

DISSERTATION

DEVELOPMENT AND INITIAL VALIDATION OF THE COMPREHENSIVE HIV
ADHERENCE WITH TREATMENT SCALE

Submitted by

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ABSTRACT

DEVELOPMENT AND INITIAL VALIDATION OF THE COMPREHENSIVE HIV TREATMENT ADHERENCE SCALE

HIV remains a significant public health concern despite decreasing rates of transmission in the U.S. (Centers for Disease Control and Prevention, 2020c). Contributing factors include low rates of treatment adherence (de Bruin et al., 2010) and high rates of comorbidities with other medical and mental health conditions (Bing et al., 2001; Gallant et al., 2017; Lerner et al., 2020). Antiretroviral therapy (ART) has significantly improved HIV health outcomes and reduced AIDS diagnoses and AIDS-related mortality (Crum et al., 2006; Glass et al., 2008; Ickovics & Meade, 2002; Paterson et al., 2000; Stone, 2001; World Health Organization, 2015). Because of ART's effectiveness, HIV is considered a chronic rather than terminal health condition for people adherent with treatment (Aberg, 2006; Swendeman, Ingram, & Rotheram-Borus, 2009). Treatment for HIV as a chronic health condition includes several pro-health behaviors in addition to ART adherence to support overall wellness. To support future research and treatment recommendations, the current study developed a measure of adherence with pro-health behavior and conducted an initial analysis of the measure's psychometric properties with a sample of 118 people living with HIV. Structural equation modeling explored relations among antecedents (personality, treatment self-efficacy, treatment information, and treatment motivation) and health outcomes of pro-health behaviors and ART adherence. Regularly assessing engagement in, as well as antecedents and outcomes of, treatment behaviors can

enhance communication between providers and people living with HIV, reinforce HIV's status as a manageable chronic condition, and link people living with HIV to appropriate interventions.

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DEDICATION

This dissertation is dedicated to my husband, Nathan Rahm, who is a steadfast partner and always willing to walk full-heartedly with me on every path we set on. My mother, Leann Feucht, who raised me to do my best, live with integrity, and have fun getting lost in exploration. And my sister, Erica Knigge, who has always been my closest friend and ally. The love and support from all of my family and friends provides me the safe base I need to set forth on new endeavors.

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INTRODUCTION

Human immunodeficiency virus (HIV) remains a significant public health issue in the United States and abroad, although efforts to prevent HIV transmission in the U.S. have resulted in a decrease in annual transmission rates (Centers for Disease Control and Prevention [CDC], 2020a). In 2018, there were 37,978 new cases of HIV diagnosed in the U.S., reflecting a 7% decline in annual transmissions since 2014. In 2014, the rate of decline had been 10% since 2010 (CDC, 2017). The majority of new infections in 2018 occurred among men who have sex with men (MSM), who accounted for 69% of all new diagnoses. Within this group, Black or African American MSM were disproportionately represented, making up 25% of all new infections, followed by Latino or Hispanic MSM accounting for 20% and White men accounting for 17%. Women comprised 11% of all new infections – through heterosexual contact – in 2018. Among the total population, 42% of all new infections occurred among Black or African American and 27% among Latinx or Hispanic individuals. Adolescents and young adults were also disproportionately impacted by HIV, who accounted for 21% of all new infections. Within this age demographic, 83% of new diagnoses occurred among MSM of all race groups and 42% among Black or African American young MSM. In all, approximately 1,200,000 people are currently living with HIV in the U.S., including an estimated 14% of people living with HIV (PLWH) unaware of their status due to lack of testing (CDC, 2020a).

HIV is transmitted through contact with blood, semen, pre-seminal fluid, vaginal fluids, breast milk, and rectal fluids (CDC, 2020b). In the U.S., nearly 90% of infections are transmitted sexually, 7% transmitted through intravenous drug use, and less than 1% are perinatal transmission (CDC, 2017). Substance-use behavior is related to HIV transmission through

sharing needles contaminated by blood with HIV and indirectly through health-risk sexual behavior resulting from decreased inhibition (Mansergh et al., 2006).

After transmission, HIV attacks the immune system through three distinct stages (CDC, 2020c). In the initial acute HIV infection stage, individuals experience flu-like symptoms for up to a few weeks beginning 2-4 weeks after initial HIV transmission. Although individuals may not know they are infected with HIV, the virus is highly contagious during the initial acute stage because of a high viral load in the bloodstream. In the second stage, termed chronic HIV infection or clinical latency, the virus remains active although individuals may not have symptoms or feel ill. This stage can last for several years without treatment, with some people remaining in this second stage for 10 years or longer. HIV attacks CD4 cells, resulting in impaired immune functioning and increased risk for other infections and infection-related cancers. Because of this, high viral load and low CD4 cell counts reflect poor HIV-related health outcomes. The onset of infections and cancers resulting from HIV-related impaired immune functioning indicates the third and final stage of HIV: acquired immunodeficiency syndrome (AIDS). The progression of HIV to AIDS causes the onset of more severe illnesses that the weakened immune system cannot fend off, and AIDS-related death typically occurs within 3 years without treatment. Although rates of AIDS diagnoses have decreased due to the effectiveness of HIV treatment, in 2016 alone, 18,160 individuals in the U.S. were diagnosed with AIDS (CDC, 2017).

In addition to the direct health concerns of HIV infection and AIDS-related opportunistic infections and mortality, HIV is associated with several medical and mental health comorbidities (Bing et al., 2001; Gallant et al., 2017; Lerner et al., 2020). Briefly, HIV infection is associated with elevated risk for hypertension and cardiovascular disease, Hepatitis C, kidney disease and

renal failure, cancer, diabetes, hyperlipidemia, bone density disorders, depression, and neurocognitive decline. Some of these conditions may be an effect of the virus itself even with effective treatment (e.g., mild neurocognitive decline); associated with medications used to treat HIV (e.g., reduced bone density); or associated with health-risk behavior (e.g., substance-use related Hepatitis C co-infection; Hoy et al., 2017; Lerner et al., 2020; Lo Re et al., 2014; Saylor et al., 2016). Although advances in prevention and treatment have reduced HIV transmission, AIDS diagnoses, and AIDS-related mortality, comprehensive treatment for PLWH must include health behaviors that address these co-occurring conditions (see Lerner et al., 2020).

HIV Treatment

Antiretroviral Therapy

HIV-related health outcomes have improved with the development and use of antiretroviral therapy (ART; Gonzalez et al., 2011), an HIV treatment regimen comprised of one or more medications (National Institutes of Health [NIH], 2020). By consistently using ART, health outcomes are improved due to achieving a suppressed viral load status, typically defined as fewer than 200 copies of the virus per milliliter (mL) of blood, or an undetectable viral load status, typically defined as fewer than 50 copies per mL of blood (e.g., Grulich et al., 2015; Rodger et al., 2016). Achieving an undetectable viral load helps restore immune functioning, thereby preventing the transition from stage 2, chronic HIV infection, to stage 3, AIDS (Crum et al., 2006; Glass et al., 2008; Ickovics & Meade, 2002; Paterson et al., 2000; Stone, 2001). Further, an undetectable viral load prevents the sexual transmission of HIV to others (Grulich et al., 2015; Rodger et al., 2016). Because of ART's effectiveness, the global number of AIDS-related deaths decreased by 60% between 2004 and 2019: from 1.7 million per year to an estimated 690,000 per year (UNAIDS, 2020). As reported in the 2018 surveillance report from

the CDC, 65% of all PLWH in the U.S. had a suppressed viral load, 85% of PLWH who were engaged in HIV care had a suppressed viral load, and nearly two-thirds of PLWH had maintained a suppressed viral load for 12 months (CDC, 2020d).

The positive health impacts of ART have changed the conceptualization of HIV to a chronic health condition rather than an acute or terminal illness in regions where ART is available (Aberg, 2006; Nigatu, 2012; Swendeman et al., 2009). Chronic conditions are those that typically are not completely curable, progress slowly, are not transmittable to others, and have symptom presentations that change across the lifespan (WHO, 2018). The overall goal of managing HIV as a chronic condition is to maintain or augment immune functioning, prevent the onset of AIDS and AIDS-related infections, improve overall quality of life, and prevent the transmission of HIV to others (Pau & George, 2014). In treating HIV as a chronic condition, PLWH assume responsibility in self-managing their treatment, including taking ART as directed; engaging in pro-health behaviors that foster maximum medication effectiveness and prevent or reduce the onset of other health conditions or infections; recognizing symptoms of other infections and seeking treatment; working with health providers to determine courses of treatment; and managing emotional reactions or mental health symptoms (Holman & Lorig, 1997; Swendeman et al., 2009).

Health-Promotion and Self-Management Behaviors

While ART has dramatically increased health outcomes for PLWH, managing HIV as a chronic condition includes engaging in health behaviors to self-manage treatment beyond taking medication (Swendeman et al., 2009). Such behaviors include attending regular appointments with health providers, eating healthily, exercising, using condoms during sex, reducing substance use, managing stress and mental health symptoms, establishing and engaging social support, and

disclosing HIV status as-necessary (e.g., to sexual partners; CDC, 2016; Iribarren et al., 2018; Johnson et al., 2007; Swendeman et al., 2009). The overall goals of these health behaviors are to manage physical health symptoms specific to HIV (e.g., supporting the suppression of viral loads), address side effects of medication (e.g., nausea, weight changes, and reduced bone density), prevent HIV-related diseases or opportunistic infections (e.g., sexually transmitted infections and Hepatitis C), foster patient independence with treatment, and improve overall quality of life (Evers & Quintiliani, 2013; Kennedy et al., 2001; Lerner et al., 2020; Swendeman et al., 2009; Willison & Andrews, 2005). One way that engaging in health-promotion behaviors, such as diet and exercise, can improve HIV-specific health outcomes is via their associations with ART adherence (Pellowski & Kalichman, 2016). This multiple health behavior change can be conceptualized through a “coaction framework”, whereby a change in one health behavior increases the likelihood of other health behaviors (Johnson et al., 2014; Paiva et al., 2012; Pellowski & Kalichman, 2016). Promoting multiple health behaviors in a comprehensive treatment plan is a promising direction for increasing ART adherence and maximizing health outcomes for PLWH.

Adherence with Treatment

Adherence with ART has been a primary focus in HIV treatment and research due to the risks of failing to suppress viral loads, reversing progress towards viral suppression, impairing immune functioning, and developing treatment resistance – all associated with nonadherence (e.g., Parienti et al., 2008). ART treatment regimens have evolved from complex dosing requiring multiple pills per day to single-dose-per-day regimens. To suppress viral loads and maintain or improve immune functioning, previous generation multi-dose medications required patients to achieve a 95% adherence level, or taking 95% of all scheduled doses (de Bruin et al.,

2010). Newer generation ART regimens are both less complex, with single-pill dosing, and more robust to imperfect adherence (Bangsberg, 2006; Viswanathan et al., 2015). These ART medications suppress viral loads with 85-89% adherence levels (Viswanathan et al., 2015), with adherence levels less than 80% associated with failure to suppress viral loads (Parienti et al., 2008). However, individual differences in health-related behaviors and access to healthcare may impact the adherence level needed to effectively suppress viral loads. Thus, while new medications are more forgiving, adherence of at least 95% is generally recommended by healthcare providers and in the research literature (e.g., Viswanathan et al., 2015)

In the U.S., studies report average adherence rates of 60-70% (Simoni et al., 2006), with 10% of patients missing at least one dose per day and 18% of patients missing doses weekly (Catz et al., 2001; Chesney et al., 2000). A nationally representative study on past 3-day adherence rates found that 86% of PLWH were ART adherent, although 72% took their medications as scheduled and 69% followed medication directions, resulting in only 60% of PLWH taking medications on-time and as directed (Beer & Skarbinski, 2014). One goal of reducing regimen complexity has been to decrease treatment burden and improve adherence rates. However, some studies have found single-dose regimens to be associated with an improvement in adherence (Beer & Skarbinski, 2014; Cohen et al., 2013), and others have not found a significant difference (Cook et al., 2017). Addressing ART nonadherence and retaining PLWH in care are important health behavior goals (Marks et al., 2010; Stone, 2001; Wainberg, 1998). Examining factors associated with ART nonadherence – essential for preventing the onset of AIDS and HIV-related opportunistic infections and death – may elucidate potential barriers to engaging in other health behaviors necessary for managing HIV and comorbid conditions.

Individual-Level Predictors of Treatment Nonadherence

PLWH experience unique factors that contribute to difficulty self-managing treatment and maintaining optimal ART adherence (Swendeman et al., 2009). Both individual-level and sociocultural factors impact ART adherence. Individual-level factors, especially psychological factors, have been hypothesized to be primary causes of HIV treatment nonadherence (e.g., Cook, McCabe, Emiliozzi, & Pointer, 2009). Psychological factors include reactions to treatment, treatment self-efficacy, motivation, mental health, stress, and personality. Studies have found psychological factors to impact treatment adherence more than the complexity of ART regimens, side effects of medications, and patient demographics (Cook et al., 2009), as well as social problems such as housing insecurity, interpersonal conflict, and legal problems (see Cook et al., 2017). Importantly, individual psychological factors provide opportunities for direct intervention (Houston et al., 2016).

Interventions to address psychological factors are critical in long-term management of HIV as a chronic condition. One mechanism for providing interventions is through regular contact with health providers. Health providers, including mental health and addictions treatment providers, can be particularly helpful in intervening on HIV-related health behaviors through frequent contact with PLWH (Mitchell & Oltean, 2007; Spector & Remien, 2015). Health appointments provide opportunities for clinicians to evaluate patients' knowledge of and engagement in health and health-risk behavior, work with patients to identify strategies for health behavior change, assess ART adherence, and connect patients with other resources (e.g., Fisher, Cornman, et al., 2006). In line with this, regular screening for adherence with ART and other health behaviors (e.g., safer sex and reduced substance use), as well as individual-level factors impacting adherence, is recommended in health appointments (CDC et al., 2014).

Reactions to Treatment and Readiness to Engage

Generally, patients with chronic conditions, including HIV, initiate and are more adherent with treatment when they perceive the condition to be more severe or threatening (Cook, 2006; Langness et al., 2014). As a result, some PLWH wait to start taking prescribed ART medications until their health has declined (Castro et al., 2015). Further, PLWH may not initiate treatment due to concerns about medication side effects, beliefs about treatment ineffectiveness, or the lifelong duration of treatment (Kalichman et al., 2016). Similarly, patients who experience negative health symptoms, such as feeling sick due to another condition, may perceive symptoms as side effects of medications or evidence of the ineffectiveness of ART and discontinue treatment. Reactions to treatment, such as experiencing shame, denial, non-acceptance of diagnosis and treatment, and feeling alone relate to difficulty maintaining ART adherence (Batchelder et al., 2013). PLWH who struggle with ART adherence may experience a health- or life- threatening event which causes people to resume treatment (Enriquez, Lackey, O'Connor, & McKinsey, 2004). The re-initiation of treatment is often associated with a desire to live, thereby beginning a process by which individuals change their attitudes and beliefs about medication, find a healthcare provider, develop interpersonal supports, feel more in control of their lives, and develop health goals. In sum, while people differ in how they initially interpret their HIV diagnosis, perceived severity of symptoms and diagnosis is related to the onset of treatment. ART adherence may decline as the initial health concern becomes less salient or as people experience health symptoms misattributed to ART. When people experience an HIV-related health stressor, they may be more likely to bolster their treatment adherence.

Treatment Fatigue and Motivation

After initiating or re-initiating treatment, ART adherence tends to decline over time, especially as PLWH acclimate to the diagnosis and prognosis (Cook, 2006). This may occur because of treatment fatigue, or the burden of life-long treatment regimens (see Claborn, Miller, & Meier, 2015). ART requires several behavioral changes – managing and picking up prescription medication, attending regular appointments with health providers, and taking prescribed medications daily – all of which contribute to the psychological burden of ART (Chesney et al., 2000; Claborn, Meier, et al., 2015; Friedland, 2006). However, measurement of treatment fatigue has focused on behaviors specific to ART adherence, such as taking medication, rather than the broader scope of health behaviors necessary to improve quality of life and overall health for PLWH.

Even after establishing behavioral patterns to support taking ART (e.g., regularly scheduling medication doses), ART adherence varies with moment-to-moment changes in motivation (Cook et al., 2017). In a study of the effects of state motivation on adherence, daily changes in mood, feeling in control of health, perceived social support, and ability to cope were all associated with state motivation. Feeling in control of health, having social support, and coping all indirectly impacted ART adherence through state motivation, while state mood also directly impacted ART adherence (Cook et al., 2017). It is important to note that social stressors, including housing insecurity, legal problems, and interpersonal conflict, did not impact either treatment motivation or adherence. Further, these factors examined at the trait, or stable, level did not impact treatment adherence. Thus, assessing and intervening on individual-level, psychological states is important in maintaining ART adherence. Related to this, intention to engage in health behaviors is directly related to viral suppression through ART adherence,

indicating an important domain of measurement and intervention (Nelsen et al., 2013).

Interventions to promote health behaviors, coping, social support, mood, and perceived control over health outcomes may be associated with ART adherence through reduced treatment fatigue and increased state motivation even when experiencing distress (Claborn, Meier, et al., 2015; Cook et al., 2017).

Treatment Self-Efficacy

In addition to motivation, an individual's belief in their own ability to engage in and manage their treatment, or treatment self-efficacy, is associated with treatment adherence for a variety of health conditions, including HIV (Bandura, 1989; Claborn, Meier, et al., 2015; Johnson et al., 2007). Treatment self-efficacy for HIV has been conceptualized as a two-factor construct, with one factor reflecting ability to integrate treatment into daily life and the second associated with persevering through challenges with treatment (Johnson et al., 2007). Treatment self-efficacy is positively associated with patients' beliefs about the benefits of ART, social support, problem-solving abilities, and beliefs about coping abilities, and negatively associated with concerns about medication side effects, depressive symptoms, and the complexity of treatment (Johnson et al., 2007, 2012). Importantly, treatment self-efficacy is related to adherence with ART and positive health outcomes. For example, a study of Black or African American PLWH with fewer socioeconomic resources – who continue to be disproportionately impacted by HIV – found treatment self-efficacy significantly differed between those who were not treatment adherent and those who were, with high self-efficacy associated with an increased likelihood of maintaining treatment adherence (Houston et al., 2016). Among PLWH adherent with treatment, nearly half demonstrated high self-efficacy while less than a quarter demonstrated low self-efficacy. Further, other factors related to nonadherence, such as

depression, did not differ significantly between those who were adherent and those who were not (Houston et al., 2016). These associations suggest that high self-efficacy may increase treatment adherence. Adherence with ART enhances PLWH's self-efficacy and motivation, thereby creating a potential feedback loop such that high self-efficacy and motivation lead to increased ART adherence, which then leads to higher self-efficacy for adhering with treatment and motivation to continue adherence behavior (Fisher, Fisher, et al., 2006).

While studies of treatment self-efficacy for PLWH typically focus on ART adherence, some studies have called for examining the role of self-efficacy with a more comprehensive set of treatment behaviors (Johnson et al., 2007). This is important to note, as individuals receiving treatment differ in regard to self-efficacy for specific components of treatment, such as taking and managing medications, maintaining contact with health providers, and identifying and managing symptoms of physical and mental health (Houston et al., 2016). Thus, while treatment self-efficacy is associated with ART adherence, further exploration of treatment self-efficacy's effects on the broader range of health behaviors to comprehensively treat HIV as a chronic condition is needed.

Personality Traits

Treatment motivation and self-efficacy, described above, are state-based factors that may fluctuate over time and across experiences. However, in predicting treatment behavior, it is also important to consider trait-based factors that tend to be stable over time. Personality traits – including emotion regulation, impulsivity, and sensation seeking – are trait-based factors that have been associated with ART adherence, sexual behavior, substance use, and mental health (e.g., Dunne, Cook & Ennis, 2019; Gross, 2015). Emotion regulation is a multi-faceted trait comprised of identifying and understanding emotional states, accepting emotions, using coping

skills to manage emotions when necessary, and engaging in goal-directed behavior in response to or despite emotion states (Gratz & Roemer, 2004). Among PLWH, emotion regulation relates to ART adherence such that individuals higher in emotion regulation are better able to adhere to ART despite barriers (Leyro et al., 2015). Alternatively, individuals who suffer from negative affect and who engage in behaviors to escape emotional states, thereby reflecting emotion dysregulation processes, may be more likely to use substances, struggle to maintain ART adherence, and miss health appointments (Du Bois & McKirnan, 2012).

Impulsivity is another trait that has been associated with HIV-risk behaviors and HIV treatment (Dunne et al., 2019; Mustanski et al., 2017). In one study examining impulsivity as a two-factor construct, having a decision-making style that emphasizes present reward over future consequences was associated with ART nonadherence (Dunne et al., 2019). Conversely, behavioral acting out was not associated with ART adherence. In a study using the five-factor Negative Urgency, Lack of Premeditation, Lack of Perseverance, Sensation Seeking, and Positive Urgency (UPPS-P; Cyders et al., 2007; Whiteside & Lynam, 2001) model of impulsivity, facets were differentially associated with risk factors for HIV among young MSM (Mustanski et al., 2017). Interestingly, none of the facets were associated with condomless sexual behavior in this sample despite previous studies finding them to be associated with health-risk sexual behavior (Rahm-Knigge, Prince, & Conner, 2018; Semple et al., 2006). Examining impulsivity as a multi-dimensional construct that incorporates cognitive, affective, and behavioral facets can lead to a better understanding of the relations between impulsivity and HIV treatment and health-risk behaviors among PLWH.

Sensation seeking is “the seeking of varied, novel, complex, and intense sensations and experiences, and the willingness to take physical, social, legal, and financial risks for the sake of

such experiences” (Zuckerman, 1994, p. 27). In one study of sensation seeking, low levels of the need for thrill or adventure were related with increased ART adherence among Black or African American PLWH (Sayegh et al., 2016). It could be that increased risk-, thrill-, or adventure-seeking relates to engaging in more adventure-type activities that may interfere with strict ART routines. Further, individuals who are higher in sensation seeking are more likely to use substances, as observed in individuals with social anxiety and high risk seeking (Rahm-Knigge, Prince, & Conner, 2019). Recognizing the effects of personality on ART adherence among PLWH provides an opportunity for assessment and intervention. For example, providers can identify individuals at-risk for nonadherence and recommend appropriate interventions to promote adherence early-on. While traits such as emotion regulation are assumed to be relatively stable, strategies individuals use to manage the effects of these traits develop across the lifespan and can vary by context or circumstance (Gross, 2015). In addition, individuals can learn skills to manage the effects of these traits on their health behaviors.

Mental Health

Mental health concerns are associated with HIV treatment and related health outcomes (Bing et al., 2001). PLWH are disproportionately affected by mental illness, with nearly half of PLWH meeting criteria for at least one mental health disorder. For example, studies have found that nearly half of PLWH in the U.S. suffer from depressive symptoms (Bing et al., 2001). Because depression has been associated with ART nonadherence, treating depressive symptoms is an important component of comprehensive HIV treatment (Cruess et al., 2007; Gonzalez et al., 2011). Indeed, interventions aimed at addressing both depression and ART nonadherence demonstrate improvement in both (Safren et al., 2009, 2012). A limitation in understanding the relation between depression and HIV is research methodology. To date, the majority of research

has been cross-sectional (Gonzales et al., 2016). Thus, while depression is associated with ART adherence and other health behaviors, depression itself may also be an impactful health outcome. For example, some evidence suggests that ART adherence is associated with decreased depressive symptoms via the potential effects of medication on the production of dopamine and serotonin (Zangerle et al., 2002, 2010). Health promotion behaviors (e.g., exercise) to treat HIV as a chronic health condition may also be associated with depression and other mental health conditions (O'Brien et al., 2016), which may contribute to better ART adherence. Further examination of relations among depression, ART adherence, and HIV health behavior is needed.

While much of the research on mental health and HIV has focused on depression, other conditions, especially anxiety, have been associated with ART nonadherence (Gonzalez et al., 2011; Nel & Kagee, 2013). Similarly, trauma and posttraumatic stress disorder (PTSD) have been investigated as risk factors for worsening health outcomes, especially when comorbid with depression (Gonzalez et al., 2011; Leserman, 2008). In a study of traumatic events and PTSD, nearly 75% of PLWH experienced one traumatic event at some point in their lives, with most participants experiencing several traumas and 38% endorsing symptoms fulfilling criteria for a clinical diagnosis of PTSD (Wagner et al., 2012). Almost half of participants with trauma-related symptoms indicated that the initial diagnosis of being HIV-positive was a traumatic event. Despite this, research on associations between PTSD and treatment adherence are mixed, with some studies indicating that individuals with a diagnosis of PTSD are less ART adherent (Boarts et al., 2009; Mugavero et al., 2006) or that PTSD diagnosis, number of traumatic events, and type of traumatic events do not relate to adherence (Wagner et al., 2012). However, treatment adherence may be negatively impacted by the severity and recurrence of trauma-related symptoms or experiences of discrimination (Wagner et al., 2012). Because of higher rates of

trauma, depression, and other mental health disorders among PLWH, prioritizing mental health care among people receiving HIV treatment can improve HIV-related health outcomes and increase access to crucial mental health care (see Remien et al., 2019).

Alcohol and Substance Use

In addition to mental health, both alcohol use and alcohol use disorder are prevalent among PLWH and are significantly negatively associated with ART adherence (Kalichman et al., 2009; Remien et al., 2019). For example, Kalichman and colleagues found that 40% of PLWH on ART reported alcohol use, with 20% of those using alcohol consuming 3 or more drinks in a single drinking episode. The majority of participants believed alcohol and ART interact toxically. Alarmingly, some PLWH stopped ART during drinking episodes even when they did not believe ART and alcohol interacted negatively. Among those reporting they do not drink, 80% reported they do not drink because they believe alcohol and ART interact negatively and 25% of those who do not drink reported they would stop ART medications if using alcohol. It should be noted that there is no evidence of harmful effects of using alcohol while taking ART medications and PLWH should be encouraged to remain adherent to ART medications during drinking episodes (Kalichman et al., 2009). Stopping medications to consume alcohol predicted worse health outcomes, such as lower CD4 cell counts, while frequency of alcohol use, problems related to alcohol use, and amount of alcohol consumed did not directly impact HIV-related health outcomes (Kalichman et al., 2009).

Alcohol use among PLWH is associated with other substance use, with one study of PLWH on ART finding that 25% of participants who reported alcohol use also reporting using cannabis, cocaine, or both (Kalichman et al., 2009). Substance use among PLWH interacts with overall negative affect, and both negative affect and substance use relate to ART nonadherence

(Batchelder et al., 2013). Similarly, shame and non-acceptance of diagnosis, feeling isolated, and lacking a strong self-concept relate to increased risk of substance use and ART nonadherence. From a neurocognitive perspective, HIV, cocaine, heroin, and methamphetamine are associated with declines in cognitive functioning, with resulting cognitive decline resulting in poorer ART adherence (Anderson et al., 2015; Meade et al., 2011; Moore et al., 2012). However, a systematic review of 38 studies examining relations between substance use and ART adherence indicated that individuals who use substances are not significantly more nonadherent than individuals who do not use substances, yet access to appropriate addictions treatment has fostered improved ART adherence (Malta et al., 2010).

In addition to decreasing ART adherence, alcohol and substance use predict engagement in health-risk sexual behaviors. For example, interrupting ART adherence when consuming alcohol has been associated with increased likelihood of engaging in condomless sex. In another study, gay or bisexual men living with HIV who used at least two substances, including cocaine, crack, sedatives, injection drugs, and alcohol, were significantly more likely to engage in health-risk sexual behavior than PLWH who do not use alcohol or other substances (Friedman et al., 2009). Both failure to suppress viral loads related to ART nonadherence and condomless sex increase risk of transmitting HIV to others and contracting other sexually transmitted infections (Kalichman et al., 2011). Thus, increased substance use is a risk factor for ART nonadherence, health-risk sexual behaviors, and related negative health outcomes (Kalichman & Rompa, 2003). In conceptualizing comprehensive care for HIV, promoting coping skills and managing symptoms of mental health and substance use are crucial for managing ART adherence, preventing health-risk behavior, and improving overall quality of life (Remien et al., 2019).

Social Support and Relationships

Although mental health and substance use have been associated with adherence to ART medications, social support may act as a buffer against their effects (Claborn, Meier, et al., 2015). Additionally, positive social support may protect PLWH from the effects of treatment fatigue on ART nonadherence. For example, one study found that when PLWH received positive HIV-related social support, participants endorsed higher state treatment self-efficacy. This was especially true for individuals who initially reported more helplessness, avoidance, and perceived stigma and less initial treatment self-efficacy and social support (Turan et al., 2016).

Unfortunately, many PLWH may experience low social support, with PLWH identifying as ethnic or racial minorities, MSM, or having fewer socioeconomic resources being especially vulnerable (Houston et al., 2015). Although HIV-related social support is associated with better treatment self-efficacy, disclosing HIV status is not critical in the relation between social support and ART adherence. One study found that PLWH who had supportive interactions with family and friends were able to get help to address other HIV-related concerns, such as depression, even without disclosing HIV status (Rasmussen et al., 2013). Conversely, lacking social support predicts ART nonadherence, even beyond the effects of alcohol and other substance use (Palmer et al., 2003).

Similar to the effects of social support, partners of PLWH influence ART adherence. For example, when primary partners of PLWH maintain positive beliefs regarding the efficacy of ART and have fewer negative beliefs regarding potential harms of medication, PLWH are more likely to maintain ART adherence (Johnson et al., 2012). When primary partners have higher levels of commitment to PLWH, those on ART are more likely to suppress viral loads. However, when primary partners experience depressive symptoms, PLWH describe lower treatment self-

efficacy, although this may not impact ART adherence or associated health outcomes. Taken together, the effects of social support and relationships highlight the importance of engaging others in promoting health and itself may be an important treatment behavior.

Communication and Relationships with Health Providers

As identified earlier, attending health appointments and communicating with health-providers are both treatment behaviors themselves and associated with ART adherence. Several systems- and individual- level factors impact attendance with health appointments. From a systems perspective, PLWH may distrust the healthcare system, which is directly related to poorer ART adherence, appointment attendance, and health outcomes (Pellowski et al., 2013; Simoni et al., 2012). Medical mistrust may be more salient for traditionally underserved demographic groups, including people who identify as Black or African American, sexual minorities, and individuals with fewer socioeconomic resources. These groups historically have been the victims of stigma and medical abuse (CDC et al., 2014; Pellowski et al., 2013; Rintamaki et al., 2006). Although action has been taken to prevent discrimination in healthcare systems in the U.S., disparities in access to quality health services and experiences of racism in healthcare persist, contributing to mistrust of the medical system (Bogart et al., 2010; Pellowski et al., 2013; Simoni et al., 2012). On the other hand, PLWH in treatment who perceive their healthcare providers to understand and incorporate patients' cultural backgrounds are more likely to engage in health-promotion behaviors and demonstrate improved health outcomes (Gaston, 2013). Better communication between patients and providers and increased satisfaction with healthcare providers have been associated with better ART adherence and appointment attendance (Catz et al., 2001; Gaston, 2013) and may also be associated with improvements in other health behaviors.

Theoretical Framework

Collectively, individual-level factors are associated with ART adherence and may be associated with other treatment behaviors necessary for managing HIV and comorbid conditions. Factors that impact ART adherence can be integrated using the information-motivation-behavioral skills (IMB) model of highly active ART (HAART) adherence (Fisher, Fisher, Amico, & Harman, 2006). Per the IMB model, information about ART characteristics, including dosing, side effects, and adherence requirements, and motivation to adhere to ART, including beliefs about ART effectiveness and social support, are necessary elements of ART adherence. While information and motivation directly predict ART adherence behavior (i.e., taking medications as prescribed), their primary effects are through behavioral skills. Behavioral skills are one's actual abilities or self-efficacy to follow dosing requirements, remember to take medications, address side effects, engage social support, and self-reinforce ART adherence over time. The IMB model is a partial mediation model, such that information and motivation predict adherence behavior directly and through behavioral skills. Further, adherence behavior predicts improved HIV-specific health outcomes, such as immune functioning. The IMB model theorizes moderation effects of psychological health (e.g., depression), addictions, housing, food insecurity, and access to healthcare (Fisher, Fisher, et al., 2006). However, an empirical study testing the IMB model found that depression did not moderate the IMB model (Horvath et al., 2014). The IMB model also specifies a feedback loop such that improved health outcomes relate to increased information and motivation.

In addition to conceptualizing how factors affecting ART adherence are organized and related, the IMB model also identifies a three-step process for developing interventions (Fisher et al., 2008; Fisher & Fisher, 1992). The first step, called "elicit," is to identify the specific

information, motivation, and behavioral skills necessary for adherence. The second step is to develop an intervention in consideration of the psychological and social factors or contexts impacting adherence. The last step, “evaluation-outcome,” is to examine the effects of the designed intervention on addressing information, motivation, and behavioral skills. The IMB model has been applied to health behaviors for other health conditions, including diabetes management (Osborn & Egede, 2010) and breast self-examination (Misovich et al., 2003). Related to HIV, current measures of treatment adherence focus on ART (The LifeWindows Project Team, 2006) and examination of associations with other HIV-related treatment behaviors may be useful.

One way in which the IMB model of ART adherence may be associated with engagement in other health behaviors is through the coaction framework of multiple health behavior change (Johnson et al., 2014; Paiva et al., 2012; Pellowski & Kalichman, 2016). Specifically, increased ART adherence may be associated with increases in other recommended health behaviors (e.g., reducing substance use, coping skills for mental health, engaging social support, condom use during sex, and exercise). Research has identified a potential coaction effect between ART adherence and specific health behaviors (e.g., exercise; Pellowski & Kalichman, 2016), and some studies have found ART nonadherence to be associated with increases in other health-risk behaviors (e.g., condomless sex and substance use; Kalichman & Rompa, 2003). Further investigation into relations among other HIV health behaviors, and the effects of health behaviors on health outcomes, may improve efficiency and impact of healthcare for PLWH (Evers & Quintiliani, 2013; Pellowski & Kalichman, 2016). A step in this direction is identifying which health behaviors are important to assess and developing a useful measure for further research and clinical needs assessment.

Measuring HIV Treatment Behavior

Assessing needs and treatment behavior, including taking ART, exercising, maintaining nutrition, engaging social support, coping with mental health symptoms, reducing alcohol and other substance use, and using condoms during sex, can foster improved communication between health providers and PLWH and assess needs for further resources (Catz et al., 2001). Regular assessment allows providers to identify changes in treatment needs over time and promote retention in care (French et al., 2011). Because retaining PLWH in care is a primary treatment goal and promotes overall wellness, reduces new infections, prevents HIV/AIDS- related mortality, and is cost-saving, the existing literature base has called for the identification and measurement of risk factors of treatment nonadherence early in treatment (Colasanti et al., 2017; Shah et al., 2016).

Several methods of measuring ART adherence exist, including self-report by patients, tracking health-appointment attendance, counting pills to assess for missing doses, tracking health outcomes (e.g., viral load), and medication-event monitoring systems (i.e, pill bottles that electronically track if they have been opened, serving as a proxy for health providers to track if patients have taken scheduled doses; see Sahay, Reddy, & Dhayarkar, 2011). However, to track treatment progress, multiple methods of assessment are recommended (Sahay et al., 2011). Most measures of adherence focus predominantly on ART adherence and not on health-promotion or medical self-management behaviors, and the only method viable across treatment settings and providers is the self-report measure (Knobel et al., 2002; Miller & Hays, 2000). Self-report measures may be effective for tracking comprehensive treatment progress across the continuum of HIV care. Fortunately, self-report measures of ART adherence tend to correspond with biological outcomes (e.g., viral load; Cook et al., 2007, 2009; Knobel et al., 2002). A self-report

measure of comprehensive health behaviors for managing HIV as a chronic health condition may provide important information about the needs and health of PLWH.

Study Rationale

ART adherence is an imperative treatment behavior for managing chronic HIV and preventing AIDS and AIDS-related mortality (e.g., Gonzalez et al., 2011). However, comprehensive treatment for HIV includes a range of health behaviors to promote patient independence and quality of life, as well as address or prevent comorbid conditions and side effects of ART (Evers & Quintiliani, 2013; Lerner et al., 2020; Swendeman et al., 2009). Individual-level psychosocial factors increase the risks of ART nonadherence and negative health and quality-of-life outcomes (Sahay et al., 2011). Combinations of multiple individual-level factors are associated with increased risk of transmitting HIV to others and not achieving viral suppression (Blashill et al., 2015; Singer & Clair, 2003; Stall et al., 2003). As PLWH experience more factors working against adherence, their HIV-related health outcomes worsen (Blashill et al., 2015). Managing these factors are important areas of intervention. Engaging in health behaviors to address these factors can help PLWH manage their health independently and augment positive health outcomes.

Psychologists, mental health and addictions counselors, and social workers are often engaged in the continuum of HIV care and can intervene on health behavior change to manage HIV as a chronic health condition (Mitchell & Oltean, 2007; Spector & Remien, 2015). Indeed, the American Psychological Association (APA) recommends treatment for PLWH to address both biomedical (e.g., ART), and behavioral (e.g., risk reduction) interventions to support optimal health outcomes (APA, 2018). However, studies have found that mental health and addictions professionals tend to not inquire about HIV-related risk factors or discuss HIV-related

prevention and intervention. For example, one study found less than one-third of addictions counselors working with people at-risk for HIV inquire about risk factors for transmitting HIV, one-third of providers directly avoided discussing HIV, less than one-sixth provided education about safe needle exchange for people using intravenous drugs, half believed their patients were not at-risk despite not inquiring, and many had misconceptions about HIV progression (Spector & Remien, 2015). Although many of the counselors who participated in the study indicated low self-efficacy in communicating about HIV risk factors and related health, the majority reported interest in developing communication and assessment skills.

To support health professionals to assess adherence with comprehensive HIV treatment – inclusive of biomedical and behavioral interventions – the proposed study aims to create a self-report measure of adherence with health behaviors. The developed measure aims to provide a nuanced examination of relations among recommended HIV treatment behaviors and their effects on health outcomes. Further, the proposed study seeks to identify antecedents to nonadherence with comprehensive HIV treatment, helping providers and PLWH identify areas of intervention (Catz et al., 2001). Creating a self-report measure for providers to quickly and regularly assess patients' treatment adherence will encourage communication between providers and people living with HIV about a repertoire of health behaviors, which can facilitate better treatment adherence (Gaston, 2013). Exploring the developed measure's reliability and validity can assist with research on the effects of coercion among health behaviors and expand the scope of theoretical orientations of health behavior change (e.g., IMB model of ART adherence) beyond ART adherence in a fuller conceptualization of HIV treatment.

Hypotheses

The proposed study aimed to address three primary goals. First, to develop a measure of adherence with health-promotion and medical self-management behaviors for PLWH. Items were written to encompass a broad range of comprehensive treatment behaviors, including exercise, diet, engaging social support, managing mental health, reducing substance use, practicing safer sex, and attending health appointments. Four researchers or clinicians specializing in HIV reviewed and helped edit items. Second, using the developed Comprehensive HIV Adherence with Treatment (CHAT) scale to examine antecedents of treatment adherence. Third, to explore HIV-related health outcomes of adherence with comprehensive treatment. After developing and refining items for the proposed CHAT scale and evaluating the scale's factor structure, several hypotheses were tested.

Hypothesis 1: Items developed for the CHAT scale would load onto three factors which would be correlated: physical health (e.g., exercise), mental health (e.g., managing symptoms of depression) and medical management (e.g., attending healthcare appointments).

Hypothesis 2: The developed CHAT scale would demonstrate construct validity.

Hypothesis 2a: The CHAT scale would demonstrate convergent validity with ART adherence (measured by the Simplified Medication Adherence Questionnaire; Knobel et al., 2002) and self-efficacy for maintaining treatment (measured by the Adherence Self-Efficacy Scale; Johnson et al., 2007).

Hypothesis 2b: The CHAT scale would demonstrate discriminant validity with the HIV-knowledge factor of the HIV-Intention Measure (Nelsen et al., 2012).

Hypothesis 3: Antecedents of adhering with comprehensive treatment behaviors would be identified.

Hypothesis 3a: Higher levels of treatment self-efficacy would predict higher adherence with comprehensive treatment.

Hypothesis 3b: Higher levels of depression would predict poorer adherence with comprehensive treatment.

Hypothesis 3c: Higher levels of emotion dysregulation would predict poorer adherence with comprehensive treatment factors.

Hypothesis 3d: Higher levels of impulsivity would predict poorer adherence with comprehensive treatment factors,

Hypothesis 3e: Higher levels of sensation seeking would predict poorer adherence with comprehensive treatment factors.

Hypothesis 4: Adherence with comprehensive treatment would predict health outcomes.

Hypothesis 4a: Higher levels of comprehensive treatment adherence would predict improved HIV-related health outcomes, including lower viral load and “undetectable” status.

Hypothesis 4b: Higher levels of comprehensive treatment adherence would predict improved general physical health outcomes, including lower blood pressure, fewer unscheduled health appointments, and fewer other infections or diseases.

METHODS

Recruitment and Procedures

Institutional review board approval for this study was obtained from the Colorado State University Research Integrity and Compliance Review Office (CSU RICRO). Participants were recruited from 15 HIV or infectious diseases clinics and AIDS services organizations, given the challenge of recruiting a large sample of PLWH. Appendix A provides a full list of recruitment sites. The flyers distributed by recruitment sites are presented in Appendix B and included study information, researcher contact information, a web link to the survey hosted on the Colorado State University host system, and recommendations for accessing the study website in a private location on a secure network.

In response to decreased participant recruitment resulting from the COVID-19 pandemic – and specifically that many recruitment sites transitioned to a telehealth format, removed all unnecessary papers and objects from clinics, or stopped recruiting research participants – advertising for the study via Facebook was initiated in February, 2020. Approval was obtained by CSU RICRO prior to launching the Facebook advertisement campaigns. The advertisement campaign focused on HIV/AIDS related interests, including: AIDS Foundation of Chicago, Hairdressers Against Aids, Broadway Cares/Equity Fights AIDS, AmfAR, The Foundation for AIDS Research, Elton John AIDS Foundation, AIDS Walk New York, Prevention of HIV/AIDS, International AIDS Society, AIDS Healthcare Foundation, AIDS.gov, Epidemiology of HIV/AIDS, Greater Than AIDS, POZ (magazine), International HIV/AIDS Alliance, AIDS/LifeCycle, National AIDS Trust, World AIDS Day, Start Talking. Stop HIV., and HIV/AIDS research. A subsample of the advertisements focused on men who also indicated

interest in Gay Pride and the LGBT community in addition to the HIV/AIDS interests.

Advertisements were displayed to Facebook users across the United States. Images used for the Facebook advertisements were obtained from pexels.com and were licensed as free to use and edit. Text for the advertisements included “This online research survey from Colorado State University looks at how treatment behavior improves health for people living with HIV. We are also looking at traits that may make it more difficult to follow treatment. You will be emailed a \$10 Amazon e-gift card after finishing the survey. You can participate if you are 1) 18 years old or older, and 2) Receiving HIV treatment. The survey takes 1-1.5 hours to complete. Please take the survey in an area where you have privacy and on a secured network”. The set of Facebook advertisements is presented in Appendix C.

Data were collected online using the Qualtrics platform. Upon accessing the survey, participants were provided with study information and informed consent procedures. After consenting, participants responded to survey items, including items in development for the CHAT Scale. To protect participants’ health information and HIV status, name and most contact information were not collected. Participants were compensated with \$10.00 gift cards to Amazon.com, which were emailed to participants. Participants were encouraged to provide a non-identifying email address (one in which their first and/or last names are not used), and Qualtrics was programmed to collect email addresses in a separate survey such that email addresses were not connected to participant data.

Participants

Participants were 118 adult PLHW (ages 21.60-80.66; $M_{age} = 45.84$, $SD = 12.35$). Demographic data and health information were measured via self-report questions. Participants were asked to report their date of birth (to calculate age at the time of participation), sex, gender,

sexual orientation, household income, number of people who live off that income, medication regimen, last known CD4 count, detectable vs. undetectable HIV status, number of hospitalizations over the previous 3 months, number of unscheduled health appointments (e.g., urgent care) over the previous 3 months, height, weight, last known blood pressure, and if they have co-occurring health conditions. Reported information was used to calculate and categorize body mass index (height and weight; CDC, 2020e), poverty status (income and number of people who live off that income; U.S. Department of Health & Human Services [HHS], 2019, 2020), and blood pressure category (American Heart Association, 2021). CD4 counts were dichotomized as having fewer than 500 cells per cubic mL, suggestive of impaired immune functioning, or 500 or greater cells per cubic mL, suggestive of normal immune functioning (HHS, 2017).

Participants reported living with HIV for between 3 months and 35 years ($M = 13.92$ years, $SD = 10.10$ years) and receiving treatment at the time of participation. Participants were on their current ART regimens for between 1 month and 35 years ($M = 3.95$ years, $SD = 5.15$ years). Most participants reported an undetectable HIV status ($N = 101$, 86.3%) and half of participants ($n = 59$) reported having at least one co-occurring health condition. Among those with co-occurring health conditions, the mean number of conditions was 3.10 ($SD = 4.27$). In the final sample, 70 participants (59.3%) were recruited from clinics or AIDS services organizations and 48 participants (40.7%) were recruited from Facebook. Participants' demographic information is presented in Table 1, and participants' health information is presented in Table 2. Missing data were examined among demographic variables and variables to be included in the analysis, with 11.4% of data missing. Results of Little's MCAR test ($\chi^2 = 3490.56$, $DF = 3443$, p

= .28) suggested no missing data patterns. Variables with high proportions of missing data were excluded in the final analysis and are identified in the Analysis section.

Table 1
Participant Demographic Information

Characteristic	<i>N</i>	%
Sex		
Male	94	79.7
Female	20	16.9
Missing or Prefer to Not Respond	4	3.4
Gender		
Man	95	80.5
Woman	20	16.9
Other	1	.8
Missing or Prefer to Not Respond	2	1.7
Sexual Orientation		
Exclusively Gay/Lesbian	67	56.8
Mostly Gay/Lesbian	11	9.3
Between Bisexual and Gay/Lesbian	2	1.7
Bisexual	10	8.5
Between Bisexual and Straight	4	3.4
Mostly Straight	3	2.5
Exclusively Straight	17	14.4
Cannot Respond Using This Scale	2	1.7
Missing	2	1.7
Race		
American Indian or Alaskan Native	2	1.7
Asian	10	8.5
Black or African American	18	15.3
Native Hawaiian or Other Pacific Islander	1	.8
White	77	65.3
Multi-racial	4	3.4
Missing or Prefer to Not Respond	6	5.1
Ethnicity		
Hispanic or Latino	21	17.8
Not Hispanic or Latino	93	78.8
Missing or Prefer to Not Respond	4	3.4
Poverty Status		
Above Poverty Guidelines	64	54.2
Below Poverty Guidelines	20	16.9
Missing or Prefer to Not Respond	34	28.8

Table 2
Participant Health Information

Variable	<i>N</i>	%
Detectable HIV Status	10	8.5
Undetectable HIV Status	101	85.6
HIV Status Missing, Unknown, or Prefer to Not Respond	7	5.9
CD4 Count		
< 500 cells per cubic mL	26	22.0
≥ 500 cells per cubic mL	54	45.8
Missing or Prefer to Not Respond	38	32.2
ART Regimen Number of Medications		
0	2	1.7
1	68	57.6
2	32	27.1
3	11	9.3
≥ 4	3	2.4
Missing or Prefer to Not Respond	2	1.7
ART Regimen Dose		
Single dose per day	104	88.1
Multiple dose per day	12	1.2
Missing or Prefer to Not Respond	2	1.6
Number of unscheduled health visits past 3 months		
0	80	67.8
1	14	11.9
2	11	9.3
3-6	3	2.4
Missing or Prefer to Not Respond	10	8.5
Number of hospitalizations past 3 months		
0	94	87.0
1	9	7.6
2	3	2.5
3-5	2	1.6
Missing or Prefer to Not Respond	7	5.9
Body Mass Index		
Underweight (< 18.50)	3	2.5
Normal (18.50-24.99)	46	39.0
Overweight (25.00-29.99)	41	34.7
Obese (> 29.99)	24	2.3
Missing or Prefer to Not Respond	4	3.4
Blood Pressure		
Normal	19	16.1
Elevated	16	13.6
High Stage 1	14	11.9
High Stage 2	10	8.5
Missing or Prefer to Not Respond	59	50.0

Measures

Treatment Self-Efficacy

Treatment self-efficacy was measured by the HIV Treatment Adherence Self-Efficacy Scale (HIV-ASES; Johnson et al., 2007). The HIV-ASES measures two facets of treatment self-efficacy: integrating treatment behaviors into daily life (Integration) and beliefs about persevering in long-term treatment plans (Perseverance). Participants responded to items (e.g., “In the past month, how confident have you been that you can stick to your treatment schedule even when your daily routine is disrupted?”) with an 11-point scale ranging from 1 “Cannot do at all” to 11 “Completely certain can do”. In the present study, the internal consistencies for Integration (9 items; $\alpha = .93$) and Perseverance (3 items; $\alpha = .77$) were acceptable.

Information, Motivation, Behavioral Skills Model

The three subscales of the LifeWindows Information Motivation Behavioral Skills ART Adherence Questionnaire (LW-IMB-AAQ; The LifeWindows Project Team, 2006) was used to measure the information, motivation, and behavioral skills constructs of the IMB Model. Participants responded to items (e.g., “How hard or easy is it for you to get our HIV medication refills on time?”) on a 5-point Likert-type scale. Depending on the item, responses ranged from 1 “I strongly disagree” to 5 “I strongly agree”, or 1 “Very hard” to 5 “Very easy”. To create subscale scores, several items were reverse-scored (Information 3, Information 5, Motivation 1, Motivation 2, Motivation 3, Motivation 6, Motivation 7, Motivation 8, Motivation 9, and Motivation 10). In the present study, the internal consistencies for the Information (items; $\alpha = .74$), Motivation (10 items; $\alpha = .81$), and Behavioral Skills (13 items; $\alpha = .92$) subscales were acceptable.

Medication Adherence

ART adherence was measured by the Simplified Medication Adherence Questionnaire (SMAQ; Knobel et al., 2002). The SMAQ is a six-item measure of adherence with ART medication regimens. The SMAQ asks about medication adherence over the previous week, weekend, and past 3 months, and has demonstrated sensitivity, specificity, and associations with virological outcomes (e.g., viral load; Knobel et al., 2002). Participants responded to four questions (e.g., “Do you ever forget to take your medicine?”) with a “yes/no” response option; to one question (“Thinking about the past week, how often have you not taken your medicine?”) with “Never”, “1-2 times”, “3-5 times”, “6-10 times”, or “>10 times”; and to one question (“Over the past 3 months, how many days have you not taken any medicine at all?”) with “ ≤ 2 ” or “>2”. Participants were coded as nonadherent if they responded “yes” to any of the yes/no items or reported not taking their medications more than 2 times in the past week or 3 months. In the present study, internal consistency was questionable (6 items; $\alpha = .66$).

HIV Knowledge

Participants’ self-perceptions of their HIV knowledge was assessed using four items from the HIV-Intention Measure (HIV-IM; Nelsen et al., 2012). Participants responded to items (e.g., “I know a lot about living with HIV infection”) using a Likert-type scale ranging from 1 “Strongly Agree” to 6 “Strongly Disagree”. Internal consistency for the HIV-IM Knowledge subscale was acceptable ($\alpha = .82$) in the present study.

Depression

The Center for Epidemiologic Studies Depression Scale Revised (CESD-R; Eaton, Smith, Ybarra, Muntaner, & Tien, 2004) was used to screen for symptoms of depression. The CESD-R contains 20 items which map onto 9 symptom groups: sadness or dysphoria, 3 items; anhedonia,

2 items; appetite, 2 items; sleep, 3 items; thinking or concentration, 2 items; guilt or worthlessness, 2 items; tired or fatigue, 2 items; movement or agitation, 2 items; suicidal ideation, 2 items. Participants reported if they have never experienced symptoms (0) or if they have for 1-2 days (1), 3-4 days (2), 5-7 days (3), or nearly every day for 2 weeks (4). In the present study, a total score of all 20 items was calculated. The CESD-R demonstrated excellent internal consistency (20 items; $\alpha = .95$) in the present study.

Emotion Dysregulation

Emotion dysregulation was assessed with the Difficulties with Emotion Regulation Scale (DERS; Gratz & Roemer, 2004). The DERS is comprised of six subscales measuring distinct facets of emotion dysregulation: non-acceptance of emotional responses (Non-Acceptance), difficulties engaging in goal directed behavior (Goals), impulse control difficulties (Impulse), lack of emotional awareness (Awareness), limited access to emotion regulation strategies (Strategies), and lack of emotional clarity (Clarity). Participants responded to items (e.g. “When I’m upset, I become angry with myself for feeling that way”) using a 5-point Likert-type scale, with responses ranging from 1 “Almost Never” to 5 “Almost Always”. Several items were reverse scored: 1, 2, 6, 7, 8, 10, 17, 20, 22, 24, and 34. Internal consistency was acceptable for all DERS subscales in the present study: Non-Acceptance (6 items; $\alpha = .92$), Goals (5 items; $\alpha = .88$), Impulse (6 items, $\alpha = .87$), Awareness (6 items; $\alpha = .81$), Strategies (8 items; $\alpha = .92$), and Clarity (5 items; $\alpha = .85$).

Impulsivity

Impulsivity was measured using a modified version of the five-factor Urgency, Lack of Premeditation, Lack of Perseverance, Sensation Seeking Scale (UPPS; Whiteside & Lynam, 2001). The modified version (UPPS-P; Cyders et al., 2007) separates urgency into negative

urgency, or the tendency to act out in response to negative emotion states, and positive urgency, or acting out in response to positive emotion states. In the present study, Sensation Seeking was not included as a facet of impulsivity and instead considered its own trait and measured separately. Participants responded to items (e.g., “Sometimes I do impulsive things that I later regret”) using a 4-point Likert-type scale with responses ranging from 1 “Agree Strongly” to 4 “Disagree Strongly”. Several items were reverse-scored (items 2, 3, 5, 7, 8, 9, 10, 12, 13, 15, 17, 18, 20, 22, 23, 25, 26, 29, 30, 31, 34, 35, 36, 39, 40, 41, 44, 45, 46, 47, 49, 50, 51, 52, 54, 56, 57, 58, and 59). Internal consistency was adequate in the present study for all UPPS-P subscales: Negative Urgency (12 items; $\alpha = .89$), Lack of Premeditation (11 items; $\alpha = .84$), Lack of Perseverance (10 items; $\alpha = .84$), and Positive Urgency (14 items; $\alpha = .94$).

Sensation Seeking

Sensation seeking was measured using the Sensation Seeking Personality Type scale (SSPT; Conner, under review). The SSPT is comprised of two subscales: Risk Seeking and Experience Seeking. Participants responded to items (e.g., “I think it is important to try as many new things as I can”) using a 5-point Likert-type scale, with responses ranging from 1 “Strongly Disagree” to 5 “Strongly Agree”. Items 3 and 16 were reverse scored. Internal consistency for Risk Seeking (5 items; $\alpha = .83$) and Experience Seeking (5 items; $\alpha = .85$) were acceptable in the current study. Descriptive information for the SSPT and all measures is presented in Table 3.

CHAT Scale Development

Items were developed for a novel measure of adherence with comprehensive treatment behaviors, the Comprehensive HIV Adherence with Treatment (CHAT) Scale. The development of the pool of initial items, as well as proposed refinement and evaluation, followed recommendations from DeVellis (2012). Classical test theory was applied to refine and test the

measure. Classical test theory posits an underlying construct drives item responses and observed scores (i.e., participants' responses) reflect a combination of participants' true scores and random error (DeVellis, 2012). Scale development follows guidelines from DeVellis (2012) divided over several steps. Steps 1-5 focus on item development and content validity by defining the construct, writing initial items, choosing an appropriate format for item responses, having initial items by reviewed experts, and considering the inclusion of validation items. Steps 6-8 focus on item evaluation, reliability, and decision-making about trimming items.

Table 3
Descriptive Statistics for Measures

Measure	<i>M</i> (<i>SD</i>)	Skew	Kurtosis
HIV-ASES: Integration	85.15 (16.00)	-1.47	1.72
HIV-ASES: Perseverance	26.98 (6.59)	-1.05	.28
SMAQ	0.62 (.49) ^a	-.51	-1.78
IMB Information	37.92 (5.62)	-.69	-.33
IMB Motivation	36.43 (7.87)	-.19	-.78
IMB Behavioral Skills	54.17 (8.80)	-.66	-.42
HIV Intention Measure: Knowledge	7.43 (3.22)	.98	.63
CESD-R	18.59 (17.64)	1.17	.73
DERS Non-Acceptance	12.17 (5.76)	.97	-.03
DERS Goals	12.23 (4.76)	.62	-.08
DERS Impulse	11.48 (5.15)	1.21	1.02
DERS Awareness	13.66 (4.76)	.45	-.23
DERS Strategies	16.09 (7.25)	1.11	.47
DERS Clarity	9.78 (3.79)	.98	.98
UPPS-P Negative Urgency	26.05 (7.58)	-.33	-.42
UPPS-P Lack of Premeditation	19.95 (5.24)	.11	-.02
UPPS-P Lack of Perseverance	17.96 (5.06)	-.04	.02
UPPS-P Positive Urgency	25.64 (9.19)	.30	-.40
SSPT Risk Seeking	11.83 (4.25)	.19	-.78
SSPT Experience Seeking	18.45 (3.90)	-.45	.34

^a The SMAQ is a dichotomous measure, with 0 = adherent with medication ($n = 39$), 1 = nonadherent with medication ($n = 64$) and missing $n = 15$.

Step 1: Identify the Construct to Measure

The construct, comprehensive treatment adherence, was identified in consideration of the reviewed literature to encapsulate health-promotion and medical self-management behaviors. These behaviors include exercising, engaging social support, managing mental health, attending appointments with providers, reducing alcohol and substance use, and practicing safer sex. Despite recommendations for PLWH to engage in these health-promotion and medical self-management behaviors, current measures of treatment adherence focus on ART adherence. The identified construct taps into a broader scope of health behaviors for PLWH receiving treatment. These behaviors are traditionally considered protective factors for ART adherence (e.g., social support), rather than important treatment behaviors associated with their own health and quality of life outcomes. The identified construct broadens the definition of HIV treatment to encapsulate these behaviors. By operationalizing comprehensive treatment in this way, the effects of these behaviors on health outcomes can be better examined and PLWH and their health providers can identify potential treatment needs.

Step 2: Create the Item Pool

Early in the measure development, a large pool of potential items was drafted with the intention of capturing as much of the intended construct as possible (DeVellis, 2012). Per recommendations, care was taken to avoid writing items that were wordy or required an advanced reading level, were redundant, or contained more than one idea (double-barreled items). Care was also taken to avoid criterion contamination by preventing overlap between items measuring predictors of treatment adherence (e.g., items measuring sensation seeking) and CHAT Scale items measuring treatment adherence (Raykov & Marcoulides, 2011). To reduce the effects of forgetting or mis-reporting due to memory error, recall periods were kept short. For

example, a meta-analysis on recall period and response format for HIV-risk behaviors identified acceptable reliability for a 3-month recall period for sexual behavior and a 30-day recall period for substance-use behavior (Napper et al., 2010). Because the CHAT scale is intended to be used quickly by health providers and researchers, the estimated length of the final measure was estimated to be a maximum of 30 items. In line with DeVellis's (2012) recommendations that the initial item pool be 3-4 times larger than the final measure, the initial pool was comprised of 101 items written to encapsulate a range of treatment behaviors including ART adherence and health-promotion and medical self-management behaviors (see Appendix D for a draft of initial items).

Step 3: Choose an Appropriate Response Format

Measures of ART adherence tend to focus on number of days non-adherent or number of medications not taken over a short period of time (Sahay et al., 2011). While ART follows a specific regimen for quantity and dose of medication per day, other treatment behaviors are less structured and are less amenable to count-based reporting. In consideration of DeVellis's (2012) recommendation of choosing a response format appropriate for the initial pool of items and the overall measurement of adherence with comprehensive treatment behaviors, a Likert-type response format was selected. A study on appropriate response format found that a rating response was more reliable than a count-response format (i.e., number of times per recall period; Napper et al., 2010). Response options were presented on a 5-point scale ranging from "Strongly Disagree" to "Strongly Agree" with an option to indicate "N/A or prefer to not answer". This allowed participants to respond with their level of engagement with a variety of treatment behaviors and allow for easy interpretation across a variety of treatment and research settings.

Step 4: Expert Review

DeVellis (2012) recommends a panel of experts review items to ensure they measure the intended construct, are written clearly, concisely, and nonjudgmentally while also comprehensively represent the construct being measured. The pool of items was reviewed and edited by three experts in HIV treatment and treatment adherence research (Alex Washington, Ph.D.; Paul Cook, Ph.D.; Kristina Phillips, Ph.D.) and one health provider with experience treating PLWH (Donna Rolin, Ph.D.). Reviewers rated each item based on its clarity, conciseness, and relation to adherence with comprehensive treatment. Reviewers also provided suggestions for additional items. The aim of this was to ensure that both the construct and the items measuring it were useful for research and clinical purposes.

Step 5: Evaluate the Inclusion of Validation Items

Individuals' responses may be impacted by social desirability, thereby negatively impacting the validity of the measure under development (DeVellis, 2012). One study on ART adherence among PLWH found that self-report measures of adherence predicted virological outcomes for people who scored low on social desirability but not among people who scored high on social desirability (Nieuwkerk et al., 2010). In light of this, care was taken to follow recommendations for including items that are nonjudgmental. Items were screened by the panel of experts for potential perceptions of judgment or risk for skewed responses resulting from social desirability.

Step 6: Item Administration Using a Development Sample

For item evaluation, a development sample should be used to test how items relate to each other and to the intended construct (DeVellis, 2012). The development sample should be sufficiently large and representative in terms of characteristics of the target population, with the

goal of identifying how the construct predicts item responses in the population. Because the target population is PLWH receiving treatment, participants were recruited from HIV clinics, infectious diseases clinics, and AIDS services organizations, as well as through Facebook advertisements shown to people in the United States who “liked” interests related to HIV issues.

Steps 7 and 8: Item Evaluation and Appropriate Scale Length

Initial Item Evaluation. The overall goal of the proposed scale development was to have a high correlation between the CHAT scale and participants’ actual engagement in the wide range of treatment behaviors necessary to manage HIV as a chronic health condition (DeVellis, 2012). This was evaluated through several sub-steps. First, item means were examined. Items with mean scores near the center of the range were more likely to have high variability and capture the full range of true scores. Second, items’ variances were examined to identify items which best discriminate between participants. Third, correlations between items were examined in order to assess how intercorrelated the items were. The more intercorrelated the items were, the higher each individual item’s reliability. The matrix of intercorrelations was examined to identify items with the best reliabilities. Negative correlations between items indicated items to be reverse-scored or items not performing well and subsequently dropped from the measure. Last, item discrimination was evaluated using the correlation between each item’s mean and the CHAT Scale’s remainder score. This correlation is similar to the item-total correlation, except the remainder score (scale total score minus the item score) is calculated for each item to prevent inflated correlation coefficients caused by including the item in the total score (McDonald, 1999). More discriminating items were ones with higher correlations. After trimming items, the remaining pool was considered for further analysis.

Exploratory Factor Analysis. After the initial item evaluation, exploratory factor analysis (EFA) was used to explore underlying latent variables driving responses to the CHAT Scale. The goals of the factor analysis were to identify the number of factors represented by the set of items; condense the scale by identifying a smaller subset of items which measure the construct well; determine each factor's meaning by integrating theory with examination of how items relate to each other; and specify items performing well and poorly (DeVellis, 2012). While it was hypothesized that the CHAT Scale would capture factors reflecting physical health, mental health, and medical self-management, EFA was conducted because research on HIV treatment adherence focuses on ART adherence and less is known about relations among other treatment behaviors. The overall sample ($N = 118$) was randomly split into two halves with equal proportions of Facebook and clinic recruitment. One half was used for the EFA to identify the initial structure of the scale.

The EFA was conducted using principal axis factoring (PAF), which, similar to principal components analysis (PCA), seeks to reduce the information obtained from the individual observed variables into factors (DeVellis, 2012). However, PCA seeks to identify the number of factors which best explain the most information of the original items, while PAF assumes an underlying construct, or latent variable, drives responses to observed variables. In PAF, each item's variance not shared with other items is considered error and removed from the model, and resulting factors are error-free representations of the underlying latent variable. To increase the interpretability of the factors, the EFA used Geomin oblique factor rotation. Oblique factor rotation is used when correlations between factors are hypothesized, while orthogonal rotation is used when factors are hypothesized to not correlate with each other. The EFA analysis was

conducted using MPlus Version 8.5 (Muthén & Muthén, 1998-2017) and maximum likelihood estimation with robust standard errors (MLR).

The goal of extracting factors was to derive a parsimonious model such that the extracted factors explained more variance than individual items loading onto each factor (DeVellis, 2012). Methods of identifying the number of extracted factors include the eigenvalue rule (Kaiser, 1960), scree test (Nunnally, 1978) and parallel analysis (Hayton et al., 2004). An eigenvalue is the proportion of shared variance explained by the factor, and eigenvalues greater than 1 indicate that more variance is explained by the factor than by a single item. This has been interpreted as a rule in which factors with eigenvalues less than 1 are dropped from the model, as they explain less variance than a single item. However, this is an unreliable method of identifying the number of factors and often results in too many factors extracted (Bandalos & Boehm-Kaufman, 2009). A scree plot graphs the eigenvalue for each factor in order from highest eigenvalue to lowest eigenvalue (DeVellis, 2012). On the scree plot, a break point, at which the plot levels off, can be observed. After this break point, the explanatory power of each additional factor is minimal. However, interpretation of the scree plot is subjective. To reduce subjective interpretation of the scree plot, parallel analysis was conducted in the current study. In parallel analysis, an EFA is conducted on a matrix of randomly generated data the same size as the matrix for the obtained data. The random data are compared against the obtained data. Only the factors from the obtained data with eigenvalues greater than those of the randomly generated data are retained.

After extracting the number of factors through parallel analysis, standardized factor loadings were examined. Factor loadings indicate how measured items relate to the factor, with higher factor loadings reflecting items that more strongly relate to the factor and therefore to the underlying latent variable. Generally, factor loadings should be greater than .40, with lower

factor loadings identifying items that may need to be edited or omitted (Ford et al., 1986). Items that load onto multiple factors with standardized factor loadings greater-than or equal-to .35 and with less than a .20 difference between them were considered for omission from the scale, as these items violated simple structure by measuring multiple factors. After trimming items that performed poorly, the resulting factor structure was interpreted based on themes in the items loading onto each factor. Although scales with more items tend to be more reliable, the intended use of the CHAT Scale is to provide a quick measure of adherence with comprehensive treatment (DeVellis, 2012). Thus, the final length of the scale considered both results of the analysis and meaningful interpretability of the factors and relations among items.

Reliability. In addition to evaluating item performance through initial item evaluation and EFA, internal consistency reliability was examined to determine if items were related to each other and to the underlying factors (DeVellis, 2012). Coefficient alpha was calculated and is the proportion of the scale's total variance caused by communal variance (i.e., variance caused by an underlying latent construct) to indicate how interrelated items are. Scales with higher alpha coefficient values are interpreted as having greater interrelatedness among items, with coefficients greater than .90 preferred and greater than .70 acceptable (Nunnally, 1978). Coefficient alpha presents with limitations: It is often a low estimate of reliability, especially if items are correlated; is impacted by the number of items such that fewer items may result in lower alpha values even if the scale is unidimensional; does not directly indicate whether a single construct is measured by a single scale; and assumes tau-equivalence such that items have equal factor loadings (DeVellis, 2012; Raykov & Marcoulides, 2011). To address these limitations, coefficient omega (McDonald, 1999) was also calculated after conducting the EFA. Coefficient omega is calculated with the unstandardized factor loadings derived from the factor analysis and

the error variance of the factor (McDonald, 1999; Raykov & Marcoulides, 2011). Using the factor loadings in omega relaxes alpha's assumption that items load equally onto the intended factor, and the assumption of unidimensionality is tested directly through the factor analysis (Savalei & Reise, 2019). The thresholds for omega follow the same general guidelines as the alpha coefficient.

Confirmatory Factor Analysis. After evaluating items, trimming the CHAT scale, and assessing internal consistency, confirmatory factor analysis (CFA) was used to assess the resulting model. Specifically, the CFA sought to confirm the derived number of factors and relations between items and their factors by constraining these paths (DeVellis, 2012). Because the CFA was also included as the measurement model for a larger structural equation model described in more detail below, the total sample was used for the CFA. The CFA was conducted in Mplus Version 8.5 (Muthén & Muthén, 1998-2017) using MLR.

To examine how well the proposed model fits the data, multiple indices of model fit were examined. First, the chi square (χ^2) statistic compares the sample's covariance matrix to the covariance matrix of the estimated model, with good fit indicated by a nonsignificant χ^2 statistic, reflecting that the proposed model does not significantly differ from the model observed by the data (Ullman, 2013). A limitation of the χ^2 statistic is its sensitivity to sample size, with large samples magnifying small differences and thus inflating significance. To address this, other indices of fit were included. Second, the comparative fit index (CFI) controls for sample size and compares the estimated model to a model of complete independence in which there are no constrained paths among measured variables. CFI values range from 0 to 1, with excellent fit indicated by values greater than .95 and good fit indicated by values greater than .90 (Hu & Bentler, 1999). Third, the root mean squared error of approximation (RMSEA) compares a

saturated model to the estimated model and factors in degrees of freedom to estimate lack of model fit (Hu & Bentler, 1999). Perfect model fit is indicated by a values of 0, excellent fit by values less than .06, and poor model fit by values greater than .10 (Browne & Cudeck, 1992). Confidence intervals of the RMSEA point estimate can be used along with the point estimate to assess goodness of fit. Lastly, the Standardized Root Mean Square Residual (SRMR) is a standardized measure of the average differences, or residuals, between the hypothesized and observed models (Hu & Bentler, 1999; Iacobucci, 2010). For the SRMR, a value of 0 indicates perfect model fit, with good fit indicated by values of .05 or less, adequate fit by .08 or less, and poor fit by values of .10 and greater. Similar to the EFA, item factor loadings and relations among factors were evaluated, as well as internal consistency using omega and interrelatedness among items using the alpha coefficient.

Validity. Convergent validity with medication adherence was assessed using the SMAQ (Knobel et al., 2002). Using the SMAQ, participants were categorized as “adherent” or “nonadherent.” Point-biserial correlations between participants’ “adherent” versus “nonadherent” membership and engagement in comprehensive treatment behaviors as measured by the CHAT Scale were examined. Convergent validity with treatment self-efficacy was also examined using the HIV-ASES Integration and Perseverance subscales (Johnson et al., 2007). Because treatment self-efficacy relates to ART adherence and virological outcomes for PLWH, a strong correlation was expected between the HIV-ASES and the CHAT Scale. Discriminant validity was tested between the CHAT Scale and participants’ perceptions of their HIV knowledge using the HIV-Intention Measure (Nelsen et al., 2012). Previous studies have found self-perceived knowledge about HIV using these items does not relate to ART adherence (Nelsen et al., 2013). A non-significant correlation between HIV knowledge and the CHAT Scale was expected.

Exploring Relations Among CHAT Scale Factors, Predictors, and Health Outcomes

Detectable HIV Viral Load Status

After the development of the CHAT Scale and initial validity analysis, relations among CHAT Scale factors, health outcomes, and predictors of nonadherence were explored. An important HIV health outcome is attaining an undetectable HIV viral load status (e.g., Crum et al., 2006; Glass et al., 2008; Ickovics & Meade, 2002; Paterson et al., 2000; Stone, 2001). In the present study, most participants reported an undetectable status (85.6%), while a small percentage reported a detectable status (8.5%). Because having a detectable status was endorsed by a small proportion of participants, relations between undetectable/detectable status and independent variables of interest were explored using Firth logistic regressions, which are a penalized likelihood method of logistic regression that employ bias reduction methods to adjust for imbalance in dichotomous outcomes (Firth, 1993).

A total of five separate Firth regression models were conducted independently of each other, with detectable/undetectable status entered as the dependent variable in all models. Having an undetectable viral load, endorsed by most participants, was coded as 0, and having a detectable viral load was coded as 1. In the first model, participant recruitment method (in-clinic vs. Facebook) was entered as the independent variable to examine if significant differences emerged regarding recruitment method and detectable/undetectable status. In the second model, all factors of the CHAT scale were entered as independent variables. In the third model, medication adherence (as measured by the SMAQ) was entered as the independent variable. In the fourth, both HIV-ASES subscales were entered as independent variables. In the fifth, all three subscales of the LW-IMB-AAQ measure were entered as independent variables. Analyses were conducted using `logistf` R package (Heinze, Ploner, & Jiricka, 2020) in R Studio (R Core

Team, 2020). Significant results were interpreted using 99% confidence intervals of the odds ratio, with confidence intervals not containing 1.00 indicating significance.

Structural Equation Modeling

Theory-informed paths among personality measures, depression, the IMB model, HIV treatment self-efficacy, the CHAT Scale, and health-related outcomes were explored using structural equation modeling (SEM) implemented in Mplus Version 8.5 (Muthén & Muthén, 1998-2017) using MLR due to the zero-inflated distributions of number of unscheduled health appointments and number of co-occurring medical conditions. To determine the sample size necessary to conduct the SEM, it is commonly accepted to have 10 participants or observations per parameter in the model (Schreiber et al., 2006). Correlations among measures were examined to identify paths to specify in the model. In response to the small sample size obtained and in consideration of parsimony of paths, significant correlation coefficients greater than 0.30 were considered as potential paths for the SEM. The SEM was conducted in two stages, trimming non-significant paths in each stage.

The first stage explored paths among IMB model variables, HIV-ASES variables, SMAQ, and CHAT-Scale factors to health outcomes (number of unscheduled health appointments and number of co-occurring health appointments). Because the IMB model is a mediation model (Fisher et al., 2008), indirect effects among these paths were tested. Other health-related data, such as blood pressure, number of hospitalizations, and CD4 counts, were not included in the model due to high missingness or low endorsement rates. In the second stage, paths from personality variables (UPPS-P, SSPT, and DERS) to CHAT Scale factors and SMAQ were added. Model fit was assessed across models using the Akaike Information Criterion (AIC; Akaike, 1973) and sample-size adjusted Bayesian Information Criterion (SABIC; Sclove, 1987)

relative fit indices. These indices were used because the outcome variables had negative binomial count distributions (number of unscheduled health appointments and number of co-occurring conditions). Other model fit statistics described in the EFA and CFA analysis are not available when outcome variables are specified as count distributed (Muthen, L. K., 2009). Perfect model fit is indicated by AIC and SABIC values of 0 and, because the model was conducted iteratively by removing non-significant paths and re-running the model, improvement in model fit was indicated by AIC and SABIC values approaching zero.

RESULTS

CHAT Scale Development and Initial Item Evaluation

The initial pool of items was reviewed to ensure the wording and content were measuring treatment behavior. Several items were dropped from further analysis due to concerns of poor wording or not measuring intended behaviors or constructs (items 2, 4, 5, 6, 8, 10, 12, 14, 21, 23, 27, 32, 35, 40, 43, 44, 45, 51, 54, 56, 61, 65, 68, 79, 89, 94, and 100). Remaining items were recoded such that participants who responded “N/A or prefer to not respond” were coded as missing, Strongly Disagree = 1, Disagree = 2, Neutral = 3, Agree = 4, and Strongly Agree = 5.

Items were examined to identify those that should be reverse-scored due to hypothesized negative relations with the intended construct (items 3, 13, 15, 16, 17, 33, 54, 55, 57, 58, 60, 62, 63, 64, 66, 69, 73, 87, and 88). Items for which participants responded with a restricted range of response options (e.g., no participants chose Strongly Disagree or Strongly Agree) were dropped from the item pool (items 80, 83, 85, 86, 91, 96, and 98). Items for which there was a non-endorsement rate greater than or equal to 25% were also omitted (items 29, 30, 34, 50, 62, 63, 66, 67, and 90). Item means and standard deviations were examined, as presented in Table 4, and those with low or high means or with low variability were dropped from the analysis (items 19, 48, 71, 77, 81, 84, 87, 92, 93, 95, 97, 99, and 101). Inter-item correlations, presented in Table 5, were examined among the remaining items to identify those negatively correlating with several other items. Additionally, correlations between each item’s mean and the scale remainder score were examined to evaluate item discrimination and are presented in Table 6. Items 16 and 33 were negatively correlated with several other items and the remainder score and were subsequently dropped from further analysis. All remaining items were retained for EFA.

Table 4
CHAT Item Pool Descriptive Information

Item	<i>n</i> (%)	<i>M</i> (<i>SD</i>)	Skew	Kurtosis
1. I exercise more days than not (for example, 4+ days per week).	109 (92)	2.80 (1.45)	.16	-1.36
3. I exercise less when I feel stressed.	104 (88)	3.09 (1.13)	-.01	-.64
7. I schedule exercise.	104 (88)	2.79 (1.33)	-.06	-1.40
9. I do physical activities.	109 (92)	3.55 (1.08)	-.80	.06
11. I have a balanced diet.	110 (93)	3.25 (1.13)	-.50	-.53
13. I sometimes miss meals.	109 (92)	2.82 (1.26)	.38	-1.12
15. I find myself making sacrifices to get enough food.	109 (92)	3.96 (1.22)	-1.06	.06
16. I have gained more weight than I want over the last few months.	108 (92)	3.12 (1.42)	-.14	-1.38
17. I have lost more weight than I want over the last few months.	109 (92)	4.06 (1.14)	-1.16	.41
18. I have talked with my healthcare providers about vitamins I need in my diet.	108 (92)	2.94 (1.30)	-.13	-1.27
19. I disclose my HIV status when necessary.	107 (91)	4.15 (.89)	-1.29	2.09
20. I always use condoms with sexual partner(s).	97 (82)	2.85 (1.52)	.14	-1.45
22. I bring up safe-sex practices with my sexual partner(s).	96 (81)	3.39 (1.23)	-.43	-.73
24. I talk with my healthcare providers about my sexual behavior.	104 (88)	3.83 (1.13)	-1.14	.71
25. I always engaged in safe sex over the last 3 months.	93 (79)	3.10 (1.58)	-.18	-1.56
26. Even when my viral load is undetectable, I practice safe sex.	98 (83)	3.07 (1.48)	-.14	-1.41
28. In the last 3 months, I always used protection during sex.	89 (75)	2.87 (1.49)	.05	-1.45
29. I always used protection during oral sex with all partners over the past 3 months.	84 (71)	2.19 (1.35)	.88	-.48
30. I always used protection during anal sex with all partners over the past 3 months.	77 (65)	2.68 (1.47)	.28	-1.35
31. I regularly get tested for sexually transmitted infections.	98 (83)	4.15 (1.01)	-1.36	1.61
33. I don't disclose my HIV status to sexual partners out of fear of being rejected.	101 (86)	4.06 (1.17)	-.99	-.18
34. I ask new sexual partner(s) if they are on PrEP before having condomless (bare) sex.	83 (70)	3.49 (1.34)	-.57	-.83

36. I use coping skills when my mood is down.	106 (90)	3.69 (.94)	-.95	1.04
37. I reach out to my healthcare providers if I feel too stressed or sad.	104 (88)	3.27 (1.32)	-.31	-1.18
38. I manage difficult emotions effectively.	107 (91)	3.54 (.98)	-.54	.12
39. I have healthy ways to relax.	107 (91)	3.84 (.91)	-.82	.72
41. I talk to others about feeling sad or anxious.	106 (90)	3.62 (.96)	-.69	.23
42. I look up resources (providers, videos, apps) to help me improve my mood.	105 (89)	3.52 (1.05)	-.73	-.09
46. I take care of daily tasks even if I don't feel up to it.	106 (90)	3.69 (.96)	-.78	.15
47. I contact people who support me when I feel stressed.	106 (90)	3.40 (1.10)	-.54	-.57
48. I keep contact with people important to me.	106 (90)	4.07 (.94)	-1.33	2.06
49. I talk with people who support me about my health concerns.	106 (90)	3.80 (1.01)	-1.01	1.01
50. My partner(s) and I discuss my health goals.	82 (69)	3.68 (1.14)	-.72	-.11
52. I let others know when I am feeling down.	105 (89)	3.25 (1.11)	-.25	-.65
53. I ask people important to me to help me manage my health.	104 (88)	3.06 (1.19)	-.25	-.94
55. I do not talk about my health goals.	104 (88)	3.39 (1.13)	-.33	-.78
57. I avoid social situations.	106 (90)	3.20 (1.29)	-.16	-1.09
58. I spend more time alone than I want.	106 (90)	2.79 (1.31)	.08	-1.32
59. I follow my healthcare providers' orders for my HIV medications even if I am using alcohol or other drugs.	93 (79)	4.13 (1.01)	-1.42	1.78
60. Drinking alcohol gets in the way of taking care of my physical health.	92 (78)	4.09 (1.17)	-1.26	.56
62. I skip medications when using alcohol or drugs.	84 (71)	4.01 (1.34)	-1.10	-.21
63. I forget to take medications when drunk or high.	82 (69)	4.01 (1.20)	-.90	-.50
64. Over the last 30 days, I used substances to not think about my health concerns.	92 (78)	4.35 (1.03)	-1.48	1.10
66. Drugs or alcohol get in the way of taking care of my health.	85 (72)	3.98 (1.33)	-1.08	-.11
67. I report my drug or alcohol use to my healthcare providers.	79 (67)	3.72 (1.43)	-.97	-.41
69. Over the past 30 days, I used drugs or alcohol to cope.	92 (78)	3.95 (1.44)	-.96	-.68
70. I take scheduled medication doses.	105 (89)	4.25 (1.09)	-1.65	2.10
71. I make a plan for taking my medications.	104 (88)	4.09 (.94)	-1.12	1.24

72. I schedule my medication doses throughout the day.	96 (81)	3.84 (1.18)	-1.02	.18
73. I forget to take my medications.	103 (87)	4.10 (1.11)	-.95	-.34
74. I create reminders to take my medications.	99 (84)	3.35 (1.41)	-.45	-1.17
75. I look up my medication information.	102 (86)	3.84 (1.18)	-.86	-.21
76. I take my medication with me so I can take it no matter where I am.	103 (87)	3.92 (1.17)	-1.05	.31
77. I communicate concerns about medication side effects with my health providers.	101 (86)	4.12 (.97)	-1.51	2.57
78. I create strategies to help me remember to take my medications (for example, alarms or pillboxes).	102 (86)	3.92 (1.28)	-1.01	-.18
80. I store my medications as recommended.	104 (88)	4.35 (.75)	-.95	.43
81. I always attend appointments with my health providers.	104 (88)	4.30 (.87)	-1.53	2.93
82. I look up who to contact in a medical emergency.	103 (87)	3.82 (1.15)	-.81	-.14
83. I seek medical advice if I am worried about my health.	103 (87)	4.37 (.71)	-1.17	1.74
84. I attend health appointments even when I feel fine.	104 (88)	4.40 (.79)	-1.57	3.11
85. I communicate my health concerns to my providers.	104 (88)	4.54 (.56)	-.67	-.61
86. I schedule check ups with my healthcare providers.	104 (88)	4.48 (.62)	-1.03	1.25
87. I cancel my appointments with healthcare providers without rescheduling.	103 (87)	4.31 (.99)	-1.53	1.79
88. I skip healthcare appointments.	102 (86)	4.31 (1.13)	-1.46	.81
90. I take time off of work or school to attend health appointments if needed.	86 (73)	4.21 (.88)	-1.27	1.74
91. If I miss an appointment, I reschedule a new appointment.	100 (85)	4.40 (.77)	-1.38	1.90
92. I follow my treatment plan.	102 (86)	4.47 (.74)	-1.76	4.48
93. I discuss concerns about my treatment plan with my healthcare provider.	103 (87)	4.42 (.81)	-1.70	3.43
95. I ask my healthcare providers questions about my treatment plan.	103 (87)	4.19 (.93)	-1.52	2.74
96. I follow my healthcare providers' recommendations.	103 (87)	4.37 (.66)	-.77	.51
97. I discuss barriers to following my treatment plan with my healthcare providers.	99 (84)	4.03 (.90)	-1.10	1.59

98. I get routine medical tests like blood pressure and cholesterol checks.	102 (86)	4.43 (.64)	-.91	.91
99. I get lab results from blood tests.	103 (87)	4.50 (.68)	-1.80	5.57
101. I work with my healthcare providers to get my treatment on track after disruptions (for example, after traveling or hospitalizations).	91 (77)	4.16 (.90)	-1.28	2.10

Table 5

Inter-Item Correlations

Item	1	3	7	9	11	13	15	16	17	18	20	22	24	25	26
1															
3	.03														
7	.50	-.17													
9	.41	.05	.44												
11	.04	.03	.22	-.07											
13	.20	.12	.26	-.03	.23										
15	.11	.20	.12	-.09	.13	.43									
16	-.08	.23	-.23	.09	-.07	.17	-.23								
17	.11	-.18	.10	-.19	.15	.19	.50	-.57							
18	.21	.00	.08	-.16	.06	.07	.25	-.10	.08						
20	.24	.03	.24	.13	.06	.03	-.04	-.09	-.01	.20					
22	.11	.05	.13	-.20	.22	.00	.24	-.34	.19	.56	.62				
24	-.27	-.17	-.13	-.02	-.25	-.22	-.20	-.20	.12	.09	-.05	.08			
25	.26	-.09	.42	.23	.11	.16	.11	-.09	.03	.23	.72	.50	-.13		
26	.15	-.07	.36	.09	.03	.10	-.02	-.18	.02	.20	.79	.55	.06	.84	
28	.32	.02	.34	.16	.02	.16	-.04	-.11	.00	.20	.83	.53	-.08	.77	.87
31	.15	.03	.07	.07	.05	-.38	-.08	-.23	.12	.15	-.11	.06	.17	-.10	-.21
33	-.15	-.06	-.25	.02	-.17	-.29	.00	.18	-.03	.05	-.22	-.15	.00	-.16	-.28
36	-.18	.08	-.21	.07	.00	.00	.07	.11	.07	.12	.02	.02	.13	-.01	.01
37	-.08	.07	.05	-.04	-.04	-.17	-.03	-.15	-.08	.34	.06	.30	.40	.10	.13
38	.27	.22	.27	.25	.06	-.05	.01	-.09	-.02	-.16	.08	-.13	.01	-.08	-.10
39	.30	-.05	.40	.23	.13	.16	.35	-.35	.30	.11	.08	.03	-.10	.20	.06
41	-.17	.05	.05	-.07	.26	.02	.05	.12	-.14	.12	-.20	-.15	-.21	-.07	-.17
42	-.09	-.10	.07	-.12	.26	.14	-.07	-.02	.13	.21	.18	.24	.15	.04	.14
46	.08	.13	-.11	.07	-.03	-.01	.15	.08	.20	-.05	.01	-.04	.02	-.03	-.10
47	.05	.16	.10	.03	.01	.05	.29	-.16	.07	.12	.04	.11	.20	-.09	-.02
49	-.03	.17	.12	.10	.05	-.13	.25	-.11	.14	.18	-.10	.07	.06	-.09	-.18
52	.23	.09	.28	.27	.10	.04	.01	.02	-.13	.22	-.04	-.11	.01	.03	.00

Item	1	3	7	9	11	13	15	16	17	18	20	22	24	25	26
53	.03	.18	.31	.11	-.06	.03	.11	-.18	-.04	.24	.03	.09	.20	.04	.10
55	-.14	.05	.08	.09	.15	-.03	.02	.02	-.17	.31	-.06	.12	.17	-.08	-.11
57	.05	.11	.15	-.03	.18	.23	.47	-.35	.34	.15	-.07	.10	.00	-.08	-.05
58	-.14	.07	.12	.00	.07	.15	.33	-.14	.16	.10	.08	.08	.04	.05	.03
59	-.07	-.19	.01	.13	-.19	-.18	.09	-.22	.24	-.12	-.15	-.04	.20	-.07	-.18
60	.00	.22	-.14	.18	-.37	-.14	-.05	.02	-.03	-.27	-.18	-.23	-.16	-.19	-.33
64	.16	-.16	.28	.22	.01	.21	.31	-.10	.40	-.01	.00	-.11	-.02	.14	.06
69	.17	.18	.21	.02	-.15	.15	.24	-.10	.24	.16	.16	.15	.08	.17	.23
70	.05	.00	.08	.17	-.31	-.01	.22	-.25	.24	-.17	-.29	-.17	.04	-.13	-.11
72	-.07	.06	.25	.08	-.20	-.06	-.07	-.20	-.03	.07	-.04	.07	.27	-.07	.06
73	.06	.03	-.03	-.03	-.20	.14	.36	-.26	.37	.01	-.25	-.06	.10	-.11	-.22
74	-.15	-.17	.09	.01	.17	-.22	-.27	-.15	-.21	.33	.03	.16	.28	-.03	.06
75	-.02	.13	-.07	.03	-.11	-.06	.13	.12	.03	.38	-.02	.23	.38	.01	-.03
76	.28	-.05	.22	.19	-.09	-.10	.04	-.14	.02	.35	-.08	.10	.01	.09	-.06
78	.06	-.19	.21	.14	-.03	-.43	-.27	-.38	.03	.21	.07	.18	.19	.11	.12
82	-.13	-.05	.00	-.21	.20	.10	.06	-.05	.23	.19	.05	.17	.27	-.10	-.10
88	.10	.05	.08	.01	-.22	.04	.34	-.29	.38	.03	-.03	.14	.06	.10	.01

Item	28	31	33	36	37	38	39	41	42	46	47	49	50	52	53
28															
31	-.21														
33	-.26	.10													
36	-.02	-.01	-.02												
37	.12	.40	-.04	.00											
38	.07	.13	-.08	.05	.20										
39	.06	.22	-.09	.18	.09	.55									
41	-.22	.22	.00	.23	.29	-.09	.07								
42	.13	.17	-.23	.34	.16	.07	.26	.03							
46	-.05	.25	.02	.27	.30	.38	.30	.14	.18						
47	-.03	.34	-.03	.13	.40	.36	.35	.21	.16	.37					
49	-.19	.61	.14	.25	.42	.24	.29	.36	.11	.38	.58				
52	-.02	.26	-.13	.02	.26	.19	.21	.33	.04	.21	.42	.49			
53	.10	.25	-.37	.03	.53	.26	.24	.26	.15	.31	.56	.54	.53		
55	-.11	.01	-.22	.05	.34	-.07	-.12	.37	.15	.03	.19	.30	.43	.57	
57	-.09	.22	-.11	.12	.13	.27	.50	.00	.31	.32	.55	.39	.30	.38	.17
58	-.04	.04	-.09	-.13	.25	.17	.29	.15	.13	.22	.31	.27	.31	.37	.33
59	-.17	.45	.32	.06	.33	.05	.21	.05	.11	.07	.27	.29	-.14	.00	-.18
60	-.16	.22	.36	-.19	.09	.12	.03	-.02	-.21	.18	.10	.28	-.05	.05	-.18
64	-.01	.02	-.02	.12	-.08	.15	.51	-.07	.12	.32	.14	.24	.18	.11	-.15
69	.19	.25	.02	-.07	.35	.25	.44	-.01	.27	.37	.48	.31	.14	.29	-.20
70	-.10	.06	.10	-.06	.12	.01	.08	.01	-.08	.30	.30	.15	-.08	.19	-.03
72	.01	.12	-.06	-.12	.42	.29	.29	-.04	.23	.14	.32	.32	.14	.54	.22
73	-.22	.18	.25	-.10	.19	.02	.35	.15	-.10	.38	.13	.10	-.11	-.01	-.12
74	-.02	.37	-.14	-.05	.45	-.09	-.03	.35	.10	-.12	.35	.30	.35	.47	.41
75	-.06	.14	.17	.08	.42	.12	-.01	-.02	.22	.40	.42	.40	.21	.46	.41
76	-.03	.46	.14	.05	.38	.08	.21	.26	-.15	.26	.32	.48	.45	.38	.15
78	.11	.41	.04	-.16	.48	.14	.18	.14	-.04	.12	.19	.20	.19	.44	.07
82	-.19	.16	.07	.04	.16	.22	.33	-.04	.56	.21	.30	.21	-.02	.21	.24
88	-.01	.29	.26	-.06	.18	.10	.36	-.11	-.04	.42	.21	.28	.04	.15	-.24

Item	57	58	59	60	64	69	70	72	73	74	75	76	78	82	88
57															
58	.44														
59	.09	.05													
60	-.09	.01	.50												
64	.31	.23	.10	.20											
69	.41	.27	.26	.31	.52										
70	.31	.00	.34	.33	.21	.29									
72	.22	.36	.21	.30	.08	.48	.26								
73	.28	.14	.36	.27	.20	.30	.59	.09							
74	.12	.17	.08	-.05	-.08	.10	-.18	.30	-.26						
75	.20	.20	.10	.08	.02	.25	.17	.39	.10	.15					
76	.23	.03	.27	.23	.17	.22	.19	.17	.21	.28	.36				
78	-.03	.01	.26	.19	.03	.24	.10	.42	.02	.56	.19	.47			
82	.40	.30	.08	-.15	.12	.24	-.06	.37	.14	.05	.53	.02	.06		
88	.36	.25	.38	.38	.44	.50	.39	.27	.56	-.19	.27	.53	.28	.21	

Table 6
Correlations between Items and Total Remainder Score

Item	Remainder Correlation
1. I exercise more days than not (for example, 4+ days per week).	.20
3. I exercise less when I feel stressed.	.07
7. I schedule exercise.	.37
9. I do physical activities.	.18
11. I have a balanced diet.	.03
13. I sometimes miss meals.	.09
15. I find myself making sacrifices to get enough food.	.29
16. I have gained more weight than I want over the last few months.	-.33
17. I have lost more weight than I want over the last few months.	.21
18. I have talked with my healthcare providers about vitamins I need in my diet.	.37
20. I always use condoms with sexual partner(s).	.23
22. I bring up safe-sex practices with my sexual partner(s).	.34
24. I talk with my healthcare providers about my sexual behavior.	.09
25. I always engaged in safe sex over the last 3 months.	.29
26. Even when my viral load is undetectable, I practice safe sex.	.23
28. In the last 3 months, I always used protection during sex.	.23
31. I regularly get tested for sexually transmitted infections.	.36
33. I don't disclose my HIV status to sexual partners out of fear of being rejected.	-.10
36. I use coping skills when my mood is down.	.07
37. I reach out to my healthcare providers if I feel too stressed or sad.	.53
38. I manage difficult emotions effectively.	.29
39. I have healthy ways to relax.	.53
41. I talk to others about feeling sad or anxious.	.14
42. I look up resources (providers, videos, apps) to help me improve my mood.	.28
46. I take care of daily tasks even if I don't feel up to it.	.44
47. I contact people who support me when I feel stressed.	.60
49. I talk with people who support me about my health concerns.	.57
52. I let others know when I am feeling down.	.39
53. I ask people important to me to help me manage my health.	.59
55. I do not talk about my health goals.	.19
57. I avoid social situations.	.49
58. I spend more time alone than I want.	.39
59. I follow my healthcare providers' orders for my HIV medications even if I am using alcohol or other drugs.	.24
60. Drinking alcohol gets in the way of taking care of my physical health.	.07
64. Over the last 30 days, I used substances to not think about my health concerns.	.36
69. Over the past 30 days, I used drugs or alcohol to cope.	.62
70. I take scheduled medication doses.	.20
72. I schedule my medication doses throughout the day.	.44

73. I forget to take my medications.	.24
74. I create reminders to take my medications.	.23
75. I look up my medication information.	.48
76. I take my medication with me so I can take it no matter where I am.	.48
78. I create strategies to help me remember to take my medications (for example, alarms or pillboxes).	.34
82. I look up who to contact in a medical emergency.	.34
88. I skip healthcare appointments.	.48

Exploratory Factor Analysis

The EFA was conducted as an iterative process. In each iteration, the eigenvalues and parallel analysis were examined to identify the factor structure best fitting the data. In all, five iterations of the EFA were conducted. The eigenvalues and parallel analysis across all five EFAs are presented in Table 7, and a three-factor solution was identified in the final model. In the EFA, a total of 27 items were dropped. The final three-factor structure identified through the EFA is presented in Table 8.

Table 7
Exploratory Factor Analysis Parallel Analysis

	Factor Eigenvalue (Parallel Analysis)					
	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6
EFA 1 (43 items)	7.24 (3.54)	5.26 (3.14)	3.75 (2.91)	3.00 (2.70)	2.53 (2.44)	2.02 (2.28)
EFA 2 (27 items)	6.75 (2.87)	4.29 (2.47)	2.50 (2.27)	2.09 (2.08)	1.75 (1.87)	1.29 (1.70)
EFA 3 (21 items)	5.75 (2.54)	3.58 (2.22)	2.24 (1.97)	1.66 (1.81)	1.16 (1.60)	1.08 (1.48)
EFA 4 (17 items)	5.53 (2.24)	2.65 (1.96)	2.01 (1.71)	1.15 (1.55)	1.07 (1.41)	0.83 (1.25)
EFA 5 (16 items)	5.26 (2.21)	2.66 (1.87)	2.00 (1.65)	1.14 (1.49)	0.86 (1.34)	0.73 (1.22)

Note. Values in bold reflect the eigenvalues (and parallel analysis) of the discerned number of factors for each iteration of the EFA. The final EFA iteration is EFA 5 with 3 factors.

Table 8

EFA Factor Loadings

Item	<i>M</i> (<i>SD</i>)	Skew (Kurtosis)	Factor 1	Factor 2	Factor 3
1. I exercise more days than not (for example, 4+ days per week).	2.67 (1.44)	.45 (-1.16)	.75	-.05	-.05
7. I schedule exercise.	2.79 (1.26)	-.06 (-1.28)	.81	.02	.22
9. I do physical activities.	3.58 (1.06)	-.77 (.06)	.75	-.26	.00
22. I bring up safe-sex practices with my sexual partner(s).	3.25 (1.22)	-.28 (-.84)	-.43	.82	-.00
26. Even when my viral load is undetectable, I practice safe sex.	2.90 (1.39)	-.09 (-1.33)	.01	.94	.06
28. In the last 3 months, I always used protection during sex.	2.76 (1.35)	.07 (-1.23)	.02	.82	.02
37. I reach out to my healthcare providers if I feel too stressed or sad.	3.14 (1.24)	-.14 (-1.15)	-.14	.09	.61
42. I look up resources (providers, videos, apps) to help me improve my mood.	3.65 (.93)	-.73 (.18)	.01	-.14	.64
47. I contact people who support me when I feel stressed.	3.37 (1.08)	-.39 (-.82)	-.07	-.10	.67
53. I ask people important to me to help me manage my health.	3.16 (1.00)	-.32 (-.54)	.12	.02	.71
55. I do not talk about my health goals.	3.41 (1.03)	-.24 (-.85)	.02	-.23	.61
59. I follow my healthcare providers' orders for my HIV medications even if I am using alcohol or other drugs.	4.09 (1.00)	-1.17 (.83)	-.28	-.25	.44
69. Over the past 30 days, I used drugs or alcohol to cope.	3.91 (1.38)	-.86 (-.80)	.07	.03	.58
72. I schedule my medication doses throughout the day.	3.71 (1.15)	-.74 (-.40)	-.17	.02	.75
75. I look up my medication information.	3.80 (1.16)	-.70 (-.48)	-.06	-.21	.81
82. I look up who to contact in a medical emergency.	3.75 (1.03)	-.63 (-.31)	.02	-.30	.92

Note. Factors that items significantly loaded onto are indicated by values in bold.

After conducting the EFA, inter-item correlations for each factor (presented in Table 9) and correlations between each item and each factor's remainder score (presented in Table 10) were reviewed. Upon review, two items (items 55 and 59) shared low correlations with other items in factor 3 and were subsequently dropped from the scale. Internal consistency was calculated for each factor and was acceptable for factor 1 ($\alpha = .77$; $\omega = .79$, 95% CI [.70, .89]), factor 2 ($\alpha = .87$; $\omega = .89$, 95% CI [.83, .94]), and factor 3 ($\alpha = .88$; $\omega = .88$, 95% CI [.82, .93]). A content review of items in each factor suggested that items in factor 1 all pertained to exercise or physical activity, items in factor 2 were associated with sexual health, and items in factor 3 were related to coping, engaging social support, and treatment planning. Factor 1 was labeled Exercise and Physical Activity, factor 2 was labeled Sexual Health, and factor 3 was labeled Coping and Engagement. The Coping and Engagement factor was significantly correlated with Sexual Health ($r = .33$, $p = .03$), although Exercise and Physical activity was not significantly correlated with Coping and Engagement ($r = .14$, $p = .40$) or Sexual Health ($r = -.17$, $p = .32$).

Table 9
EFA Inter-Item Correlations

Factor 1	1	7	9						
Item 7	.62								
Item 9	.52	.47							
Factor 2	22	26	28						
Item 26	.70								
Item 28	.59	.80							
Factor 3	37	42	47	53	55	59	69	72	75
Item 42	.37								
Item 47	.31	.41							
Item 53	.54	.35	.51						
Item 55	.31	.17	.39	.62					
Item 59	.38	.08	.28	.08	.04				
Item 69	.55	.47	.28	.50	.01	.32			
Item 72	.64	.35	.36	.68	.42	.29	.66		
Item 75	.51	.30	.36	.55	.45	.27	.39	.72	
Item 82	.59	.55	.58	.50	.42	.37	.42	.58	.68

Table 10
Correlations between Items and Factor Remainder Score

Item	Remainder Correlation
<i>Factor 1</i>	
1. I exercise more days than not (for example, 4+ days per week).	.67
7. I schedule exercise.	.64
9. I do physical activities.	.55
<i>Factor 2</i>	
22. I bring up safe-sex practices with my sexual partner(s).	.68
26. Even when my viral load is undetectable, I practice safe sex.	.84
28. In the last 3 months, I always used protection during sex.	.76
<i>Factor 3</i>	
37. I reach out to my healthcare providers if I feel too stressed or sad.	.69
42. I look up resources (providers, videos, apps) to help me improve my mood.	.49
47. I contact people who support me when I feel stressed.	.54
53. I ask people important to me to help me manage my health.	.71
55. I do not talk about my health goals.	.43
59. I follow my healthcare providers' orders for my HIV medications even if I am using alcohol or other drugs.	.34
69. Over the past 30 days, I used drugs or alcohol to cope.	.57
72. I schedule my medication doses throughout the day.	.79
75. I look up my medication information.	.68
82. I look up who to contact in a medical emergency.	.77

Confirmatory Factor Analysis

After exploring the factor structure of the EFA, the CFA was conducted as the measurement model for further structural equation modeling using the full sample. Model fit indices of the CFA were mixed. The χ^2 statistic ($\chi^2 = 119.56, p < .001$) suggested a significant difference between the sample's covariance matrix and estimated covariance matrix. The CFI (.89) approached acceptable fit. Both the RMSEA (.07, 90% CI [.05, .10], $p = .057$) and SRMR (.07) values indicated adequate fit. All items significantly loaded onto their factors ($p < .001$), and the Sexual Health factor was significantly correlated with the Coping and Engagement factor ($r = .32, p = .01$). The Exercise and Physical Activity factor did not significantly correlate with

Sexual Health ($r = .19, p = .22$) or Coping and Engagement ($r = .24, p = .12$). The CFA factor structure and item factor loadings are presented in Table 11. Internal consistency was calculated separately for each factor and was acceptable for Exercise and Physical Activity ($\alpha = .74; \omega = .73, 95\% \text{ CI } [.64, .82]$), Sexual Health ($\alpha = .86; \omega = .88, 95\% \text{ CI } [.85, .92]$), and Coping and Engagement ($\alpha = .83; \omega = .83, 95\% \text{ CI } [.78, .88]$).

Table 11
Confirmatory Factor Analysis Standardized Factor Loadings

Item	Factor Loading (SE)
<i>Exercise and Physical Activity</i>	
1. I exercise more days than not (for example, 4+ days per week).	.61 (.13)
7. I schedule exercise.	.83 (.13)
9. I do physical activities.	.61 (.12)
<i>Sexual Health</i>	
22. I bring up safe-sex practices with my sexual partner(s).	.65 (.07)
26. Even when my viral load is undetectable, I practice safe sex.	.98 (.05)
28. In the last 3 months, I always used protection during sex.	.85 (.07)
<i>Coping and Engagement</i>	
37. I reach out to my healthcare providers if I feel too stressed or sad.	.60 (.08)
42. I look up resources (providers, videos, apps) to help me improve my mood.	.46 (.10)
47. I contact people who support me when I feel stressed.	.53 (.10)
53. I ask people important to me to help me manage my health.	.71 (.07)
69. Over the past 30 days, I used drugs or alcohol to cope.	.61 (.08)
72. I schedule my medication doses throughout the day.	.72 (.08)
75. I look up my medication information.	.63 (.09)
82. I look up who to contact in a medical emergency.	.64 (.09)

Note. All standardized factor loadings were significant ($p < .001$).

Validity

Convergent Validity

After confirming the factor structure of the CHAT Scale, convergent validity with the SMAQ and each HIV-ASES subscale was examined. The SMAQ scores were dichotomized such that 0 indicated adherence with HIV ART and 1 indicated nonadherence with HIV ART. Total

scores for the Integration and Perseverance subscales of the HIV-ASES were used. Both the SMAQ and HIV-ASES subscales were added to the CHAT Scale measurement model. Results of the point biserial correlations between each CHAT Scale factor and the SMAQ score, and correlations between each CHAT Scale factor and each HIV-ASES subscale, are presented in Table 12.

Table 12
Correlations Testing Convergent and Discriminant Validity

	Exercise and Physical Activity	Sexual Health	Coping and Engagement
SMAQ	-.21	-.29*	-.31*
HIV-ASES Integration	.02	.02	.39**
HIV-ASES Perseverance	-.03	.04	.48*
HIV-IM Knowledge	.14	.03	-.31*

Note. * $p < .05$; ** $p < .001$. Values are standardized correlation coefficients.

The Exercise and Physical Activity factor of the CHAT Scale was not significantly correlated with the SMAQ or HIV-ASES subscale scores. The Sexual Health factor of the CHAT Scale was significantly negatively correlated with the SMAQ, indicating that increased engagement in sexual health behavior was associated with increased medication adherence over the past 3 months. The Coping and Engagement factor of the CHAT Scale was significantly positively associated with the HIV-ASES Integration and HIV-ASES Perseverance subscales, meaning that increased coping and engagement behavior was associated with increased efficacy for integrating treatment behaviors into daily life and persevering through long-term treatment plans. Further, the Coping and Engagement factor was significantly negatively associated with the SMAQ, reflecting that higher scores on this factor were associated with increased medication

adherence. In summary, results of this initial convergent validity analysis indicated support for the Coping and Engagement factor, with some support for the Sexual Health factor.

Discriminant Validity

Discriminant validity was explored between the CHAT Scale factors and self-reported knowledge of HIV. Correlations between CHAT Scale factors and HIV-IM Knowledge subscale were added to the measurement model. Table 12 also presents the results of this discriminant validity analysis. The HIV-IM Knowledge subscale was not significantly correlated with the Exercise and Physical Activity and the Sexual Health factors of the CHAT Scale, as hypothesized. The Coping and Engagement factor was significantly negatively associated with the HIV-IM Knowledge subscale, suggesting that as self-perceived knowledge of HIV increased, coping and engagement behavior decreased.

Relations Among CHAT Scale Factors, Predictors, and Health Outcomes

Firth Logistic Regressions of Viral Load Status

Results of the five separately conducted Firth logistic regression models, with self-reported detectable vs. undetectable viral load status entered as the outcome variable in all independent models, are presented in Table 13. Model 1 examined if recruitment method (in-clinic or Facebook) significantly predicted viral load status; results were not significant. In model 2, CHAT Scale factors were entered as independent variables and none of the factors significantly predicted viral load status. Model 3 regressed viral load status on ART adherence as measured by the SMAQ; results indicated that past 3-month ART adherence did not significantly predict self-reported viral load status. Both HIV-ASES subscales were the independent variables in model 4; neither significantly predicted viral load status. In model 5, all subscales of the LW-IMB-AAQ (IMB model) were entered as predictors and none of the subscales significantly

predicted detectable viral load status. Overall, none of the independent variables of interest (variables that pertained to HIV treatment or participant recruitment method) predicted viral load status.

Table 13
Firth Logistic Regression Models Predicting the Odds of a Detectable Viral Load Status

Model 1	LR Test	DF	<i>p</i>	Wald test	<i>n</i>
Recruitment Method	.03	1	.86	.03	111
	Variable	OR	Coefficient (SE)	99% CI Low	99% CI High
	Intercept	.18	-1.70 (.34)	.07	.40
	Recruitment Method	1.10	.09 (.53)	.27	4.16
Model 2	LR Test	DF	<i>p</i>	Wald test	<i>n</i>
CHAT Scale	2.64	3	.45	2.64	67
	Variable	OR	Coefficient (SE)	99% CI Low	99% CI High
	Intercept	.00	-5.45 (2.46)	.00	1.10
	Exercise and Physical Activity	1.21	.11 (.12)	-.83	1.62
	Sexual Health	1.04	.03 (.09)	-.82	1.34
	Coping and Engagement	1.09	.08 (.07)	-.93	1.32
Model 3	LR Test	DF	<i>p</i>	Wald test	<i>n</i>
SMAQ	.07	1	.79	.07	97
	Variable	OR	Coefficient (SE)	99% CI Low	99% CI High
	Intercept	.17	-1.75 (.47)	.04	.50
	SMAQ	1.17	.16 (.58)	.28	5.81
Model 4	LR Test	DF	<i>p</i>	Wald test	<i>n</i>
HIV-ASES	7.57	2	.02	6.17	101
	Variable	OR	Coefficient (SE)	99% CI Low	99% CI High
	Intercept	1.32	.27 (1.42)	.03	42.90
	Integration	.91	-.09 (.04)	0.82	1.00
	Perseverance	1.22	.20 (.10)	.97	1.69
Model 5	LR Test	DF	<i>p</i>	Wald test	<i>n</i>
LW-IMB-AAQ	7.85	3	.05	6.93	99
	Variable	OR	Coefficient (SE)	99% CI Low	99% CI High
	Intercept	1.16	.15 (2.10)	.00	228.55
	Information	1.12	.11 (.07)	.94	1.39
	Motivation	.93	-.08 (.05)	.81	1.04
	Behavioral Skills	.94	-.06 (.04)	.83	1.05

Note. 99% Confidence Intervals (CI) reported are of the Odds Ratios (OR).

Structural Equation Modeling

Correlations among other variables of interest were explored to identify potential paths for SEM. Standardized correlation coefficients are reported in Table 14. BMI was not significantly associated with any of the personality and HIV measures and was subsequently excluded from further analysis. Remaining correlations with coefficients $\geq .30$ were considered potential paths for structural equation modeling, informed by reviewed literature and theory. The proposed model is presented in Figure 1, with 59 parameters specified. This suggested that a sample size of 590 participants would be needed to power the model (Schreiber et al., 2006). To account for low power for this initial exploration, the SEM was conducted in two stages.

In the first stage of the SEM, the measurement model of the CHAT Scale was specified and paths were tested among HIV-related variables and health outcomes (number of unscheduled health appointments and number of other health conditions). Model fit information using AIC, BIC, and SABIC is presented in Table 15, reflecting improvement in model fit as non-significant parameters were trimmed (i.e., values closer to zero with each model). The final stage 1 model is presented in Figure 2 and path coefficients, effect sizes (standardized coefficients), and significance are presented in Table 16. Because most of the significant paths in the final stage 1 model were retained through the second stage of modeling, these paths are explained in more detail below. The second stage of the SEM introduced personality variables as exogenous variables to the stage 1 model. The correlation matrix presented in Table 14 was reviewed to identify standardized correlation coefficients ($\geq .30$) as potential paths in the model. Personality variables were entered into the model as predicting SMAQ and CHAT Scale factors. Non-significant paths were trimmed from the model, and path coefficients, effect sizes, and significance of the final model are presented in Table 17. Figure 3 presents the final model.

Table 14
Correlations Among Variables for SEM

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.
1. CHAT Exercise												
2. CHAT Sexual	.10											
3. CHAT Coping	.20	.36**										
4. IMB Information	-.03	.13	.40**									
5. IMB Motivation	-.05	-.06	.24*	.55**								
6. IMB Behavioral	.01	.10	.37**	.60**	.58**							
7. DERS Non-Accept	-.25*	.18	-.11	-.20*	-.32**	-.37**						
8. DERS Goals	-.31*	.18	-.13	-.18*	-.33**	-.40**	.70**					
9. DERS Impulse	-.23	.12	-.06	-.22*	-.37**	-.39**	.73**	.64**				
10. DERS Aware	-.17	-.19	-.55**	-.35**	-.26*	-.27*	.23*	.25*	.26*			
11. DERS Strategies	-.25*	.09	-.16	-.30**	-.41**	-.45**	.86**	.75**	.83**	.33**		
12. DERS Clarity	-.09	-.15	-.40**	-.41**	-.27*	-.36**	.40**	.35**	.41**	.69**	.51**	
13. UPPS-P Neg Urg	-.15	.00	-.29*	-.32*	-.32**	-.33*	.48**	.41**	.51**	.41**	.50**	.37**
14. UPPS-P Premed	-.17	-.23*	-.31*	-.29**	-.16	-.29*	.15	.18	.28*	.36**	.20*	.26**
15. UPPS-P Persever	-.19*	-.11	-.39**	-.47**	-.33*	-.49**	.32**	.31**	.36**	.35**	.37**	.41**
16. UPPS-P Pos Urg	-.02	-.02	-.15	-.30**	-.23*	-.25*	.35**	.21*	.46**	.30**	.40**	.35**
17. SSPT Risk Seek	.02	-.32*	-.30*	-.21*	-.17	-.15	.15	.13	.21*	.31**	.19*	.34**
18. SSPT Exp Seek	.24*	-.05	.24*	.23*	.12	.18*	-.10	-.11	-.11	-.28**	-.20*	-.32**
19. HIV-ASES Int	.03	.02	.39**	.48**	.42**	.71**	-.32**	-.38**	-.37**	-.33**	-.38**	-.44**
20. HIV-ASES Per	-.03	.04	.49**	.31**	.26*	.52**	-.14	-.17	-.20*	-.23*	-.19*	-.30**
21. CESD-R	-.38**	-.21*	-.26*	-.21*	-.27*	-.35**	.48**	.42**	.47**	.24*	.52**	.44**
22. SMAQ	-.21	-.29*	-.30*	-.21*	-.27*	-.49**	.30*	.25*	.24	.22*	.20	.23*
23. Blood Pressure	-.18	-.38*	-.03	-.07	-.07	-.13	.36*	.16	.37*	.28*	.37*	.36*
24. BMI	-.14	.14	.09	.06	.03	.21*	.13	.14	.05	-.02	.10	-.07
25. CD4	-.09	-.02	-.06	-.19	-.19	-.02	.29*	.21	.22	-.03	.20	.16

Note. * $p < .05$., ** $p < .001$. Values are standardized correlation coefficients.

	13.	14.	15.	16.	17.	18.	19.	20.	21.	22.	23.	24.
13. UPPS-P Neg Urg												
14. UPPS-P Premed	.51**											
15. UPPS-P Persever	.45**	.66**										
16. UPPS-P Pos Urg	.78**	.53**	.40**									
17. SSPT Risk Seek	.49**	.47**	.28*	.58**								
18. SSPT Exp Seek	.00	.01	-.37**	.09	.24*							
19. HIV-ASES Int	-.20	-.33**	-.50**	-.17	-.12	.17						
20. HIV-ASES Per	-.17	-.25*	-.26*	-.15	-.09	.11	.76**					
21. CESD-R	.35**	.22*	.32**	.37**	.13	-.20*	-.28**	-.26*				
22. SMAQ	.12	.09	.28*	.13	.17	-.06	-.39**	-.22	.11			
23. Blood Pressure	.25	.37*	.38*	.38**	.42*	.05	-.14	.04	.28	.41*		
24. BMI	.17	.02	.05	.17	.05	.05	.16	.21	.10	-.05	.34*	
25. CD4	.19	.09	.23	.07	.12	-.07	-.08	.14	-.07	.17	.07	.18

Note. * $p < .05$., ** $p < .001$. Values are standardized correlation coefficients.

Table 15
Structural Equation Model Fit Statistics

Model	AIC	BIC	SABIC
<i>Stage 1</i>			
Iteration 1	8342.51	8580.15	8302.07
Iteration 2	8336.02	8549.36	8299.71
Iteration 3	8335.69	8546.32	8299.84
<i>Stage 2</i>			
Iteration 1	8755.92	8989.54	8708.42
Iteration 2	8131.97	8342.75	8090.75
Final	8133.24	8341.38	15553.25

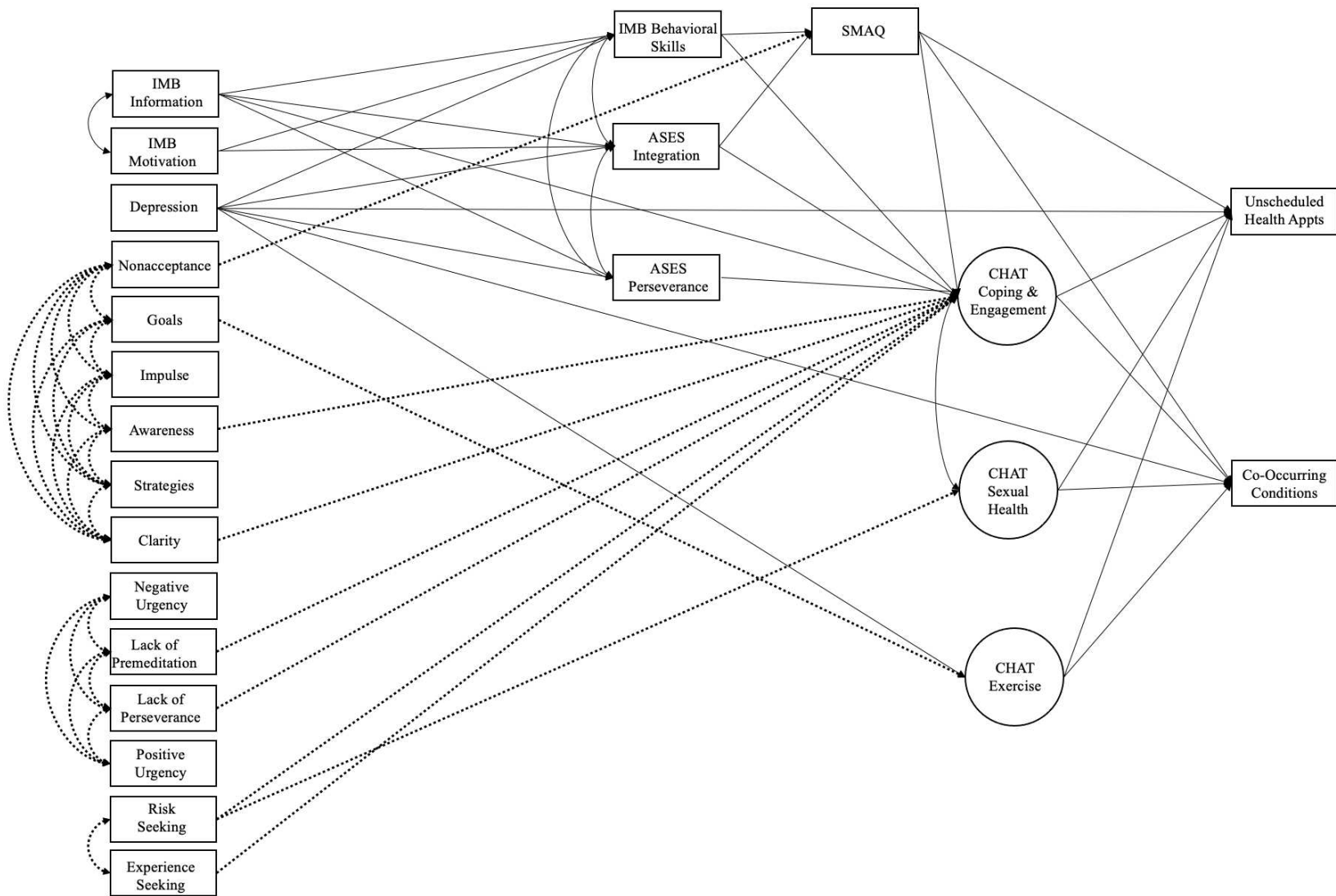


Figure 1. Proposed Structural Equation Model.

Note. Paths specified in Stage 1 indicated by a solid arrow. Paths specified in Stage 2 indicated by a dotted arrow.

Table 16
Significant Paths of the Final Stage 1 Structural Equation Model

Path	B	SE	p	β	p
CHAT Exercise and Physical Activity by					
Item 1	1.00	0.00	<.001	0.63	<.001
Item 7	1.11	0.22	<.001	0.77	<.001
Item 9	0.82	0.20	<.001	0.68	<.001
CHAT Sexual Health by					
Item 22	1.00	0.00	<.001	0.66	<.001
Item 26	1.78	0.27	<.001	0.97	<.001
Item 28	1.59	0.25	<.001	0.85	<.001
CHAT Coping and Engagement by					
Item 37	1.00	0.00	<.001	0.59	<.001
Item 42	0.62	0.16	<.001	0.47	<.001
Item 47	0.76	0.20	<.001	0.54	<.001
Item 53	1.05	0.17	<.001	0.69	<.001
Item 69	1.12	0.20	<.001	0.61	<.001
Item 72	1.10	0.17	<.001	0.73	<.001
Item 75	0.97	0.17	<.001	0.65	<.001
Item 82	0.98	0.19	<.001	0.67	<.001
CHAT Sexual Health with Coping and Engagement	0.16	0.80	.049	0.31	.023
IMB Information with Motivation	25.38	4.28	<.001	0.56	<.001
HIV-ASES Integration with Perseverance	60.37	11.71	<.001	0.72	<.001
IMB Behavioral Skills on					
IMB Information	0.67	0.14	<.001	0.44	<.001
IMB Motivation	0.34	0.09	<.001	0.31	<.001
SMAQ on IMB Behavioral Skills	-0.11	0.03	.001	-0.47	<.001
IMB Behavioral Skills with					
HIV-ASES Integration	48.60	10.19	<.001	0.55	<.001
HIV-ASES Perseverance	16.22	4.00	<.001	0.41	<.001
HIV-ASES Integration on					
IMB Information	1.16	0.33	<.001	0.42	<.001
IMB Motivation	0.29	0.12	.010	0.14	.016
HIV-ASES Perseverance on IMB Information	0.39	0.13	.002	0.34	.001
CHAT Exercise and Physical Activity on CESD	-0.02	.01	.001	-0.36	.001
CHAT Coping and Engagement on					
IMB Information	0.04	0.01	.002	0.31	<.001
HIV-ASES Perseverance	0.05	0.01	<.001	0.40	<.001
Unscheduled Health Appointments on CESD	0.03	0.01	.003	0.54	.004
Co-Occurring Conditions on CESD	0.02	0.01	.025	0.41	.026

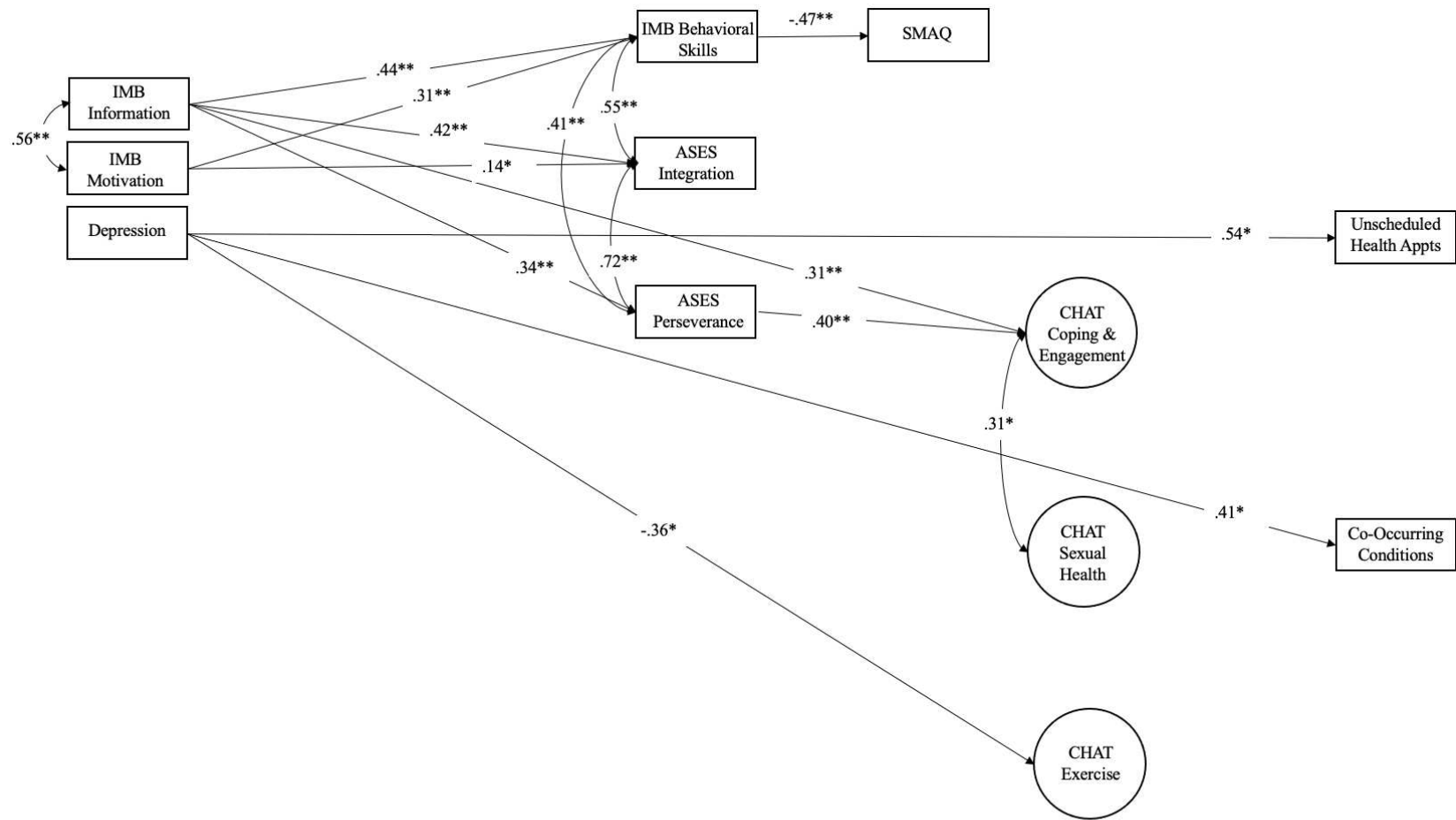


Figure 2. Final Stage 1 Structural Equation Model.
Note. $* p < .05$, $** p < .001$.

Table 17
Significant Paths of the Final Structural Equation Model

Path	B	SE	p	β	p
CHAT Exercise and Physical Activity by					
Item 1	1.00	0.00	<.001	0.64	<.001
Item 7	1.10	0.23	<.001	0.77	<.001
Item 9	0.79	0.20	<.001	0.68	<.001
CHAT Sexual Health by					
Item 22	1.00	0.00	<.001	0.66	<.001
Item 26	1.76	0.25	<.001	0.97	<.001
Item 28	1.58	0.25	<.001	0.85	<.001
CHAT Coping and Engagement by					
Item 37	1.00	0.00	<.001	0.56	<.001
Item 42	0.66	0.16	<.001	0.46	<.001
Item 47	0.76	0.22	<.001	0.51	<.001
Item 53	1.08	0.19	<.001	0.67	<.001
Item 69	1.09	0.22	<.001	0.56	<.001
Item 72	1.14	0.18	<.001	0.72	<.001
Item 75	0.99	0.16	<.001	0.63	<.001
Item 82	1.06	0.20	<.001	0.68	<.001
CHAT Sexual Health with Coping and Engagement	0.14	0.07	.041	0.31	.020
IMB Information with Motivation	25.76	4.26	<.001	0.57	<.001
HIV-ASES Integration with Perseverance	62.24	12.26	<.001	0.72	<.001
IMB Behavioral Skills on					
IMB Information	0.66	0.14	<.001	0.43	<.001
IMB Motivation	0.34	0.09	<.001	0.31	<.001
SMAQ on IMB Behavioral Skills	-0.11	0.03	.001	-0.47	<.001
IMB Behavioral Skills with					
HIV-ASES Integration	50.56	10.83	<.001	0.56	<.001
HIV-ASES Perseverance	16.78	4.24	<.001	0.41	<.001
HIV-ASES Integration on					
IMB Information	1.21	0.35	.001	0.43	<.001
IMB Motivation	0.28	0.12	.023	0.14	.029
HIV-ASES Perseverance on IMB Information	0.38	0.13	.004	0.33	.002
CHAT Exercise and Physical Activity on CESD	-0.02	0.01	.002	-0.35	.002
CHAT Sexual Health on SSPT Risk Seeking	-0.06	0.3	.015	-0.31	.011
CHAT Coping and Engagement on					
HIV-ASES Perseverance	0.05	0.01	<.001	0.41	<.001
DERS Awareness	-0.08	0.01	<.001	-0.50	<.001
Unscheduled Health Appointments on CESD	0.03	0.01	.003	0.53	.004
Co-Occurring Conditions on CESD	0.02	0.01	.039	0.40	.041

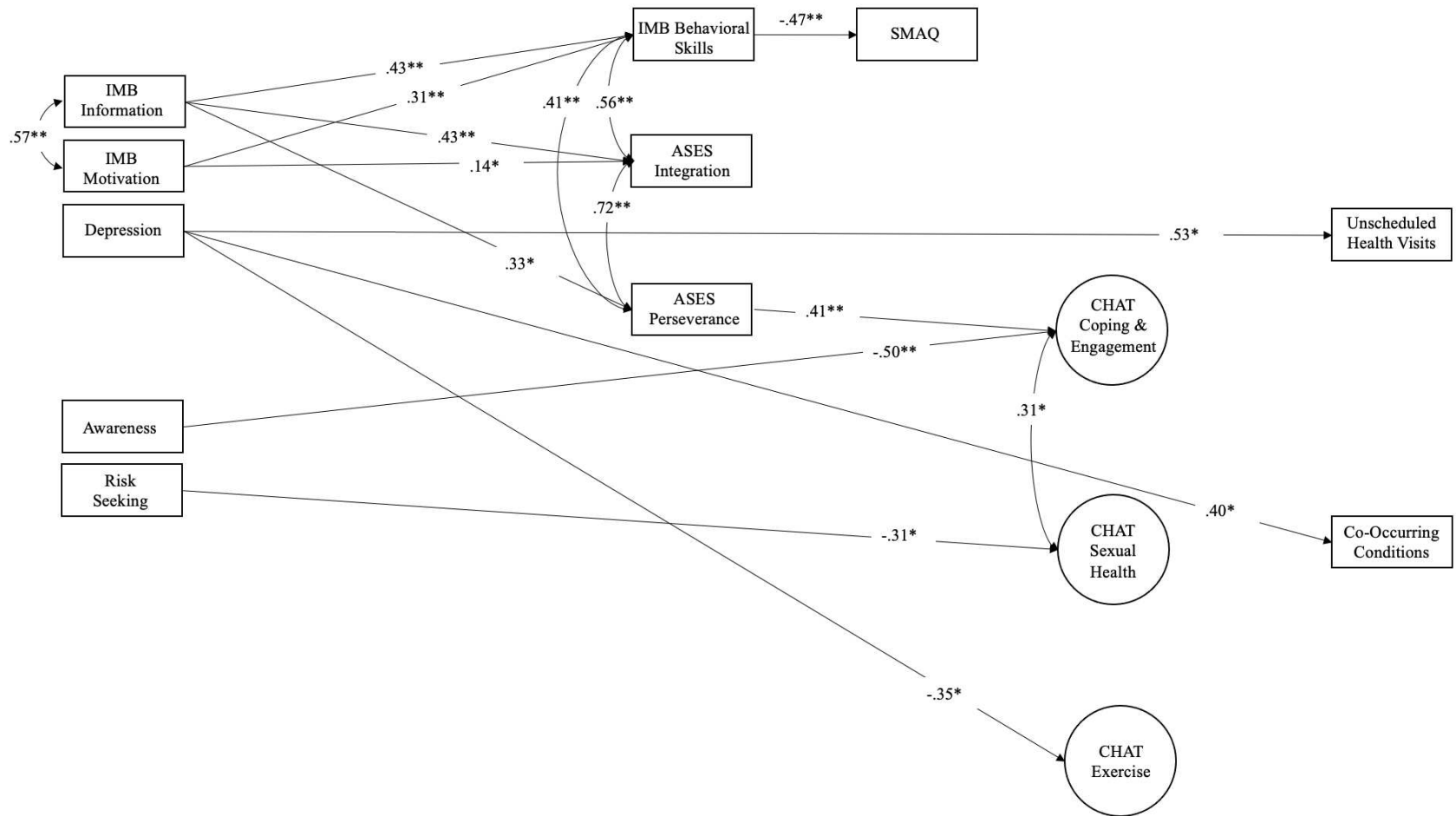


Figure 3. Final Stage 2 Structural Equation Model.
Note. * $p < .05$, ** $p < .001$

In the final model, the measurement model of the CHAT Scale was retained, with items significantly loading onto their factors and CHAT Sexual Health correlating with CHAT Coping and Engagement. Depression significantly negatively predicted CHAT Exercise and Physical Activity (medium effect) and positively predicted number of co-occurring health conditions (medium effect) and unscheduled health appointments (large effect). Number of unscheduled health appointments and number of co-occurring conditions were not predicted by SMAQ or CHAT Scale factors.

The IMB model was supported in the final model, with IMB Information and Motivation significantly positively correlated with each other (large effect) and both positively predicting IMB Behavioral Skills (medium effects). Because medication adherence (SMAQ) was a dichotomized measured variable, logistic regression of IMB Behavioral Skills predicting SMAQ scores was conducted in the model. The logistic regression was significant (OR = .90, 95% CI [0.84, 0.96]). This indicated that a 1 unit increase in IMB Behavioral Skills was associated with a 10% decrease in the odds of nonadherence with medications.

Results of the final model also indicated significant associations among the IMB variables and treatment self-efficacy. Specifically, HIV-ASES Integration was significantly positively predicted by IMB Information (medium effect) and IMB Motivation (small effect). HIV-ASES Perseverance was positively predicted by IMB Information (medium effect). IMB Behavioral Skills was also positively associated with HIV-ASES Integration (large effect) and HIV-ASES Perseverance (medium effect). HIV-ASES Perseverance positively significantly predicted CHAT Coping and Engagement (medium effect). Few significant paths were found from personality variables to CHAT Scale factors. SSPT Risk Seeking significantly negatively predicted CHAT Sexual Health (medium effect), reflecting that as individuals increase in their

propensity for risk-taking, their adherence with sexual health behaviors decreases. DERS Awareness significantly negatively predicted CHAT Coping and Engagement (large effect), such that as lacking awareness of emotions increased, adherence with healthy coping behaviors, engaging social support, and planning treatment decreased. Personality variables did not significantly predict CHAT Exercise and Physical Activity or SMAQ.

After building the final model, theorized indirect effects of IMB Behavioral Skills on paths from IMB Information and IMB Motivation to SMAQ were tested. Significance for each indirect effect was calculated using 95% Monte Carlo confidence intervals (Selig & Preacher, 2008). The indirect effects from IMB Information ($B = -.08$, $SE = 0.03$, 95% CI [-0.14, -0.03]) and IMB Motivation ($B = -0.04$, $SE = 0.02$, 95% CI [-0.08, -0.01]) to SMAQ were both significantly negative. Although direct paths from IMB Information and Motivation to SMAQ were not tested in the model building process due to correlation coefficients not meeting the threshold for inclusion, these paths were added to the final model as a validity check. The direct paths from IMB Information ($B = 0.04$, $SE = 0.06$, $p = .55$) and IMB Motivation ($B = -0.01$, $SE = 0.04$, $p = .85$) were non-significant and removed from the final model. Another indirect effect tested in the model was from IMB Information to CHAT Coping and Engagement through HIV-ASES Perseverance. This indirect effect was significant ($B = 0.02$, $SE = 0.01$, 95% CI [.004, .04]). This suggests that, while IMB Information did not directly predict CHAT Coping and Engagement in the final model, the relationship between these two variables may be explained by persevering through challenges with treatment.

Although the SEM was underpowered to control for additional variables, differences in the SEM variables by recruitment method (in-clinic or Facebook) were explored. The means, standard deviations, and effect sizes are reported in Table 18. Overall, effect sizes were minimal

or small, with the exception of a medium effect for UPPS-P Lack of Premeditation. Additionally, potential associations between treatment adherence and time living with HIV and time on current ART regimen were also examined. Time living with HIV was not significantly correlated with SMAQ ($r = .07, p = .45$), CHAT Exercise and Physical Activity ($r = -.14, p = .13$), CHAT Sexual Health ($r = -.11, p = .24$), or CHAT Coping and Engagement ($r = -.04, p = .67$).

Similarly, time on current ART regimens was not significantly correlated with SMAQ ($r = .04, p = .68$), CHAT Exercise and Physical Activity ($r = -.04, p = .67$), CHAT Sexual Health ($r = .14, p = .14$), or CHAT Coping and Engagement ($r = .06, p = .49$).

Table 18
Means, Standard Deviations, and Effect Sizes for Differences between Recruitment Methods

	In-Clinic <i>M</i> (<i>SD</i>)	Facebook <i>M</i> (<i>SD</i>)	Cohen's <i>D</i>
CHAT Exercise	9.25 (2.88)	9.13 (3.55)	0.04
CHAT Sexual Health	8.96 (3.92)	9.39 (3.39)	-0.12
CHAT Coping	28.74 (6.73)	28.36 (6.18)	0.06
SMAQ	0.60 (0.49)	0.66 (0.48)	-0.13
IMB Information	37.98 (5.86)	37.81 (5.33)	0.03
IMB Motivation	37.31 (7.98)	35.19 (7.63)	0.27
IMB Behavioral Skills	55.31 (8.89)	52.52 (8.50)	0.32
DERS Non-Accept	11.89 (5.26)	12.57 (6.43)	-0.12
DERS Goals	11.53 (4.78)	13.20 (4.62)	-0.36
DERS Impulse	11.10 (4.73)	12.02 (5.69)	-0.18
DERS Awareness	13.48 (4.57)	13.91 (5.05)	-0.09
DERS Strategies	15.42 (6.72)	17.05 (7.93)	-0.22
DERS Clarity	9.58 (3.81)	10.07 (3.79)	-0.13
UPPS-P Negative Urgency	26.10 (7.49)	25.98 (7.80)	0.02
UPPS-P Premeditation	21.10 (5.18)	18.29 (4.94)	0.55
UPPS-P Perseverance	18.56 (4.98)	17.10 (5.12)	0.29
UPPS-P Positive Urgency	26.18 (9.69)	24.86 (8.47)	0.14
SSPT Risk Seeking	12.03 (4.52)	11.51 (3.84)	0.12
SSPT Experience Seeking	18.21 (3.98)	18.81 (3.79)	-0.15
HIV-ASES Integration	86.70 (15.32)	82.93 (16.86)	0.24
HIV-ASES Perseverance	27.32 (6.43)	26.50 (6.86)	0.12
CESD-R	19.45 (17.98)	17.36 (17.27)	0.12
# Unscheduled Health Visits	0.68 (1.37)	0.50 (1.03)	0.15
# Co-Occurring Conditions	2.00 (4.30)	0.91 (1.18)	0.33

Note. Effect sizes were calculated using the pooled *SD*.

DISCUSSION

Study Aims and Scale Design

Preventing HIV transmission, treating HIV infection, and stopping the progression of HIV to AIDS are important individual and public health concerns (CDC, 2020a). Antiretroviral therapy for HIV, or ART, is effective at helping PLWH attain an undetectable viral load, thereby preventing the transmission of the virus to others, as well as preventing AIDS and AIDS-related mortality (CDC, 2017). Although there is not a known cure for HIV, the efficacy of ART maintains HIV as a chronic and manageable health condition rather than terminal illness (Aberg, 2006; Nigatu, 2012; Swendeman et al., 2009). Treating HIV as a chronic health condition requires PLWH to engage in pro-health and medical self-management behaviors in addition to ART adherence, such as exercising, practicing safer sexual health behavior, engaging social support, managing mental health, reducing alcohol and other substance use, attending medical appointments, and maintaining ART adherence (CDC, 2016; Iribarren et al., 2018; Johnson et al., 2007; Swendeman et al., 2009). These health behaviors can improve the health and wellbeing of PLWH by managing the physical effects of HIV, addressing negative side effects of ART, preventing or reducing the impacts of co-occurring health conditions, coping with the emotional and psychological effects of living with a chronic health condition, and improving quality of life (Johnson et al., 2014; Paiva et al., 2012; Pellowski & Kalichman, 2016; Swendeman et al., 2009).

To support research and clinical intervention, the primary goal of the current study was to develop a measure of adherence with a broader set of health behaviors important in treating HIV as a chronic health condition. Important applications of such a measure are assessing needs for

intervention and facilitating communication about health behaviors between PLWH and their health providers (e.g., Catz et al., 2001), so as to retain PLWH in care and track changes in health needs over time (French et al., 2011). Importantly, integrating this more comprehensive set of treatment behaviors into treatment may have an additive effect on health and quality of life. Independently, these behaviors have been associated with health outcomes. For example, exercise may help PLWH with weight management, bone density disorders, and blood pressure – all factors potentially comorbid with HIV and its treatment (Pellowski & Kalichman, 2016). Recent studies investigate a potential “coaction effect” of multiple health behavior change that suggests engagement in one health behavior is associated with increased engagement in others (Johnson et al., 2014; Paiva et al., 2012; Pellowski & Kalichman, 2016). This promising work may be paired with existing interventions for ART adherence to increase engagement in other health behaviors and maximize health outcomes. One such intervention framework is the IMB model of highly active ART, wherein PLWH’s information about and motivation to engage in treatment predict behavioral skills, or one’s abilities and self-efficacy to engage in treatment (Fisher et al., 2006). Information, motivation, and behavioral skills are hypothesized to predict ART adherence, and interventions are specified by the IMB model to improve ART adherence. A limitation in understanding potential coaction effects of multiple health behaviors necessary to manage HIV as a chronic health condition is that existing measures of treatment adherence focus on ART adherence (Sahay et al., 2011).

In pursuit of this study’s goal, an initial pool of 101 items was written and edited in collaboration with a team of four researchers and clinicians with expertise in HIV treatment. The pool of items was informed by existing literature on recommended health behaviors to manage HIV as a chronic health condition. To ensure the measure was relevant to the needs of living

with HIV, 118 PLWH were recruited from HIV clinics, AIDS services organizations, and Facebook to participate in a one-time survey. Data collected were used to evaluate items and explore the psychometric properties of the resulting Comprehensive HIV Adherence with Treatment (CHAT) Scale. The final scale was comprised of 14 items loading onto three factors related to HIV health: Exercise and Physical Activity, Sexual Health, and Coping and Engagement. Items tapped into several important domains associated with managing of HIV as a chronic health condition and supporting ART adherence. Each of the three final CHAT Scale factors demonstrated acceptable internal consistency reliability.

The results of the scale development partially supported Hypothesis 1: “Items developed for the CHAT scale would load onto three factors which would be correlated: physical health (e.g., exercise), mental health (e.g., managing symptoms of depression) and medical management (e.g., attending healthcare appointments)”. Although three factors were identified in the analysis, items did not necessarily load onto the expected factors. For example, items written to measure ART adherence and nutrition were not retained through the analysis as expected. It could be that while nutrition-related behavior can have an impact on health, items relating to diet and nutrition (e.g., “I sometimes miss meals”) may have been more strongly influenced by social or systemic factors contributing to nutrition or food insecurity than to the hypothesized underlying construct of engagement in health behavior. Regarding ART adherence, most items (e.g., “I take scheduled medication doses”) were negatively skewed with low variability. Although ART adherence is critical in HIV treatment, several measures (e.g., the Simplified Medication Adherence Questionnaire; Knobel et al., 2002) exist to measure this behavior and may be used in tandem with the CHAT Scale. Scores on the SMAQ indicated that only one-third of participants in the present study were adherent with ART treatment regimens, which

contrasted with the low variability and high skew of CHAT Scale items drafted to measure ART adherence. This indicated that CHAT Scale medication adherence items did not discriminate between those who were and were not adherent with medications. Despite not including items that directly assessed ART adherence, final items of the CHAT otherwise reflected behaviors relevant to treating HIV as a chronic health condition, including exercising, using protection during sex and discussing safe-sex practices with partners, communicating with healthcare providers, asking for support, scheduling medication doses, and coping.

Initial Evidence of Validity

Associations with ART Adherence

While the CHAT Scale did not result in items that directly assessed ART adherence, factors of the novel measure were associated with ART adherence. This was indicated by the initial evidence of the CHAT Scale's construct validity, which was tested in Hypothesis 2: "the CHAT Scale would demonstrate construct validity". Convergent validity with the SMAQ measure of medication adherence was supported for the CHAT Scale Sexual Health and Coping and Engagement factors. The significant correlations among the SMAQ and CHAT Scale Sexual Health and Coping and Engagement factors suggest a potential coaction effect among these health behaviors. Specifically, being adherent with ART medications was associated with increased adherence with safer sex behaviors, engaging social support, coping, planning treatment, and communicating with health providers. Interestingly, CHAT Exercise and Physical Activity was not significantly correlated with the SMAQ, despite previous research finding significant associations and potential coaction between exercise and medication adherence (Pellowski & Kalichman, 2016).

The relation between medication adherence and CHAT Scale factors was probed further in a larger structural equation model examining many paths among variables. Although significant bivariate correlations were observed between medication adherence and the Sexual Health and Coping and Engagement factors of the CHAT Scale, paths from medication adherence to these factors were not significant in the larger multivariate analysis. This suggests that medication adherence does not necessarily predict increased Sexual Health or Coping and Engagement behaviors, and future testing of the directionality of these paths is needed. However, significant associations between medication adherence and the Sexual Health and Coping and Engagement factors of the CHAT Scale underline the relevance of a more comprehensive conceptualization of HIV treatment in research and intervention.

Associations with Treatment Self-Efficacy

Individual-level psychological constructs are associated with ART adherence (Cook, McCabe, Emiliozzi, & Pointer, 2009) and relations between these constructs and CHAT Scale factors were explored. One such construct that often relates to ART adherence is treatment self-efficacy, or one's beliefs in their abilities to integrate treatment into daily life and persevere with treatment despite challenges (Houston et al., 2016; Johnson et al., 2007, 2012). As such, convergent validity was also explored between CHAT Scale factors and treatment self-efficacy, with support found for the Coping and Engagement factor. Increases in treatment self-efficacy were associated with increases in coping, engaging social support, planning treatment, and communicating with health providers. The finding that treatment self-efficacy related to this factor of the CHAT Scale is reflected by the scope of the HIV-ASES, which conceptualizes HIV treatment more broadly than ART adherence by using the terms "treatment" and "treatment plan" in lieu of "medication" or "ART". The finding that treatment self-efficacy was not

significantly associated with the Sexual Health or Exercise and Physical Activity factors of the CHAT Scale may suggest that these behaviors were not thought of as “treatment” when participants responded to HIV-ASES items. Further examination of comprehensive HIV treatment, treatment self-efficacy, and behaviors measured by the CHAT Scale may clarify the relations between self-efficacy and the broader array of health behaviors needed to manage HIV as a chronic health condition. However, initial evidence suggests that HIV treatment self-efficacy is associated with a broader operationalization of treatment.

Associations with Perceived HIV Knowledge

In addition to testing how the CHAT Scale aligns with ART adherence and self-efficacy, the present study tested how the CHAT Scale performed against self-perceived knowledge of HIV (HIV-IM; Nelsen et al., 2012). Unlike treatment self-efficacy, this perceived knowledge measure has not been significantly associated with HIV treatment adherence in past research (Nelsen et al., 2012). As hypothesized, neither the Exercise and Physical Activity nor the Sexual Health factors were significantly correlated with self-perceived HIV knowledge, providing support for discriminant validity. This suggests that how much people believe they know about HIV does not relate to their adherence with exercise or safer sex behaviors. The Coping and Engagement factor was significantly negatively correlated with perceived HIV knowledge, suggesting that as beliefs in one’s knowledge of HIV increase, coping, engaging social support, and treatment behavior decrease. Although caution is warranted in over-interpreting this correlation in the present study, further exploration of this relation may indicate an important area of intervention and assessment. For example, individuals with HIV-associated neurocognitive disorders may experience both decreased self-awareness and increased over-confidence in memory and planning (Casaletto et al., 2014). It could also be that as one’s

knowledge of HIV and treatment increases, the need for support, coping, and planning to maintain treatment decreases and thus PLWH's adherence with these behaviors decreases. Further exploration of this association, as well as a comparison of self-assessed knowledge to actual knowledge of HIV and HIV treatment, may clarify the impact of the present findings.

Antecedents of HIV Treatment Adherence

Treatment Self-Efficacy as an Antecedent

In addition to developing the CHAT Scale and assessing initial evidence of construct validity, another goal of the present study was to identify antecedents to treatment adherence so as to identify potential barriers to, and areas of intervention for, treatment adherence. Individual-level antecedents were identified by testing Hypothesis 3: "Antecedents of adhering with comprehensive treatment behaviors would be identified". Because treatment self-efficacy was significantly correlated with the CHAT Scale Coping and Engagement factor in the validity analysis described earlier, it was also explored as an antecedent to CHAT Scale factors and ART adherence. Through the analysis, self-efficacy was indeed identified as a significant antecedent of treatment adherence. Specifically, increased self-efficacy with persevering through challenges in one's HIV treatment predicted increased adherence with coping, engaging social support, and treatment behaviors (CHAT Coping and Engagement). This means that belief in one's ability to weather challenges in treatment may lead to engaging in behaviors needed to maintain treatment, especially during difficulties. Conversely, lower beliefs in one's ability to persevere could lead to poor coping, engaging social support, and treatment planning behaviors.

Interestingly, neither factor of treatment self-efficacy (perseverance and integration) predicted ART adherence. This was not expected, as studies using the HIV-ASES operationalization of HIV treatment self-efficacy have found significant support for associations

between treatment self-efficacy and medication adherence (Houston et al., 2016; Johnson et al., 2007, 2012). Further, past research on HIV treatment self-efficacy has focused on medication adherence, complexity in medication regimens, and barriers to treatment, despite the goal of conceptualizing HIV treatment and treatment self-efficacy more broadly (Johnson et al., 2007). The findings from both the validity analysis and exploration of antecedents in the present study provide support for conceptualizations of HIV treatment and treatment self-efficacy to include more behaviors than just ART adherence. Given the null finding for predictive paths from treatment self-efficacy to ART adherence, as well as from ART adherence to CHAT Scale factors, future exploration of relations among treatment self-efficacy, the CHAT Scale, and ART adherence are needed.

Depression as an Antecedent

Another individual-level psychological factor explored as an antecedent to treatment adherence was depression. Findings indicated that increased depressive symptoms predicted lower adherence with exercise and physical activity (CHAT Scale Exercise and Physical Activity). In addition to depression's impact on treatment behavior, increased depressive symptoms also predicted two health outcomes: increased number of unscheduled health appointments and number of co-occurring conditions. These findings build on previous research recognizing the negative impacts of depression on treatment behavior and health and signify that comprehensive treatment for HIV should include assessment of and interventions for depression (Cruess et al., 2007; Gonzalez et al., 2011; Safren et al., 2009, 2012). Although depression predicted decreased exercise and worse predicted health outcomes, it is interesting to note that depression did not predict medication adherence. One explanation for this finding could be that the SMAQ dichotomized medication adherence, and previous studies examining associations

between depression and medication adherence have found lower effect sizes when medication adherence is measured categorically rather than continuously (see Gonzalez et al., 2011). Nonetheless, these results contribute to the evidence that depression has significant impacts on health and health behavior for PLWH (Bing et al., 2001; Cruess et al., 2007; Gonzalez et al., 2011).

Personality Traits as Antecedents

In addition to depression, personality variables were explored as individual-level antecedents of treatment adherence. Personality traits included difficulties with emotion regulation (DERS; Gratz & Roemer, 2004), sensation seeking (SSPT; Conner, under review), and impulsivity (UPPS-P Scale; Cyders et al., 2007). Of the personality variables explored, increases in the propensity to pursue and derive reward from risk-taking predicted decreased CHAT Sexual Health scores, suggesting that higher risk-seeking was associated with riskier sexual behavior. This is congruent with results from nonclinical samples finding that risk-seeking is associated with increased health-risk sexual behavior (e.g., Rahm-Knigge, Prince, & Conner, 2018). Another personality variable, awareness of one's emotions, predicted CHAT Coping and Engagement. Specifically, increased difficulty with emotional awareness predicted less adherence with behaviors related to coping, engaging social support, and managing treatment. This supports prior research finding that emotion dysregulation and related processes, such as cognitive escape from one's emotions, are associated with decreased HIV treatment adherence (Du Bois & McKirnan, 2012; Leyro et al., 2015).

Although personality tends to be stable over time, interventions that help people prevent unintended negative outcomes or manage personality-related symptoms may be helpful. For example, interventions to help people building coping and emotion regulation skills can improve

outcomes (e.g., Gross, 2015). Other personality variables did not predict CHAT Scale factors or medication adherence, although several were associated with treatment adherence in bivariate analysis. The presence of several significant correlations among personality variables and treatment adherence, but nonsignificant predictive paths, may encourage future research in this area with a larger sample better powered to explore the full range of factors comprising difficulties with emotion regulation, sensation seeking, and impulsivity.

Collectively, results of the present study suggest that individual-level psychological factors previously associated with ART adherence (i.e., depression, personality, and treatment self-efficacy) may be antecedents to adherence with the broader array of health behaviors in comprehensive HIV treatment. Addressing these barriers to adherence in comprehensive care for PLWH could increase health behavior, improve health, and reduce or prevent negative health outcomes. Future studies with a larger sample sufficiently powered to run such analyses are needed to test the directionality and strength of these relations. Overall, Hypothesis 3 was partially supported.

Health Outcomes of HIV Treatment and Related Constructs

Viral Load Status

Treatment behaviors that help PLWH manage HIV as a chronic health condition aim to increase positive health outcomes and reduce negative health outcomes (Evers & Quintiliani, 2013; Kennedy et al., 2001; Lerner et al., 2020; Swendeman et al., 2009; Willison & Andrews, 2005). To explore relations between treatment behaviors and health outcomes, Hypothesis 4: “Adherence with comprehensive treatment would predict health outcomes” was tested. First, the potential predictive utility of the CHAT Scale on viral load status, an important health outcome for PLWH (CDC, 2020c), was examined. The CHAT Scale did not significantly predict self-

reported detectable or undetectable viral load status. Interestingly, other established measures of treatment adherence and related constructs did not predict viral load status either. These measures included medication adherence (SMAQ; Knobel et al., 2002); the IMB model (LW-IMB-AAQ; The LifeWindows Project Team, 2006); and treatment self-efficacy (HIV-ASES Integration and Perseverance subscales; Johnson et al., 2007).

One explanation for why none of these established members predicted viral load status could be related to low variability of the viral load status data. In the current sample, only 8.5% of participants reported a detectable viral load status and 85.6% of participants reported an undetectable status. This is congruent with U.S. statistics showing that 85% of PLWH who are engaged in HIV treatment have achieved an undetectable status (CDC, 2020a). However, analytic methods that adjusted for this low variability were employed. Another explanation could be non-correspondence between the timeframes of when participants' viral load status results were last assessed and the items of the CHAT Scale and SMAQ. Both the SMAQ and CHAT Scale ask participants about behavior over the past three months, although viral load and CD4 count are commonly assessed every six months for PLWH retained in treatment (HHS, 2020). In the current study, the average time since labs were last drawn was 3.53 months, although there was high variability ($SD = 3.45$ months). It could be that differences in time scale contributed to this null result.

The finding that medication adherence did not predict viral load status is initially puzzling, as medication reduces HIV viral load (NIH, 2020). It could be that the SMAQ measure is more sensitive at detecting nonadherence than the 85-95% level of adherence recommended to suppress viral loads (Bangsberg, 2006; Viswanathan et al., 2015). Most participants reported an undetectable viral load status (85.6%), while only approximately one-third of participants were

considered fully adherent with medications per the SMAQ. One item in particular (“Do you ever forget to take your medicine”?) resulted in a nearly 50% split between those who are adherent and those who are nonadherent. Additionally, the Cronbach’s alpha value of the SMAQ was questionable in the present study, indicating items may not have performed well together. This signifies further work is needed to explore the sensitivity and internal consistency of the SMAQ.

Null findings between treatment self-efficacy and viral load status could be due to potential discordance between one’s self-efficacy to engage in treatment and actual adherence with treatment. In the present study, self-efficacy in integrating one’s treatment into daily life was associated with medication adherence in bivariate analysis but not multivariate analysis, and persistence with treatment despite barriers was not significantly associated in either analysis. These findings provide mixed support for relations between these two factors of treatment self-efficacy and medication adherence, which contrasts with previous research finding that both treatment self-efficacy factors relate to medication adherence (e.g., Johnson et al., 2007). This is compounded by the finding described above that medication adherence did not predict viral load status, discounting a potential indirect effect from treatment self-efficacy to viral load status. Pertaining to the CHAT Scale and viral load status, although items were initially developed to assess adherence with ART, these were dropped and none of the retained items directly assessed medication adherence. Thus, the final set of behaviors assessed in the CHAT Scale may not have a direct impact on viral load status. While the CHAT Scale and other measures did not detect differences in viral load status in the present study, the high proportion of participants reporting an undetectable status is nonetheless a favorable outcome. Future research that attempts to recruit a larger sample of participants with a detectable viral load status may better assess the predictive utility of the CHAT Scale.

Co-Occurring Health Conditions and Unscheduled Health Visits

The predictive utilities of the CHAT Scale and medication adherence on other health-related outcomes were also tested in SEM. In the present study, one-third of participants had a normal body mass index (BMI), and another one-third had an overweight BMI; most had no hospitalizations (87.0% of participants) or unscheduled health appointments (67.8%) in the past three months; half reported no co-occurring conditions; and one-third of participants who reported their blood pressure were in the normal range and another one-third in the elevated range (50.0% missing). Also, of participants who reported their CD4 counts (32.2% missing), two-thirds had a healthy count. Because of low variability or high missingness on many of these variables, two health outcomes were selected for further predictive validity analysis: number of unscheduled health appointments in the past three months and number of co-occurring conditions. Overall, findings were null for Hypothesis 4 such that the CHAT Scale did not predict health outcomes.

Collectively, findings that CHAT Scale factors did not predict health outcomes was discouraging, as health behaviors have previously been associated with positive and negative health outcomes for PLWH (e.g., Evers & Quintiliani, 2013; Kennedy et al., 2001; Lerner et al., 2020; Swendeman et al., 2009; Willison & Andrews, 2005) and measures of ART adherence have been associated with virological outcomes in past research (e.g., Cook et al., 2007, 2009; Knobel et al., 2002). As reported above, the present sample did not report many health concerns, either due to low endorsement or high missingness. Additionally, the vast majority of the sample reported an undetectable viral load status, a positive health outcome for PLWH. Other established measures of HIV treatment behavior and related constructs, including ART adherence, also did not predict health outcomes. Taken together, health behaviors measured by

the CHAT Scale are strongly encouraged in treatment due to their potential impact on health (CDC, 2016; Iribarren et al., 2018; Johnson et al., 2007; Swendeman et al., 2009) and future exploration of the utility of the CHAT Scale is warranted.

The IMB Model

This study also tested the paths within the IMB model and explored the model's potential relations with comprehensive treatment behaviors. Per the IMB model, information about treatment and motivation to engage in treatment predict behavioral skills, which includes one's abilities and self-efficacy to engage in treatment (see Fisher, Fisher, Amico, & Harman, 2006). In turn, behavioral skills predict medication adherence and partially mediate the paths from information and motivation to medication adherence. The present study provided support for the IMB model. Information and motivation predicted behavioral skills, and behavioral skills predicted medication adherence. Information and motivation did not directly predict medication adherence, but indirect effects from information and motivation to medication adherence through behavioral skills were significant. In addition to the paths among information, motivation, behavioral skills, and treatment adherence, the IMB model hypothesizes depression as a moderator (Fisher, Fisher, et al., 2006). Contrary to this hypothesis, previous empirical testing found depression to not moderate the model (Horvath et al., 2014). In the present study, depression was added as a control to behavioral skills and medication adherence but did not significantly predict either variable and was subsequently trimmed. This finding supported previous research on the robustness of the IMB model (Horvath et al., 2014).

Although the model's paths to medication adherence were supported, none of the IMB factors significantly predicted any of the CHAT Scale factors directly. One reason for this null finding could be that the operationalization of the IMB model employed (LW-IMB-AAQ; The

LifeWindows Project Team, 2006) focuses exclusively on ART medications. In addition to the CHAT Scale, potential relations among the IMB model and self-efficacy with the broader scope of HIV treatment as operationalized by the HIV-ASES were explored. Behavioral skills and treatment self-efficacy factors were correlated in multivariate analysis, suggesting potential conceptual overlap since both tap into self-efficacy constructs. This was supported by significant predictive paths from information and motivation to treatment self-efficacy factors. Also, while information did not predict the CHAT Scale Coping and Engagement factor directly, self-efficacy to persevere through challenges in treatment facilitated this relation through an indirect effect. Findings point to the potential expansion of the operationalization of behavioral skills and self-efficacy in the IMB model from focusing only on ART adherence to a broader definition of HIV treatment.

In consideration of all paths explored, results of the current study highlight opportunities for future research on the effects of personality, depression, treatment self-efficacy, and the IMB model on HIV treatment behaviors. Further, results provide some support for a broader operationalization of HIV treatment adherence to include the health behaviors measured by the CHAT Scale. By expanding the operationalizations of HIV treatment and related constructs to include the wider range of behaviors needed to manage HIV as a chronic health condition, researchers and clinicians can continue exploring the impacts of antecedents on treatment and of treatment on health outcomes.

Limitations

Results of the present study should be interpreted in consideration of its limitations. The first set of limitations pertains to the sample recruited and data obtained. This study sought to recruit adult PLWH through HIV clinics or AIDS services organizations. However, due to

limitations in recruiting from this population following the COVID-19 pandemic, Facebook advertising was employed. A strength and limitation of the present study was that many clinics and AIDS services organizations across the United States agreed to advertise the study. This, along with nation-wide Facebook recruiting, captured a broader spectrum of services PLWH have access to. However, HIV-related treatment services, including ART regimens, may vary across sites. A limitation in controlling for the effects of these and other variables (e.g., type of ART regimen prescribed) in the present study was small sample size. Further participant recruitment would be needed for all of the analyses to be sufficiently powered to examine the effects of such controls and run the proposed SEM. Unfortunately, the COVID-19 pandemic made it impossible to get a large enough sample to achieve sufficient power in a reasonable timeframe.

Because the study relied on self-report methods, it is not possible to verify participants' HIV status and other self-reported health information (e.g., blood pressure and detectable or undetectable status). Care was taken to examine participant responses to ensure that self-reported viral loads, detectable/undetectable status, CD4 counts, and other important medical outcomes were reasonably reported. As an example, viral load was compared to detectable/undetectable status to ensure consistency in reporting. The self-report nature of the study may have impacted participants' responses to health outcomes and behaviors. For example, participants may have minimized engagement in health-risk behavior, overreported health-promotion behavior, misrepresented or misunderstood viral load status, or not remembered laboratory results. Related to this, there were high rates of missing data for blood pressure, CD4 counts, and viral load. This may be due to participants not knowing these values rather than refusal to respond, as reflected by low rates of missing for height, weight, viral load status, and ART regimen information.

Access to medical records could alleviate these burdens on participants, reduce missing values, and verify participants' laboratory and health information.

A second set of limitations concerns the analytic approach. The present study conceptualized engagement in multiple health behaviors through the coercion framework and IMB model. Because coercion predicts that a change in one health behavior leads to a change in another, the cross-sectional methodology employed by the present study helps to establish associations among health behaviors (Johnson et al., 2014; Paiva et al., 2012; Pellowski & Kalichman, 2016). However, a longitudinal design is needed to explore changes in health behaviors over time and potential causal pathways. Similarly, results of the present study supported theorized paths within the IMB model. However, the IMB model specifies a feedback loop whereby increased ART adherence affects the information and motivation constructs. A longitudinal design would allow for examination of this feedback loop. Additionally, depression may be a predictor, moderator, or health outcome of HIV treatment (e.g., Fisher, Fisher, et al., 2006; Gonzalez et al., 2011; Zangerle et al., 2010). While the present study controlled for the effects of depression, longitudinal assessment of the relations between depression and other study constructs would better identify the impacts of depression over time.

Implications and Conclusion

Despite these limitations, the present study addresses an important need in HIV research and treatment. This study developed and provided an initial evaluation of the psychometric properties of the CHAT Scale – a measure of adherence with comprehensive treatment of HIV. In doing so, this study contributed to the expansion of HIV treatment adherence to include a broader range of treatment behaviors necessary to manage HIV as a chronic health condition (e.g., Swendeman et al., 2009). Although recommendations to engage in these behaviors are

present in the extant literature and are often made in treatment settings (CDC, 2016; Iribarren et al., 2018; Johnson et al., 2007; Swendeman et al., 2009), a measure of adherence with these behaviors had not previously been established. While findings were mixed, future research with a larger sample, verified health-related outcomes, and longitudinal analysis may override the limitations of the present study and further support the use of the CHAT Scale. The current development and future refinement of the CHAT Scale will support research on health behavior change, coercion, and health outcomes related to HIV.

The development of the CHAT Scale also addresses a significant need in clinical settings. Periodic assessment of health behavior adherence with the CHAT Scale can enhance communication between health providers and PLWH, reduce interview burden in time-limited appointments, help PLWH and providers track changes in health behavior over time, and assess for the impacts of behavior on patients' health (e.g., Catz et al., 2001; French et al., 2011). Positive communication between providers and PLWH about health and health needs is particularly impactful in retaining PLWH in care. The brief, self-report format of the CHAT Scale can facilitate positive and targeted communication about health behavior between PLWH and their health providers. Additionally, the CHAT Scale can be used by providers across the spectrum of HIV healthcare. For PLWH, use of the CHAT Scale may reinforce the impact of health behavior on health outcomes and emphasize the status of HIV as a chronic and manageable health condition. Because of the anticipated positive impact of adherence with comprehensive treatment behaviors on health, such as through a coercion effect (Johnson et al., 2014; Paiva et al., 2012; Pellowski & Kalichman, 2016), ongoing development of both the CHAT Scale and conceptualization of comprehensive HIV treatment are necessary.

Importantly, treating HIV as a chronic, manageable health condition for which adherence with many health behaviors is promoted and assessed can enhance the overall health and wellbeing of PLWH. For example, the IMB model has demonstrated utility in understanding and intervening on ART nonadherence (Fisher, Fisher, et al., 2006). By broadening the scope of treatment conceptualized by the IMB model to include adherence with other pro-health behaviors measured by the CHAT Scale, providers and researchers could more holistically address the needs of PLWH. In practice, PLWH and their health providers will be able to screen for areas of intervention, communicate about treatment needs, and maximize health and quality-of-life outcomes. This novel study contributes to this life-impacting work.

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APPENDICES

Appendix A

Participant Recruitment Sites and Dates Added

- Boulder County AIDS Project (January, 2019)
- Colorado Health Network, Fort Collins, CO (January, 2019)
- University of Colorado Health Infectious Diseases (January, 2019)
- Colorado Health Network, Colorado Springs, CO (February, 2019)
- Colorado Health Network, Denver, CO (March, 2019)
- Colorado Health Network, Grand Junction, CO (April, 2019)
- Salud Ryan White Clinic, Fort Collins, CO (April, 2019)
- Beacon Infectious Diseases, Boulder, CO (May, 2019)
- Drew Center for AIDS Education and Research, Los Angeles, CA (June, 2019)
- Positive Care Center, UCSF, San Francisco, CA (June, 2019)
- Center for AIDS Research and Global Health at Harborview Medical Center, University of Washington, Seattle, WA (August, 2019)
- Nashville Cares, Nashville, TN (September, 2019)
- HIV Achieve Research Collaboration, AIDS Healthcare Foundation (March, 2020)
- Wayne State University (April, 2020).

Appendix B

Flyers Distributed by Recruitment Sites



COLORADO STATE UNIVERSITY

PSYCHOLOGY



Natural Sciences

Comprehensive Treatment Adherence Study

Ryan Rahm-Knigge, M.S., & Bradley Conner, Ph.D.

As researchers at Colorado State University, we are interested in understanding comprehensive treatment plans and how pro-health behaviors improve wellness for people living with chronic conditions. We also are interested in identifying traits which may make it more difficult to follow treatment plans. Our goal is to help people improve their health with comprehensive treatment.

- Participants in this study will be asked to complete an online survey.
- The online survey takes about 1 hour to 1.5 hours to complete.
- Participants will be reimbursed with a \$10 Amazon gift card.
- Results of this study will be used by medical and psychology professionals to help people follow treatment plans and engage in pro-health behaviors.

To take part in this study, you must:

1. Be aged **18 or over**
2. Be receiving treatment

If you meet these criteria and would like to participate in this study, please use the link below to access the survey.

- The link has more detailed information about the study.
- For your privacy, we recommend going to the link in a private location on a secured network.
- The link will direct you to the secure survey software:

psywebserv.psych.colostate.edu/surveys/TreatmentStudy

If you have any questions and/or would like a link emailed to you, please contact Ryan Rahm-Knigge at ryan.rahm-knigge@colostate.edu

Thank you very much for your consideration

Approved: 6/21/2019

v.6.21.2019



COLORADO STATE UNIVERSITY

PSYCHOLOGY  **College of Natural Sciences**

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CSU#: 19-9070H
APPROVED: 06/21/2019 * EXPIRES: 06/20/2022

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Appendix C

Facebook Advertisements

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Appendix D

Initial CHAT Scale Item Pool

1. I exercise more days than not (for example, 4+ days per week).
2. Exercise helps me manage my stress.
3. I exercise less when I feel stressed.
4. It is difficult for me to make exercise a priority.
5. Exercise helps me cope.
6. Other things get in the way of me exercising.
7. I schedule exercise.
8. I have researched different types of exercises.
9. I do physical activities.
10. It is hard to find time to exercise.
11. I have a balanced diet.
12. I have healthy food to eat (for example, vegetables, fruits, lean meats, and meals with low fat and low sugar).
13. I sometimes miss meals.
14. I do not have enough food.
15. I find myself making sacrifices to get enough food.
16. I have gained more weight than I want over the last few months.
17. I have lost more weight than I want over the last few months.
18. I have talked with my healthcare providers about vitamins I need in my diet.
19. I disclose my HIV status when necessary.
20. I always use condoms with sexual partner(s).
21. My partner(s) and I always discuss safe sex.
22. I bring up safe-sex practices with my sexual partner(s).
23. I keep my sexual health concerns a secret.
24. I talk with my healthcare providers about my sexual behavior.
25. I always engaged in safe sex over the last 3 months.
26. Even when my viral load is undetectable, I practice safe sex.
27. I have difficulty talking about my sexual health.
28. In the last 3 months, I always used protection during sex.
29. I always used protection during oral sex with all partners over the past 3 months.
30. I always used protection during anal sex with all partners over the past 3 months.
31. I regularly get tested for sexually transmitted infections.
32. I would leave a sexual partner if I ever felt unsafe.
33. I don't disclose my HIV status to sexual partners out of fear of being rejected.
34. I ask new sexual partner(s) if they are on PrEP before having condomless (bare) sex.
35. My mood gets in the way of taking care of myself.
36. I use coping skills when my mood is down.
37. I reach out to my healthcare providers if I feel too stressed or sad.
38. I manage difficult emotions effectively.
39. I have healthy ways to relax.
40. I have skills to help me focus on taking care of my health even when I am down.
41. I talk to others about feeling sad or anxious.

42. I look up resources (providers, videos, apps) to help me improve my mood.
43. I keep my negative moods a secret from others.
44. I avoid doing things that make me feel upset.
45. I feel too shut down to do things.
46. I take care of daily tasks even if I don't feel up to it.
47. I contact people who support me when I feel stressed.
48. I keep contact with people important to me.
49. I talk with people who support me about my health concerns.
50. My partner(s) and I discuss my health goals.
51. I get help from people in my life.
52. I let others know when I am feeling down.
53. I ask people important to me to help me manage my health.
54. I keep my health concerns secret.
55. I do not talk about my health goals.
56. I am too embarrassed to talk to others about my health.
57. I avoid social situations.
58. I spend more time alone than I want.
59. I follow my healthcare providers' orders for my HIV medications even if I am using alcohol or other drugs.
60. Drinking alcohol gets in the way of taking care of my physical health.
61. Other people worry about my drinking or drug use.
62. I skip medications when using alcohol or drugs.
63. I forget to take medications when drunk or high.
64. Over the last 30 days, I used substances to not think about my health concerns.
65. I am missing out because of my drug or alcohol use.
66. Drugs or alcohol get in the way of taking care of my health.
67. I report my drug or alcohol use to my healthcare providers.
68. I keep my drug or alcohol use a secret.
69. Over the past 30 days, I used drugs or alcohol to cope.
70. I take scheduled medication doses.
71. I make a plan for taking my medications.
72. I schedule my medication doses throughout the day.
73. I forget to take my medications.
74. I create reminders to take my medications.
75. I look up my medication information.
76. I take my medication with me so I can take it no matter where I am.
77. I communicate concerns about medication side effects with my health providers.
78. I create strategies to help me remember to take my medications (for example, alarms or pillboxes).
79. I have reminders to take my medications.
80. I store my medications as recommended.
81. I always attend appointments with my health providers.
82. I look up who to contact in a medical emergency.
83. I seek medical advice if I am worried about my health.
84. I attend health appointments even when I feel fine.
85. I communicate my health concerns to my providers.

86. I schedule “check ups” with my healthcare providers.
87. I cancel my appointments with healthcare providers without rescheduling.
88. I skip healthcare appointments.
89. My healthcare providers have expressed concern about me missing appointments.
90. I take time off of work or school to attend health appointments if needed.
91. If I miss an appointment, I reschedule a new appointment.
92. I follow my treatment plan.
93. I discuss concerns about my treatment plan with my healthcare provider.
94. My treatment plan is hard to follow.
95. I ask my healthcare providers questions about my treatment plan.
96. I follow my healthcare providers' recommendations.
97. I discuss barriers to following my treatment plan with my healthcare providers.
98. I get routine medical tests like blood pressure and cholesterol checks.
99. I get lab results from blood tests.
100. My blood pressure is under control.
101. I work with my healthcare providers to get my treatment on track after disruptions (for example, after traveling or hospitalizations).