



Evaluating Evidence-Informed Behavioral Health Models to Improve HIV Health Outcomes: Quantitative Findings from the Ryan White HIV/AIDS Program Special Projects of National Significance Black Men Who Have Sex with Men Initiative

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Abstract

The Black Men who have Sex with Men (MSM) Initiative was implemented at eight sites to engage and retain Black MSM in HIV medical care and supportive services (SS) by addressing their behavioral health (BH) care needs. Using a pre-post design and generalized logistic mixed-effects models adjusting for patient-level random effects, site, baseline age, and baseline mental health status, we evaluated whether participants experienced increased postintervention attainment of (1) Awareness of HIV medical care, BH care, and SS; (2) Screening, referral, linkage, receipt, and engagement in HIV care, BH care, and SS; and (3) Retention, antiretroviral therapy prescription, and suppressed viral load. Among 758 evaluated participants, the proportion of participants who were aware of, screened for, screened positive for, and referred to BH and SS, retention in care (72% to 79%), and viral load suppression (68% to 75%) increased between baseline and postintervention. Among participants who screened positive and received BH services were statistically more likely to be linked to [OR, 1.34 (95% CI: 1.08–1.66)] and retained in [OR, 1.36 (95% CI: 1.00–1.83)] care. Among those who screened positive and received SS were statistically more likely to be retained in care [OR, 1.54 (95% CI: 1.07–2.22)]. Measures of linkage to care declined significantly during the study period, perhaps because of COVID-19 that delayed in-person care. This study suggests that interventions designed to increase utilization of BH services and SS can be effective at improving retention in care and viral load suppression among Black MSM, at least among those currently using HIV services.

Keywords: AIDS, mental health, HIV, patient care, racial

Introduction

BLACK MEN WHO have sex with men (MSM) account for 20–25% of all new US HIV infections.¹ Black MSM are also less likely to achieve viral suppression than the national average for participants served by the Ryan White HIV/AIDS Program (RWHAP).² Black MSM experience disparities in access to health care, as well as face stigma and discrimination based on race, sexual orientation, gender expression,

gender identity, and HIV status.^{3,4} Stigma, discrimination, and medical mistrust influence Black MSM's ability to comfortably and safely access HIV medical care and increase the risk of depression and other behavioral health (BH) conditions.^{5,6} Untreated BH needs can impact retention in HIV medical care.⁷ Compared to other MSM receiving outpatient HIV medical care, Black MSM face higher rates of shortages for stable housing, nutritional support, substance use treatment, and mental health services.⁸

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To address the unique clinical, BH, and social support needs of Black MSM with HIV, the US Department of Health and Human Services Health Resources and Services Administration's (HRSA) HIV/AIDS Bureau (HAB) RWHAP Part F Special Projects of National Significance (SPNS) funded the *Implementation of Evidence-Informed Behavioral Health Models to Improve HIV Health Outcomes for Black Men who have Sex with Men* ("the Black MSM Initiative"). This initiative sought to engage and retain Black MSM in HIV medical care and supportive services (SS) by addressing their BH needs.⁹ SPNS funded eight Black MSM Initiative demonstration sites to adapt and implement one of four evidence-informed models of care (MOCs) with integrated clinical and BH care to serve the comprehensive needs of Black MSM with HIV. All MOCs were originally developed to improve HIV medical care and treatment and/or HIV health outcomes for men of color and were expected to improve linkage, engagement, retention in care, and viral load suppression outcomes. The four MOCs include a youth-focused case management intervention (YFM),¹⁰ Strength Through Youth Livin' Empowered (STYLE),¹¹ Brothers United/the Damien Center's Linkage to Care (L2C) program,¹² and Project Silk.¹³ The YFM model was adapted to include adult Black MSM at most sites (Tables 1 and 2). The primary difference between the YFM and other MOCs is that the YFM is shorter in duration and provides a more intense service delivery schedule.¹⁴

This article presents quantitative findings from the outcome evaluation of the Black MSM Initiative. Compared to baseline, we evaluated whether participants experienced increased postintervention attainment of (1) Awareness of HIV medical care, BH care, and SS; (2) Screening, referral, linkage, receipt, and engagement in HIV medical care, BH care, and SS; and (3) Retention, antiretroviral therapy (ART) prescription, and suppressed viral load for participants who received at least one routine HIV medical care visit during the intervention year. We further evaluated differences in outcomes by adjusting for site, baseline age, and baseline mental health status assessed using the self-reported Patient Health Questionnaire (PHQ-8). In addition, we compared differences in outcomes by MOCs, baseline self-reported substance use status, and receipt of BH care and SS during 12 months of intervention.

Methods

The target population for the initiative was individuals 13 years or older with HIV who identify as Black MSM (including cisgender men, transgender men, and gender non-conforming individuals assigned male at birth). We used data from two data sources: (1) BMSM-Patient Survey (PS) and (2) Main Outcomes Instrument (MOI) with each source collected at baseline, 6 months, and 12 months. The PS included self-reported data on demographics, HIV health outcomes, BH care, and satisfaction with the intervention. The MOI reported HIV medical care, outcomes, and BH and SS dates obtained through electronic health record (EHR) review. One site was excluded from the evaluation sample due to insufficient data, and we further restricted the analysis sample to participants that responded to at least one cycle of PS.

As defined by HRSA, *HIV medical care services* include all HIV medical care and treatment services allowable through the RWHAP; *BH care* refers to services for mental or

TABLE 1. OVERVIEW OF THE DEMONSTRATION SITES

Demonstration site	City, state	Selected MOC	Organizational type	Length of intervention	Target population
Christian Community Health Center	Chicago, IL	Youth-focused case management intervention	Community-based clinic (FQHC)	12 months	Black MSM LWH aged 18+
Parkland HIV Services Department, Dallas County Hospital District	Dallas, TX	Youth-focused case management intervention	Hospital system	9 months	Black MSM LWH aged 17–34
Duke University	Durham, NC	STYLE	Academic program, nonclinical	12 months	Black MSM LWH aged 18–35
Friends Research Institute, Inc.	Los Angeles, CA	Youth-focused case management intervention	Community research site	3 months	Black MSM LWH aged 18–65
Gay Men's Health Crisis, Inc.	New York, NY	Project Silk	Community-based organization	12 months	Black MSM LWH aged 18–45
CrescentCare	New Orleans, LA	Brothers United/The Damien Center's L2C	Community-based clinic (ASO, FQHC)	12 months	Black MSM and Black transmen LWH aged 13+
East Bay Advanced Care, Sutter Bay Hospitals	Oakland, CA	Youth-focused case management intervention	Hospital system	6–18 months, depending on enrollment date	Black MSM LWH (no age range)
Project ARK at Washington University	St. Louis, MO	Youth-focused case management intervention	Academic program, clinical	6 months	Black MSM LWH aged 18–29

TABLE 2. MODELS OF CARE AND SITE ADAPTATIONS

<i>Model of care</i>	<i># Of sites</i>	<i>Model summary</i>	<i>Core components</i>	<i>Site adaptations</i>
Youth-focused case management intervention	5	The goal of this intervention was to improve retention in HIV medical care for young Latino and Black MSM. Case managers provided supportive services to fill participants' identified needs for housing, nutrition support, substance abuse treatment, or mental health services.	Two Bachelor-level case managers Clinic- and venue-based outreach 24 month intervention Psychosocial case management services	Expanding eligible age range Shortening intervention length (between 3 and 18 months) Using peer case managers
STYLE	1	STYLE was designed to improve retention in HIV medical care through a social marketing campaign, outreach to youth and provision of HIV testing services, and a coordinated medical and social support network for recently diagnosed and lost-to-care youth with HIV.	Medical case manager and peer outreach worker Targeted venue-based and social marketing outreach 24 month intervention Case management and ancillary support services	Combining case manager and outreach worker position Adding a behavioral health provider Shortening intervention length to 12 months Using an app to engage participants virtually
Project silk	1	Project Silk was a youth-led, adult-supported drop-in program for LGBTQ individuals that offered recreation opportunities, food and snacks, health services like HIV/STI testing, access to mental health counseling, and community resources.	Engagement with House & Ball community Recreation-based safe space focusing on artistic expression Colocated supportive services L2C specialists One-stop shop for comprehensive care and referral services Support groups	Expanding the target population to include non-House & Ball participants Adding an onsite behavioral health therapist
Brothers United/the Damien Center L2C	1	This program, run by an Indianapolis community-based organization, provided comprehensive wraparound and supportive services to the Black LGBTQ community. The program offered prevention and testing. Those who tested positive were referred to services that help them engage in care.		

emotional well-being and/or actions that affect wellness, including screening and treatment for substance use disorders, alcohol and drug addiction, and serious psychological distress, suicide, and mental disorders.¹⁵ We defined awareness of HIV medical care, BH, and substance use services as survey response of strongly agree, agree, or somewhat agree to questions in the PS. Using the MOI data, we defined linkage to care as at least one routine HIV medical care visit within the previous 3 and 6 months. We considered participants with an HIV diagnosis within 1 year of enrollment as newly diagnosed. We defined linkage to care among newly diagnosed as at least one routine HIV medical care visit in the previous 3 months. We defined receipt of HIV medical care as participants with two or more routine HIV medical care visits in the previous 12 months.

We defined screening for BH/SS needs as participants who had been screened in the previous 6 or 12 months. Among those that were screened for BH/SS, we defined need as those who screened positive for BH/SS screening in the previous 6 and 12 months. Among those that screened positive, we defined referral to BH/SS care as BH/SS care referrals in the previous 6 and 12 months. Among those that were referred, we defined receipt of BH/SS care as at least one BH/SS visit in the previous 6 and 12 months. Following HRSA definitions,¹⁶ we defined retention in care as those with at least one routine HIV-related medical visit in the previous year with a second visit at least 90 days after (at least one of the two visits must be a medical visit with a provider with prescribing privileges, the other could be an HIV viral load test); we defined ART prescription as a visit in which ART was prescribed in the previous 6 and 12 months; and we defined viral load suppression as participants with an HIV viral load of less than 200 copies/mL at their last HIV viral load test in the previous 12 months (Table 3 for outcome definitions). We applied decision rules based on dependencies of variables to clean data inconsistencies. Missing data in the PS and the MOI were addressed using multiple imputations with 100 imputations using a fully conditional specification. Continuous variables like age and PHQ-8 score were imputed using predictive mean matching. Binary variables were predicted using logistic regression (Appendix Table A1).

The evaluation used a pre-post design to estimate the change in outcomes between baseline and 12 months. Baseline is indicated by participant enrollment date and marks the beginning of the study period, and 6 and 12 months indicate follow-up times from baseline. To test significance of differences between time points, we used generalized logistic mixed-effects models which compared each participant-level study outcome at each collection time, as a function of time, and controlled for patient-level random effects. Statistical significance was determined based on the significance of the time parameter using an alpha of 0.05.

For linkage, retention, and viral load outcomes, we conducted further analyses to assess the impact of the intervention among the following subgroups: Participants enrolled in other MOCs compared to participants in the YFM; indicated participants who at baseline self-reported substance use problems compared to those who did not; indicated participants who received BH services within 12 months of intervention compared to indicated participants who did not; and indicated participants who received SS compared to indicated participants who did not. Models testing the effect of

BH care and SS were restricted to indicated participants who screened positive for needing those services. Each model additionally controlled for the participant's value of the dependent variable at baseline, site, baseline age, and baseline PHQ-8 score. Results of the model show the adjusted odds ratio of a participant with the given characteristic of obtaining the outcome at 12 months compared to the reference group and the significance of that odds ratio (Table 4). We conducted all analyses using SAS 9.4 (Cary, NC). Ethical conduct of the study was overseen by NORC Institutional Review Board, which determined the study to not be human subjects research because no identifying information about participants was received.

Results

A total of 758 participants contributed to the analysis, with a range of 66–180 participants enrolled at each of the seven assessed sites. Of these, 465 were enrolled in the YFM MOCs versus 293 in other MOCs combined. After accounting for missing data, an estimated 202 participants reported baseline substance use, 210 received at least one BH service in the 12 months of the intervention, and 303 received at least one SS in the 12 months of the intervention. Of the 27 measures tested, 14 improved significantly, three declined significantly, and the remaining were not statistically different at 12 months compared to baseline (Table 5). Of the measures related to HIV medical care, linkage to HIV medical care in previous 3 and 6 months declined significantly, while retention in care and suppressed viral load in previous 12 months increased significantly (Table 1). Rates of ART prescription in previous 12 months increased slightly but not significantly and were greater than 90% in each wave of data collection (Table 1).

Awareness of BH increased significantly from 77% at baseline to 83% and 86% at 6 months and 12 months. Awareness of HIV medical care and SS did not significantly change at 6 and 12 months compared to baseline. Linkage to HIV medical care in the previous 3 months dropped significantly from 56% at baseline to 40% at 6 months and to 35% at 12 months. Similarly, linkage to HIV medical care during the previous 6 months dropped significantly from 74% at baseline to 67% at 6 months and 54% at 12 months. Among newly diagnosed participants, there were no significant changes in linkage to HIV medical care in the previous 3 months. Among all participants, there were no significant changes between baseline and 6 or 12 months in receipt of two routine HIV medical care visits in the previous 12 months.

Screening for BH in the previous 6 months increased significantly between baseline (59%) and 6 months (82%); however, the change between baseline and 12 months was not significant. Screening for BH in the previous 12 months increased significantly from 73% at baseline to 89% at 6 months and 87% at 12 months. Screening for SS in the previous 6 months increased significantly between baseline (57%) and 6 months (76%); however, the change between baseline and 12 months was not significant. Screening for SS in the previous 12 months increased significantly from 71% at baseline to 88% at 6 months and 83% at 12 months.

Identified need (positive screen) for BH among participants screened in the previous 6 months increased significantly from 57% at baseline to 69% at 6 months and then declined to 45% at 12 months. Identified need for BH among participants

TABLE 3. DEFINITIONS OF EACH EVALUATED OUTCOME MEASURE

<i>No.</i>	<i>Measure</i>	<i>Numerator (Participants who...)</i>	<i>Denominator^a</i>
1	Awareness of HIV medical care	responded that they know where to get medical care for their HIV (Strongly agree, agree, somewhat agree)	Study population
2	Awareness of BH care	responded that they know where to get help for emotional issues like stress, anxiety, or depression (Strongly agree, agree, somewhat agree)	Study population
3	Awareness of substance use	responded that they know where to get help if drugs or alcohol are causing issues in my life (Strongly agree, agree, somewhat agree)	Study population
4	Linkage to HIV medical care in the previous 3 months	had a routine HIV medical care visit in the last 3 months	Study population
5	Linkage to HIV medical care in the previous 6 months	had a routine HIV medical care visit in the last 6 months	Study population
6	Linkage to HIV medical care in the previous 3 months among newly diagnosed	had a routine HIV medical care visit within 3 months of HIV Dx date	Study population with an HIV Dx date within 12 months of enrollment
7	Receipt of 2 routine HIV medical care visits in the previous 12 months	had 2 or more HIV visits within the past year	Study population
8	Behavioral screening in the previous 6 months	were screened for BH needs in the past 6 months	Study population
9	Behavioral screening in the previous 12 months	were screened for BH needs in the past 12 months	Study population
10	Support service screening in the previous 6 months	were screened for SS needs in the past 6 months	Study population
11	Support service screening in the previous 12 months	were screened for SS needs in the past 12 months	Study population
12	Identified need (positive screen) for BH among participants screened in the previous 6 months	were screened positive for BH needs in the past 6 months	Study population that screened for BH needs in the past 6 months
13	Identified need (positive screen) for BH among participants screened in the previous 12 months	were screened positive for BH needs in the past 12 months	Study population that screened for BH needs in the past 12 months
14	Identified need (positive screen) for SS among participants screened in the previous 6 months	were screened positive for SS needs in the past 6 months	Study population that screened for SS needs in the past 6 months
15	Identified need (positive screen) for SS among participants screened in the previous 12 months	were screened positive for SS needs in the past 12 months	Study population that screened for SS needs in the past 12 months
16	Referred for BH among participants screened positive in the previous 6 months	were referred for BH needs in the past 6 months	Study population that screened positive for BH needs in the past 6 months
17	Referred for BH among participants screened positive in the previous 12 months	were referred for BH needs in the past 12 months	Study population that screened positive for BH needs in the past 12 months
18	Referred for SS among participants screened positive in the previous 6 months	were referred for SS needs in the past 6 months	Study population that screened positive for SS needs in the past 6 months
19	Referred for SS among participants screened positive in the previous 12 months	were referred for SS needs in the past 12 months	Study population that screened positive for SS needs in the past 12 months
20	Receipt of BH services among participants referred in the previous 6 months	received BH services in the last 6 months	Study population that was referred for BH needs in the past 6 months
21	Receipt of BH services among participants referred in the previous 12 months	received BH services in the last 12 months	Study population that was referred for BH needs in the past 12 months
22	Receipt of SS among participants referred in the previous 6 months	received SS in the last 6 months	Study population that was referred for SS needs in the past 6 months

(continued)

TABLE 3. (CONTINUED)

No.	Measure	Numerator (Participants who...)	Denominator ^a
23	Receipt of SS among participants referred in the previous 12 months	received SS in the last 12 months	Study population that was referred for SS needs in the past 12
24	Retention in care in the previous 12 months	had a second visit at least 90 days after. (At least one of the two visits needs to be a medical visit with a provider with prescribing privileges and the other could be an HIV viral load test)	Study population with at least one routine HIV related medical visit in the measurement year
25	Receipt of ART prescription in the previous 6 months	were prescribed ART in the last 6 months	Study population with at least one routine HIV related medical visit in the measurement year
26	Receipt of ART prescription in the previous 12 months	were prescribed ART in the last 12 months	Study population with at least one routine HIV related medical visit in the measurement year
27	Suppressed viral load in the previous 12 months	had an HIV viral load of less than 200 copies/mL at the last HIV viral load test in the last 12 months	Study population with at least one routine HIV related medical visit in the measurement year

^aStudy population refers to all enrolled participants that responded to at least one cycle of Patient Survey (PS).

screened in the previous 12 months increased significantly from 65% at baseline to 78% at 6 months and 72% at 12 months. Similarly, identified need for SS among participants screened in the previous 6 months increased significantly from 73% at baseline to 84% at 6 months and 81% at 12 months. Identified need for SS among participants screened in the previous 12 months also increased significantly from 79% at baseline to 86% at 6 months and 88% at 12 months.

Participants referred to BH care, among participants who screened positive in the previous 6 months, increased significantly from 37% at baseline to 64% at 6 months and then declined to 48% at 12 months. Participants referred to BH care, among participants who screened positive in the previous 12 months, increased significantly from 51% at baseline to 77% at

6 months and 79% at 12 months. Similarly, participants referred to SS care, among those who screened positive in the previous 6 months, increased significantly from 52% at baseline to 66% at 6 months and 67% at 12 months. Participants referred to SS care, among participants who screened positive in the previous 12 months, also increased significantly from 61% at baseline to 71% at 6 months and 78% at 12 months.

Receipt of BH services among participants referred in the previous 6 months and 12 months did not change significantly between baseline and 6 or 12 months. There was no significant change between receipt of SS among participants referred in the previous 6 or 12 months between baseline and 6 months, but increased significantly between baseline and 12 months, 64% to 79% and 58% to 69%, respectively.

TABLE 4. ODDS RATIOS OF SELECTED STRATIFICATION VARIABLES ON THE ATTAINMENT OF LINKAGE TO CARE, RETENTION IN CARE, AND VIRAL LOAD SUPPRESSION AT 12 MONTHS

Stratification variable	Odds ratios and confidence intervals for outcomes		
	Linkage to care – 6M	Retention in care – 12M	Viral load suppression – 12M
Non-YFM MOCs ^a compared to YFM	1.02 (0.87–1.19)	1.12 (0.86–1.45)	1.53 (1.16–2.03) ^c
Self-reported baseline substance problems ^b	0.85 (0.71–1.02)	0.78 (0.57–1.06)	0.98 (0.72–1.33)
Receipt of BH services ^c	1.34 (1.08–1.66) ^c	1.36 (1.00–1.83) ^c	1.26 (0.93–1.69)
Receipt of SS ^d	1.22 (0.97–1.53)	1.54 (1.07–2.22) ^c	1.08 (0.79–1.49)

All Models are adjusted for site, baseline age, baseline PHQ-8 score, and baseline attainment of the modeled indicator. By controlling for baseline attainment, the odds ratio is interpreted as the relative log odds of a member of the stratification group of attaining the outcome at 12 months compared to the reference group, controlling for their attainment at baseline.

^aNon-YFM MOCs refer to participants at sites that did not use the Youth Focused case management intervention, the reference is participants at sites that did use the Youth Focused case management intervention.

^bParticipants who self-reported substance use problems in their baseline patient survey compared to patients who did not report substance use problems in their baseline survey.

^cParticipants who screened positive for the need for BH services who received BH services compared to the participants who screened positive for the need for BH services who did not receive those services.

^dParticipants who screened positive for the need for SS who received BH services compared to participants who screened positive for the need for SS who did not receive those services.

A ^c inside the table notes statistically significant changes at the 5% level.

BH, behavioral health; MOCs, models of care; SS, supportive services; YFM, youth-focused case management intervention.

TABLE 5. PROPORTION OF PARTICIPANTS ACHIEVING MEASURE AT BASELINE, 6 MONTHS, AND 12 MONTHS

<i>Means for each measure</i>	<i>Baseline</i>	<i>6 months</i>	<i>12 months</i>
Awareness of HIV medical care	0.97	0.98	0.96
Awareness of BH care	0.77	0.83 ^c	0.86 ^c
Awareness of Substance Use Services	0.83	0.83	0.87
Linkage to HIV Medical Care in the previous 3 months	0.56	0.40 ^c	0.35 ^c
Linkage to HIV Medical Care in the previous 6 months	0.74	0.67 ^c	0.54 ^c
Linkage to HIV Medical Care in the previous 3 months among newly diagnosed ^a	0.58	0.51	0.46
Receipt of 2 routine HIV Medical Care Visits in the previous 12 months	0.59	0.61	0.58
Behavioral screening in the previous 6 months	0.59	0.82 ^c	0.60
Behavioral screening in the previous 12 months	0.73	0.89 ^c	0.87 ^c
Support service screening in the previous 6 months	0.57	0.76 ^c	0.57
Support service screening in the previous 12 months	0.71	0.88 ^c	0.83 ^c
Identified need (positive screen) for BH among participants screened in the previous 6 months	0.57	0.69 ^c	0.45 ^c
Identified need (positive screen) for BH among participants screened in the previous 12 months	0.65	0.78 ^c	0.72 ^c
Identified need (positive screen) for SS among participants screened in the previous 6 months	0.73	0.84 ^c	0.81 ^c
Identified need (positive screen) for SS among participants screened in the previous 12 months	0.79	0.86 ^c	0.88 ^c
Referred for BH among participants screened positive in the previous 6 months	0.37	0.64 ^c	0.48 ^c
Referred for BH among participants screened positive in the previous 12 months	0.51	0.77 ^c	0.79 ^c
Referred for SS among participants screened positive in the previous 6 months	0.52	0.66 ^c	0.67 ^c
Referred for SS among participants screened positive in the previous 12 months	0.61	0.71 ^c	0.78 ^c
Receipt of BH services among participants referred in the previous 6 months	0.55	0.49	0.46
Receipt of BH services among participants referred in the previous 12 months	0.66	0.57	0.56
Receipt of SS among participants referred in the previous 6 months	0.64	0.62	0.79 ^c
Receipt of SS among participants referred in the previous 12 months	0.58	0.60	0.69 ^c
Retention in care ^b in the previous 12 months	0.72	0.72	0.79 ^c
Receipt of ART prescription in the previous 6 months ^b	0.82	0.84	0.73
Receipt of ART prescription in the previous 12 months ^b	0.91	0.93	0.93
Suppressed viral load in the previous 12 months ^b	0.68	0.72 ^c	0.75 ^c

^aParticipants diagnosed within 12 months of enrollment.

^bAmong participants with at least one routine HIV medical care visit in the 12 months. ^cSignificant change compared to baseline.

Retention in care did not change significantly from baseline to 6 months but increased significantly from 72% at baseline to 79% at 12 months. Receipt of ART prescription at 6 and 12 months did not change significantly between baseline and 6 or 12 months. Suppressed viral load (<200 copies/mL) in the previous 12 months increased significantly from 68% at baseline to 72% at 6 months and 75% at 12 months.

Adjusting for intervention site, baseline age, and baseline PHQ-8 score did not change outcomes except for rendering the difference between baseline and 12 months insignificant among participants who screened positive and were referred for BH services in the previous 6 months. In a sensitivity analysis, changes in outcomes were examined among participants with complete data. The direction of change (increase or decrease) did not reverse for any outcomes. However, the increase in awareness of HIV medical care and retention in care between baseline and 6 months became significant. The change in receipt of SS in the previous 12 months became nonsignificant between baseline and 12 months. Receipt of ART prescription in the previous 6 months became significant between baseline and 12 months (Table 6).

Participants in the non-YFM MOCs were significantly more likely to have a suppressed viral load at 12 months [OR, 1.53 (95% CI: 1.16–2.03)] compared to participants in the YFM. The two models were statistically the same in achieving linkage and retention in care. Participants who reported substance use problems at baseline were less likely

to attain any of the three tested outcomes, but these results were not statistically significant. Among persons who screened positive for the need for BH services, participants who received at least one BH service during the 12 months of intervention were significantly more likely to be linked [OR, 1.34 (95% CI: 1.08–1.66)] and retained [OR, 1.36 (95% CI: 1.00–1.83)] in care. These participants were also more likely to be virally suppressed, but this result was not statistically significant. Among participants that screened positive for needing SS, those who received them were more likely to be retained in care [OR, 1.54 (95% CI: 1.07–2.22)]. They were also more likely to be linked to care and be virally suppressed, but these results were not statistically significant.

Discussion

Participants at the seven sites evaluated as part of the HRSA Black MSM Initiative experienced statistically significant improvements in 14 of the 27 evaluated measures at the completion of the intervention compared to their baseline attainment of those same measures. Participants experienced improvements in several measures of the services the intervention was designed to address such as awareness of, screening for, identification of need, and referral to BH and SS. Overall, participants in the intervention also experienced improvements in retention in care and viral load suppression. We saw no statistically significant changes in ART prescription

TABLE 6. SENSITIVITY ANALYSIS OF MEAN PROPORTION ACHIEVING EACH OUTCOME AT EACH TIME MEASUREMENT BASED ON A COMPLETE CASE ANALYSIS WITHOUT ADJUSTMENT FOR MISSING DATA

	Baseline		6 Months		12 Months	
	N	Mean	N	Mean	N	Mean
<i>Means for each measure</i>						
Awareness of HIV medical care	740	0.97	506	0.99 ^c	427	0.97
Awareness of BH care	738	0.77	505	0.84 ^c	427	0.86 ^c
Awareness of support services	740	0.83	506	0.84	429	0.87
Linkage to HIV medical care in the previous 3 months	617	0.56	731	0.40 ^c	707	0.35 ^c
Linkage to HIV medical care in the previous 6 months	617	0.73	731	0.67 ^c	707	0.53 ^c
Linkage to HIV medical care in the previous 3 months among newly diagnosed ^a	69	0.58	69	0.51	68	0.46
Receipt of 2 routine HIV medical care visits in the previous 12 months	617	0.61	731	0.61	707	0.58
Behavioral screening in the previous 6 months	668	0.61	729	0.82 ^c	637	0.60
Behavioral screening in the previous 12 months	668	0.73	729	0.89 ^c	637	0.85 ^c
Support service screening in the previous 6 months	624	0.58	664	0.75 ^c	585	0.55
Support service screening in the previous months	624	0.70	664	0.87 ^c	585	0.80 ^c
Identified need (positive screen) for BH among participants screened in the previous 6 months	430	0.59	596	0.70 ^c	380	0.47 ^c
Identified need (positive screen) for BH among participants screened in the previous 12 months	487	0.65	651	0.78 ^c	542	0.75 ^c
Identified need (positive screen) for SS among participants screened in the previous 6 months	364	0.76	495	0.85 ^c	321	0.84 ^c
Identified need (positive screen) for SS among participants screened in the previous 12 months	437	0.78	575	0.86 ^c	468	0.88 ^c
Referred for BH among participants screened positive in the previous 6 months	238	0.38	415	0.64 ^c	180	0.50 ^c
Referred for BH among participants screened positive in the previous 12 months	315	0.51	507	0.77 ^c	407	0.80 ^c
Referred for SS among participants screened positive in the previous 6 months	276	0.56	420	0.70 ^c	270	0.74 ^c
Referred for SS among participants screened positive in the previous 12 months	341	0.64	495	0.73 ^c	414	0.81 ^c
Receipt of BH services among participants referred in the previous 6 months	91	0.56	266	0.50	90	0.49
Receipt of BH services among participants referred in the previous 12 months	162	0.66	392	0.57	325	0.59
Receipt of SS among participants referred in the previous 6 months	155	0.67	295	0.65	200	0.83 ^c
Receipt of SS among participants referred in the previous 12 months	217	0.66	359	0.64	337	0.72
Retention in care in the previous 12 months	512	0.68	572	0.72 ^c	521	0.79 ^c
Receipt of ART prescription in the previous 6 months ^b	482	0.81	513	0.84	484	0.73 ^c
Receipt of ART prescription in the previous 12 months ^b	482	0.90	513	0.92	484	0.92
Suppressed viral load in the previous 12 months ^b	533	0.68	570	0.72 ^c	509	0.76 ^c

Participants with complete data differ for each measure at each time point due to varying levels of missing data.

^aParticipants diagnosed within 12 months of enrollment.

^bAmong participants with at least one routine HIV medical care visit in the 12 months.

^cSignificant change compared to baseline.

over the intervention period; however, rates of ART prescription in the last 12 months were high across all three time periods (91% at baseline and 93% at both 6 and 12 months).

Somewhat counterintuitively, linkage to HIV medical care in the last 6 months significantly declined during the observation period (from 74% at baseline to 54% at 12 months) despite improvements in retention and viral load suppression and the small but statistically insignificant increase in ART prescriptions. Receipt of two routine HIV medical care visits was also not statistically different over the observation period. These results may be, in part, attributable to the shorter look back period for the linkage outcome and the COVID-19 pandemic, which delayed receipt of in-person care and may have contributed to delays in routine medical visits, rather than programmatic deficiencies. COVID-19 barriers may have been particularly acute for individuals with limited prior experience accessing services. Our discussion with sites indicated that in the prevaccination period of COVID-19, doctors would in some cases advise their patients to avoid in-person medical visits as long as their ART prescriptions were current. In addition, three of the seven demonstration sites

conducted interventions of 9 months or less, limiting their ability to impact an outcome measured at 12 months.

Retention in care, ART prescription, and viral load suppression were each measured among the population with at least one routine HIV visit in the last 12 months. Among this population, retention and viral load suppression each significantly improved, and ART prescription remained at consistently high levels across the observation period. Among all participants, including those without at least one routine HIV visit in the last 12 months, outcomes improved slightly, but increases were not significant. For example, among all participants using complete case analysis (including those without any HIV medical care visit in past 12 months), retention increased from 56% at baseline to 58% at 12 months, ART prescription increased from 77% at baseline to 78% at 12 months, and suppressed viral load improved from 59% at baseline to 62% at 12 months. These nonsignificant increases led us to conclude that the intervention was effective for participants that started the intervention at risk of falling out of care but had minimal impact on participants who were not in care at baseline as measured by having at least one routine HIV visit in the last year.

For BH services, screening, identified need, and referral for BH services significantly increased at 6 months and 12 months (except for BH screening in the previous 6 months), while the receipt of BH services among those that were screened decreased slightly (although this result was not significant). This result is potentially explained by the difficulty of providing in-person BH services during the COVID-19 pandemic. In contrast, screening for, need identification, referral to, and receipt of SS all increased during the observation period, possibly because SS did not require as much in-person interaction.

We observed differences in outcomes across different subgroups of participants. Participants in MOCs other than the YFM were statistically more likely to have suppressed viral load at 12 months compared to participants in the YFM. As a group, participants in the YFM started the intervention with lower rates of viral suppression than participants in other models, which the model controlled for. However, persons with unsuppressed viral load may take longer than a year to achieve viral suppression.¹⁷ Several of the interventions that used the YFM targeted difficult-to-reach populations such as young Black and Latino MSM and people without housing, known populations that are empirically challenging to engage and retain in care.^{10,18–20} That said, our results do not suggest that the YFM resulted in superior outcomes than other MOCs.

Participants who reported substance use problems at baseline were slightly less likely to be linked to, retained in care, or have a suppressed viral load at 12 months, but these differences were not statistically significant. While this evidence suggests that persons with self-reported substance use were more difficult to serve, more research is required to establish this relationship.²¹ Among persons who screened positive for a BH service need, those who received BH services were statistically more likely to be linked to and retained in care. They also were more likely to be virally suppressed, but this result was not statistically significant. Similarly, of those who screened positive for needing SS, those who received SS were statistically more likely to be retained in care. They were also more likely to be linked to care and virally suppressed, but these results were not statistically significant. These results suggest that providing BH and SS to those who need them can influence the greater attainment of HIV medical care goals, but more research is needed.

Published estimates of the YFM indicate that about 78% of the young MSM had a critical or immediate need for stable housing, nutrition support, substance abuse treatment, or mental health services.¹⁰ Our findings for the YFM subgroup are similar, indicating that 66% of participants with baseline identified need for BH services and 78% of participants with baseline identified need for SS. Overall, across MOCs we observed that 66% and 79% participants with baseline identified need for BH and SS, respectively. The same study suggested that 70% of the participants were retained in primary HIV medical care at 6 months. Another study examining the “STYLE” MOCs reported 63% retention in care in the last 4 months.¹¹ Our study across all models showed a significant increase in retention in the previous 12 months from 68% at baseline to 72% at 6 months and 79% at 12 months among complete cases, as well as from 72% at baseline to 72% at 6 months to 79% at 12 months among all participants, including imputations for missing data.

This study is limited by its implementation during COVID-19, data collection methods, missing data, and HRSA outcome definitions. The COVID-19 Public Health Emergency,

which started a few months after study recruitment began, created challenges for participant recruitment and delivery of in-person health care and BH services. It is difficult to know what the impact of the interventions would be in the absence of COVID-19, but the success of the program in increasing many programmatic outcomes despite the challenges of COVID-19 is notable.

Data for this study were extracted using a manual review of EHR information with the intent of creating an equal data generating process across sites with and without direct access to institutional health care records. Potentially higher data quality could be achieved by extracting EHRs directly from participating sites with the ability to provide these data. Several sites had the ability to provide direct EHRs for most of their participants, although all sites were required to obtain medical and BH records from other institutions for at least some of their participants who obtained care outside their institution. Challenges of extracting EHR documentation of outcomes, particularly during the COVID-19 public health emergency, contributed to the large amount of missing data experienced by the study.

On average, across the 27 measures evaluated, ~20.7% of observations were missing at each time point. We used fully conditional specification to account for missingness. However, more complete data may have altered our results or resulted in some differences being significant where currently they are not.

Finally, we based our outcome evaluation on RWHAP definitions to develop estimates that would be comparable to participants in other RWHAP programs and provide actionable information for HRSA HAB. In many cases such as measures of retention in care, ART prescription, and viral load suppression, these definitions limited our study population to participants who received at least one routine HIV medical care visit in the last 12 months. Those who met this definition experienced statistically significant increases in retention in care and viral load suppression, two key performance measures of HIV medical care. Among all participants enrolled, these measures also improved, but the increase was not statistically significant.

This study highlights the critical needs of Black MSM with HIV and demonstrates that MOCs that emphasize identifying BH and SS needs and providing services to meet those needs can be effective in improving some BH, SS, and HIV medical care outcomes. Because this intervention occurred during the COVID-19 pandemic, it is difficult to generalize these findings to a nonpandemic environment. However, we would argue that the success achieved by these interventions during the pandemic is highly suggestive that these programs can be effective in a postemergency environment.

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(Appendix follows →)

Appendix

APPENDIX TABLE A1. DATA CLEANING AND MISSING DATA IMPUTATION ON VARIABLES

<i>Data cleaning</i>	
<i>Variable</i>	<i>Details</i>
HIV medical care visit dates	Swapped the date of the second to last routine HIV medical care visit to the date of the last routine HIV medical care visit where the date of the second to last routine HIV medical care visit was present, but the date of the last routine HIV medical care visit was absent, or where the date of the second to last routine HIV medical care visit was sooner than the date of last routine HIV medical care visit. When the dates of the last and second to last routine HIV medical care visits were the same, we considered these as only one visit. We counted services as single instead of multiple when one of the routine HIV medical care visits was on the same date as another routine HIV medical care visit (same day services).
Enrollment date	We set enrollment date equal to baseline when reported enrollment date was different for baseline, 6 months, or 12 months. We assigned enrollment date as the HIV diagnosis date when the HIV diagnosis date was after than enrollment date.
HIV diagnosis date	We assigned the earliest HIV diagnosis date to all time points when the HIV diagnosis date was not same across three data collection time points or was missing for one or two of the time points.
Behavioral Health (BH) and support services (SS) variables	We assigned BH and SS referral dates same as the first engagement date when referral dates were missing but engagement dates were present. We assigned BH and SS screening positive dates as the referral date if the screening positive dates were missing but the referral date was present. We assigned BH and SS screening dates as the screening positive date when screening dates were missing but screening positive dates were present. We counted services as single instead of multiple if one of the BH engagement dates was same as another BH engagement date (same day services).
Imputation steps	
After applying specific rules, we considered remaining missing data missing at random and imputed it using fully conditional specification multiple imputation resulting in 100 imputations. Five steps were taken to conduct the imputation.	
First, we conducted logical imputation and editing to impute baseline age and baseline diagnosis date. If baseline age was missing, a direct substitution from 6 months data was used to impute baseline age. If data at 6 months were also missing, 12 months minus 1 year was used for baseline age.	
We imposed an edit for variables related to screening, screening positive, referral to, and receipt of BH or SS, if achieving an outcome at a later stage of the hierarchy reset values at earlier stages of the hierarchy achieved. For example, if a participant received BH services but had missing data for screening, screened positive, and referral we assumed that the individual had achieved all these outcomes.	
Second, some of the measures have denominators other than the entire population. In this case, separate imputation was used before imputing outcomes for the subpopulations. We performed this imputation using fully conditional specification multiple imputation but with only one imputation. This was done to allow for the multiple imputations of the numerators of the measures.	
We completed imputation for the subpopulation that is part of the denominator and hence eligible for the numerator imputation for all measures which have specific denominators other than the study population. We imputed variables with a common denominator in the same step.	
Finally, we applied consistency edits to ensure consistency across variables. For instance, when there are both 6 month and 12-month look backs for the same measure, if the 6 month measure value was imputed as meeting the criteria for the measure, then the 12 month measure value was assigned to also be meeting the same criteria. Appendix Table A2 provides details on the variables imputed, the method of imputation, and the predictors used to impute each variable.	
Because of the dependencies between these values of BH and SS care cascade of screening, screening positive, referral, and receipt of BH services and SS (for example, we assumed that all persons who received BH services within the previous 12 months had also been screened, screened positive, and referred within the previous 12 months), we imputed these outcomes as four nominal values; (1) the level of BH services received at 6 months, (2) the level of SS received at 6 months, (3) the level of BH services received at 12 months, and the level of SS received at 12 months. We defined level as 0 if no services were received, 1 if only screening had occurred, 2 if a participant had been screened and screened positive, 3 if a participant had been screened, screened positive, and referred, and 4 if a participant had been screened, screened positive, referred, and received services. To impute each variable, we first applied data cleaning and adjustment described above and then assigned each of the four nominal variables above based on the complete case variables. We then imputed missing values of each variable.	

(Appendix continues →)

APPENDIX TABLE A2. FULLY CONDITIONAL SPECIFICATION IMPUTATION MODELS

<i>Measure</i>	<i>Time point</i>	<i>Imputation method</i>	<i>Predictors</i>
Awareness of HIV medical care	Baseline	Logistic	Receipt of 2 routine HIV medical care visits in the previous 12 months at baseline Age at baseline
	First follow-up	Logistic	Youth focused case management intervention indicator Receipt of 2 routine HIV medical care visits in the previous 12 months at first follow-up Age at baseline
	Second follow-up	Logistic	Youth focused case management intervention indicator Receipt of 2 routine HIV medical care visits in the previous 12 months at second follow-up Age at baseline
	Baseline	Logistic	Youth focused case management intervention indicator Awareness of behavioral health care at first follow-up Awareness of behavioral health care at second follow-up Total number of behavioral health visits in the last 12 months at baseline PHQ-8 Score at baseline Age at baseline Site
Awareness of BH care	First follow-up	Logistic	Awareness of behavioral health care at baseline Awareness of behavioral health care at second follow-up Total number of behavioral health visits in the last 12 months at first follow-up PHQ-8 Score at first follow-up Age at baseline Site
	Second follow-up	Logistic	Awareness of behavioral health care at baseline Awareness of behavioral health care at first follow-up Total number of behavioral health visits in the last 12 months at second follow-up PHQ-8 score at second follow-up Age at baseline Site

(continued)

APPENDIX TABLE A2. (CONTINUED)

<i>Measure</i>	<i>Time point</i>	<i>Imputation method</i>	<i>Predictors</i>
Awareness of support services	Baseline	Logistic	Awareness of support services at first follow-up Awareness of support services at second follow-up Self-reported substance use issue at baseline PHQ-8 score at baseline Age at baseline Site
	First follow-up	Logistic	Awareness of support services at baseline Awareness of support services at second follow-up Self-reported substance use issue at first follow-up PHQ-8 score at first follow-up Age at baseline Site
	Second follow-up	Logistic	Awareness of support services at baseline Awareness of support services at first follow-up Self-reported substance use issue at second follow-up PHQ-8 score at second follow-up Age at baseline Site
	Baseline	Logistic	Linkage to HIV medical care in the previous 3 months at first follow-up Linkage to HIV medical care in the previous 3 months at second follow-up Awareness of HIV medical care at baseline Age at baseline Site
	First follow-up	Logistic	Linkage to HIV medical care in the previous 3 months at baseline Linkage to HIV medical care in the previous 3 months at second follow-up Awareness of HIV medical care at first follow-up Age at baseline Site
	Second follow-up	Logistic	Linkage to HIV medical care in the previous 3 months at baseline Linkage to HIV medical care in the previous 3 months at first follow-up Awareness of HIV medical care at second follow-up Age at baseline Site

(continued)

APPENDIX TABLE A2. (CONTINUED)

<i>Measure</i>	<i>Time point</i>	<i>Imputation method</i>	<i>Predictors</i>
Linkage to HIV medical care in the previous 6 months	Baseline	Logistic	Linkage to HIV medical care in the previous 6 months at first follow-up Linkage to HIV medical care in the previous 6 months at second follow-up Awareness of HIV medical care at baseline Age at baseline Site
	First follow-up	Logistic	Linkage to HIV medical care in the previous 6 months at baseline Linkage to HIV medical care in the previous 6 months at second follow-up Awareness of HIV medical care at first follow-up Age at baseline Site
	Second follow-up	Logistic	Linkage to HIV medical care in the previous 6 months at baseline Linkage to HIV medical care in the previous 6 months at first follow-up Awareness of HIV medical care at second follow-up Age at baseline Site
	Baseline	Logistic	Age at baseline Youth focused case management intervention indicator
Linkage to HIV medical care in the previous 3 months among newly diagnosed ^a Receipt of 2 routine HIV medical care visits in the previous 12 months	Baseline	Logistic	Receipt of 2 routine HIV medical care at first follow-up Receipt of 2 routine HIV medical care at second follow-up Awareness of HIV medical care at baseline Linkage to HIV medical care in the previous 6 months at baseline Age at baseline Site
	First follow-up	Logistic	Receipt of 2 routine HIV medical care at baseline Receipt of 2 routine HIV medical care at second follow-up Awareness of HIV medical care at first follow-up Linkage to HIV medical care in the previous 6 months at first follow-up Age at baseline Site
	Second follow-up	Logistic	Receipt of 2 routine HIV medical care at baseline Receipt of 2 routine HIV medical care at first follow-up Awareness of HIV medical care at second follow-up Linkage to HIV medical care in the previous 6 months at second follow-up Age at baseline Site
	Baseline	Logistic	Age at baseline Youth focused case management intervention indicator

(continued)

APPENDIX TABLE A2. (CONTINUED)

<i>Measure</i>	<i>Time point</i>	<i>Imputation method</i>	<i>Predictors</i>
Behavioral care progression (screened, screened positive, referred, received) in the previous 6 months	Baseline	Cumulative logistic	Behavioral care progression (screened, screened positive, referred, received) in the previous 6 months at first follow-up Behavioral care progression (screened, screened positive, referred, received) in the previous 6 months at second follow-up Awareness of behavioral health care at baseline PHQ-8 score at baseline Age at baseline Youth focused case management intervention indicator
	First follow-up	Cumulative logistic	Behavioral care progression (screened, screened positive, referred, received) in the previous 6 months at baseline Behavioral care progression (screened, screened positive, referred, received) in the previous 6 months at second follow-up Awareness of behavioral health care at first follow-up PHQ-8 score at first follow-up Age at baseline Youth focused case management intervention indicator
	Second follow-up	Cumulative logistic	Behavioral care progression (screened, screened positive, referred, received) in the previous 6 months at baseline Behavioral care progression (screened, screened positive, referred, received) in the previous 6 months at first follow-up Awareness of behavioral health care at second follow-up PHQ-8 score at second follow-up Age at baseline Youth focused case management intervention indicator
	Baseline	Cumulative logistic	Behavioral care progression (screened, screened positive, referred, received) in the previous 12 months at first follow-up Behavioral care progression (screened, screened positive, referred, received) in the previous 12 months at second follow-up Awareness of behavioral health care at baseline PHQ-8 score at baseline Age at baseline Youth focused case management intervention indicator
	First follow-up	Cumulative logistic	Behavioral care progression (screened, screened positive, referred, received) in the previous 12 months at first follow-up Behavioral care progression (screened, screened positive, referred, received) in the previous 12 months at second follow-up Awareness of behavioral health care at baseline PHQ-8 score at baseline Age at baseline Youth focused case management intervention indicator
Behavioral care progression (screened, screened positive, referred, received) in the previous 12 months	Second follow-up	Cumulative logistic	Behavioral care progression (screened, screened positive, referred, received) in the previous 12 months at baseline Behavioral care progression (screened, screened positive, referred, received) in the previous 12 months at first follow-up Awareness of behavioral health care at second follow-up PHQ-8 score at second follow-up Age at baseline Youth focused case management intervention indicator

(continued)

APPENDIX TABLE A2. (CONTINUED)

<i>Measure</i>	<i>Time point</i>	<i>Imputation method</i>	<i>Predictors</i>
Support service care progression (screened, screened positive, referred, received) in the previous 6 months	Baseline	Cumulative logistic	Reported care team mentions support services in the last 12 months at baseline Age at baseline
	First follow-up	Cumulative logistic	Youth focused case management intervention indicator Reported care team mentions support services in the last 12 months at first follow-up Age at baseline
	Second follow-up	Cumulative logistic	Youth focused case management intervention indicator Reported care team mentions support services in the last 12 months at second follow-up Age at baseline
	Baseline	Cumulative logistic	Youth focused case management intervention indicator Reported care team mentions support services in the last 12 months at baseline Age at baseline
Support service care progression (screened, screened positive, referred, received) in the previous 12 months	First follow-up	Cumulative logistic	Youth focused case management intervention indicator Reported care team mentions support services in the last 12 months at first follow-up Age at baseline
	Second follow-up	Cumulative logistic	Youth focused case management intervention indicator Reported care team mentions support services in the last 12 months at baseline Age at baseline
	Baseline	Logistic	Receipt of 2 routine HIV medical care visits in the previous 12 months at baseline Age at baseline Site
	First follow-up	Logistic	Receipt of 2 routine HIV medical care visits in the previous 12 months at first follow-up Age at baseline Site
Receipt of ART prescription in the previous 6 months	Second follow-up	Logistic	Receipt of 2 routine HIV medical care visits in the previous 12 months at second follow-up Age at baseline Site
	Baseline	Logistic	Suppressed viral load in the previous 12 months at baseline Age at baseline Site
	First follow-up	Logistic	Suppressed viral load in the previous 12 months at first follow-up Age at baseline Site
	Second follow-up	Logistic	Suppressed viral load in the previous 12 months at second follow-up Age at baseline Site

(continued)

APPENDIX TABLE A2. (CONTINUED)

<i>Measure</i>	<i>Time point</i>	<i>Imputation method</i>	<i>Predictors</i>
Receipt of ART prescription in the previous 12 months	Baseline	Logistic	Receipt of 2 routine HIV medical care visits in the previous 12 months at baseline Age at baseline Site
	First follow-up	Logistic	Receipt of 2 routine HIV medical care visits in the previous 12 months at first follow-up Age at baseline Site
	Second follow-up	Logistic	Receipt of 2 routine HIV medical care visits in the previous 12 months at second follow-up Age at baseline Site
	Baseline	Logistic	Receipt of ART prescription in the previous 12 months at baseline Self-report of undetectable at last viral load test at baseline Age at baseline Site
Suppressed viral load in the previous 12 months	First follow-up	Logistic	Receipt of ART prescription in the previous 12 months at first follow-up Self-report of undetectable at last viral load test at first follow-up Age at baseline Site
	Second follow-up	Logistic	Receipt of ART prescription in the previous 12 months at second follow-up Self-report of undetectable at last viral load test at second follow-up Age at baseline Site
Age	Baseline	Predictive mean matching	Diagnosis date site
Self-reported substance use issue at first follow-up	Baseline	Cumulative logistic	Awareness of support services at baseline PHQ-8 Score at baseline Age at baseline
	First follow-up	Cumulative logistic	Youth focused case management intervention indicator Awareness of support services at baseline PHQ-8 Score at baseline Age at baseline
	Second follow-up	Cumulative logistic	Youth focused case management intervention indicator Awareness of support services at baseline PHQ-8 Score at baseline Age at baseline
			Youth focused case management intervention indicator

(continued)

APPENDIX TABLE A2. (CONTINUED)

<i>Measure</i>	<i>Time point</i>	<i>Imputation method</i>	<i>Predictors</i>
PHQ-8 score	Baseline	Predictive mean matching	PHQ-8 score at first follow-up
			PHQ-8 score at second follow-up
	First follow-up		Behavioral care progression (screened, screened positive, referred, received) in the previous 12 months at baseline
			Age at baseline
	Second follow-up	Predictive mean matching	PHQ-8 score at baseline
			PHQ-8 score at second follow-up
PHQ-8 score	Baseline	Predictive mean matching	Behavioral care progression (screened, screened positive, referred, received) in the previous 12 months at first follow-up
			Age at baseline
	First follow-up		PHQ-8 score at baseline
			PHQ-8 score at second follow-up
	Second follow-up	Predictive mean matching	Behavioral care progression (screened, screened positive, referred, received) in the previous 12 months at first follow-up
			Age at baseline

^aParticipants diagnosed within 12 months of enrollment.