

# Baseline Predictors of Ninety Percent or Higher Antiretroviral Therapy Adherence in a Diverse Urban Sample: The Role of Patient Autonomy and Fatalistic Religious Beliefs

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## Abstract

The role of patient autonomy and influence of religious/spiritual beliefs on antiretroviral therapy (ART) adherence is to date not fully understood. This study assessed baseline predictors of high ART adherence ( $\geq 90\%$ ) measured by electronic drug monitors (EDM) at 12 and 24 weeks after enrollment in a randomized controlled trial testing behavioral interventions to improve ART adherence. Baseline data were collected with audio computer-assisted self interviews (ACASI) surveys among a diverse urban sample of HIV-infected participants ( $n = 204$ ) recruited from community clinics in a large midwestern city. Baseline variables included a range of established ART adherence predictors as well as several less frequently studied variables related to patient autonomy and religious/spiritual beliefs. Statistically significant ( $p < 0.05$ ) variables identified in univariate analyses were included in subsequent multivariate analyses predicting higher than 90% adherence at 12 and 24 weeks. Several baseline predictors retained statistical significance in multivariate analysis at 24 weeks. Baseline levels of autonomous support from friends and family, motivation to adhere, and having an active coping style were all positively associated with adherence, while the belief that God is in control of one's health was negatively associated with adherence. Results indicate that effective interventions should include a focus on promoting patients' autonomous regulation and religious/spiritual beliefs regarding ART adherence.

## Introduction

WHILE THE ASSOCIATION between antiretroviral therapy (ART) adherence and viral suppression has become more forgiving with the use of newer, more potent protease inhibitor (PI)-boosted and non-nucleoside reverse transcriptase inhibitors (NNRTI)-based regimens, moderately high levels of adherence are still required to achieve viral suppression and avoid drug resistance.<sup>1-3</sup> In addition to improving individual treatment success, strong ART adherence has an impact on secondary prevention by reducing viral load, and consequently reducing the risk of transmission at the population level.<sup>4,5</sup> Furthermore, strong adherence can lead to significant reductions in costs of care, and can minimize the need for complex salvage therapies and hospitalizations.<sup>6</sup>

Achieving and maintaining high adherence is an ongoing challenge for both clients and providers. The demands of

daily dosing and impact of medication side effects can be onerous and requires a high degree of commitment from patients.<sup>7</sup> Providers must inform clients about the risks and benefits of ART in the most compelling way to encourage adherence, and identify early those most likely to struggle with their regimens. Identifying characteristics of patients that are clinically meaningful predictors of subsequent adherence is therefore important for targeting adherence interventions.

Although rarely looked at comprehensively in the same study, factors associated with poor ART adherence include: (1) demographics [e.g., younger age,<sup>8</sup> low educational attainment,<sup>9</sup> low income level,<sup>10</sup> and number of children (for women<sup>11</sup>)], (2) lifestyle (e.g., active drug<sup>12</sup>/alcohol use,<sup>13</sup> homelessness<sup>14,15</sup>), (3) regimen variations (e.g., more frequent dosing and high number of pills,<sup>16</sup> complexity of administration, and shorter duration of antiretroviral use<sup>9</sup>), (4) psychosocial variables (e.g., stress, anxiety and depression,<sup>13,17</sup> lack of self-efficacy to adhere,<sup>10,18</sup> and lack of perceived

efficacy of ART<sup>9</sup>), and (5) clinically related factors (e.g., low baseline CD4 count,<sup>9,12</sup> high baseline viral load,<sup>16</sup> and severe side effects of medication<sup>16,18</sup>).

Recent research has begun to explore factors that may be particularly important in diverse communities such as the relationship between religion/spirituality and HIV adherence.<sup>19,20</sup> For example, the potentially important construct of God Locus of Health Control (GLHC)<sup>21</sup> (believing that God is in control of your health) has proven useful in understanding adherence to other health behaviors such as breast cancer screening.<sup>22</sup> Among African American women, high GLHC scores have been found to be associated with poorer health behaviors such as infrequent clinical breast exams and mammography.<sup>22</sup> GLHC has received considerably less attention in the context of HIV adherence. The impact of religious/spirituality beliefs and behaviors on adherence have yet to be explored using a state of the art method such as electronic drug monitors (EDM).<sup>19,20,23,24</sup> Another relatively new and potentially important focus of adherence research is the role of patients' autonomous motivation for adherence.<sup>23,25</sup> Extensive research on other health issues indicates that autonomous regulation (i.e., making health decisions based on a sense of choice or full volition) leads to longer-term behavior change and more positive health behaviors than behaviors that are externally motivated through persuasion or motivation to comply with the demands of others.<sup>26–29</sup> Autonomous regulation is characterized by an internal perceived locus of control<sup>30</sup> rather than an external locus of control (such as with a high GHLC). Autonomous motivation differs from GLHC in that it concerns the nature of a person's motivation to engage in a health behavior (i.e., whether perceived as freely chosen) rather than the perceived locus of what determines his or her health status. Autonomous regulation can also be fostered by providers, family, and friends through the provision of autonomy support. Support by others for one's ability to make one's own decisions regarding one's health has been shown to increase autonomous regulation and positive health behaviors.<sup>26,27</sup> Despite their potential importance in understanding ART adherence, these variables have not been explored using EDM data.

In this study we attempted to identify the most clinically meaningful predictors of adherence from among those assessed at the onset of the study. We examined both established baseline predictors of adherence as well as more novel variables in a diverse sample of HIV-infected patients recruited through community clinics for a randomized trial of behavioral interventions to increase adherence. Adherence was assessed with EDM over the course of 24 weeks. We examined baseline predictors of adherence at the end of the intensive treatment period (week 12) and follow-up (week 24).

## Methods

Project MOTIV8, a three-armed, multisite randomized controlled trial was conducted between 2004 and 2009 to assess the effect of behavioral interventions on ART adherence among 204 HIV-infected community clinic patients. MOTIV8 compared the success of motivational interviewing-based cognitive behavioral therapy (MI-CBT) counseling with modified directly observed therapy (MI-CBT/mDOT) versus MI-CBT counseling alone versus the standard care (SC) to increase ART adherence.

## Participants and Procedures

Participants were recruited from four outpatient clinics and two private practices in a large midwestern city. Participants were randomly assigned to one of the three study groups (MI-CBT/mDOT, MI-CBT only, or SC) for a period of 24 weeks. The intensive portion of the intervention was administered during the first 12 weeks, followed by a gradual reduction in contact during the remaining 12 weeks. Eligible patients were HIV-infected, at least 18 years of age, English speaking, resided within a 25-mile radius of the project offices, and who were either naïve to treatment, reported adherence problems, or were changing their ART regimen. Exclusion criteria included pregnancy, an acute illness or planned move that would interfere with their ability to participate in study procedures, lack of cognitive capacity to consent, or lack of health care provider assent for participation.

Baseline data were collected with audio computer-assisted self interviews (ACASI) surveys. All baseline measures hypothesized to influence adherence to ART were assessed to determine predictors of adherence. The main outcomes of the trial have been presented elsewhere (Goggin et al., unpublished data).<sup>31</sup> Trial procedures were approved and monitored by the appropriate Institutional Review Boards.

## Measures

### Outcome measure

**Adherence** ART adherence was measured using EDM, specifically medication bottle caps (Medication Event Monitoring System; www.aardex.ch) that record the date and time of each opening. EDM was used to track adherence to the medication in a patient's regimen with the most complex dosing schedule. This method has previously been demonstrated to be an accurate representation of adherence for all medications in a regimen.<sup>32</sup> Raw EDM adherence data were cleaned to ensure that the most accurate picture of participants' adherence was represented in the final dataset. First we ensured that no patient had greater than 100% adherence in any 24-h period. Next, we removed from the denominator documented periods of time where the participant was unable to use the EDM cap (e.g., hospitalization, physician-ordered medication holiday, incarceration, or lost cap). Finally we calculated summary adherence variables for each participant. For the analyses described here, we focused on one summary measure of adherence, 90% or greater adherence to all doses during the 30-day period before each evaluation visit (12 and 24). Although thresholds ranging from 70% to 95% were considered, the cutoff point of 90% adherence was determined to be the most clinically relevant.<sup>33</sup>

### Baseline measures

Demographic measures included age, race, gender, sexual orientation, education, income, housing status, relationship status, and number of children. Data on alcohol use (any versus none) and recent (past 3 months) drug use, depression (Center for Epidemiologic Studies Depression Scale [CES-D])<sup>34</sup> and stress (Perceived Stress Scale [PSS])<sup>35</sup> were collected. Clinically related baseline measures included viral load copies (>100,000), CD4 cell count (<200), having a PI-based regimen, and starting ART for the first time. These data were recorded from participants' medical records.

Scales measuring several other baseline variables that have been well researched in prior adherence studies were also included: knowledge about ART,<sup>32,36</sup> beliefs in the efficacy of ART,<sup>37</sup> perceived difficulty of regimen,<sup>23</sup> satisfaction with provider,<sup>38</sup> self-efficacy to adhere,<sup>39</sup> and social support for adherence.<sup>40</sup> Patients' Stage of Change<sup>41</sup> at baseline was assessed as a categorical variable comparing those in the preparation, action or maintenance stages.

We describe in greater detail below some of the baseline measures that are more novel or relevant for understanding our results.

**Brief Motivation Scale (BMS).** Motivation to adhere was measured with the novel 4-item BMS which was developed for this study<sup>42</sup> and based on the concepts defined by Amrhein and colleagues.<sup>43</sup> Patients were asked to rate their level of commitment, need, readiness, and reasons to adhere (e.g., "I will stick exactly to my medication schedule") using a 10-point scale (Cronbach  $\alpha = 0.83$ ).

**Autonomous support.** Support for autonomy surrounding ART was assessed using adapted items from the Health Care Climate Questionnaire (HCCQ).<sup>44,23</sup> Participants responded to 14 items 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. The subscales for providers, friends and family demonstrated good internal consistency (Cronbach  $\alpha = 0.82$ , 0.82, 0.88, respectively). The friends and family subscales were highly correlated ( $r = 0.75$ ,  $p < 0.001$ ) and were determined through factor analysis to represent the same construct. As a result, items from the two subscales were averaged to create the variable "autonomous support from friends and family" (Cronbach  $\alpha = 0.94$ ).

**Autonomous regulation.** A 12-item adapted version of the Treatment Self-Regulation Questionnaire (TSRQ)<sup>23,44</sup> was used to assess the extent to which individuals engage in specific health behaviors of their own volition because such behaviors hold personal importance for them, rather than responding to external pressures. Mean participant ratings for items on the autonomous responses subscale (e.g., "I want to take responsibility for my own health") comprise the measure of autonomous regulation (Cronbach  $\alpha = 0.81$ ).

**Multidimensional Health Locus of Control (MHLC).** The 18-item Form C of the MHLC<sup>45</sup> scale was used to measure health locus of control or the extent to which participants believe their HIV disease was due to: (1) their own behavior; (2) their doctor; (3) powerful others; or (4) chance, luck, or fate. (Cronbach  $\alpha$  0.61, 0.73, 0.46, and 0.58, respectively).

**God Locus of Health Control (GLHC).** The 6-item GLHC scale<sup>21</sup> measured external control attributed to God's control over one's health status, for example: "Whether or not my HIV disease improves is up to God." (Cronbach  $\alpha = 0.90$ ).

**Coping.** The Brief Coping Orientations to Problems Experienced (Brief COPE)<sup>46</sup> is a 28-item self-report measure of coping styles. We considered 13 of the 14 subscales: self-distraction, active coping, denial, substance abuse, emotional support, instrumental support, behavioral disengagement,

positive reframing, planning, humor, acceptance, religion and self-blame (Cronbach  $\alpha$ : 0.50–0.94).

**Religious/spiritual beliefs.** The Religious COPE scale<sup>47</sup> assesses both positive and negative forms of religious/spiritual coping. We used the "Religious/Spiritual Methods of Coping to Gain Control" section of the RCOPE to examine participants' endorsement of Collaborative Religious Coping (e.g., "I work together with God as partners." Cronbach  $\alpha = 0.94$ ), Self-Directing Religious Coping (e.g., "I make decisions about what to do without God's help." Cronbach  $\alpha = 0.79$ ), and Passive Religious Deferral Coping styles (e.g., "I don't try much of anything; simply expect God to take control." Cronbach  $\alpha = 0.82$ ). In addition, we used the Religious Beliefs and Behavior Scale (RBB) which measures religious practices<sup>48</sup> such as church attendance and prayer.

## Statistical Analysis

Potential predictor variables were explored with frequencies and proportions for categorical variables and with means and standard deviations for continuous variables using STATA intercooled 10 (StataCorp, College Station, TX). Study group was used as a covariate in multivariate analyses. Univariate analyses assessed associations between baseline variables and 90% or more adherence at 12 weeks and again at 24 weeks using  $\chi^2$  analyses for categorical predictor variables and  $t$  tests for continuous predictor variables. Prior to running the multivariate analyses, we examined intercorrelations of significant univariate predictors. Univariate baseline predictors were entered for selection in the multivariate analysis predicting 90% or more adherence at 12 and 24 weeks, respectively. Backward stepwise logistic regression was used to select predictors for the final model. Missing predictor data were not imputed.

## Results

### Participant characteristics

As displayed in Table 1, the majority of participants were male (75%) and African American (57%) with over half of the sample (53%) identifying as either homosexual or bisexual. Mean age of participants was 40 years, and 34% were ART inexperienced at baseline.

### Adherence to HIV medications

Of the 204 participants with baseline data, 180 and 168 participants had complete EDM adherence data at 12 and 24 weeks, respectively. At 12 weeks, 59% ( $n = 107/180$ ) adhered to their regimen at least 90% of the time, and 56% ( $n = 94/168$ ) were 90% or more adherent at 24 weeks. Evaluated as a continuous variable (% of medications taken), the mean adherence at 12 weeks was 83.2, standard deviation (SD) = 24.7. At 24 weeks, mean adherence was 80.4, SD = 26.6.

### Univariate Analyses of Baseline Variables

Baseline categorical variables and continuous variables considered as potential predictors of subsequent adherence are identified in Tables 2 and 3, respectively. Those variables significantly associated with EDM adherence were subsequently entered into the logistic regression analysis.

TABLE 1. BASELINE CHARACTERISTICS OF STUDY PARTICIPANTS, MOTIV8 ADHERENCE STUDY (N = 204)

	N	%	Mean (SD)
Age	204		40.4 (9.5)
Race			
African American	116	57	
White	64	32	
>1 race/other	23	11	
Hispanic	19	9	
Gender			
Male	152	75	
Sexual orientation			
Heterosexual	95	47	
Homosexual	78	38	
Bisexual/other	29	15	
Relationship status			
Single	114	56	
Married/committed	50	25	
Div/sep/widowed	38	19	
Children			
Yes	100	49	
Educational attainment			
<High school	46	23	
High school	62	30	
>High school	96	47	
Monthly household income			
\$0-\$1,000	125	63	
\$1,001-\$2,000	36	18	
Over \$2,000	24	12	
Don't know/declined	19	9	
Housing status			
Secure housing <sup>a</sup>	132	65	
Substance use			
Any alcohol use	114	56	
Binge alcohol use	40	20	
Recent drug use	88	43	
HIV clinical indicators			
CD4 count < 200	90	44	
Viral load > 100,000	69	34	
ART treatment history			
ART naïve	69	34	

<sup>a</sup>Secure housing defined as renting or owning a residence. ART, antiretroviral therapy.

*Twelve weeks*

As shown in Table 2,  $\chi^2$  analyses revealed stage of change (maintenance stage) and being ART inexperienced were positively associated with 90% or greater adherence ( $p < 0.05$ ). Any alcohol use, a CD4 count less than 200 copies per milliliter, and a PI-based regimen were all negatively associated with 90% or more adherence ( $p < 0.05$ ). As shown in Table 3, *t* tests revealed continuous variables significantly associated with 90% or greater adherence (i.e., higher mean scores for those with greater than versus less than 90% adherence): motivation to adhere, self-efficacy to adhere, social support for adherence, autonomous regulation, autonomous support from friends and family, use of a positive reframing coping style and active coping style ( $p < 0.05$ ). Variables negatively associated with 90% or more adherence included: depressive symptoms, perceived stress, a coping style of substance abuse, passive deferral religious coping, perceived difficulty of regimen, and number of doses per day of medication ( $p \leq 0.05$ ).

TABLE 2. PEARSON'S  $\chi^2$  ANALYSIS FOR CATEGORICAL VARIABLES ASSOCIATED WITH  $\geq 90\%$  ADHERENCE AT 12 AND 24 WEEKS

Baseline variables	12 weeks		24 weeks	
	N (% $\geq 90\%$ adh)	p	N (% $\geq 90\%$ adh)	p
Gender				
Male	133 (56)		124 (52)	
Female	47 (70)	0.08	44 (68)	0.06
Race				
African American	98 (59)		94 (54)	
Caucasian	60 (65)	0.28	55 (60)	0.75
Other	22 (45)		19 (53)	
Sexual orientation				
Heterosexual	81 (62)		73 (71)	
Homosexual	71 (59)	0.75	68 (59)	0.20
Bisexual	28 (53)		27 (50)	
Relationship status				
Not committed	135 (59)		125 (62)	
Married/committed	45 (60)	0.93	43 (63)	0.29
Educational attainment				
<High school	37 (54)		38 (47)	
High school	57 (51)	0.11	48 (50)	0.16
>High school	86 (67)		82 (63)	
Secure housing				
Yes	124 (61)		116 (59)	
No	56 (55)	0.45	52 (50)	0.30
Have children				
Yes	86 (63)		81 (63)	
No	94 (56)	0.38	87 (49)	0.08
Any alcohol use				
Yes	101 (47)		90 (45)	
No	78 (74)	<0.01	77 (69)	0.003
Recent drug use				
Yes	78 (54)		69 (54)	
No	101 (63)	0.20	98 (58)	0.56
Monthly household income				
$\leq 1,000$	108 (55)		100 (52)	
>1,000	72 (65)	0.19	68 (62)	0.21
Stage of change				
Preparation	69 (43)		59 (44)	
Action	29 (65)	0.03	27 (63)	0.20
Maintenance	23 (69)		22 (59)	
Baseline CD4				
>200	105 (66)		99 (63)	
<200	75 (51)	0.04	69 (46)	0.04
Baseline viral load				
>100,000	59 (58)		56 (43)	
<100,000	121 (60)	0.73	112 (63)	0.02
PI-based regimen				
Yes	117 (54)		108 (51)	
No	63 (70)	0.04	60 (65)	0.08
ART experience				
Naïve	60 (75)		61 (67)	
Experienced	120 (52)	<0.01	107 (49)	0.03

PI, protease inhibitor; ART, antiretroviral therapy.

*Twenty-four weeks*

$\chi^2$  Analyses revealed results similar to those at 12 weeks in that inexperience with ART was positively associated with 90% or greater adherence, while any alcohol use and CD4 count less than 200 were negatively associated with 90% or

TABLE 3. T TEST ANALYSIS FOR CONTINUOUS-LEVEL VARIABLES ASSOCIATED WITH 90% OR GREATER ADHERENCE AT 12 AND 24 WEEKS

Baseline variables	12 weeks		24 weeks	
	<90% Adherence Mean (sd)	≥90% Adherence Mean (sd)	<90% Adherence Mean (sd)	≥90% Adherence Mean (sd)
Age	39.8 (9.3)	41.7 (9.5)	39.4 (9.4)	41.9 (9.7)
Depressive symptoms	21.8 (11.7) <sup>a</sup>	15.7 (10.8)	22.0 (12.6) <sup>a</sup>	14.8 (9.7)
Perceived stress	27.2 (8.4) <sup>a</sup>	21.8 (8.1)	27.8 (8.2) <sup>a</sup>	22.2 (7.9)
Motivation to adhere	9.1 (1.1) <sup>b</sup>	9.5 (0.94)	8.9 (1.3) <sup>c</sup>	9.6 (0.75)
Self-efficacy to adhere	7.7 (1.7) <sup>c</sup>	8.6 (1.4)	7.7 (1.7) <sup>a</sup>	8.6 (1.4)
Social support for adherence	2.8 (1.0) <sup>c</sup>	3.2 (0.87)	2.8 (1.0) <sup>b</sup>	3.2 (0.91)
Autonomous regulation	6.6 (0.63) <sup>b</sup>	6.8 (0.52)	6.6 (0.62) <sup>d</sup>	6.8 (0.51)
Autonomous support				
Friends & family	5.3 (1.5) <sup>c</sup>	6.4 (0.99)	5.7 (1.6) <sup>c</sup>	6.4 (0.87)
Provider	6.4 (0.80)	6.5 (0.77)	6.4 (0.78)	6.5 (0.78)
Brief coping				
Substance abuse	0.9 (0.99) <sup>a</sup>	0.5 (0.75)	0.8 (0.94) <sup>b</sup>	0.4 (0.78)
Positive reframe	1.7 (0.91) <sup>b</sup>	2.0 (0.92)	1.8 (0.94) <sup>b</sup>	2.0 (0.89)
Planning	1.8 (0.87)	2.1 (0.82)	1.8 (0.85) <sup>c</sup>	2.1 (0.81)
Active coping	1.8 (0.81) <sup>b</sup>	2.1 (0.86)	1.7 (0.86) <sup>c</sup>	2.2 (0.81)
Emotional support	1.5 (0.95)	1.7 (0.97)	1.4 (0.93) <sup>b</sup>	1.7 (0.96)
Religious coping				
Collaborative	1.7 (1.1)	2.0 (1.0)	1.8 (1.1)	2.0 (1.00)
Self-directing	1.2 (0.87)	1.0 (0.96)	1.1 (0.97)	1.0 (0.94)
Passive deferral	1.2 (1.1) <sup>b</sup>	0.9 (0.92)	1.2 (0.99)	0.9 (0.94)
Locus of health control				
Internal	4.7 (0.96)	4.6 (0.90)	4.6 (0.90)	4.7 (0.91)
Chance	2.9 (1.1)	2.7 (1.2)	3.1 (1.2) <sup>b</sup>	2.7 (1.20)
Doctor	5.3 (0.89)	5.4 (0.89)	5.3 (0.85)	5.4 (0.90)
Others	2.9 (1.3)	3.0 (1.4)	3.3 (1.3)	2.9 (1.40)
God	3.2 (1.7)	2.9 (1.5)	3.4 (1.6) <sup>b</sup>	2.9 (1.50)
Knowledge about ART	8.9 (1.6)	9.0 (1.9)	8.9 (1.8)	9.0 (1.90)
Perceived difficulty of regime	1.8 (0.73) <sup>b</sup>	1.6 (0.77)	1.8 (0.72) <sup>b</sup>	1.5 (0.68)
Number of med doses	1.6 (0.56) <sup>b</sup>	1.4 (0.57)	1.6 (0.56) <sup>b</sup>	1.4 (0.57)
Medical symptoms (mean #)	8.0 (4.9)	7.8 (4.9)	8.1 (5.1)	7.6 (4.70)
Satisfaction w/provider	1.4 (0.46)	1.3 (0.36)	1.4 (0.45) <sup>b</sup>	1.3 (0.37)

<sup>a</sup>*p* < 0.001.<sup>b</sup>*p* < 0.05.<sup>c</sup>*p* < 0.01.

ART, antiretroviral therapy.

greater adherence at 24 weeks (Table 2). Table 3 displays results of *t* tests at 24 weeks, which were very consistent with the 12-week findings. Notable exceptions were individuals with 90% or more adherence who reported greater use of both planning and emotional support as coping styles and greater satisfaction with their health care providers at 24 weeks. In addition, those perceiving an external locus of health control including "God" and "chance," and those with higher levels of passive deferral religious coping were significantly less likely to have high adherence at 24 weeks.

### Multivariate Analyses of Baseline Predictors

All variables significantly associated with adherence at each time point in the univariate analyses were included in the relevant multivariate analysis conducted for each time point, with treatment group included as a covariate. Prior to conducting the multivariate analyses, intercorrelations between all significant variables in the univariate analyses were examined to ensure that constructs were distinct. All intercorrelations were less than 0.6, with the exception of perceived

stress and depressive symptoms which were correlated at 0.75. We retained both depression and stress because they are well established as separate constructs in adherence literature.<sup>13,17</sup> As described in the measures section, factor analysis of the subscales of autonomous support from friends and autonomous support from family (correlation = 0.75) were found to load on a single factor and were consequently combined as "autonomous support from friends and family." The final model (Table 4) displays significant multivariate predictors of 90% or more adherence at 12 and/or 24 weeks.

### Twelve weeks

At 12 weeks there were three significant independent predictors in the final model. Those reporting greater autonomous support from friends and family to make their own decisions regarding their HIV treatment were over 3.5 times more likely to adhere at least 90% of the time compared to those reporting lower levels of autonomous support [adjusted odds ratio (AOR) 3.6 [1.7–7.9], *p* < 0.001]. Those reporting any alcohol use were 99% less likely to have 90% or more

TABLE 4. MULTIVARIATE LOGISTIC REGRESSION TO IDENTIFY BASELINE PREDICTORS OF  $\geq 90\%$  ADHERENCE AT 12 AND 24 WEEKS

Predictors	12 weeks AOR (95% CI), p	24 weeks AOR (95% CI), p
Autonomous support (friends/family)	3.6 (1.6–7.9), 0.001	1.9 (1.1–3.5), 0.032
Alcohol use (Any)	0.01 (0.001–20), 0.002	0.13 (0.04–0.49), 0.002
CD4 cell count (<200)	0.17 (0.04–0.71), 0.015	<sup>b</sup>
Brief Motivation Scale (BMS)	<sup>b</sup>	2.8 (1.3–6.0), 0.010
Coping style (active coping)	<sup>b</sup>	2.3 (1.2–4.5), 0.013
God locus of health control	<sup>a</sup>	0.58 (0.40–0.84), 0.004
Perceived stress (high)	<sup>b</sup>	0.92 (0.84–0.99), 0.046

<sup>a</sup>Not included in 12 week multivariate analysis because not significant in univariate analysis.

<sup>b</sup>Indicates variable is not a significant predictor in multivariate regression.

AOR, adjusted odds ratio; CI, confidence interval.

adherence (AOR 0.01 [0.001–0.20],  $p = 0.002$ ) compared to those who reported no alcohol use. People with a baseline CD4 count less than 200 were 83% less likely than those with a CD4 count greater than 200 to achieve high adherence (AOR 0.17 [0.04–0.71],  $p = 0.015$ ).

#### Twenty-four weeks

At 24 weeks there were six significant independent predictors in the final model. As at week 12, higher autonomous support from friends and family remained predictive of high adherence (AOR 1.9 [1.1–3.5],  $p = 0.032$ ) and any use of alcohol continued to be associated with lower adherence (AOR 0.13 [0.04–0.49],  $p = 0.002$ ). In addition, those with higher mean scores for motivation to adhere to medications at baseline were nearly 3 times more likely to achieve high adherence compared to those with lower motivation scores (AOR 2.8 [1.3–6.0],  $p = 0.01$ ), and those with a higher mean score for active coping were over twice as likely to have 90% or higher adherence (AOR 2.3 [1.2–4.5],  $p = 0.013$ ). However, those more likely to have perceived God as the locus of control over their health were 42% less likely to have 90% or greater adherence compared to those less likely to perceive God as in control of their health (AOR 0.58 [0.39–0.84],  $p = 0.004$ ). Finally, people with higher levels of perceived stress were 9% less likely to achieve high adherence compared to those with lower levels of perceived stress (AOR 0.92 [0.84–0.99],  $p = 0.046$ ).

#### Discussion

Many of the established predictors of adherence were identified in univariate analysis including depression, perceived stress, alcohol use, CD4 and viral load counts, frequency of dosing, social support, self-efficacy and experience with ART. Several novel variables were also predictive of high ART adherence in the univariate analyses, including autonomous support from friends and family to make decisions regarding treatment, autonomous regulation, motivation to adhere, and positive coping styles, while religious/spiritual beliefs (i.e., perceiving God as in control of one's health) predicted lower ART adherence.

The multivariate analyses identified the best set of independent predictors of adherence at each time point. Higher autonomous support from friends and family and the absence of any alcohol use emerged as key independent predictors both in the short and long run of better adherence. Having

a higher CD4 count was the only other predictor of better adherence in the short run. Higher motivation to adhere, an active coping style, a lower perception of God as in control of one's health, and lower perceived stress were the best predictors of higher adherence.

While perceived stress and alcohol use are established predictors of adherence, these results reveal the importance of a number of more novel predictors related to motivation and coping, particularly in the long run. Surprisingly, established psychosocial predictors such as self-efficacy, social support, and depression did not emerge as key independent predictors. This may be a result of having a sample of HIV-infected individuals that includes more African Americans and more females than might have been typical in many past adherence studies. For example, religious beliefs and coping styles are likely to be particularly important among African Americans living with HIV. The emergence of the importance of more novel motivation and coping variables suggests new ways to understand adherence behavior as well as new directions for assessments designed to predict adherence difficulties.

#### Autonomous support from friends and family

We found evidence to support the concept of patient autonomy to make informed and responsible choices for care. Autonomous support from friends and family, autonomous regulation, self-efficacy and social support each predicted high adherence to HIV medications in univariate analysis; however, only autonomous support from friends and family remained a significant baseline predictor in multivariate analysis at 12 and 24 weeks. This finding emphasizes the importance of feeling supported and empowered by peers and family members to make one's own decisions regarding HIV treatment, as opposed to passively complying with medical advice or other external forces (e.g., partners, family).

#### Religious/spiritual beliefs

We explored both positive and negative religious/spiritual beliefs, practices and coping styles for their associations with HIV treatment adherence. Those with stronger baseline beliefs that God is in control of their HIV disease and how it progresses were significantly (42%) less likely to have 90% or higher adherence at 24 weeks in multivariate analysis. At 12 weeks, univariate analyses indicated that those who endorsed the use of passive deferral as a form of religious coping (i.e., leaving things up to God) were less likely to have 90% or

more adherence, marginal significance ( $p=0.05$ ). A similar construct, fatalistic religious coping, has been associated with several negative health behaviors.<sup>49</sup> According to Crute, this type of religious-based fatalism, specifically the belief that “whatever happens to them (e.g., HIV) happens for a purpose and that no drug can truly help” is commonly held by African American and other minority women.<sup>50</sup>

This is consistent with recent research showing that people living with HIV who believed that God/Higher Power controlled their health were over five times more likely to defer antiretrovirals than those without such beliefs.<sup>19</sup> Other negative religious beliefs such as “HIV is a punishment from God,” and “HIV is a sin” have also been associated with poor adherence and delays in seeking treatment.<sup>20</sup> However, a collaborative style of religious coping in which a strong individual works together with a strong belief in God has been associated with positive health behaviors.<sup>51</sup> Several studies document the positive impact of religious/spiritual beliefs among people living with HIV in terms of their psychological well being,<sup>52,53</sup> and specifically in regard to adherence,<sup>24,54</sup> and improved treatment outcomes.<sup>54,55</sup> To our knowledge, this is the first study to explore the impact of specific religious/spiritual beliefs on ART adherence using EDM.

The potential impact of religious/spiritual beliefs on health outcomes may depend on individuals’ interpretation of their role in determining their health; viewing God as a source of inspiration and strength to do what needs to be done versus abdicating full responsibility to God. While the belief that “its all in God’s hands” may provide comfort for someone overwhelmed by life’s circumstances or who feels powerless to affect change, religious fatalism is particularly problematic for health outcomes, such as ART adherence, that require a high degree of patient involvement.

#### *Clinical implications*

The Brief Motivation Scale (BMS) utilized in this study predicted those with nearly a three-fold increased odds of having high adherence at 24 weeks. Based on the available research and experience in practice, many HIV providers may have developed a combination of subjective and objective strategies to identify poor adherers. There is clear evidence, however, that their ability to accurately predict which patients will do well and which will not is poor.<sup>56</sup> While this is a newly created and validated measure, it offers promise as a brief (4-item) objective measure easily incorporated into an initial treatment consultation to aid providers in identifying which patients may need referral for additional support services. The BMS should be confirmed through use with varied populations.

Previous studies have highlighted the beneficial impact of the provider’s ability to convey an understanding of the individual’s choices and encourage behaviors that coincide with the patient’s value system.<sup>26</sup> Among our sample, however, it was autonomous support from friends and family (not from provider) that proved most predictive of adherence. Friends and family are in an ideal position to support autonomous decision making. When they do, as this study suggests, it has a positive impact on treatment decision making resulting in higher ART adherence. Support groups could be an effective setting to foster autonomous support for peers’ ability to make positive choices regarding their HIV treatment, and to help individuals identify positive sources of support. Simi-

larly, programs for family members might focus on the development of the attitudes and skills necessary to provide autonomous support and communicate confidence in the patient’s ability to make the best choices for their health.

Understanding the influence of religion/spirituality has become increasingly important as its role remains particularly strong among African Americans,<sup>57,58</sup> who are at increased risk for both HIV infection and poorer treatment outcomes.<sup>59</sup> By inquiring about religious/spiritual beliefs related to treatment during consultations, providers can encourage patients’ ability to affect their health and potentially identify someone more inclined to play a passive role in their treatment. As faith leaders and faith-based organizations increase their participation in HIV education and outreach,<sup>60</sup> these findings highlight an opportunity to reach out to religious/spiritual groups to help them support individual autonomy in the context of HIV treatment and reduce stigma in the community. Given that nearly 40% of Americans and over 50% of African Americans attend church on a weekly basis,<sup>57</sup> and most (87%) of those sampled from African American churches believe the church should talk about HIV,<sup>60</sup> faith communities can be ideal partners for providing HIV education and treatment support.

#### *Strengths and limitations*

This study contributes to the HIV adherence literature by comprehensively considering psychosocial, behavioral, lifestyle, clinical and demographic factors potentially associated with adherence. This study also includes the less commonly emphasized influences of patient autonomy, motivation, coping styles, religious/spiritual beliefs and practices, and perceived locus of health control. Using EDM as the measure for adherence provided additional rigor for accurate reporting. The sample of HIV infected individuals was diverse and the study design allowed comparison between short and long-term follow-up. Although data analyses are longitudinal, they are still correlational which does not exclude the possibility of a confounding variable that could mediate the relationship of a predictor variable and ART adherence. Rather than a hypothesis driven or theoretically driven approach the analyses were exploratory, using a stepwise approach to variable selection. Nevertheless, a comprehensive list of established and novel variables was included. These data must only be interpreted for their value as one-point-in-time baseline predictors. A volunteer bias, skewing data toward higher adherence levels, likely exists due to the nature of voluntary participation in clinical trials.

#### **Conclusion**

The medical and pharmacologic innovations in HIV treatment have simplified dosing schedules and reduced side effects,<sup>61</sup> making aspects of adherence easier now than in the past. Despite these improvements, many people still struggle to achieve adherence levels required to suppress the virus. While many psychosocial and behavioral factors may be more complex to modify, they present intervention opportunities to improve adherence.<sup>62</sup> Recognition of the important role of religious/spiritual beliefs on health outcomes presents opportunities for faith communities to address HIV care and emphasize individuals’ ability for self-determination versus fatalistic thinking. Promoting self-motivated and self-regulated treatment adherence holds promise for high levels of long term adherence. Cost-effective and feasible interventions to increase

self-motivated adherence are needed in a multitude of settings including clinical practice, faith communities, and among patients' immediate support network of friends and family.

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