Exploring the HIV continuum of care among young black MSM

Lisa Hightow-Weidman[1]☉*, Sara LeGrand[2]☉, Seul Ki Choi[3]‡, Joseph Egger[2]‡, Christopher B. Hurt[1]‡, Kathryn E. Muessig[3]☉

1 Institute of Global Health and Infectious Diseases, University of North Carolina at Chapel Hill, Chapel Hill, North Carolina, United States of America, **2** Duke Global Health Institute, Duke University, Durham, North Carolina, United States of America, **3** Department of Health Behavior, Gillings School of Public Health, University of North Carolina at Chapel Hill, Chapel Hill, North Carolina, United States of America

☉ These authors contributed equally to this work.
‡ These authors also contributed equally to this work.
* lisa_hightow@med.unc.edu

Abstract

Background

HIV disproportionately impacts young, black men who have sex with men (YBMSM) who experience disparities across the HIV care continuum. A more nuanced understanding of facilitators and barriers to engagement in care, missed visits, antiretroviral uptake, adherence and viral suppression could improve care and intervention design.

Methods

A randomized controlled trial of an online intervention, healthMpowerment, enrolled 465 YBMSM (18–30 years); 193 identified as HIV-positive. Bivariable and multivariable analyses of baseline data explored predictors of: engagement in care, missed visits, antiretroviral uptake, self-reported adherence, and viral suppression.

Results

Mean age was 24.9 years; most identified as gay (71.0%) and were receiving HIV care (89.1%). Among those in care, 52.1% reported no missed visits in the past 12 months, 41 (24.6%) reported one missed visit, and 39 (23.4%) reported two or more. Having insurance (prevalence odds ratio [POR] 4.5; 95% CI: 1.3, 15.8) and provider self-efficacy (POR 20.1; 95% CI: 6.1, 64.1) were associated with being in care. Those with a college degree (POR 9.1; 95% CI: 1.9, 45.2) and no recent marijuana (POR 2.6; 95% CI: 1.2, 5.6) or methamphetamine use (POR 5.4; 95% CI: 1.0, 28.5) were less likely to miss visits. Most (n = 153, 84.1%) had been prescribed antiretroviral therapy. A majority of participants (70.8%) reported ≥90% adherence; those with depressive symptoms had 4.7 times the odds of reporting adherence <90% (95% CI: 1.65, 13.37). Of participants who reported viral load testing in the past six months, 65% (n = 102) reported an undetectable viral load. Disclosure to sex partners was associated with viral suppression (POR 6.0; 95% CI: 1.6, 22.4).

Conclusions

Multi-level facilitators and barriers to engagement across the continuum of care were identified in this sample of YBMSM. Understanding the distinct needs of YBMSM at each stage of the continuum and addressing them through tailored approaches is critical for long term success in care.

Background

Black men who have sex with men (BMSM) experience disparities along all stages of the HIV care continuum. Compared with other men who have sex with men (MSM), BMSM are more likely to test positive or have undiagnosed HIV [1, 2]. More BMSM compared to White or Latino MSM are infected-but-unaware [1, 3]. Moreover, HIV-positive BMSM are less likely to be engaged in care, access or adhere to antiretroviral therapy (ART), or be virally suppressed compared with other HIV-positive MSM [1, 3–5]. Data from 3 waves (2008, 2011, 2014) of the National HIV Behavioral Surveillance (NHBS) found that despite improvements in ART coverage among all groups of MSM, BMSM were less likely to be taking ART in each of the 3 study years, even after controlling for education, income and health insurance [6]. While many continuum-based studies have focused on groups who are already engaged in care [7–10], one notable exception is Rosenberg, et al., who used Centers for Disease Control and Prevention (CDC) estimates of infection to construct HIV care continua for Black and White MSM for 2009–2010. Their modeling suggested that only 24% of BMSM were in care and 16% were virally suppressed [11].

There are also disparities in the care continuum related to age. Among those aged 13–24 years diagnosed with HIV in the United States (US), approximately 38% have achieved viral suppression [12]. One recent study conducted within the Adolescent Medicine Trials Network for HIV Interventions (ATN) found that among 1548 adolescents and young adults (81% male, 72% Black, 70% gay/bisexual) initially identified with HIV infection, 68% were linked to care, 54% were engaged in care, 31% started antiretroviral therapy (ART), and 7% reached an undetectable viral load (VL) during the study period. This is substantially lower than the estimated 50% of persons achieving viral suppression across all age groups [12, 13].

While much of the literature has focused on identifying factors that affect HIV rates among young BMSM (YBMSM) [3, 4], the relationship between psychosocial, structural, and social network factors (e.g. social isolation, social support) and HIV care outcomes has been less fully explored. Two recent studies focusing on YBMSM in care reported disparate results. While Hussen, et al., observed no associations between social support, psychological distress and continuum of care outcomes in a study of 132 HIV-positive YBMSM recruited from adolescent medicine HIV clinics [14], Magnus, et al., found that among a sample of newly engaged in care HIV-positive young MSM of color (n = 224, 73% Black), those with a history of depression were less likely to report missed visits [15]. In a population-based sample of 214 YBMSM, a history of criminal justice involvement was found to be positively associated with both retention in care and viral suppression [16]. These prior studies notwithstanding, a greater understanding of how multilevel barriers and facilitators experienced by YBMSM impact the care continuum, from engagement through viral suppression, can provide valuable information to improve provision of care and the design of interventions."

HealthMpowerment.org (HMP) is a mobile- phone-optimized, Internet-based intervention for both HIV-positive and negative YBMSM (age 18–30) that provides HIV and sexually

transmitted infection (STI) prevention and care information, resources, tailored feedback, game-based elements and a social networking platform to offer and receive social support from peers [17, 18]. This paper presents baseline data from HIV positive participants in the HMP study to explore potential sociodemographic, psychosocial, and HIV care-related predictors of outcomes along the HIV care continuum among YBMSM.

Methods

Sample

A randomized controlled trial comparing HMP to a control website that provided HIV/STI information enrolled 465 YBMSM between November 2013 and October 2015. Participants completed an online baseline survey at an in-person visit and follow-up assessments were conducted online at 3, 6 and 12-months post enrollment. Baseline data from 193 participants who identified as HIV positive at baseline are presented here. Written informed consent was obtained from participants at the time of study enrollment. This study was approved by the University of North Carolina at Chapel Hill Institutional Review Board.

Eligibility criteria

Study eligibility criteria at enrollment were: (1) age 18 to 30; (2) born biologically male; (3) self-identify as Black; (4) currently reside in North Carolina; (5) currently have access to a mobile device (e.g. smartphone, tablet) that connects to the internet and has texting capabilities; (6) any of the following in the past six months: (a) condomless anal sex with a male partner, (b) any anal sex with more than three male sex partners, (c) exchange of money, gifts, shelter, or drugs for anal sex with a male partner, or (d) anal sex while under the influence of drugs or alcohol (i.e., high or drunk within two hours of sex).

Recruitment

Study flyers inviting individuals to participate were posted at local college campuses and previously identified off-campus venues (bars, clubs, coffee shops) frequented by YBMSM. Advertisements and targeted messages were posted on websites, including Craigslist, relevant Facebook groups, and Grindr. Participants were also recruited through word of mouth and flyers at local case management organizations, and HIV/STI clinics.

Measures

Sociodemographic items assessed age, level of education, income, arrests (last 3 months), homelessness (past 6 months), health insurance, and sexual identity (gay vs. non-gay).

Psychosocial. Social support: The Medical Outcomes Study Social Support Survey (MOS-SSS) was used to measure perceived social support [19]. Subscales for emotional/informational (8 items) (alpha = 0.97), tangible (4 items) (alpha = 0.92), affectionate (3 items) (alpha = 0.94), and positive social interaction (3 items) (alpha = 0.96) were calculated. Item responses were based on a 5-point Likert scale. Subscale scores were transformed so that the lowest possible score was 0 and the highest possible score was 100; higher scores indicate greater perceived social support.

Social isolation: Social isolation was derived from the 6-item version of the Lubben Social Network Scale (alpha = 0.83) [20]. The scale assesses social network size and the ease and frequency of contact with network members (range = 0–30) with a higher score indicating a lower likelihood of social isolation. Individuals with a score <12 were considered socially isolated.

Depression: Depressive symptoms were assessed with the Center for Epidemiologic Studies Depression Scale (CES-D), a 20-item validated survey of clinically significant distress as a marker for clinical depression (alpha = 0.90) [21]. A dichotomous depression variable was created using a CES-D score of ≥16, which suggests clinically relevant depressive symptomology.

Anxiety: The seven-item version of the General Anxiety Disorder scale (GAD-7) was used to measure anxiety (alpha = 0.93) [22]. Items measured the frequency with which respondents experienced anxiety symptoms in the past two weeks. Scores of 0, 1, 2, and 3, were assigned to the response categories of "not at all," "several days," "more than half the days" and "nearly every day," respectively (range 0–21). Scores of 5, 10, and 15 represent cut points for mild, moderate, and severe anxiety, respectively.

Substance use: Substance use items assessed any use of alcohol, marijuana or synthetic marijuana, crack or powder cocaine, methamphetamine, club drugs (e.g., ketamine, methylenedioxymethamphetamine [MDMA], gamma-hydroxybutyrate [GHB]), opiates and inhalants in the past 3 months.

HIV disclosure: Participants were asked to indicate how many friends, family and sex partners they had disclosed their HIV status to with response options of none, a few, most, or all. Each disclosure variable was dichotomized to indicate disclosure to none versus a few, most, or all.

HIV care related. Self-efficacy for communicating with health care provider: Six items based on a 5-point Likert scale were adapted from Shively et al. [23] to measure communication with HIV care providers among HIV-positive participants (alpha = 0.96). Scores of 1 through 5 were assigned to responses of "not at all sure," "somewhat sure," "moderately sure," "very sure" and "totally sure," respectively. Mean scores ≥4 were categorized as high self-efficacy for communicating with health care provider, while scores < 4 were categorized as low self-efficacy.

Engagement in care: To assess engagement in HIV care, participants were asked if they were currently enrolled in or receiving HIV care of any kind. Participants were also asked to describe reasons for not being in care.

Missed HIV care appointments: Adherence to scheduled medical appointments with HIV care providers over the past 12 months was assessed by self-reported number of missed visits. We dichotomized missed appointments into no missed HIV medical appointments or having one or more missed appointments [24, 25]. Missed visits are the most immediately available measure of retention in care and are associated with mortality [25].

Antiretroviral (ART) uptake: Participants were asked about current and ever (start date) ART use. Participants who had never used ART were asked to describe their reasons (e.g. don't need them, no money or insurance, worried about side effects).

Medication adherence/viral suppression: A Visual Analogue Scale was used to assess medication adherence. Participants selected a value ranging from 0–100% to indicate their adherence on a regular basis [26]. A dichotomous variable was created with values greater than or equal to 90% classified as adherent [27]. Viral suppression was provided via self-report for those who reported having had a viral load performed in the past 6 months using a two-part question: 1) was your viral load undetectable and 2) If not undetectable, participants were asked to indicate the range that most closely matched their last viral load (e.g. 20–500 copies, 501–9,999 copies).

Statistical analysis

Logistic regression models of baseline data were used to explore sociodemographic, psychosocial, and HIV care-related predictors of five key outcomes: engagement in care, no missed

visits, ART uptake, self-reported adherence and viral suppression. Independent predictors of these outcomes were selected based on empirical considerations established through formative work and a thorough review of the literature. The final selection of variables chosen were those found to impact both HIV acquisition risk and engagement in the HIV continuum of care for both YBMSM, our target population, as well as other HIV infected populations. Prevalence odds ratios (POR) with 95% confidence intervals were calculated as the measure of association. Bivariate logistic regression was conducted with each independent variable for all five outcome variables and multivariable logistic regression models with stepwise backward selection constructed for each outcome variable. All independent factors significant at the $p \leq 0.1$ level in bivariable analyses were included in multivariable logistic regression analysis and predictors with the highest p-value were deleted from the model in a step-wise fashion. The model with lower Akaike Information Criterion (AIC) values was considered the better model. For significant bivariable factors that were highly correlated with one another (i.e., collinear, $r \geq 0.70$), the factor with the lowest AIC in the model was retained in the final multivariable model. No alpha adjustment for multiple testing was applied. All analyses were performed using SAS 9.4 (SAS Institute, Cary, NC).

Results

Description of sample

Mean age was 24.9 years; most identified as gay (71.0%) (Table 1). Forty percent of the sample was socially isolated and 112 (58.6%) received a CES-D score that met criteria for clinical depression. About one-third (33.2%) of the sample had a history of homelessness in the prior six months. Substance use was common with 79.3% reporting alcohol use, 68.4% reporting marijuana use, 14.0% crack/cocaine use and 7.3% methamphetamine use.

Engagement in care

Most participants, 172 (89.1%) reported being currently enrolled in or receiving HIV care. The most common reasons for not being in care were inconvenient location or transportation issues (n = 9, 42.9%) and cost concerns (n = 7, 33.3%). A majority of participants (n = 146. 80.2%) reported a high degree of self-efficacy for communicating with their health care provider. In multivariable analyses (Table 2), having insurance (POR 8.47; 95% CI: 2.59, 27.73) and having high self-efficacy for communication with a health care provider (POR 13.19; 95% CI: 3.72, 46.77) were associated with being in care.

No missed HIV care visits

Among those in care, 87 (52.1%) reported no missed visits in the past 12 months, 41 (24.6%) reported one missed visit, and 39 (23.4%) reported two or more. Of those reporting missed visits (n = 80), most had missed visits in the past 3 months (70.0%). In multivariable analysis, those with a college degree (POR 9.43; 95% CI: 1.91, 46.66) and those with no marijuana use (POR 2.49; 95% CI: 1.14, 5.44) and no methamphetamine use in the prior 3 months (POR 5.42, 95% CI: 1.03, 28.52) were less likely to miss visits.

Antiretroviral uptake

Eighty-four percent were on ART (n = 153). Among the 29 YBMSM not currently taking ART, the most common reasons were participants' concerns regarding their ability to adhere to medication (34.5%), fear of side effects (24.1%) and not having found a doctor (27.6%). The mean time from diagnosis to ART uptake was 9.4 months; the median was 2.4 months. In

Table 1. Descriptive statistics of HIV-positive HMP participants at study entry.

		(n = 193)
		N (%)
		Mean [SD]
Age (n = 192)		24.91 [3.11]
Education		
	• < High school	21 (10.9)
	• High school/GED, Some technical/college	138 (71.5)
	• College degree or more	34 (17.6)
Income (n = 191)		
	• < $10,999	102 (53.4)
	• $11,000-$20,999	41 (21.5)
	• $21,000–30,999	26 (13.6)
	• >/ = $31,000	22 (11.5)
Arrested (last 3 months)		13 (6.7)
Homeless (last 6 months)		64 (33.2)
Health insurance		155 (80.3)
How do you best describe yourself?		
	• Gay	138 (71.5)
	• Non-gay	55 (28.5)
Social support		
	• Emotional/Informational (n = 191)	69.9 [29.2]
	• Tangible (n = 191)	65.2 [31.0]
	• Affectionate (n = 189)	68.7 [32.6]
	• Positive social interaction (n = 191)	68.5 [30.6]
Social isolation (n = 192)		77 (40.1)
Depression (n = 191)		112 (58.6)
Anxiety (n = 189)		
	• Minimal/Mild	130 (68.8)
	• Moderate/Severe	59 (31.2)
Substance use (past 3 months)		
	• Alcohol	153 (79.3)
	• Marijuana	132 (68.4)
	• Crack and powder cocaine	27 (14.0)
	• Methamphetamine	14 (7.3)
	• Club drugs (Ecstasy, Ketamine, GHB)	14 (7.3)
	• Opiates	10 (5.2)
	• Inhalants	14 (7.3)
Disclosure of HIV status to **friends** (n = 168)		
	• None	25 (14.9)
	• A few/Most people/All	143 (85.1)
Disclosure of HIV status to **family** (n = 168)		
	• None	39 (23.2)
	• A few/Most people/All	129 (76.8)
Disclosure of HIV status to **sex partners** (n = 168)		
	• None	15 (8.9)
	• A few/Most people/All	153 (91.1)
Self-efficacy for health care provider (HCP) communication		

(*Continued*)

Table 1. (*Continued*)

		(n = 193)
		N (%) Mean [SD]
	• Mean <4	47 (24.4)
	• Mean ≥4	146 (80.2)
Engagement in care		172 (89.1)
No missed HIV care visits (n = 167)		87 (52.1)
Antiretroviral uptake (n = 182)		153 (84.1)
Antiretroviral adherence (VAS) (> = 90) (n = 137)		97 (70.8)
Virally suppressed (n = 157)		102 (65.0)

multivariable analysis (Table 3), having insurance (POR 6.74; 95% CI: 2.43, 18.74) and not using cocaine or crack (POR 5.87; 95% CI: 1.60, 21.48) were associated with ART uptake.

Self-reported adherence and viral suppression

A majority of participants (70.8%) reported ≥90% adherence. In bivariable analyses (Table 4), lack of depressive symptoms, higher levels of tangible support, and not being homeless in the past 6 months were associated with self-reported adherence ≥90%. In multivariable analyses, those with depressive symptoms had 4.7 times the odds of reporting adherence <90% (95% CI: 1.65, 13.37).

Sixty-five percent of HIV-positive YBMSM who reported completing viral load testing in the past six months reported an undetectable viral load (n = 102). In multivariable analyses, any disclosure to sex partners was associated with higher likelihood of viral suppression (POR 6.03; 95% CI: 1.62, 22.40). Not reporting homelessness in the past 6 months approached statistical significance (p = 0.06).

Discussion

This analysis revealed a range of factors and characteristics associated with suboptimal outcomes for YBMSM on five indicators along the HIV care continuum. Notably, some associations—such as the beneficial effect of health insurance and the detrimental effect of drug use—were significant across more than one continuum outcome. Yet, overall, each outcome had a unique set of associated factors. Understanding these distinct needs of YBMSM at each stage of the continuum and addressing them through tailored approaches is critical for achieving the prevention benefits of viral suppression through "treatment as prevention" and sustaining long-term optimal health outcomes. Below we discuss our findings at each step of the continuum and potential intervention implications for YBMSM.

The majority of HIV-positive men in this study were engaged in care. This is likely related to the fact that among those who were HIV-infected, about half (n = 102) were recruited through case management organizations or HIV providers. Although a potential source of bias, this also highlights the importance of community and health-care related partnerships with research groups to enroll HIV-infected YBMSM in large studies. Further, participants in this study reported a high overall self-efficacy for communicating with their health care providers. While not directly measured in this study, perception of racism and medical mistrust by Black patients, including BMSM, has been found to impact patient-provider communication, health care access, and uptake of prevention services [28, 29]. In prior studies, BMSM

Table 2. Bivariable and multivariable analysis for engagement in care and no missed visits.

		Engagement in Care[a]				No Missed Visits[b]			
		Unadjusted POR (95% CI)	p-value	Adjusted POR (95% CI)	p-value	Unadjusted POR (95% CI)	p-value	Adjusted POR (95% CI)	p-value
Age		0.99 (0.85, 1.15)	0.89	—	—	0.93 (0.85, 1.03)	0.17	—	—
Education									
	• < High School	1.00	0.59			1.00	**0.01**	1.00	**0.02**
	• High school/GED, Some technical/college	1.30 (0.42, 6.18)	0.49	—	—	3.42 (1.05, 11.07)	0.04	3.62 (1.00, 13.11)	0.70
	• >/ = College degree	0.97 (0.21, 4.54)	0.97			8.53 (2.14, 34.09)	**<0.01**	9.43 (1.91, 46.66)	**0.01**
Income							**0.10**		0.12
	• < $10,999	1.00	0.83			1.00		1.00	
	• $11,000-$20,999	1.01 (0.30, 3.41)	0.99	—	—	1.81 (0.81, 4.04)	0.15	1.03 (0.41, 2.59)	0.29
	• $21,000–30,999	0.60 (0.17, 2.09)	0.42			0.61 (0.23, 1.60)	0.32	0.27 (0.08, 0.85)	0.02
	• >/ = $31,000	0.69 (0.17, 2.74)	0.60			2.32 (0.81, 6.64)	0.12	0.95 (0.27, 3.27)	0.53
Arrested (last 3 months)									
	• Yes	1.00		—	—	1.00		—	—
	• No	0.67 (0.08, 5.40)	0.70			0.60 (0.17, 2.14)	0.43		
Homeless (last 6 months)									
	• Yes	1.00		1.00		1.00		1.00	
	• No	2.47 (0.99, 6.17)	**0.05**	1.02 (0.32, 3.25)	0.98	2.12 (1.08, 4.15)	**0.03**	1.58 (0.70, 3.56)	0.27
Health insurance									
	• Yes	9.55 (3.60, 25.39)	**<0.01**	8.47 (2.59, 27.73)	**<0.01**	0.61 (0.25, 1.48)	0.27	—	—
	• No	1.00		1.00		1.00			
How do you best describe yourself?				—	—			—	—
	• Non-gay	1.00				1.00			
	• Gay	1.29 (0.49, 3.40)	0.60			1.51 (0.77, 2.98)	0.23		
Social support									
	• Emotional/ Informational[c]	1.21 (1.04, 1.40)	**0.01**			1.12 (1.00, 1.25)	**0.04**	1.09 (0.95, 1.26)	0.24
	• Tangible[c]	1.23 (1.07, 1.42)	**<0.01**	1.16 (0.97, 1.39)	0.10	1.12 (1.00, 1.24)	**0.05**		
	• Affectionate[c]	1.08 (0.95, 1.23)	0.26			1.01 (0.91, 1.11)	0.87		
	• Positive Social Interaction[c]	1.04 (0.90, 1.20)	0.64			1.01 (0.91, 1.12)	0.88		
Social isolation									
	• Yes	1.00		—	—	1.00		1.00	
	• No	1.96 (0.77, 4.99)	0.16			2.13 (1.13, 4.04)	**0.02**	1.26 (0.54, 2.94)	
Depression				—	—			—	—
	• Yes	1.00				1.00			

(Continued)

Table 2. (*Continued*)

		Engagement in Care[a]				No Missed Visits[b]			
		Unadjusted POR (95% CI)	p-value	Adjusted POR (95% CI)	p-value	Unadjusted POR (95% CI)	p-value	Adjusted POR (95% CI)	p-value
	• No	1.47 (0.56, 3.83)	0.43			1.48 (0.80, 2.76)	0.22		
Anxiety									
	• Minimal/Mild	1.42 (0.55, 3.62)	0.47	—	—	0.90 (0.46, 1.75)		—	—
	• Moderate/Severe	1.00				1.00	0.75		
Alcohol									
	• Yes	1.00		—	—	1.00		—	—
	• No	1.13 (0.36, 3.55)	0.84			1.04 (0.49, 2.22)	0.91		
Marijuana									
	• Yes	1.00		—	—	1.00		1.00	
	• No	1.56 (0.54, 4.43)	0.42			2.62 (1.32, 5.19)	**0.01**	2.49 (1.14, 5.44)	**0.02**
Crack/powder cocaine									
	• Yes	1.00		—	—	1.00		—	—
	• No	1.52 (0.47, 4.93)	0.48			1.68 (0.68, 4.18)	0.26		
Methamphetamine									
	• Yes	1.00		—	—	1.00		1.00	
	• No	2.44 (0.62, 9.57)	0.20			4.72 (0.97, 22.95)	**0.05**	5.42 (1.03, 28.52)	**0.05**
Club drugs									
	• Yes	1.00		—	—	1.00		—	—
	• No	0.71 (0.15, 3.42)	0.67			1.11 (0.33, 3.79)	0.87		
Opiates									
	• Yes	1.00		—	—	1.00		—	—
	• No	2.16 (0.43,10.91)	0.35			0.42 (0.08, 2.23)	0.31		
Inhalants									
	• Yes	1.00		—	—	1.00		—	—
	• No	2.44 (0.62, 9.57)	0.20			3.11 (0.80, 12.17)	**0.10**		
Disclosure of HIV status to **friends**				—	—			—	—
	• None	1.00				1.00			
	• A few/ Most people/All	0.62 (0.08, 5.12)	0.66			1.61 (0.66, 3.95)	0.29		
Disclosure of HIV status to **family**				—	—			—	—
	• None	1.00				1.00			
	• A few/ Most people/All	1.45 (0.36, 5.91)	0.60			1.20 (0.56, 2.58)	0.63		
Disclosure of HIV status to **sex partners**				—	—			—	—
	• None	1.00				1.00			

(*Continued*)

Table 2. (*Continued*)

		Engagement in Care[a]				No Missed Visits[b]			
		Unadjusted POR (95% CI)	p-value	Adjusted POR (95% CI)	p-value	Unadjusted POR (95% CI)	p-value	Adjusted POR (95% CI)	p-value
	• A few/ Most people/All	1.14 (0.14, 9.69)	0.90			0.81 (0.25, 2.68)	0.73		
Self-efficacy for HCP communication									
	• Mean <4	1.00		1.00		1.00		—	—
	• Mean $\geq$4	20.12 (6.12, 64.05)	**<0.01**	13.19 (3.72, 46.77)	**<0.01**	0.66 (0.29, 1.50)	0.32		

a 193 were included in bivariable analysis; 191 were included multivariable analysis due to missing independent variable values. Emotional/Informational social support and tangible social support were significant in bivariable analysis, but tangible social support was included in the multivariable model with lower AIC.

b 167 were included in bivariable analysis; 162 were included multivariable analysis due to missing independent variable values. Emotional/Informational social support and tangible social support were significant in bivariable analysis, but emotional/informational social support was included in the multivariable model with lower AIC.

c The odds for 10 units increase in social support.

were found to be less likely to report primary care provider awareness of their sexual orientation compared to White MSM [30]. However, few studies have examined the relationships between BMSM and primary care providers, particularly among those who are HIV-positive. Additional in-depth research is needed to elucidate barriers and facilitators to optimal and productive patient-provider communication that can be targeted for interventions to impact engagement in care.

Despite high levels of care engagement there were also high rates of missed visits. Missed visits have multiple negative consequences: interruptions in ART due to lapses in insurance or drug assistance coverage, delays in health care (e.g. sexually transmitted infection screening and immunizations), and timely evaluations for ART toxicity and adherence. In this study, missed visits were associated with lower education. These results align with findings from a linkage-to-care study of 1891 adolescents and young adults living with HIV (27.8% perinatally infected; 72.2% behaviorally infected) which found that missed appointments were common among those with less education living in economically disadvantaged areas [31]. While not measured in this study, Harper et al. found that in a sample of 200 HIV-positive male adolescents, 66% of whom were Black, those with a stronger connection to their racial/ethnic identity were less likely to have missed an HIV medical appointment during the prior 3 months, while those with more negative attitudes towards gay/bisexual people were more likely to have missed appointments [32]. These findings thus highlight the importance of addressing individual, developmental and structural factors when possible.

Missed visits among YBMSM in this sample were also associated with marijuana use. The impact of marijuana on continuum of care metrics has been less studied than other substances [33, 34] and the limited studies have reported that the effect of marijuana on retention in care are inconclusive. In a study of 212 HIV seropositive YBMSM in Chicago, there was no significant association found between intermittent or heavy marijuana use and retention in care [35]. Another study, however, found weekly or daily marijuana use to be associated with loss to follow-up [36]. Given the high proportion of marijuana use among people living with HIV [37–41] as well as increasing trends towards legalization of marijuana, additional research

Table 3. Bivariable and multivariable analysis for antiretroviral therapy uptake.

		ART Uptake[a]			
		Unadjusted POR (95% CI)	p-value	Adjusted POR (95% CI)	p-value
Age		1.05 (0.92, 1.19)	0.47	—	—
Education					
	• < High School	1.00	0.69		
	• High school/GED, Some technical/college	1.57 (0.47, 5.25)	0.46	—	—
	• >/ = College degree	1.16 (0.28, 4.76)	0.84		
Income					
	• < $10,999	1.00	0.40		
	• $11,000-$20,999	0.60 (0.24, 1.52)	0.28	—	—
	• $21,000–30,999	0.86 (0.26, 2.88)	0.81		
	• >/ = $31,000	3.43 (0.43, 27.62)	0.25		
Arrested (last 3 months)					
	• Yes	1.00		1.00	
	• No	3.78 (1.14, 12.51)	**0.03**	1.65 (0.35, 7.87)	0.53
Homeless (last 6 months)					
	• Yes	1.00		1.00	
	• No	2.57 (1.15, 5.76)	**0.02**	1.53 (0.57, 4.15)	0.40
Health insurance					
	• Yes	7.00 (2.91, 16.86)	**<0.01**	6.74 (2.43, 18.74)	**<0.01**
	• No	1.00		1.00	
How do you best describe yourself?				—	—
	• Non-gay	1.00			
	• Gay	1.39 (0.60, 3.24)	0.44		
Social support					
	• Emotional/Informational[b]	1.08 (0.95, 1.24)	0.25		
	• Tangible[b]	1.12 (0.98, 1.27)	**0.09**	1.04 (0.89, 1.22)	0.64
	• Affectionate[b]	1.08 (0.95, 1.22)	0.23		
	• Positive Social Interaction[b]	1.04 (0.91, 1.19)	0.54		
Social isolation					
	• Yes	1.00		—	—
	• No	0.96 (0.43, 2.18)	0.93		
Depression					
	• Yes	1.00		—	—
	• No	1.27 (0.55, 2.94)	0.57		
Anxiety					
	• Minimal/Mild	1.57 (0.68, 3.64)	0.29	—	—
	• Moderate/Severe	1.00			
Alcohol					
	• Yes	1.00		—	—
	• No	0.77 (0.30, 1.96)	0.58		
Marijuana					
	• Yes	1.00		—	—
	• No	1.53 (0.61, 3.81)	0.37		
Crack/powder cocaine					
	• Yes	1.00		1.00	
	• No	7.01 (2.79, 17.60)	**<0.01**	5.87 (1.60, 21.48)	**<0.01**

(*Continued*)

Table 3. (*Continued*)

		ART Uptake[a]			
		Unadjusted POR (95% CI)	p-value	Adjusted POR (95% CI)	p-value
Methamphetamine					
	• Yes	1.00		—	—
	• No	2.56 (0.73, 8.95)	0.14		
Club drugs					
	• Yes	1.00		1.00	
	• No	0.35 (0.10, 1.23)	**0.10**	0.92 (0.10, 8.61)	0.94
Opiates					
	• Yes	1.00		1.00	
	• No	4.74 (1.19, 18.85)	**0.03**	2.35 (0.22, 25.44)	0.48
Inhalants					
	• Yes	1.00		1.00	
	• No	3.78 (1.14, 12.51)	**0.03**	1.35 (0.28, 6.53)	0.71
Disclosure of HIV status to **friends**				—	—
	• None	1.00			
	• A few/ Most people/All	0.20 (0.03, 1.52)	0.12		
Disclosure of HIV status to **family**				—	—
	• None	1.00			
	• A few/ Most people/All	1.98 (0.80, 4.88)	0.14		
Disclosure of HIV status to **sex partners**				—	—
	• None	1.00			
	• A few/ Most people/All	0.83 (0.18, 3.90)	0.81		
Self-efficacy for HCP communication					
	• Mean <4	1.00		1.00	
	• Mean ≥4	3.13 (1.32, 7.42)	**0.01**	1.98 (0.63, 6.16)	0.24

a 182 were included in bivariable analysis; 180 were included multivariable analysis due to missing independent variable values.

b Odds for 10 unit increase in social support.

specifically addressing the context and frequency of marijuana use and its impact on HIV care and treatment is warranted.

Most participants in this sample were on ART and reported adhering to ≥90% of their prescribed medication. While health insurance and not using cocaine (including crack) were positively associated with ART uptake, depressive symptomology was the sole factor associated with poor adherence. More than half of the sample (59.4%) reported clinically relevant depressive symptoms. It is clear that depression negatively impacts adherence; a meta-analysis across nearly 100 independent samples found that depression was significantly associated with non-adherence ($p < 0.0001$) [42]. Addressing mental health must be an element of care provision across the continuum and in the development of interventions for those YBMSM living with HIV.

Despite overall high levels of engagement in care, ART uptake, and self-reported medication adherence, it is concerning that only 65% of HIV-positive YBMSM in this sample reported an undetectable viral load in the past six months. The finding that disclosure was associated with viral suppression may be interpreted in at least two ways. Disclosure is important for accessing support, which can impact engagement in care, medication adherence and ultimately, viral suppression [43]. Given the cross-sectional nature of this analysis, it is also

Table 4. Bivariable and multivariable analysis for self-reported antiretroviral adherence and viral suppression.

		Self-Reported Adherence (≥90)[a]				Self-Reported Viral Suppression[b]			
		Unadjusted POR (95% CI)	p-value	Adjusted POR (95% CI)	p-value	Unadjusted POR (95% CI)	p-value	Adjusted POR (95% CI)	p-value
Age		0.94 (0.83, 1.06)	0.30	—	—	1.05 (0.95, 1.17)	0.34	—	—
Education									
	• < High School	1.00	0.25			1.00	**0.04**	1.00	0.19
	• High school/GED, Some technical/college	2.22 (0.74, 6.70)	0.16	—	—	4.02 (1.38, 11.73)	**0.01**	3.32 (0.91, 12.13)	0.12
	• >/ = College degree	3.15 (0.76, 13.00)	0.11			3.90 (1.06, 14.33)	**0.04**	2.60 (0.57, 11.80)	0.54
Income									
	• < $10,999	1.00	0.29			1.00	0.21		
	• $11,000-$20,999	1.91 (0.69, 5.32)	0.22	—	—	1.68 (0.71, 3.97)	0.24	—	—
	• $21,000–30,999	0.87 (0.28, 2.67)	0.81			1.46 (0.53, 3.99)	0.46		
	• >/ = $31,000	2.78 (0.74, 10.45)	0.13			3.65 (0.98, 13.56)	0.05		
Arrested (last 3 months)									
	• Yes	1.00		—	—	1.00		—	—
	• No	0.97 (0.18, 5.21)	0.97			1.60 (0.47, 5.50)	0.46		
Homeless (last 6 months)									
	• Yes	1.00		1.00		1.00		1.00	
	• No	3.41 (1.56, 7.44)	**<0.01**	2.04 (0.86, 4.85)	0.11	2.61 (1.28, 5.34)	**0.01**	2.26 (0.98, 5.21)	0.06
Health insurance									
	• Yes	1.66 (0.59, 4.64)		—	—	1.28 (0.49, 3.34)		—	—
	• No	1.00	0.34			1.00	0.62		
How do you best describe yourself?				—	—			—	—
	• Non-gay	1.00				1.00			
	• Gay	1.73 (0.78, 3.86)	0.18			1.50 (0.73, 3.08)	0.27		
Social support									
	• Emotional/Informational[c]	1.12 (0.99, 1.27)	**0.07**	0.97 (0.82, 1.15)	0.74	1.01 (0.90, 1.13)	0.87		
	• Tangible[c]	1.14 (1.01, 1.29)	**0.04**			0.99 (0.88, 1.10)	0.79	—	—
	• Affectionate[c]	1.04 (0.92, 1.16)	0.54			0.97 (0.87, 1.08)	0.55		
	• Positive Social Interaction[c]	1.09 (0.97, 1.23)	0.17			0.97 (0.87, 1.08)	0.60		
Social isolation									
	• Yes	1.00		1.00		1.00		—	—
	• No	2.04 (0.96, 4.35)	**0.06**	1.16 (0.42, 3.22)	0.78	0.70 (0.35, 1.38)	0.30		
Depression									
	• Yes	1.00		1.00		1.00		—	—

(*Continued*)

Table 4. (*Continued*)

		Self-Reported Adherence (≥90)[a]				Self-Reported Viral Suppression[b]			
		Unadjusted POR (95% CI)	p-value	Adjusted POR (95% CI)	p-value	Unadjusted POR (95% CI)	p-value	Adjusted POR (95% CI)	p-value
	• No	4.91 (1.98, 12.19)	**<0.01**	4.70 (1.65, 13.37)	**<0.01**	1.15 (0.59, 2.24)	0.68		
Anxiety									
	• Minimal/Mild	1.29 (0.59, 2.83)	0.53	—	—	0.73 (0.35, 1.56)	0.42	—	—
	• Moderate/Severe	1.00				1.00			
Alcohol									
	• Yes	1.00		—	—	1.00		—	—
	• No	0.48 (0.20, 1.17)	0.11			1.10 (0.49, 2.48)	0.82		
Marijuana									
	• Yes	1.00		—	—	1.00		—	—
	• No	1.78 (0.76, 4.17)	0.19			1.33 (0.66, 2.67)	0.43		
Crack/powder cocaine									
	• Yes	1.00		—	—	1.00		1.00	
	• No	1.09 (0.31, 3.75)	0.90			3.28 (1.25, 8.60)	**0.02**	2.59 (0.84, 8.00)	0.10
Methamphetamine									
	• Yes	1.00		—	—	1.00		1.00	
	• No	1.23 (0.29, 5.18)	0.78			4.04 (0.97, 16.84)	**0.06**	3.61 (0.64, 20.37)	0.15
Club drugs									
	• Yes	1.00		—	—	1.00		1.00	
	• No	1.03 (0.19, 5.56)	0.97			0.33 (0.09, 1.24)	**0.10**	1.68 (0.35, 8.00)	0.52
Opiates									
	• Yes	1.00		—	—	1.00		—	—
	• No	1.65 (0.27, 10.27)	0.59			2.59 (0.56, 12.00)	0.23		
Inhalants									
	• Yes	1.00		—	—	1.00		—	—
	• No	0.80 (0.15, 4.13)	0.79			2.45 (0.63, 9.53)	0.20		
Disclosure of HIV status to **friends**									
	• None	1.00		—	—	1.00		—	—
	• A few/ Most people/All	1.83 (0.71, 4.72)	0.21			0.57 (0.20, 1.66)	0.30		
Disclosure of HIV status to **family**									
	• None	1.00		—	—	1.00		—	—
	• A few/ Most people/All	0.71 (0.26, 1.94)	0.51			0.86 (0.37, 2.00)	0.73		
Disclosure of HIV status to **sex partners**									
	• None	1.00		—	—	1.00		1.00	

(*Continued*)

Table 4. (*Continued*)

		Self-Reported Adherence (≥90)[a]				Self-Reported Viral Suppression[b]			
		Unadjusted POR (95% CI)	p-value	Adjusted POR (95% CI)	p-value	Unadjusted POR (95% CI)	p-value	Adjusted POR (95% CI)	p-value
	• A few/ Most people/All	1.30 (0.37, 4.61)	0.69			5.18(1.51, 17.79)	**0.01**	6.03 (1.62, 22.40)	**0.01**
Self-efficacy for HCP communication									
	• Mean <4	1.00		1.00		1.00		—	—
	• Mean ≥4	2.25 (0.92, 5.51)	**0.08**	1.24 (0.46, 3.32)	0.68	1.05 (0.43, 2.57)	0.91		

a 137 were included in bivariable analysis; 134 were included multivariable analysis due to missing independent variable values. Emotional/Informational social support and tangible social support were significant in bivariate analysis, but emotional/informational social support was included in the multivariable model with lower AIC.

b 157 were included in bivariable analysis; 145 were included multivariable analysis due to missing independent variable values.

c Odds for 10 unit increase in social support.

plausible that those who achieved viral suppression were more likely to disclose their status to an intimate partner. Importantly, both interpretations point toward a need for greater support for status disclosure. Currently, there is a lack of interventions targeting disclosure to sex partners. In a recent review, Conserve et al. identified five trials, of which only three were efficacious and all were delivered in multiple small group sessions limiting widespread implementation [44].

Several cross-cutting factors stand out across the care continuum for YBMSM in this sample. First, substance use among HIV-infected YMSM creates challenges in health care provision and has been previously associated with decreased engagement in care and poor adherence to care and medications [45–47]. Substance use can lead to inaccurate perceptions of time, the inability to adhere to routines, and impaired decision making, all important barriers to retention in care [48]. Future studies should examine both the patterns of use as well as the pathways in which both frequent and infrequent use impact care seeking and adherence behaviors. Co-location or integration of HIV care with substance use treatment to improve long-term health outcomes for YMSM should be considered to address these issues.

Second, a majority of the sample was insured (80.3%). This aligns with data from the NHBS that found that between 2008 and 2014, current insurance status among HIV-positive MSM increased from 75% to 86% (6). Many of the participants in the current study may have considered Ryan White and ADAP (AIDS Drug Assistance Program) benefits as insurance. Another explanation for the high percentage insured given the young age of the sample is the ability to be maintained on parents' insurance plans. It should also be noted that the Patient Protection and Affordable Care Act was signed into law on March 23rd, 2010, and implementation began in late 2013 –coinciding with HMP enrollment (2013–2015). Indeed, the overall percentage of U.S. adults who were uninsured dropped from 18% in the third quarter of 2013 to 11% in the first quarter of 2016 [49]. Given that having insurance was associated with greater engagement in care and ART uptake in this sample, continued efforts to ensure HIV-positive young men have access to insurance or provision of ART benefits through other means is critical.

This exploratory study has some important limitations. Study outcomes were not rare (i.e., <10%) so odds and odds ratios should not be interpreted as risks. The data included in these analyses are from the baseline survey for an online intervention and are thus cross-sectional in

nature, limiting our ability to determine causality. Our engagement and viral suppression mea-
sures were assessed via self-report, thus introducing the possibility of both recall and reporting
bias [50]. However, all our surveys were conducted online which has been shown to be a reliable
and valid method for collecting sensitive information among young adults [51, 52]. Finally, as
mentioned above, many of the HIV-positive participants in the intervention were recruited
from HIV clinics and community based organizations and thus may not be reflective of the
population of those YBMSM who are out of care.

Findings from this study have implications for both future research as well as interven-
tion development for HIV-positive YBMSM. The high rates of depression, social isolation
and substance use behaviors seen in this study have been found in other work focused on
YBMSM, including those who are HIV-positive [53–55]. These psychosocial conditions,
particularly in combination are likely to have an additive impact on continuum of care
outcomes for YBMSM. While prior work has established the impact of syndemics on
heightened risk for HIV infection among BMSM [55–58], longitudinal studies that not
only address the combined impact of syndemics over time, but also provide guidance on
how to effectively intervene as early as possible in these men's lives are needed. Validated
clinical screening tools for mental health [59, 60] and substance use disorders [61, 62]
should be administered upon initial care engagement and at regular intervals to identify
those YBMSM in need of additional services [63]. Given the high reported rates of social
isolation experienced by YBMSM in this study, network based interventions, such as Proj-
ect nGage, which focuses on helping YBMSM identify supportive relationships as a mecha-
nism to promote retention in care, could be beneficial [64].

Conclusion

The results from this large sample of YBMSM revealed multi-level barriers to engagement
across the continuum of care. To our knowledge, this is the largest sample of YBMSM in
which each stage of the care continuum was separately addressed. Structural barriers such as
insurance status and homelessness as well individual- level behaviors and psychosocial factors
such as drug use and depression limited engagement in care and virologic suppression. How-
ever, a focus on barriers alone is insufficient to understand and address the complex process of
engagement in care and ultimately sustained virologic suppression for YBMSM.

Supporting information

S1 File. COC paper data.
(XLSX)

Author Contributions

Conceptualization: Lisa Hightow-Weidman, Sara LeGrand, Kathryn E. Muessig.

Data curation: Sara LeGrand, Seul Ki Choi, Joseph Egger.

Formal analysis: Sara LeGrand, Seul Ki Choi, Joseph Egger.

Funding acquisition: Lisa Hightow-Weidman.

Investigation: Lisa Hightow-Weidman, Sara LeGrand, Kathryn E. Muessig.

Methodology: Lisa Hightow-Weidman, Sara LeGrand, Kathryn E. Muessig.

Project administration: Lisa Hightow-Weidman.

Supervision: Lisa Hightow-Weidman.

Visualization: Lisa Hightow-Weidman, Sara LeGrand, Seul Ki Choi.

Writing – original draft: Lisa Hightow-Weidman.

Writing – review & editing: Lisa Hightow-Weidman, Sara LeGrand, Christopher B. Hurt, Kathryn E. Muessig.

References

1. Millett GA, Peterson JL, Flores SA, Hart TA, Jeffries WLt, Wilson PA, et al. Comparisons of disparities and risks of HIV infection in black and other men who have sex with men in Canada, UK, and USA: a meta-analysis. Lancet. 2012; 380(9839):341–8. https://doi.org/10.1016/S0140-6736(12)60899-X PMID: 22819656

2. Marks G, Millett GA, Bingham T, Bond L, Lauby J, Liau A, et al. Understanding differences in HIV sexual transmission among Latino and black men who have sex with men: The Brothers y Hermanos Study. AIDS Behav. 2009; 13(4):682–90. https://doi.org/10.1007/s10461-008-9380-6 PMID: 18752064

3. Maulsby C, Millett G, Lindsey K, Kelley R, Johnson K, Montoya D, et al. HIV among Black men who have sex with men (MSM) in the United States: a review of the literature. AIDS Behav. 2014; 18(1):10–25. https://doi.org/10.1007/s10461-013-0476-2 PMID: 23620241

4. Millett GA, Flores SA, Peterson JL, Bakeman R. Explaining disparities in HIV infection among black and white men who have sex with men: a meta-analysis of HIV risk behaviors. AIDS. 2007; 21(15):2083–91. https://doi.org/10.1097/QAD.0b013e3282e9a64b PMID: 17885299

5. Oster AM, Wiegand RE, Sionean C, Miles IJ, Thomas PE, Melendez-Morales L, et al. Understanding disparities in HIV infection between black and white MSM in the United States. AIDS. 2011; 25 (8):1103–12. https://doi.org/10.1097/QAD.0b013e3283471efa PMID: 21505305

6. Hoots BE, Finlayson TJ, Wejnert C, Paz-Bailey G, National HIVBSSG. Updated Data on Linkage to Human Immunodeficiency Virus Care and Antiretroviral Treatment Among Men Who Have Sex With Men-20 Cities, United States. J Infect Dis. 2017.

7. Kahana SY, Fernandez MI, Wilson PA, Bauermeister JA, Lee S, Wilson CM, et al. Rates and correlates of antiretroviral therapy use and virologic suppression among perinatally and behaviorally HIV-infected youth linked to care in the United States. J Acquir Immune Defic Syndr. 2015; 68(2):169–77. https://doi.org/10.1097/QAI.0000000000000408 PMID: 25590270

8. Mugavero MJ, Davila JA, Nevin CR, Giordano TP. From access to engagement: measuring retention in outpatient HIV clinical care. AIDS patient care and STDs. 2010; 24(10):607–13. https://doi.org/10.1089/apc.2010.0086 PMID: 20858055

9. Mugavero MJ, Lin HY, Allison JJ, Giordano TP, Willig JH, Raper JL, et al. Racial disparities in HIV virologic failure: do missed visits matter? J Acquir Immune Defic Syndr. 2009; 50(1):100–8. https://doi.org/10.1097/QAI.0b013e31818d5c37 PMID: 19295340

10. Howe CJ, Cole SR, Napravnik S, Eron JJ. Enrollment, retention, and visit attendance in the University of North Carolina Center for AIDS Research HIV clinical cohort, 2001–2007. AIDS Res Hum Retroviruses. 2010; 26(8):875–81. https://doi.org/10.1089/aid.2009.0282 PMID: 20672995

11. Rosenberg ES, Millett GA, Sullivan PS, Del Rio C, Curran JW. Understanding the HIV disparities between black and white men who have sex with men in the USA using the HIV care continuum: a modeling study. Lancet HIV. 2014; 1(3):e112–e8. https://doi.org/10.1016/S2352-3018(14)00011-3 PMID: 25530987

12. Centers for Disease Control and Prevention Monitoring selected national HIV prevention and care objectives by using HIV surveillance data—United States and 6 dependent areas—2013 HIV Surveillance Supplemental Report 2015;20(No 2) http://wwwcdcgov/hiv/library/reports/surveillance/ Published July 2015 Accessed December 27, 2015 [Internet].

13. Kapogiannis B, Xu J, Mayer KH, Loeb J, Greenberg L, Monte D, et al. he HIV continuum of care for adolescents and young adults (12–24 years) attending 13 urban US centers of the NICHD-ATN-CDC-HRSA SMILE collaborative. 8th International AIDS Society Conference on HIV Pathogenesis, Treatment and Prevention; Vancouver2015.

14. Hussen SA, Harper GW, Bauermeister JA, Hightow-Weidman LB, Adolescent Medicine Trials Network for HIVAI. Psychosocial influences on engagement in care among HIV-positive young black gay/bisexual and other men who have sex with men. AIDS Patient Care STDS. 2015; 29(2):77–85. https://doi.org/10.1089/apc.2014.0117 PMID: 25682888

15. Magnus M, Jones K, Phillips G 2nd, Binson D, Hightow-Weidman LB, Richards-Clarke C, et al. Characteristics associated with retention among African American and Latino adolescent HIV-positive men: results from the outreach, care, and prevention to engage HIV-seropositive young MSM of color special project of national significance initiative. J Acquir Immune Defic Syndr. 2010; 53(4):529–36. https://doi.org/10.1097/QAI.0b013e3181b56404 PMID: 19755914

16. Schneider JA, Kozloski M, Michaels S, Skaathun B, Voisin D, Lancki N, et al. Criminal justice involvement history is associated with better HIV care continuum metrics among a population-based sample of young black MSM. AIDS. 2017; 31(1):159–65. https://doi.org/10.1097/QAD.0000000000001269 PMID: 27662544

17. Hightow-Weidman LB, Fowler B, Kibe J, McCoy R, Pike E, Calabria M, et al. HealthMpowerment.org: development of a theory-based HIV/STI website for young black MSM. AIDS Educ Prev. 2011; 23(1):1–12. https://doi.org/10.1521/aeap.2011.23.1.1 PMID: 21341956

18. Hightow-Weidman LB, Muessig KE, Pike EC, LeGrand S, Baltierra N, Rucker AJ, et al. HealthMpowerment.org: Building Community Through a Mobile-Optimized, Online Health Promotion Intervention. Health Educ Behav. 2015; 42(4):493–9. https://doi.org/10.1177/1090198114562043 PMID: 25588932

19. Sherbourne CD, Stewart AL. The MOS social support survey. Soc Sci Med. 1991; 32(6):705–14. PMID: 2035047

20. Lubben J, Blozik E, Gillmann G, Iliffe S, von Renteln Kruse W, Beck JC, et al. Performance of an abbreviated version of the Lubben Social Network Scale among three European community-dwelling older adult populations. Gerontologist. 2006; 46(4):503–13. PMID: 16921004

21. Radloff LS. The CES-D scale: A self-report depression scale for research in the general population. Applied Psychological Measurement. 1977; 1:385–401.

22. Spitzer RL, Kroenke K, Williams JB, Lowe B. A brief measure for assessing generalized anxiety disorder: the GAD-7. Archives of internal medicine. 2006; 166(10):1092–7. https://doi.org/10.1001/archinte.166.10.1092 PMID: 16717171

23. Shively M, Smith TL, Bormann J, Gifford AL. Evaluating Self-Efficacy for HIV Disease Management Skills. AiDS and Behavior. 2002; 6(4):371–9.

24. Berg MB, Safren SA, Mimiaga MJ, Grasso C, Boswell S, Mayer KH. Nonadherence to medical appointments is associated with increased plasma HIV RNA and decreased CD4 cell counts in a community-based HIV primary care clinic. AIDS Care. 2005; 17(7):902–7. https://doi.org/10.1080/09540120500101658 PMID: 16120506

25. Mugavero MJ, Westfall AO, Cole SR, Geng EH, Crane HM, Kitahata MM, et al. Beyond core indicators of retention in HIV care: missed clinic visits are independently associated with all-cause mortality. Clin Infect Dis. 2014; 59(10):1471–9. https://doi.org/10.1093/cid/ciu603 PMID: 25091306

26. Giordano TP, Guzman D, Clark R, Charlebois ED, Bangsberg DR. Measuring adherence to antiretroviral therapy in a diverse population using a visual analogue scale. HIV Clin Trials. 2004; 5(2):74–9. https://doi.org/10.1310/JFXH-G3X2-EYM6-D6UG PMID: 15116282

27. Sam TS, Hutton HE, Lau B, McCaul ME, Keruly J, Moore R, et al. Antiretroviral Therapy Use, Medication Adherence, and Viral Suppression Among PLWHA with Panic Symptoms. AIDS and behavior. 2015; 19(11):2049–56. https://doi.org/10.1007/s10461-015-1064-4 PMID: 25903506

28. Hausmann LR, Hannon MJ, Kresevic DM, Hanusa BH, Kwoh CK, Ibrahim SA. Impact of perceived discrimination in healthcare on patient-provider communication. Med Care. 2011; 49(7):626–33. https://doi.org/10.1097/MLR.0b013e318215d93c PMID: 21478769

29. Eaton LA, Driffin DD, Smith H, Conway-Washington C, White D, Cherry C. Psychosocial factors related to willingness to use pre-exposure prophylaxis for HIV prevention among Black men who have sex with men attending a community event. Sex Health. 2014; 11(3):244–51. https://doi.org/10.1071/SH14022 PMID: 25001553

30. Petroll AE, Mosack KE. Physician awareness of sexual orientation and preventive health recommendations to men who have sex with men. Sex Transm Dis. 2011; 38(1):63–7. https://doi.org/10.1097/OLQ.0b013e3181ebd50f PMID: 20706178

31. Kahana SY, Jenkins RA, Bruce D, Fernandez MI, Hightow-Weidman LB, Bauermeister JA, et al. Structural Determinants of Antiretroviral Therapy Use, HIV Care Attendance, and Viral Suppression among Adolescents and Young Adults Living with HIV. PLoS One. 2016; 11(4):e0151106. https://doi.org/10.1371/journal.pone.0151106 PMID: 27035905

32. Harper GW, Fernandez IM, Bruce D, Hosek SG, Jacobs RJ, Adolescent Medicine Trials Network for HIVAI. The role of multiple identities in adherence to medical appointments among gay/bisexual male adolescents living with HIV. AIDS Behav. 2013; 17(1):213–23. https://doi.org/10.1007/s10461-011-0071-3 PMID: 22041930

33. Malta M, Magnanini MM, Strathdee SA, Bastos FI. Adherence to antiretroviral therapy among HIV-infected drug users: a meta-analysis. AIDS Behav. 2010; 14(4):731–47. https://doi.org/10.1007/s10461-008-9489-7 PMID: 19020970

34. Hendershot CS, Stoner SA, Pantalone DW, Simoni JM. Alcohol use and antiretroviral adherence: review and meta-analysis. J Acquir Immune Defic Syndr. 2009; 52(2):180–202. https://doi.org/10.1097/QAI.0b013e3181b18b6e PMID: 19668086

35. Morgan E, Khanna AS, Skaathun B, Michaels S, Young L, Duvoisin R, et al. Marijuana Use Among Young Black Men Who Have Sex With Men and the HIV Care Continuum: Findings From the uConnect Cohort. Subst Use Misuse. 2016; 51(13):1751–9. https://doi.org/10.1080/10826084.2016.1197265 PMID: 27556866

36. Weber R, Huber M, Battegay M, Stahelin C, Castro Batanjer E, Calmy A, et al. Influence of noninjecting and injecting drug use on mortality, retention in the cohort, and antiretroviral therapy, in participants in the Swiss HIV Cohort Study. HIV medicine. 2015; 16(3):137–51. https://doi.org/10.1111/hiv.12184 PMID: 25124393

37. Center for Behavioral Health Statistics and Quality. Key substance use and mental health indicators in the United States: Results from the 2015 National Survey on Drug Use and Health (HHS Publication No. SMA 16–4984, NSDUH Series H-51). Rockville, MD: Substance Abuse and Mental Health Services Adminstration. Available from: http://www.samhsa.gov/data. Accessed November 2016.; 2016.

38. D'Souza G, Matson PA, Grady CD, Nahvi S, Merenstein D, Weber KM, et al. Medicinal and Recreational Marijuana Use Among HIV-Infected Women in the Women's Interagency HIV Study (WIHS) Cohort, 1994–2010:. JAIDS Journal of Acquired Immune Deficiency Syndromes. 2012; 61:618–26. https://doi.org/10.1097/QAI.0b013e318273ab3a PMID: 23011399

39. Mimiaga MJ, Reisner SL, Grasso C, Crane HM, Safren SA, Kitahata MM, et al. Substance use among HIV-infected patients engaged in primary care in the United States: findings from the Centers for AIDS Research Network of Integrated Clinical Systems cohort. American journal of public health. 2013; 103 (8):1457–67. https://doi.org/10.2105/AJPH.2012.301162 PMID: 23763417

40. Centers for Disease Control and Prevention. Behavioral and Clinical Characteristics of Persons Receiving Medical Care for HIV Infection—Medical Monitoring Project, United States, 2009. Morb Mortal Wkly Rep 2014; 63(SS-5).

41. Allshouse AA, MaWhinney S, Jankowski CM, Kohrt WM, Campbell TB, Erlandson KM. The Impact of Marijuana Use on the Successful Aging of HIV-Infected Adults. Journal of acquired immune deficiency syndromes. 2015; 69(2):187–92. https://doi.org/10.1097/QAI.0000000000000562 PMID: 25647530

42. Gonzalez JS, Batchelder AW, Psaros C, Safren SA. Depression and HIV/AIDS treatment nonadherence: a review and meta-analysis. J Acquir Immune Defic Syndr. 2011; 58(2):181–7. https://doi.org/10.1097/QAI.0b013e31822d490a PMID: 21857529

43. Kalichman SC, Kalichman MO, Cherry C, Grebler T. HIV Disclosure and Transmission Risks to Sex Partners Among HIV-Positive Men. AIDS patient care and STDs. 2016; 30(5):221–8. https://doi.org/10.1089/apc.2015.0333 PMID: 27158850

44. Conserve DF, Groves AK, Maman S. Effectiveness of interventions promoting HIV serostatus disclosure to sexual partners: a systematic review. AIDS and behavior. 2015; 19(10):1763–72. https://doi.org/10.1007/s10461-015-1006-1 PMID: 25645328

45. Murphy DA, Belzer M, Durako SJ, Sarr M, Wilson CM, Muenz LR. Longitudinal antiretroviral adherence among adolescents infected with human immunodeficiency virus. Archives of pediatrics & adolescent medicine. 2005; 159(8):764–70.

46. Samet JH, Horton NJ, Meli S, Freedberg KA, Palepu A. Alcohol consumption and antiretroviral adherence among HIV-infected persons with alcohol problems. Alcoholism, clinical and experimental research. 2004; 28(4):572–7. PMID: 15100608

47. O'Neil C, Palmer A, Coulter S, O'Brien N, Shen A, Zhang W, et al. Factors associated with antiretroviral medication adherence among HIV-positive adults accessing highly active antiretroviral therapy (HAART) in British Columbia, Canada. Journal of the International Association of Physicians in AIDS Care. 2012; 11(2):134–41. https://doi.org/10.1177/1545109711423976 PMID: 22318879

48. Solowij N, Jones KA, Rozman ME, Davis SM, Ciarrochi J, Heaven PC, et al. Reflection impulsivity in adolescent cannabis users: a comparison with alcohol-using and non-substance-using adolescents. Psychopharmacology. 2012; 219(2):575–86. https://doi.org/10.1007/s00213-011-2486-y PMID: 21938415

49. Gallup. U.S. uninsured rate at 11.0%, Lowest in Eight-Year Trend Washington, D.C.2016 [Available from: http://www.gallup.com/poll/190484/uninsured-rate-lowest-eight-year-trend.aspx.

50. Simoni JM, Kurth AE, Pearson CR, Pantalone DW, Merrill JO, Frick PA. Self-report measures of antiretroviral therapy adherence: A review with recommendations for HIV research and clinical management. AIDS Behav. 2006; 10(3):227–45. https://doi.org/10.1007/s10461-006-9078-6 PMID: 16783535

51. Ramo DE, Hall SM, Prochaska JJ. Reliability and validity of self-reported smoking in an anonymous online survey with young adults. Health Psychol. 2011; 30(6):693–701. https://doi.org/10.1037/a0023443 PMID: 21574709

52. Ramo DE, Liu H, Prochaska JJ. Reliability and validity of young adults' anonymous online reports of marijuana use and thoughts about use. Psychol Addict Behav. 2012; 26(4):801–11. https://doi.org/10.1037/a0026201 PMID: 22082344

53. Maksut JL, Eaton LA, Siembida EJ, Driffin DD, Baldwin R. An evaluation of factors associated with sexual risk taking among Black men who have sex with men: a comparison of younger and older populations. J Behav Med. 2016; 39(4):665–74. https://doi.org/10.1007/s10865-016-9734-x PMID: 27001255

54. Quinn K, Voisin DR, Bouris A, Schneider J. Psychological distress, drug use, sexual risks and medication adherence among young HIV-positive Black men who have sex with men: exposure to community violence matters. AIDS Care. 2016; 28(7):866–72. https://doi.org/10.1080/09540121.2016.1153596 PMID: 26917328

55. Mayer KH, Wang L, Koblin B, Mannheimer S, Magnus M, del Rio C, et al. Concomitant socioeconomic, behavioral, and biological factors associated with the disproportionate HIV infection burden among Black men who have sex with men in 6 U.S. cities. PLoS One. 2014; 9(1):e87298. https://doi.org/10.1371/journal.pone.0087298 PMID: 24498067

56. Dyer TP, Shoptaw S, Guadamuz TE, Plankey M, Kao U, Ostrow D, et al. Application of syndemic theory to black men who have sex with men in the Multicenter AIDS Cohort Study. J Urban Health. 2012; 89 (4):697–708. https://doi.org/10.1007/s11524-012-9674-x PMID: 22383094

57. Buttram ME, Kurtz SP. A mixed methods study of health and social disparities among substance-using African American/Black men who have sex with men. J Racial Ethn Health Disparities. 2015; 2(1):1–10. https://doi.org/10.1007/s40615-014-0042-2 PMID: 25960944

58. Mustanski B, Garofalo R, Herrick A, Donenberg G. Psychosocial health problems increase risk for HIV among urban young men who have sex with men: preliminary evidence of a syndemic in need of attention. Ann Behav Med. 2007; 34(1):37–45. https://doi.org/10.1080/08836610701495268 PMID: 17688395

59. Chibanda D, Verhey R, Gibson LJ, Munetsi E, Machando D, Rusakaniko S, et al. Validation of screening tools for depression and anxiety disorders in a primary care population with high HIV prevalence in Zimbabwe. J Affect Disord. 2016; 198:50–5. https://doi.org/10.1016/j.jad.2016.03.006 PMID: 27011359

60. Maurer DM. Screening for depression. Am Fam Physician. 2012; 85(2):139–44. PMID: 22335214

61. Pence BW, Gaynes BN, Whetten K, Eron JJ Jr., Ryder RW, Miller WC. Validation of a brief screening instrument for substance abuse and mental illness in HIV-positive patients. J Acquir Immune Defic Syndr. 2005; 40(4):434–44. PMID: 16280698

62. Whetten K, Reif S, Swartz M, Stevens R, Ostermann J, Hanisch L, et al. A brief mental health and substance abuse screener for persons with HIV. AIDS Patient Care STDS. 2005; 19(2):89–99. https://doi.org/10.1089/apc.2005.19.89 PMID: 15716640

63. Edwards M, Quinlivan EB, Bess K, Gaynes BN, Heine A, Zinski A, et al. Implementation of PHQ-9 depression screening for HIV-infected patients in a real-world setting. J Assoc Nurses AIDS Care. 2014; 25(3):243–52. https://doi.org/10.1016/j.jana.2013.05.004 PMID: 24103743

64. Bouris A, Voisin D, Pilloton M, Flatt N, Eavou R, Hampton K, et al. Project nGage: Network Supported HIV Care Engagement for Younger Black Men Who Have Sex with Men and Transgender Persons. J AIDS Clin Res. 2013; 4.