" for items pertaining to friends or family.

Autonomous Motivation

The Treatment Self-Regulation Questionnaire (TSRQ), developed by Williams et al. (1996), was used to assess autonomous motivation. This scale measures the extent to which individuals engage in specific health behaviors of their own volition because such behaviors hold personal importance for them, rather than doing so as a response to external pressures. In past research, the TSRQ has been modified to address specific health behaviors such as diet, exercise, and smoking cessation. Scale items were modified for the purpose of this study to address adherence to HIV medications specifically. Participants used a 7-point Likert-type scale to rate their agreement with 15 items describing the reasons they would take their HIV medications as they were prescribed to them (1 = *strongly disagree*, 7 = *strongly agree*). Mean participant ratings for the six items on the Autonomous Responses subscale (e.g., "I want to take responsibility for my own health;" $\alpha = .81$) comprised the measure of Autonomous Motivation.

Perceived Competence for Medication Adherence

A single item, modeled after Williams et al.'s measure of perceived competence (Williams et al., 2002), measured participants' beliefs in their ability to adhere to their prescribed HIV medications ("How confident are you that you can take your medications as prescribed by your doctor?"). Participants rated their response on a 5-point Likert scale (1 = *not at all confident*, 5 = *extremely confident*).

Psychological Distress

The Profile of Mood States (POMS; McNair, Lorr, & Droppleman, 1971) was used to assess psychological distress. Participants rated adjectives in three affective domains (Tension-Anxiety, Depression-Dejection, and Anger-Hostility) with respect to their mood during the past 7 days. Participants use a 5-point Likert scale (0 = *not at all*, 4 = *extremely*) such that high scores indicate high levels of psychological distress. Reliability measures for the three subscales ranged from .80 to .93.

Current Symptoms

Current symptoms were assessed with the Sign and Symptoms Checklist for Persons with HIV Disease (SSC-HIV; Holzemer et al., 1999). Participants rated the severity of 26 HIV-related symptoms over the past week using a 4-point Likert-type scale (1 = *not at all*, 4 = *severe*) such that higher scores indicate greater symptomatology. Factor scores were obtained for six broader categories of symptoms including malaise/weakness/fatigue, confusion/distress, fever/chills, gastrointestinal discomfort, shortness of breath, and nausea/vomiting. Cronbach's alpha for each of the six scales ranges from .77 to .90. Participants also rated the extent to which they attributed their current symptoms to their medications using a 5-point Likert scale (1 = *not at all*, 5 = *definitely*).

Adherence Measures

Self-Reported Adherence

Adherence to HIV medications was assessed via a brief structured interview. Trained interviewers inquired about each HIV medication separately, requesting participants to report the times they "normally" take each dose, followed by the number of doses taken over the past 3 days and the time at which each dose was taken. Consistent with previous measures of antiviral adherence (see Hogan et al., 2001; Paterson et al., 2000), interviewers recorded the number of missed doses, as well as the degree to which the timing of each dose corresponded to the prescribed dosing interval. Participants received two adherence scores based on (1) the ratio of doses taken over the past 72 hr divided by the number of doses prescribed, ("dose adherence"), as well as (2) the accuracy with which doses were taken at the prescribed dosing interval ("timing of doses"). This second measure of adherence was the ratio of the number of hours by which participants deviated from their prescribed dosing interval, divided by the 72-hr assessment period (e.g. deviance from recommended dosing intervals of 24, 12, or 8 hr for medications taken once, twice, or three times per day, respectively). Dosing ratios were measured in reference to the "baseline" time at which participants normally take each dose, and were subtracted from 1 in order to represent adherence (vs. nonadherence). Consistent with other studies which have used a similar measure to create a dichotomous variable of adherence (e.g., doses taken within a 3-hr "window" of the proper dosing time; see Paterson et al., 2000), the "timing of doses" variable provides a more sensitive measure of adherence, while also allowing for measurement on a continuous scale.

Pharmacy Refill Logs

Pharmacy refill logs also were obtained for a subsample of 40 participants in order to verify the validity of self-reported adherence measures. Pharmacy records for 40 randomly selected participants indicated the dates at which participants had obtained their last four refills of HIV medications (spanning a 4-month period), as well as the number of doses contained therein. This information was used to determine the total number of days in a 4-month period during which participants were late in refilling their prescription. Participant adherence scores were dichotomized according to those who had missed a dose and those who had not, and were compared with a dichotomous measure of prescription refill promptness (late vs. not). Chi-square analysis indicated a significant relationship between missed doses and prescription refill scores ($\chi^2 = 8.58$, $p < .001$), providing support for the construct validity of self-reported adherence measures, and indicating that participants were honest and accurate in their self-reported antiviral adherence. Further support for the validity of our adherence measures was demonstrated by the observed relationship between miss doses and viral load such that participants reporting $\geq 95\%$ adherence were more likely to report an undetectable viral load ($\chi^2 = 3.6$, $p = .05$) than those reporting $<95\%$ adherence.

Procedure

Flyers describing the study were posted in clinic waiting rooms. Patients also were notified of the opportunity to participate by their health care provider, and those who expressed interest in the study were referred to an on-site study leader. Study leaders met patients in their examination room and provided further information about the study, followed by a review of inclusion criteria. Patients provided their informed consent to participate, and then began the brief structured interview. Following the interview, they completed the 10-page packet of questionnaires. Upon completion of the questionnaire packet, participants received $10 for their time, and were thanked for their participation. Approval for the study was obtained from the respective Institutional Review Board at each study site.

RESULTS

Preliminary Analyses

Descriptive statistics for the study sample are presented in Table I. Participants had been living with HIV disease for an average of 7.7 years ($SD = 4.6$). Recent measures of viral load were undetectable for 55% of participants. CD4 cell counts ranged from 193 to 5366, with a mean CD4 count of 465 ($SD = 462.5$). Forty-five percent of participants reported being diagnosed with an opportunistic infection, and 52% had been diagnosed with AIDS in their lifetime. Participants had been on an average of three antiviral regimes, and 12% used a timer or other reminder to prompt medication administration. Substance use was relatively low with only 10% reporting alcohol use more than twice per week, and 79% abstaining from recreational drugs.

Adherence to the antiviral regime was relatively high, with 87% of participants reporting no missed doses over the 3-day period (dose adherence). According to traditional measures of adherence, which allow for a 3-hr "window" on either side

Table I. Means and Standard Deviations for Study Variables

Variable	M	SD	Range
Years HIV+	7.65	4.64	.75–18.75
Viral Load (%undetectable)	55		Undet. to 750000
CD4 cell count	456	462.5	193–5366
Number of regimes	3.26	1.51	1–5+
Difficulty of regime	4.43	.881	1–5
Perceived competence	4.57	.745	1–5
Autonomy support			
Provider support	6.14	1.39	1–7
Family support	4.71	2.55	0–7
Friend support	4.38	2.52	0–7
Autonomous motivation	6.46	.81	2–7
POMS	32.21	38.84	−30–173
Adherence			
Missed doses	94	2.0	0–100
Hours off	85	2.0	0–100

of the proper dosing time, 67.3% of participants reported perfect adherence (timing of doses).

Bivariate correlations are presented in Table II. As expected, a relationship between autonomy support from one's provider and autonomous motivation was supported ($r = .42, p < .01$). Autonomy support from one's family was also associated with autonomous motivation ($r = .20, p < .01$), though autonomy support from friends was not. Autonomous motivation was associated with the more sensitive measure of timing of doses ($r = .15, p < .05$), however it was not significantly related to dose adherence. Perceived competence was significantly associated with both measures of adherence (timing of doses $r = .27, p < .01$ and dose adherence $r = .23$, $p < .01$). Traditional predictors such as age, employment, and substance use were not directly related to either measure of adherence. Difficulty of the prescribed regime, measured by a single item on a Likert-type scale, was significantly related to both measures of adherence (timing of doses $r = .22, p < .01$; doses adherence $r = .21, p < .01$), as were the three psychological distress subscales of the POMS (tension-anxiety, depression-dejection, and anger-hostility; timing of doses $r = -.20, -.28, -.20$, all p's $< .01$ and dose adherence $r = -.19, -.28, -.20$, all p's $< .01$, respectively).

Structural Equation Model

To test the utility of the hypothesized model developed from SDT, the four study variables were entered into a four-step model including one background variable, two mediating variables, and one dependent variable (see Fig. 2). Autonomy support was entered as a latent variable, including both (1) support from one's health care provider, and (2) support from family. This background variable was expected to predict autonomous motivation, resulting in greater perceived competence, and finally in greater adherence to the HIV medications (the dependent variable). Psychological distress and difficulty of the regime were also entered as independent predictors of perceived competence and adherence, though difficulty of the prescribed regime did not contribute significantly to the model, and was therefore removed for the sake of parsimony. The dependent variable of adherence to the medications was entered as a latent variable comprised of dose adherence and timing of doses. Patient ratings of symptomatology were also associated with psychological distress (standardized coefficient $= .23$), though this relationship did not contribute significantly to the model, and was therefore excluded for the sake of parsimony.
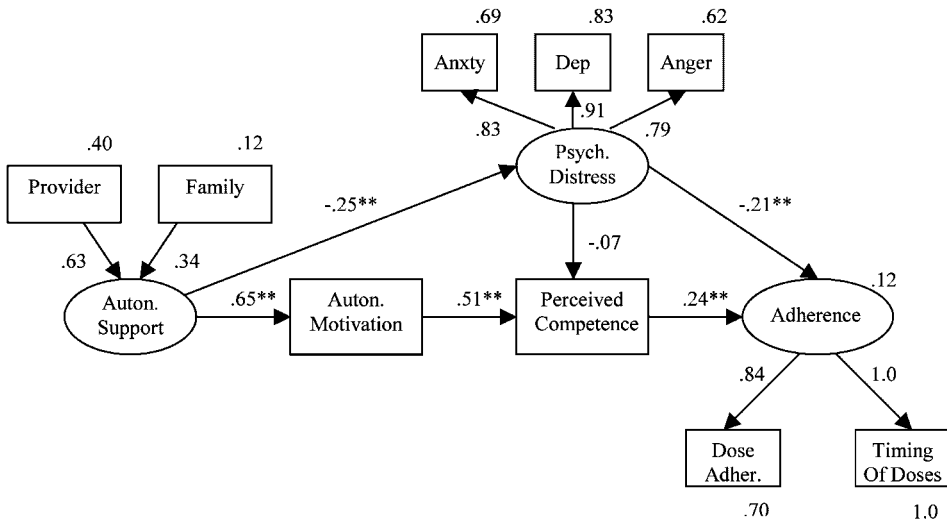
The model was tested using analysis of moment structures (AMOS; Arbuckle, 1989) and demonstrated good model fit according to the chi-square statistic, which provides an absolute index of model fit, $\chi^2(22, N = 202) = 17.47, p = .74$. Three relative indices also indicated good model fit (CFI = 1.0, TLI = 1.0, NFI = .996). Finally, the RMSEA, which ranks the model according to goodness of fit, also demonstrated good model fit (RMSEA = .00).

Five of the six paths were significant at the .01 level. As predicted, autonomy support was a significant predictor of autonomous motivation (standardized coefficient $= .65, p < .01$). Autonomous motivation also significantly predicted perceived competence (standardized coefficient $= .51, p < .01$), and perceived competence

Table II. Correlations Among Study Variables ($N = 201$)

Study variable	Provider support	Friend support	Family support	Autonomous motivation	Difficulty of regime	Perceived competence	Symptoms	Tension/ anxiety	Depression/ dejection	Anger/ hostility	Timing of Doses	Dose Adherence
Provider support	—	.16*	.21**	.42**	.29**	.30**	-.08	-.10	-.13	-.08	.07	.06
Friend support		—	.35**	.13	-.02	.00	.06	.01	-.08	-.06	.00	-.01
Family support			—	.20**	.11	.14*	-.05	-.12	-.18*	-.15*	.04	.03
Autonomous motivation				—	.21**	.52**	-.14	-.07	-.18*	-.12	.15*	.05
Difficulty of regime					—	.26**	-.40**	-.15*	-.17*	-.13	.22**	.21**
Perceived Competence						—	-.19**	-.12	-.16*	-.08	.27**	.23**
Symptoms							—	.50**	.39**	.31**	-.20**	-.19**
Tension/ Anxiety								—	.76**	.66**	-.20**	-.19**
Depression/ dejection									—	.72**	-.28**	-.28**
Anger/ hostility										—	-.20**	-.20**
Timing of doses											—	.87**
Dose adherence												—

*$p < .05$. **$p < .01$.

Fig. 2. Resulting model of adherence.

Note. N = 202.

** *p* < .01

χ^2 (22, N = 202) = 17.47, *p*=.74

CFI = 1.00, TLI = 1.00, NFI = .996.

was significantly associated with adherence to HIV medications (standardized coefficient = .24, *p* < .01). In addition, autonomy support was also a significant predictor of psychological distress (standardized coefficient = −.25, *p* < .01), and psychological distress was a significant predictor of adherence (standardized coefficient = −.21, *p* < .01). Psychological distress and perceived competence were not significantly associated (standardized coefficient = −.07, *p* > .05). Twelve percent of the variance in adherence to the medications was explained by the model.

DISCUSSION

The purpose of this study was to test SDT in relation to adherence among HIV+ patients. As expected, autonomy support was predictive of autonomous motivation for adherence, which predicted perceived competence for adherence, and ultimately, resulted in greater adherence. Adherence to HIV medications was also associated with low psychological distress.

The resulting model highlights the importance of self-determination in maintaining adherence to ART, lending support to the value of this model in predicting health behaviors, including adherence to ART. Perceived competence is identified as the strongest direct predictor of adherence, and is associated with patients' sense

of autonomy surrounding their medication adherence. Although the theoretical antecedents of perceived competence (i.e., performance accomplishments, vicarious experience, verbal persuasion, and physiological state) were originally described by Bandura (1977), empirically evidence of their existence and relative importance as related to ART adherence is lacking. Future studies should continue to explore additional factors that contribute to perceived competence as it relates to adherence, including both environmental and psychological variables. On the basis of the results of this study, likely candidates include autonomous motivation, autonomy support, patient beliefs about their ART regime (i.e., perceived difficulty and beliefs that current symptoms are related to medications) and substance use.

Consistent with Williams et al.'s most recent application of SDT in a study of smoking cessation (Williams et al., 2002) , autonomous motivation was not directly related to adherence. This can be seen as adding support for a revision of SDT to include perceived competence as a mediator of autonomous motivation and health behaviors in general. However, it is possible that adherence to HIV medication and smoking cessation represent different behavioral domains from those investigated previously (see Williams et al., 2000; Williams, Rodin, et al., 1998). For example, the necessity for antiretroviral therapy may override the role of patient autonomy in treatment adherence. It is also possible that the complexity of the regimes themselves may demand greater autonomous patient commitment to overcoming barriers for successful treatment when compared to simpler treatments in which patient perceived competence is more easily achieved, even under less autonomous circumstances. Finally, the stigma associated with HIV disease and, to a lesser but still significant extent, smoking may require more internal motivation than other less stigmatized health behaviors.

Patients living with HIV report support from both family and health care providers to make autonomous decisions with regard to treatment. Consistent with SDT, this support contributed to greater autonomous regulation of their medical regime. Participants in this study identified their health care providers as their strongest sources of support for autonomy, followed by autonomy support from family. Autonomy support from friends was not associated with autonomous motivation. A significant minority of participants (15%) reported that they had not disclosed their HIV status to friends or family numbers, making it impossible to garner treatment support these sources. Clearly patients who have not disclosed to family and friends are most comfortable talking to their providers about decisions regarding treatment for their disease or were simply required to do so in order to receive care. Patients may also view their providers as being more realistic with respect to drug adherence and therefore a better source of treatment advice and support than family and friends. Despite the relatively limited contact patients have with their providers, much of their support for making autonomous decisions comes from these relationships.

Psychological distress has often been identified as a barrier to adherence in ART (Chesney et al., 2000; Molassiotis et al., 2002). The association between such distress and adherence is demonstrated in the present study. Although not a part of the original model, psychological distress was more strongly associated with adherence than were the autonomy variables and perceived competence. Such distress may

have been influenced by various factors, including those related to the disease itself or the realization that one isn't able to adhere perfectly. Thus, although autonomy support and autonomous motivation are important in achieving strong adherence, the effects of such support may be counteracted by patients' level of psychological distress.

The results of this study lend support to the relationship between autonomy support and autonomous motivation, and their relationship to adherence. These constructs represent an important part of a larger theoretical framework that incorporates SDT with two additional constructs, namely perceived competence for medication adherence and psychological distress. Adherence to HIV medications depends upon individuals' psychological state, as well as their belief in their ability to adhere to the medications, as predicted by their autonomous role in making and carrying out treatment decisions.

Interventions for Promoting Adherence to HIV Medications

The results of this study help to identify several variables that may be targets of intervention to promote adherence among HIV+ patients. First, health care providers are identified as important loci for intervention as sources of autonomy support, perceived competence, and ultimately, adherence. Health care providers who recognize and reinforce autonomy rather than viewing it as a threat can foster a supportive and collaborative environment, improving the odds of effective disease management. Providers should be alert to factors that may interfere with adherence, including psychological distress or a passive approach towards treatment. In addition to intervening upon the role of the health care provider, interventions may directly support patients in asserting their autonomy in making decisions related to HIV treatment. Family education may also help to support patient autonomy and improve adherence rates.

Recent trends towards self-care and patient responsibility for health care rely on patients' ability to participate in treatment independent from one's health care provider. In addition to patient education, this approach relies upon patient motivation to participate in treatment. Thus, strategies for assessing and facilitating autonomous motivation of treatment are needed. The model derived from this study shows that adherence to HIV medications may be enhanced by supporting patient autonomy with regard to ART, and demonstrates the extent to which adherence is affected by such support, above and beyond traditional predictors of adherence.

Study Limitations

Measuring Adherence

Obtaining an accurate measure of adherence continues to pose a challenge to researchers. This study relied upon self-report in which participants described their regime and then reported their dosing over the past 3 days, as is common in the adherence literature (Chesney et al., 2000). Although adherence rates were

comparable to those obtained in previous studies (67% of sample reporting perfect adherence), this measure of participant recall is subject to bias as well as social desirability. To promote the accuracy of participant recall, self-reported adherence was limited to the 3-day period directly prior to a clinic visit, which may not have been representative of participants' overall level of adherence. Nonetheless, measures of exact dosing schedules during the past 3 days provide a more objective measure of adherence than do global patient-rating scales. Surprisingly, dosing schedules described by some participants in this study did not correspond to those described in drug package inserts (e.g., every 12 hr). Thus, although some patients described what they considered to be perfect adherence, some dosing schedules would not have been classified as such according to pharmacist recommendations.

Attempting to validate participant self-report with pharmacy records also posed measurement challenges for those participants who obtained medications from multiple sources, or changed drug regimes frequently. Additionally, some participants were prescribed a "drug holiday" prior to the study, and thus retained a supply of medication, even when their prescription was due for a refill. Indirect measures of adherence, such as viral load and CD4 count are also imperfect predictors of the accuracy of self-reported adherence due the inherent lag between medication administration and viral or immune response, as well as development of drug resistance.

Finally, adherence measures for the this study did not take into account the dietary restrictions associated with the various antiviral medications, which have been shown to affect viral suppression, above and beyond the timing of antiviral medication dosages (Nieuwkerk et al., 2001). Nor were additional medications prescribed for management of HIV symptoms (e.g., antinausea or antidiarrhea medications) assessed.

The findings in this study would likely be enhanced by stronger measures of adherence in order to better analyze the relationship between adherence and the psychological constructs included in self-determination theory. For example, adherence measures that do not rely upon self-report and are less sensitive to recall bias might demonstrate a stronger relationship with perceived competence and other constructs included in the model.

Recruitment and Cross-Sectional Design

It is important to note that this study employed a convenience sample and relied upon voluntary participation among patients at local HIV clinics. Although participants were recruited from four different clinics, the study sample may not be representative of the larger population of HIV+ individuals, which includes those not receiving medical services. The cross-sectional nature of this study also precludes definitive statements regarding the direction of associations among study variables. For example, although perceived competence is believed to contribute to medication adherence, this construct also may be affected by adherence itself. Psychological distress may result from poor adherence, rather than the reverse path suggested by the model.

SUMMARY

This study provides a multisite investigation of the role of autonomy in adherence to HIV medications, involving a relatively large and diverse sample. The resulting model helps to identify those constructs that are amenable to intervention, and targets key players (i.e., health care providers) in helping to enhance medication adherence. The model, which demonstrates superb model fit, explains 12% of the variance in adherence as attributed to the four study variables (autonomy support, autonomous motivation, perceived competence, and psychological distress), and provides a strong theoretical framework from which to further examine adherence to HIV medications. Further investigation is needed in order to identify other factors that also contribute to antiviral adherence.

The aversive nature of the medication regimes does not lend itself to strong adherence. Although simpler drug regimes for the treatment of HIV have been newly introduced, adherence to these regimes continues to challenge patients and providers alike, particularly in the face of developing resistance to preferred regimes. This study offers strategies for overcoming some of the barriers associated with these admittedly difficult treatments and highlights the importance of both individual factors and the role of health care providers in enhancing treatment adherence.

REFERENCES

Arbuckle, J. H. (1989). AMOS: Analysis of moment structures. *American Statistician*, *43,* 66.

Bakken, S., Holzemer, W. L., Brown, M. A., Powell-Cope, G. M., Turner, J. G., Inouve, J., et al. (2000). Relationships between perception of engagement with health care provider and demographic characteristics, health status, and adherence to therapeutic regimen in persons with HIV/AIDS. *AIDS Patient Care and STDs*, *14*(4), 189–197.

Bandura, A. (1977). Perceived competence: Toward a unifying theory of behavioral change. *Psychological Review*, *84,* 191–215.

Bangsberg, D. R., Hecht, F. M., Charlebois, E. D., Zolopa, A. R., Holodniy, M., Sheiner, L., et al. (2000). Adhernce to protease inhibitors, HIV-1 viral load, and development of drug resistance in an indigent population. *AIDS*, *14,* 357–366.

Becker, S., Dezil, C. M., Burtcel, B., Kawabata, H., & Hodder, S. (2002). Young HIV-infected adults are at greater risk for medication nonadherence. *Medscape HIV/AIDS eJournal*, *8*(4). Retrieved February 27, 2004, from http://www.medscape.com/viewarticle/438510.

Cameron, D. W., Heath-Chiozzi, M., Danner, S., Cohen, C., Kravcik, S., Maurath, C., et al. (1998). Randomized placebo-controlled trial of ritonavir in advanced HIV-1 disease. *Lancet*, *351,* 543–549.

Catz, S. L., Kelly, J. A., Bogart, L. M., Benotsch, E. G., & McAuliffe, T. L. (2000). Patterns, correlates, and barriers to medication adherence among persons prescribed newtreatments for HIV disease. *Health Psychology*, *19*(2), 124–133.

Chesney, M. A., Morin, M., & Sherr, L. (2000). Adherence to HIV combination therapy. *Social Science and Medicine*, *50,* 1599–1605.

Dunbar-Jacob, J., Burke, L. E., & Puczynski, S. (1995). Clinical assessment and management of adherence to medical regimens. In P. M. Nicassio & T. W. Smith (Eds.), *Managing chronic illness*. Washington, DC: American Psychological Association.

Friedland, G. H., & Williams, A. (1999). Attaining higher goals in HIV treatment: The central importance of adherence. *AIDS*, *13,* 61–72.

Ho, D. D., Neumann, A. U., Perelson, A. S., Chen, W., Leonard, J. M., & Markowitz, M. (1995). Rapid turnover of plasma virions and CD4 lymphocytes in HIV-1 infection. *Nature*, *373,* 123–126.

Hogan, J. W., Schuman, P., Rompalo, A. M., Howard, A. A., Korkontzelou, C., & Smith, D. K. (2001). Antiretroviral regimen complexity, self-reported adherence, and HIV patients' understanding of their

regimens: Survey of women in the HER study. *Journal of Acquired Immune Deficiency Syndromes*, *28*(2), 124–131.

Holzemer, W. L., Henry, S. B., Nokes, K. M., Corless, I. B., Brown, M., Powell-Cope, G. M., et al. (1999). Validation of the sign and symptom checklist for persons with HIV disease (SSC-HIV). *Journal of Advanced Nursing*, *30,* 1041–1049.

Kastrissios, H., Suarex, J. R., Katzenstein, D., Girard, P., Sheiner, L. B., & Blaschke, T. F. (1998). Characterizing patterns of drug-taking behavior with a multiple drug regimen in an AIDS clinical trial. *AIDS*, *12,* 2295–2303.

Kelly, J. A., Otto-Salaj, L. L., Sikkema, K. J., Pinkerton, S. D., & Bloom, F. R. (1998). Implications of HIV treatment advances for behavioral research on AIDS: Protease inhibitors and new challenges in HIV secondary prevention. *Health Psychology*, *17,* 310–319.

Lyketsos, C. G., & Treisman, G. J. (2001). Mood disorders in HIV infection. *Psychiatric Annals*, *31*(1), 45–49.

Maggiolo, F., Ripamonti, D., Arici, C., Gregis, G., Quinzan, G., Camacho, G. A., et al. (2002). Simpler regimens may enhance adherence to antiretrovirals in HIV-infected patients. *HIV Clinical Trials*, *5*(5), 371–378.

Magura, S., Laudet, A. B., Mahmood, D., Rosenblum, A., & Knight, E. (2002). Adherence to medication regimens and participation in dual focus self-help groups. *Psychiatric Services*, *53*(3), 310–6.

McNair, D., Lorr, M., & Droppleman, L. (1971). *Profile of mood states*. San Diego: EdITS/Educational and Industrial Testing Service.

Mehta, S., Moore, R. D., & Graham, N. M. H. (1997). Potential factors affecting adherence with HIV therapy. *AIDS*, *11,* 1665–1670.

Molassiotis, A., Nahas-Lopez, V., Chung, W. Y. R., Lam, S. W. C., Li, C. K. P., & Lau, T. F. J. (2002). Factors associated with adherence to antiretroviral medication in HIV-infected patients. *International Journal of STD and AIDS*, *13*(5), 301–310.

Nieuwkerk, P. T., Sprangers, M. A., Burger, D. M., Hoetelmans, R. M., Hugen, P. W., Danner, S. A., et al. (2001). ATHENA Project. Limited patient adherence to highly active antiviral therapy for HIV-1 infection in an observational cohort study. *Archives of Internal Medicine*, *161*(16), 1962–1968.

Paterson, D. L., Swindells, S., Mohr, J., Brester, M., Vergis, E. N., Squier, C., et al. (2000). Adherence to protease inhibitor therapy and outcomes in patients with HIV infection. *Annals of Internal Medicine*, *133,* 21–30.

Rabkin, J. G., & Chesney, M. (1999). Treatment adherence to HIV medications: The Achilles heel of the new therapeutics. In D. G. Ostrow & S. C. Kalichman (Eds.), *Psychosocial and Public Health Impacts of New HIV Therapies* (pp. 61–82). NY: Plenum Publisher.

Roberts, K. J., & Mann, T. (2000). Barriers to antiretroviral medication adherence in HIV-infected women. *AIDS Care*, *12*(4), 377–386.

Ryan, R. M., Plant, R. W., & O'Malley, S. (1995). Initial motivations for alcohol treatment: Relations with patient characteristics, treatment, involvement, and dropout. *Addictive Behaviors*, *20,* 279–297.

Saag, M. S., Tebas, P., Sension, M., Conant, M., Myers, R., Chapman, S. K., et al. (2002). Randomized, double-blind comparison of two nelfinavir doses plus nucleosides in HIV-infected patients (Agouron study 511). *AIDS*, *15,* 1971–1978.

Safren, S. A., Otto, Michael, W., Worth, J. L., Salomon, E., Johnson, W., et al. (2001). Two strategies to increase adherence to HIV antiretroviral medication: Life-steps and medication monitoring. *Behaviour Research & Therapy*, *39*(10), 1151–1162.

Sikkema, K., & Kelly, J. A. (1996). Behavioral medicine interventions can improve the quality of life and health of persons with HIV disease. *Annals of Behavioral Medicine*, *18*(1), 40–48.

Staszewski, S., Morales-Ramirez, J., Tashima, K. T., Rachlis, A., Skiest, D., Stanford, J., et al. (1999). Efavirenz plus zidovudine and lamivudine, evarienz plus indinavir, and indinavir plus zidovudine and lamivudine in the treatment of HIV-1 infection in adults. *New England Journal of Medicine*, *341,* 1865–1873.

Swindells, S., Mohr, J., Justis, J. C., Berman, S., Squier, C., Wagener, M. M., et al. (1999). Quality of life in patients with human immunodeficiency virus infection: Impact of social support, coping style, and hopelessness. *International Journal of STD and AIDS*, *10,* 383–391.

Tuldra, A., Fumaz, C., Ferrer, M., Bayes, R., Arno, A., Balague, M., et al. (2000). Prospective randomized two-arm controlled study to determine the efficacy of a specific intervention to improve long-term adherence to highly active antiretroviral therapy. *Journal of Acquired Immune Deficiency Syndromes*, *25*(3), 221–228.

Williams, G. C., Cox, E. M., Kouides, R., & Deci, E. L. (1999). Presenting the facts about smoking to adolescents: The effects of an autonomy supportive style. *Archives of Pediatrics and Adolescent Medicine*, *153,* 959–964.

Williams, G. C., Deci, E. L., & Ryan, R. M. (1998). Supporting patients' autonomy to promote maintained behavior change and positive health outcomes. In A. L. Suchman, R. Botelho, & P. Hinton-Walker (Eds.), *Partnerships, power, and process: Transforming health care delivery* (pp. 67–87). Rochester, NY: University of Rochester Press.

Williams, G. C., Frankel, R. M., Campbell, T. L., & Deci, E. L. (2000). Research on relationship-centered care and healthcare outcomes from the Rochester Biopsychosocial Program: A Self-Determination Theory integration. *Families, Systems, and Health*, *18*(1), 79–90.

Williams, G. C., Freedman, Z. R., & Deci, E. L. (1998). Supporting autonomy to motivate glucose control in patients with diabetes. *Diabetes Care*, *21,* 1644–1651.

Williams, G. C., Gagne, M., Ryan, R. M., & Deci, E. L. (2002). Facilitating autonomous motivation for smoking cessation. *Health Psychology*, *21*(1), 40–50.

Williams, G. C., Grow, V. M., Freedman, Z., Ryan, R. M., & Deci, E. L. (1996). Motivational predictors of weight loss and weight-loss maintenance. *Journal of Personality and Social Psychology*, *70,* 115–126.

Williams, G. C., Rodin, G. C., Ryan, R. M., & Grolnick, W. S. (1998). Autonomous regulation and long-term medication adherence in adult outpatients. *Health Psychology*, *17*(3), 269–276.