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A Social Network Analysis of HIV Treatment Partners and Patient Viral Suppression in Botswana

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Abstract

Objective—Many national HIV guidelines recommend that healthcare providers encourage patients to identify a treatment partner from their social network to support antiretroviral therapy adherence. The present study examined associations of patient and treatment partner characteristics with patient viral suppression in Botswana.

Design—131 patients [67 (51.1%) virally suppressed, 64 (48.9%) not suppressed] and their treatment partners were recruited for cross-sectional interviews from one HIV clinic.

Methods—Participants completed surveys assessing social network, socio-demographic, and psychosocial characteristics. Open-ended questions explored treatment partner relationship quality.

Results—Multivariate logistic regressions indicated a higher likelihood of viral suppression among patients who reported greater average emotional closeness to their network members [OR (95% CI)=3.8(1.3–11.5), p=.02], and whose treatment partners were spouses/partners [OR (95% CI)=2.6 (1.0–6.7), p=.04]. Qualitative analyses indicated that treatment partners of suppressed patients provided both medical and non-medical support, whereas treatment partners of unsuppressed patients focused mainly on adherence reminders and appointment accompaniment. Treatment partners, especially of unsuppressed patients, requested ongoing training and counseling skills.

Conclusions—Additional research is needed to further explore effective characteristics of treatment partners, in order to inform HIV treatment guidelines. Standard training for treatment partners could include medical-related information as well as counseling education.

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Keywords

Adherence; Antiretroviral therapy; Botswana; Social support; Viral load

INTRODUCTION

Botswana has an HIV prevalence of 21.9% among those aged 15 to 49 years[1] and 90% of people living with HIV (PLWH) on treatment are virally suppressed.[2] To eradicate HIV and maximize individual health benefits of antiretroviral therapy (ART), innovative, scalable, and low-cost interventions are needed to improve adherence among the remaining individuals who are not suppressed.

Community-based interventions hold promise for supporting PLWH with adherence, especially in resource-limited settings.[3] One intervention used in at least 20 countries is treatment partners (aka treatment/adherence buddies/supporters), who tend to be trusted family members or friends selected by patients.[4–13] Treatment partners can motivate adherence and engagement in care, and accompany patients to appointments.[14] According to 2016 Botswana guidelines,[15] "Before initiating ART ensure…that adherence partners are present for psycho-social support." Although treatment partners are still strongly recommended, recent guidelines clarified that ART initiation should not be postponed for patients without a treatment partner. However, patients are given little guidance about treatment partner selection (aside from choosing someone to whom they have disclosed), and treatment partners are given little guidance about how to support patients.

Randomized controlled trials (RCTs) of treatment partners show mixed findings.[16–19] A network meta-analysis of global health studies indicated that enhanced standard of care (adherence education/counseling) plus a treatment partner had greater effects on viral suppression than standard of care plus a treatment partner, although the analysis conflated studies of patient-selected treatment partners with studies of clinic-based volunteers or employees.[20] Two RCTs in sub-Saharan Africa, including an 8-country RCT that included Botswana, found non-significant effects on viral suppression for treatment partners trained on directly observed medication-taking (vs. untrained treatment partners).[17,21] Another RCT of treatment partners trained in adherence promotion found effects on adherence (although viral suppression was not assessed).[22] In an RCT in Nigeria, a higher percentage of patients who selected treatment partners vs. in standard-of-care reported improved adherence, but not long-term viral suppression.[23] Given known strong effects of social support on adherence,[24] mixed results may be due to moderating factors related to patient characteristics, treatment partner type, quality of support, and lack of guidelines regarding treatment partner selection and responsibilities.

Non-randomized studies have found better health and psychosocial outcomes for patients with treatment partners, and have helped to outline conditions under which treatment partners may be effective.[25–29] A study in South Africa found that patients who selected treatment partners perceived lower stigma over time.[30] Other research suggests that patients with both treatment partners and trained peer supporters (e.g., who perform directly observed adherence, home visits, and/or appointment accompaniment) have better outcomes

(e.g., improved self-reported adherence and mental health) than those with a treatment partner only.[25,31] Qualitative research in Uganda and South Africa further suggests that effective treatment partners provide material, emotional, and instrumental support, instill a sense of reciprocity (e.g., are also HIV+), and strengthen social connectedness.[32–34]

Programs that use treatment partners necessarily leverage patients' social networks, requiring that patients select someone in their social circle with whom they have a close relationship. Research shows that social networks affect health behaviors and outcomes, including adherence, in part via social support provision.[24,35–38] Moreover, close relationships have larger or similar effects on risk for mortality as compared to smoking, high body mass index, and low physical activity.[39] Thus, we examined treatment partners from a social network perspective, and in the context of social psychological literature on close relationships,[40] in terms of characteristics of patients and treatment partners, and patient-treatment partner relationships, associated with patient viral suppression.

METHODS

Setting

Participants were recruited from the Princess Marina Hospital-Infectious Disease Care Clinic, the largest HIV clinic in Gaborone, Botswana. The clinic has almost 7,000 patients (~60% women), and 80–100 patients visit daily.

Community Engagement

The team engaged with the community advisory board (CAB) of the research institute that was the main study site. The CAB, which is composed of key stakeholders, including PLWH, considers community issues relevant to project implementation and participant needs. The CAB provided input on the protocol and project design, interpretation of results, and implications for policy and future research.

Participants

Patients were eligible if they (1) were 18 years of age or older; (2) on ART and initiated ART at least 6 months before enrollment; and (3) had a treatment partner whom they were willing to refer to the study. Treatment partners were eligible if they (1) were at least 18 years-old; and (2) selected to be the treatment partner of a patient participant.

Using a case-controlled design, our goal was to purposively select half of the patient sample to be virally suppressed (viral load <400 cp/ml within prior 6 months at enrollment) and half unsuppressed (≥2 documented viral loads ≥400 cp/ml within prior 6 months). Viral load and time from ART initiation were confirmed with clinic records.

Recruitment

Each week, a clinic nurse checked medical records of patients who had appointments for potential eligibility. When potentially eligible patients arrived at the clinic, the nurse approached them for screening and invited eligible patients to return with their treatment partner.

Assessment

Patients and treatment partners participated in separate one-time interviews to assess individual-level and social network characteristics. The interviewer used EgoWeb 2.0 [41] to guide participants through the 2-hour assessment, which was conducted in Setswana. Participants received 40 pula (~US$5).

Individual-level Characteristics—The survey assessed socio-demographic characteristics (age, gender, marital status, education level, employment status, monthly income), number of years since diagnosis, and known correlates of ART adherence (a strong predictor of viral suppression), including depression (PHQ-9[42]), internalized HIV stigma (6-item Internalized AIDS-Related Stigma Scale, 1=strongly disagree to 6=strongly agree; α=.68[43]), perceived HIV discrimination (sum of 5 items assessing frequency of different types of discrimination, dichotomized as "never vs. "ever"; e.g., frequency of being gossiped about[44]), problem alcohol use,[45] and perceived barriers to care (sum of 9 items assessing agreement with different barriers, e.g., transportation issues; dichotomized as "somewhat or strongly agree" vs. "somewhat or strongly disagree").

Social Network Characteristics—We used personal network methods,[46–48] which have been shown to be reliable for capturing real-world variability of most network structure and composition characteristics,[49] and valid for capturing basic network member characteristics.[50] In the Alter (i.e., social network member) Elicitation Section, participants listed initials of 20 people with whom they were in contact in the past year (e.g., phone, in-person), starting with those most important to them. To assess Network Structure, participants indicated how often they thought each pair of alters interacted (0=never, 1=almost never, 2=sometimes, 3=always/almost always). In the Network Composition Section, for each alter, participants provided socio-demographic information (e.g., age); relationship to participant (e.g., spouse); ratings of closeness and trust (0=not at all to 2=very); and whether the patient had disclosed their serostatus to the alter.

Because social support is a strong predictor of adherence,[24] we asked participants to report the extent to which each alter was likely to provide emotional, informational, affectionate, and instrumental support using four items from the MOS social support scale,[51] with responses 0=not likely, 1=somewhat likely, and 2=very likely (α=.66). HIV discrimination was assessed with the sum of 6 yes/no items asking whether each alter expressed stigmatizing attitudes or showed discrimination (e.g., asked them to use separate plates/utensils).[52]

Network Variables—We derived network density, a structural measure, as percentage of existing ties relative to total number of possible ties.[53] Network composition indicators included network member characteristics (e.g., proportion of women).

Statistical Analysis

After examining descriptive statistics, we conducted bivariate logistic regressions predicting viral suppression with patient and treatment partner individual-level variables, and social network-level variables. Because of the large number of potential predictors (and inadequate

statistical power to examine all simultaneously), we examined variables in three separate conceptually distinct sets, conducting multivariate logistic regressions predicting viral suppression with (1) patient individual-level variables; (2) treatment partner individual-level variables; and (3) social network-level variables at least marginally significant in the bivariate models (at $p<0.10$). We then conducted a fourth regression that included all significant variables (at $p<0.10$) not highly correlated with each other (at $r>\pm0.50$) from the first three regressions. Our analysis assumed each dyad was independent and each patient was associated with a unique social network.[54] Patients' and treatment partners' data were linked using unique dyadic identification numbers.

Because research suggests that men may react more negatively than women to spouses' attempts to control their illness management,[40] we additionally tested whether gender moderated the effects of having a spouse/partner as a treatment partner; the interaction term was not significant ($p>0.10$) and thus will not be discussed further.

Our analysis sample was designed such that half of those recruited would be virally suppressed, but in Botswana, 90% of PLWH on ART are suppressed.[2] Thus, as a sensitivity analysis, we repeated bivariate regressions using post-stratification weights to account for the sample's underrepresentation of suppressed patients. Suppressed patients were assigned a weight equal to (population mean)/(sample mean), and unsuppressed patients were assigned a weight of (1–population mean)/(1–sample mean).[55] Furthermore, because our main outcome was viral suppression at one point in time, we repeated the bivariate regressions using long-term viral suppression (past-four measurements) as another sensitivity analysis.

Qualitative Component and Analysis

After the quantitative assessment, the interviewer used EgoWeb's network visualization capabilities to create a network diagram and recorded responses to open-ended questions about the diagram. Figure 1 displays two network diagrams from the sample, one of a virally unsuppressed patient (Figure 1a), and the other of a virally suppressed patient (Figure 1b). To ensure that the diagrams were representative of each subgroup, we selected participants whose characteristics were closest to the subgroup mean (within 1 SD) on key individual socio-demographic and network-level variables (listed in Table 1). Each node represents a network member and each line means that the two network members know each other; more lines represent greater interconnections between members. Treatment partners are triangles. Females are represented in grey, and males in white. Larger circles represent greater emotional closeness, showing that the suppressed patient reported greater average closeness to network members than did the unsuppressed patient.

Patients were asked to focus on the treatment partner in their network diagram and describe how the treatment partner supported them. Treatment partners were asked to focus on the patient in their network diagram and describe how they supported the patient; they also were asked their opinion about the kinds of training treatment partners need. The interviewer used probes and open-ended questions to avoid biasing answers and allow for new topic exploration.[56–58] Because responses were brief, the interviewer was able to transcribe responses verbatim into EgoWeb during the interview.

Two team members developed a codebook by reviewing open-ended responses and writing up summary notes.[59] They then marked areas of text pertaining to codes capturing types of support provided (adherence support, medical appointment support, non-medical support), from the patient and treatment partner perspective, and suggestions for treatment partner training (treatment/adherence education, basic HIV knowledge, counseling skills). Coder consistency across responses was good (Cohen's Kappa mean across codes=.87; Range=.69–1.0).[60] Responses were used in this mixed-methods analysis to complement our quantitative results, by helping to explain why some treatment partners might have been more effective than others.[61]

RESULTS

Participants

Using convenience sampling, 465 potentially eligible patients (adults who had been on ART >6 months) were screened, and of those, 141 patients were enrolled. Although data were not systematically collected on the number of eligible and ineligible patients screened, patients screened as ineligible primarily because they were unable to visit the clinic with their treatment partner for the interview (e.g., they were not in contact with their treatment partner, or their treatment partner was unavailable). All 141 of enrolled patients' treatment partners were offered participation; ten did not show up for the scheduled interview, despite multiple attempts at contact. Thus, the present analysis includes only the 131 patients whose treatment partners participated.

Table 1 shows participants' socio-demographic and social network characteristics. Patients and treatment partners had similar characteristics: they were almost 40 years-old on average, about a quarter had low education, and about 10% were low income. Patients were significantly less likely to be female ($p<.01$) and married/cohabitating ($p<.01$) than treatment partners. Patients were diagnosed with HIV over 10 years prior on average. About half of patients selected a family member as their treatment partner, 37% selected a spouse/partner, and 19% considered their treatment partner to be a friend (because the categories were not mutually exclusive, the percentages add up to >100%). Half of treatment partners were HIV-positive. By design, about half of patients (51.1%) were virally suppressed.

Bivariate and Multivariate Correlates of Viral Suppression

Individual-Level Patient Predictors—In bivariate tests, patients were more likely to be suppressed if they were older, male, married/cohabitating with a partner, and employed; endorsed fewer barriers to care; and did not report discrimination (Table 2). In the multivariate model, being older and male remained significantly related to suppression.

Individual-Level Treatment Partner Predictors—In bivariate analyses, patients were more likely to be suppressed if their treatment partner was a spouse/intimate partner and not another family member, and HIV-positive (Table 2). In the multivariate model, only one variable remained significant: patients whose treatment partners were spouses/intimate partners were more likely to be suppressed.

Social Network-Level Predictors—Patients were more likely to be suppressed if their alters were older on average, if they had a higher percentage of alters who were male, and if they felt closer emotionally to and had more trust in alters on average (Table 2). In the multivariate model, older age was marginally significant, and percentage of male alters and average alter closeness remained significant.

Final Multivariate Model: Individual- and Social Network-Level Predictors of Viral Suppression—The multivariate model combining all significant and marginally significant ($p<0.10$) predictors from the individual- and network-level models indicated that patients were more likely to be virally suppressed if they had a treatment partner who was a spouse/intimate partner and if they felt emotionally close to their alters on average (Table 3).

Sensitivity Analyses—Results of the sensitivity analyses (weighted regressions and regressions predicting long-term viral suppression) were similar in terms of the effect sizes and significance levels of the unweighted bivariate tests.

Qualitative Analysis—Table 4 shows example quotes for coding categories related to treatment partner support and training. Both patients and treatment partners discussed ways in which treatment partners supported patients, through adherence and medical appointment support, and nonmedical support. Adherence support most often included reminders to take medications, picking up refills, bringing medications to patients, and appointment accompaniment.

Of patients who reported receiving non-medical support from their treatment partner, 69% were suppressed and only 31% were unsuppressed. Treatment partners of unsuppressed patients tended to focus more narrowly on medication reminders, appointment reminders, and accompaniment, whereas treatment partners of suppressed patients tended to provide more in-depth adherence support (e.g., dropping off medications) as well as broadly supporting patients to stay healthy in non-medical ways not directly tied to medications. For example, treatment partners of suppressed patients were more likely to prepare food, bathe patients, and proactively attend to patients' needs so that patients were healthy overall. They reminded patients to eat healthy, to exercise, and not to use alcohol or drugs; they also provided general emotional support and acceptance, to motivate adherence. Few treatment partners of unsuppressed patients mentioned supporting patients for non-medical needs, and those who did tended to help with food-related needs directly related to medication-taking (e.g., reminders to eat in conjunction with medication-taking), rather than taking a broader focus on overall health (see "Non-Medical Support" quotes in Table 4).

Treatment partners of both suppressed and unsuppressed patients requested ongoing training on basic HIV knowledge and medication side effects, as well as counseling skills education to help them to be patient, motivate patients, and provide emotional support. However, a higher percentage of treatment partners of unsuppressed patients (50%) than treatment partners of suppressed patients (37%) requested counseling skills training.

DISCUSSION

The present study indicates that characteristics of patients' social networks and of the patient-treatment partner relationship are significantly associated with viral suppression, controlling for patient and treatment partner individual-level characteristics. Patients who selected spouses or other intimate partners, and who trusted and felt close to their social network members as a whole were more likely to show viral suppression. Our results are consistent with the large body of work showing robust effects of social support on health and mortality.[39] By taking a social network approach, our results extend prior research on treatment partners that have taken an individual-level patient perspective.[11,32–34]

Our qualitative results elucidated some reasons why treatment partners vary in effectiveness. We found that treatment partners of patients who are virally suppressed support patients beyond their adherence needs, providing more than adherence and appointment reminders, to consider patients' overall health and wellbeing. These results are consistent with prior research on diabetes adherence showing that adherence increases if spouses' daily adherence reminders are supportive (e.g., show appreciation and understanding), but decreases if spouses' daily adherence reminders are used as an attempt to control patients' behavior (e.g., pressuring patients to adhere).[62] Similarly, a study in Uganda found that HIV treatment partners who interacted with patients daily (after receiving SMS notifications about patients' nonadherence) were perceived to be unsupportive and overbearing.[63] Thus, in the present study, treatment partners who took a holistic approach to supporting patients could have been perceived to be more caring, which in turn motivated adherence. Alternately, treatment partners with a narrow focus on adherence may have been perceived negatively, as attempting to persuade patients without fully recognizing their life context and challenges to adherence.

Prior research on close relationships sheds light on why spouses may be more effective treatment partners. Close relationships may improve illness management to the extent that the illness is appraised by both members of the dyad to be shared or communal, in which both members of the couple take responsibility for illness management.[40] In the present study, spouses may have been more likely than other types of treatment partners to view patients' HIV as a shared stressor and to feel interdependent on patients, as the patients' survival may have been tied to their families' (and potentially children's) survival.

Our research not only has relevance for HIV, but also for other conditions requiring strict adherence that may benefit from treatment partners. Treatment partners with whom patients are in close and trusted relationships, and who interact with the patient frequently, are likely to be effective for improving health outcomes. Treatment partners who are in close relationships with patients have frequent opportunities to observe patients and provide comfort, security, and tangible support in anticipation of patients' needs, rather than waiting for patients to request support directly, or simply pressuring patients to adhere without attending to other needs. Although our results indicated that spouses were particularly helpful, not all patients have spouses. However, treatment partners, regardless of whether they are spouses, can be trained on non-confrontational counseling skills (such as

motivational interviewing[64]) and made aware that support that is perceived to be badgering is ineffective and could lead to non-adherence.

Our research is limited by the cross-sectional design and correlational analysis. Although we surmise that, consistent with prior research,[39] higher quality social relationships led to viral suppression in the present study, it is possible that patients were more able to develop close relationships because they were feeling healthier. Moreover, our study was conducted in one large urban clinic in one high prevalence country, limiting generalizability. Cultural factors, such as gender and relationship norms, may have influenced the results, possibly explaining why another study (in Kenya) found significant effects for patient gender and non-significant effects for spouses as treatment partners.[65] In addition, we could not independently validate that the treatment partner participants were patients' originally selected treatment partners. We also did not audio-record participants' responses to open-ended survey questions and thus could not check accuracy. Further, our results could have been biased by only recruiting patients who could bring their treatment partners to the interview. Patients who were not willing or able to bring their treatment partner may have had less a supportive treatment partner and been getting support from social network members other than their selected treatment partner; interviewing this group would have enabled additional insights about treatment partner support and viral suppression in the context of the overall social network. In addition, our research may have less relevance for newly diagnosed patients in the era of test-and-treat, as they may not have time to disclose their serostatus prior to ART initiation, and thus may have limited options for selecting treatment partners.

In sum, the present study indicates that social network factors may moderate the effects of treatment partners on health, including the quality and type of the patient-treatment partner relationship, and the level of trust and closeness that patients have with treatment partners and other network members. Moreover, treatment partners need a basic level of training that includes not only fundamental education about treatment (i.e., information about treatment, adherence and side effects), but also counseling skills education. Given that many countries globally have treatment guidelines recommending patient selection of treatment partners, strengthening treatment partner selection and training could have wide-reaching impact.

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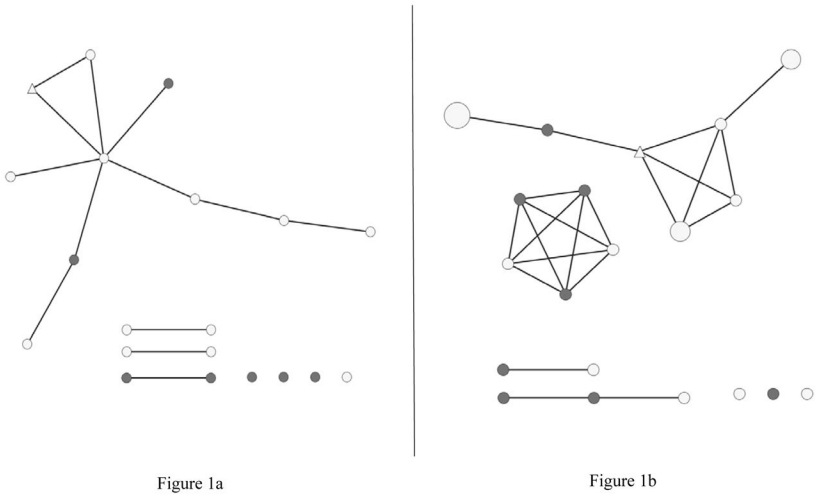

Figure 1.

Examples of Participant Social Network Diagrams. Figure 1a shows the diagram of a patient who is not virally suppressed and Figure 1b shows the diagram of a patient who is virally suppressed. Note that patients themselves are not depicted in the diagrams.

Table 1

Characteristics of the Patient and Treatment Partner Samples

	Overall (n = 262)	Patients (n = 131)	Treatment Partners (n = 131)	p-value for within-dyad difference [a]
Socio-Demographic Characteristics				
Age M (SD)	39.7 (10.6)	40.0 (9.5)	39.5 (11.5)	0.68
Female %	66.0	57.3	74.8	0.01
Married/cohabitating %	44.3	38.2	50.4	0.003
≤Primary education %	26.0	26.7	25.2	0.77
Not working %	26.7	28.2	25.2	0.38
<500 pula monthly %	9.5	11.5	7.6	0.28
Medical Characteristics				
HIV-positive	75.6	100.0	50.4	_____
Virally suppressed %	_____	51.1	_____	_____
Years since HIV diagnosis M (SD)	_____	10.4 (4.0)	_____	_____
# Barriers to care M (SD)	_____	1.1 (1.3)	_____	_____
Psychosocial Characteristics				
Any discrimination %	_____	31.3	_____	_____
Internalized stigma M (SD)	_____	2.4 (0.8)	_____	_____
Problem alcohol use %	_____	29.8	_____	_____
Depression M (SD)	_____	1.2 (1.9)	_____	_____
Treatment Partner Relationship				
Spouse/Intimate Partner %	_____	37.4	_____	_____
Family %	_____	50.4	_____	_____
Friend %	_____	19.1	_____	_____
Closeness to patient M (SD)	_____	1.4 (0.8)	_____	_____
Trust from patient M (SD)	_____	1.7 (0.6)	_____	_____
Patient Social Network Characteristics				
Average alter age M (SD)	_____	37.8 (5.9)	_____	_____
Proportion female M (SD)	_____	0.5 (0.2)	_____	_____
Proportion family members M (SD)	_____	0.3 (0.2)	_____	_____
Proportion known HIV-positive M (SD)	_____	0.9 (0.2)	_____	_____
Proportion to whom patient disclosed HIV-status M(SD)	_____	0.5 (0.3)	_____	_____
Average closeness with alters M(SD)	_____	0.4 (0.4)	_____	_____
Average trust in alters M (SD)	_____	0.6 (0.4)	_____	_____
Average social support from alters M (SD)	_____	0.4 (0.2)	_____	_____
Average stigma from alters M (SD)	_____	0.05 (0.2)	_____	_____
Density M (SD)	_____	0.2 (0.2)	_____	_____

[a] McNemar's test for dichotomous characteristics or paired t-test for continuous characteristics.

Table 2

Bivariate and Multivariate Logistic Regressions Predicting Viral Suppression with Individual-Level Variables

	Bivariate		Multivariate	
Individual-Level Variable Regressions	**Odds Ratio (95% Confidence Interval)**	**p-value**	**Odds Ratio (95% Confidence Interval)**	**p-value**
Older Age	1.06 (1.02–1.11)	0.003	1.05 (1.00–1.10)	0.047
Female	0.26 (0.12–0.54)	0.0003	0.42 (0.18–0.97)	0.04
Married/Cohabitating	2.34 (1.13–4.83)	0.02	1.25 (0.54–2.92)	0.60
Education (≤Primary)	1.92 (0.87–4.24)	0.11		
Working	2.94 (1.32–6.55)	0.01	1.69 (0.68–4.20)	0.26
Income (<500 pula/mo)	0.44 (0.14–1.35)	0.15		
Years since HIV Diagnosis	1.07 (0.98–1.17)	0.14		
# Barriers to care	0.76 (0.57–1.02)	0.07	0.90 (0.65–1.24)	0.53
Any discrimination	0.42 (0.20–0.90)	0.03	0.55 (0.23–1.35)	0.19
Internalized stigma	0.87 (0.55–1.37)	0.54	---	---
Problem alcohol use	1.57 (0.73–3.35)	0.24	---	---
Depression	1.00 (0.84–1.19)	0.99	---	---
Treatment Partner Variable Regressions				
Age [a]	1.03 (1.00–1.06)	0.098	1.02 (0.99–1.05)	0.24
Female gender [a]	0.83 (0.38–1.84)	0.65	---	---
Family member [b]	0.33 (0.16–0.68)	0.003	---	---
Friend	0.86 (0.36–2.05)	0.73		
Spouse/Partner	4.56 (2.10–9.89)	0.0001	4.08 (1.84–9.03)	0.0005
HIV-positive [a]	2.53 (1.24–5.18)	0.01	1.80 (0.82–3.92)	0.14
Closeness to patient	1.10 (0.72–1.67)	0.67	---	---
Trust from patient	0.97 (0.56–1.70)	0.92	---	---
Social Network-Level Variable Regressions				
Patient Social Network Composition				
Average alter age	1.07 (1.01–1.14)	0.03	1.06 (0.99–1.13)	0.08
Proportion female	0.04 (0.00–0.30)	0.002	0.05 (0.01–0.42)	0.01
Proportion family members	0.21 (0.03–1.80)	0.16	---	---
Proportion known HIV-positive	0.39 (0.05–2.73)	0.34	---	---
Proportion to whom patient disclosed HIV-status	0.45 (0.13–1.54)	0.20	---	---
Average closeness with alters	3.36 (1.19–9.54)	0.02	3.35 (1.09–10.23)	0.03
Average trust in alters [c]	3.31 (1.38–7.96)	0.01	---	---
Average social support from alters	1.29 (0.32–5.18)	0.72	---	---
Average stigma from alters	0.66 (0.10–4.33)	0.67	---	---
Patient Network Structure: Density	0.83 (0.11–6.12)	0.86	---	---

[a]These measures were self-reported by the treatment partner. All other treatment partner characteristics were reported by the patient when describing the treatment partner.

[b] Because “family member” was highly negatively correlated with “spouse/partner” (r=−.78, p<.0.0001), it was not included in the multivariate model.

[c] Trust was not included in the multivariate model because it was highly correlated with closeness (r=0.50, p<0.0001). When average trust with alters was substituted for average closeness, OR (95%CI)=2.96 (1.21–7.24), p=0.02.

Table 3

Final Multivariate Logistic Regression Predicting Viral Suppression with Patient Characteristics, Patient Network Composition and Structure, and Treatment Partner Characteristics

	OR (95% CI)	p-value
Patient Characteristics		
Older age	1.06 (0.99–1.13)	0.11
Female	0.58 (0.16–2.04)	0.40
Treatment Partner Characteristics		
Treatment partner is spouse/partner	2.63 (1.03–6.69)	0.04
Patient Network Composition and Structure		
Average alter age	0.98 (0.89–1.09)	0.76
Percentage female	0.37 (0.02–8.77)	0.54
Average closeness with alters	3.81 (1.26–11.52)	0.02

Note: When average trust with alters was substituted for average closeness, OR (95%CI)=3.07 (1.20–7.87), p=0.02.

Table 4

Coding Categories, Coder Consistency, and Example Quotes for Open-Ended Responses

Coding Category	Kappa	Example Quote – Patient Not Suppressed	Example Quote – Patient Suppressed
Treatment Partner Support (Patient Report): *What does your treatment partner do to support your HIV care and adherence?*			
Adherence Support (reminders, encouragement)	0.79	She reminds me to take medications all the time (female, 20 years, treatment partner is family)	He sometimes collects my medication from the hospital for me. He always calls me to remind me to take medications. (female, 46 years, treatment partner is spouse/partner
Medical Appointment Support (reminders, accompaniment)	1.0	She reminds me to take medications when its time and sometimes reminds me of my medical appointments (female, 41 years, treatment partner is friend) [a]	She motivated to test for HIV to start medication and she also assist me with my medical appointments. (male, 66 years, treatment partner is family)
Non-Medical Support (e.g., food, bathing, encouragement to live a healthy lifestyle)	0.97	She makes sure I take medication on a full stomach and when I do not have food at times she buys for me (female, 41 years, treatment partner is family)	She reminds me of taking medications she prepares food and water every morning for me to eat healthy lunch. She always motivates me to exercise (female, 42 years, treatment partner is family and friend) [b]
Treatment Partner Support (Treatment Partner Report): *What do you do to support [initials] in their HIV care and adherence?*			
Adherence Support (reminders, encouragement)	0.69	I went with her to the clinic before she started on treatment for counseling. When she told me that doctors are complaining about her results which are not pleasing I came with her for adherence counseling to hear what could be the problem and she disclosed to me that pastors at her church asked her to stop taking ARVs because she is cured. I emphasized the importance of adhering to her medications. (male, 51 years, patient is family) [a]	Last month I took him medications from the clinic when he was at the cattle post so that he will not miss his doses (male, 33 years, patient is family)
Medical Appointment Support (reminders, accompaniment)	1.0	About five months back she was not adherent… because she was drinking Black Magic Herbal Coffee which could not work because since December her viral load is high. I came with her to the clinic and informed the nurses who counseled both of us about the dangers of non-adherence. (female, 29 years, patient is family)	I make sure he takes treatment on time and always remind him of his check-up dates. sometimes I accompany him to the doctor. (female, 43 years, patient is spouse/partner) [a]
Non-Medical Support (e.g., food, bathing, encouragement to live a healthy lifestyle)	0.79	I accompany her for medical check-up. I ensure that she eats a balanced meal and that she takes her medication on time. (female, 21 years, patient is family) [c]	I advise him to stop things like drinking alcohol and smoking. He was not adherent at one time I told him that his viral load will go up. Two years back he was not adherent due to alcohol abuse I reported him to the doctor that he drinks too much alcohol and forget to take his medications. (female, 46 years, patient is spouse/partner)
Treatment Partner Training Suggestions: *To what extent did you feel prepared to be a treatment partner? What kinds of training or skills do you think that treatment partners need to be effective?*			
Medication-related Education (e.g., about side effects)	0.93	I think we need trainings on the side effects of medication and what should be done when experienced (male, 50 years, patient is spouse/ partner)	I did not get any guidance because by the time I met her she was already on ARVs. I think we need to be trained on side effects of medications how ARVs work and also patients need to be asked if they changed treatment partners so that new treatment partners can also be trained. (male, 42 years, patient is spouse/partner and friend)
Basic HIV Knowledge	0.87	I think I need to continue learning about HIV/AIDS and how to care for our patients (male, 28 years, patient is family)	To be taught about CD4 Counts and Viral load to always check medical cards [which show lab values] for their patients (female, 19 years, patient is family) (016_2)
Counseling Skills	0.77	We should be given counseling skills so that we can help our relatives who are on treatment and also be taught patience skills so that we can	We need to be taught patience, love, and counseling skills. (female, 48 years, patient is family)

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Coding Category	Kappa	Example Quote – Patient Not Suppressed	Example Quote – Patient Suppressed
		exercise patience towards our patients. (male, 57 years, patient is family and friend)	

[a] double-coded (adherence and appointment support);

[b] double-coded (adherence and non-medical support);

[c] triple-coded (adherence, appointment, and non-medical support)