

Improved Retention Associated With Community-Based Accompaniment for Antiretroviral Therapy Delivery in Rural Rwanda

Molly F. Franke,^{1,3} Felix Kaigamba,² Adrienne R. Socci,³ Massudi Hakizamungu,³ Anita Patel,³ Emmanuel Bagiruwigize,² Peter Niyigena,³ Kelly D. C. Walker,³ Henry Epino,^{3,5,6} Agnes Binagwaho,^{1,4} Joia Mukherjee,^{1,3,5} Paul E. Farmer,^{1,3,5} and Michael L. Rich^{3,5}

¹Department of Global Health and Social Medicine, Harvard Medical School, Boston, Massachusetts; ²Ruhengeri Hospital, Rwanda Ministry of Health, Ruhengeri, ³Partners In Health/Inshuti Mu Buzima, Rwinkwavu, and ⁴Ministry of Health of Rwanda, Kigali, Rwanda; ⁵Division of Global Health Equity, Brigham and Women's Hospital, and ⁶Department of Emergency Medicine, Massachusetts General Hospital, Boston

Background. Minimizing death and ensuring high retention and good adherence remain ongoing challenges for human immunodeficiency virus (HIV) treatment programs. We examined whether the addition of community-based accompaniment (characterized by daily home visits from a community health worker, directly observed treatment, nutritional support, transportation stipends, and other support as needed) to the Rwanda national model for antiretroviral therapy (ART) delivery would improve retention in care, viral load suppression, and change in CD4 count, relative to the national model alone.

Methods. We conducted a prospective observational cohort study among 610 HIV-infected adults initiating ART in 1 of 2 programs in rural Rwanda. Psychosocial and clinical characteristics were recorded at ART initiation. Death, treatment retention, and plasma viral load were assessed at 1 year. CD4 count was evaluated at 6-month intervals. Multivariable regression models were used to adjust for baseline differences between the 2 populations.

Results. Eighty-five percent and 79% of participants in the community-based and clinic-based programs, respectively, were retained with viral load suppression at 1 year. After adjusting for CD4 count, depression, physical health quality of life, and food insecurity, community-based accompaniment was protective against death or loss to follow-up during the first year of ART (hazard ratio, 0.17; 95% confidence interval [CI], .09–.35; $P < .0001$). In a second multivariable analysis, individuals receiving accompaniment were more likely to be retained with a suppressed viral load at 1 year (risk ratio: 1.15; 95% CI, 1.03–1.27; $P = .01$).

Conclusions. These findings indicate that community-based accompaniment is effective in improving retention, when added to a clinic-based program with fewer patient support mechanisms.

Keywords. retention; community health workers; nutrition; Africa; HIV.

An estimated 6.6 million individuals were receiving antiretroviral therapy (ART) in low- and middle-income

countries at the end of 2010 [1]. For these individuals, adherence to therapy (ie, the ingestion of medications as prescribed) and retention in treatment (ie, remaining on treatment without interruption) are critical in achieving the maximum clinical and virologic effect. Maximizing retention and adherence remain ongoing challenges for HIV programs. Commonly reported risk factors for suboptimal adherence, unsuppressed viral load, and low retention include financial barriers (lack of money for transport, food insecurity) [2–4], educational barriers (lack of education or comprehension

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Correspondence: Molly F. Franke, ScD, Department of Global Health and Social Medicine, Harvard Medical School, 641 Huntington Ave, Boston, MA, 02115 (molly_franke@hms.harvard.edu).

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regarding HIV medications) [5], and psychosocial conditions (depression, a lack of social support, stigmatization) [2, 6–10]. Overcoming adherence and retention barriers may be especially challenging in rural settings with high levels of poverty and where individuals must travel long distances to reach health-care facilities. Similarly, effective health education may require more frequent interaction with healthcare professionals in rural settings, where literacy rates tend to be lower than in urban areas.

Differences in ART delivery strategy may at least partially explain the heterogeneous retention rates observed across programs [11, 12]. Treatment strategies that include interventions designed to remove social and/or economic obstacles to care have been associated with improved ART adherence and HIV-related health outcomes [13, 14]. However, few reports have examined the combined influence of a comprehensive package of supports that simultaneously intervene on multiple barriers to adherence and retention. We conducted a prospective observational cohort study to examine whether the addition of “community-based accompaniment,” which included social support and once-daily home-based directly observed ART from a community health worker (CHW), nutritional support, transportation stipends, and as-needed socioeconomic support [15–17], when added to the Rwanda national model for ART delivery, would improve viral load suppression (through improved daily adherence to regimens), retention in care, and CD4 count increase at 1 year.

METHODS

Ethics Statement

This study was approved by the Partners Human Research Committee (Boston, Massachusetts) and the Rwanda National Ethics Committee (Kigali, Rwanda).

Study Setting

This study was conducted in 2 rural regions in southeastern and northern Rwanda. The Rwanda Ministry of Health (MOH), in collaboration with Partners In Health, implemented ART according to national program guidelines in combination with community-based accompaniment at select sites in southeastern Rwanda (Kayonza/Kirehe districts) in 2005. We selected comparison ART sites in Musanze district, where Rwanda MOH has provided clinic-based ART according to national program guidelines since 2004. This region was chosen for comparison because it was considered to have a well-functioning governmental ART program but lacked a nongovernmental organization implementation partner adding additional support for ART delivery. In both study regions, ART was provided first through a district hospital and

then decentralized to smaller satellite clinics. Each district hospital has a laboratory and is located 2 hours by car from the capital city of Kigali. The Global Fund to Fight AIDS, Tuberculosis and Malaria provided financial support to the health centers included in the study. The general success of both Rwanda’s national ART program and the community-based accompaniment intervention has been reported in large cohorts [17, 18].

Study Population

We enrolled individuals from 5 health centers in Kayonza/Kirehe districts where the community-based accompaniment model was implemented, and 4 health centers in Musanze district that provided clinic-based care. We consecutively enrolled consenting HIV-infected, treatment-naive adults (≥ 21 years) with a CD4 count < 350 cells/ μL who initiated ART at one of the study sites from June 2007 to August 2008. Study enrollment took place over the same time period at each site. Participants were eligible if they were residents of 1 of the 2 catchment areas, planned to reside in that area for at least 1 year, and had not previously initiated lifelong ART.

Standard of Care in the National ART Program

ART was provided free of charge to individuals who met Rwanda MOH eligibility criteria using a clinic-based model of delivery. The first-line ART regimen for HIV-infected individuals consisted of stavudine or zidovudine, lamivudine, and nevirapine. Efavirenz replaced nevirapine in individuals on tuberculosis treatment. Co-trimoxazole was prescribed to individuals with a CD4 count < 350 cells/ μL or World Health Organization HIV disease stage > 2 . CD4 counts were routinely measured prior to ART initiation and every 6 months thereafter. All patients were urged to disclose their HIV status to a family member or friend and identify a “treatment buddy.”

Community-Based Accompaniment

The community-based accompaniment model for ART delivery in Rwanda has been described previously [17]. In addition to receiving the standard of care in the national ART program, individuals receiving community-based accompaniment were visited daily in their homes by a CHW who provided social support, monitored for adverse events, identified potential barriers to adherence, and directly observed ingestion of all medications at least once per day. A monthly food ration based on a family of 4 was provided for the first 10 months of ART, and transportation stipends were given for routine clinic visits. Although no incentives were given for attendance to clinic visits, the food package could be picked up after attending regularly scheduled clinic visits and may have acted as an incentive. Individuals were accompanied to clinic visits by CHWs for the first 4 monthly visits and then as

needed. Social workers screened individuals and arranged for additional support as needed, including payment of school or health insurance fees, microfinance activities, employment assistance, or home repairs. CHWs completed an initial multi-day training on accompaniment for HIV care and monthly refresher trainings and discussion sessions thereafter.

Data Collection

Clinicians prospectively collected clinical data at the time of enrollment and during the 1-year follow-up period, using standardized forms. We collected baseline psychosocial data through interviews conducted in the local language (Kinyarwanda) and used standardized scales to measure depression (Hopkins Symptom Checklist [19, 20]), quality of life (Medical Outcomes Survey HIV Scale) [21], and social support (Duke-UNC Functional Social Support) [22]. These scales demonstrated internal consistency and construct validity in this population [23]. We used the Household Food Insecurity and Access Scale to assess food insecurity [24]. Twelve-month HIV RNA levels were quantified at the Rwanda National Reference Laboratory using the Cobas TaqMan 48 Analyzer (Roche Geneva, Switzerland), which has a detection limit of 40 copies/ μ L.

Outcomes and Outcome Definitions

Outcomes of interest were (1) attrition from treatment during the first year of ART; (2) retention with viral load suppression at 1 year; and (3) absolute change in CD4 count at 1 year. Attrition from treatment was defined as death, loss to follow-up, or default. An individual was defined as lost to follow-up if he or she had not returned to the clinic for at least 60 consecutive days. Similarly, an individual was defined as having defaulted if s/he had stopped treatment for at least 60 consecutive days. Death was defined as death due to any cause after program enrollment. Viral load suppression was defined at a threshold of <200 copies/ μ L [25].

Statistical Analysis

We used Cox proportional hazards regression models to compare times to attrition from care across ART delivery models. Individuals who transferred out of the program prior to 1 year were censored on the date of their last clinic visit. We used a Poisson regression model with a robust variance estimator to calculate the relative risk of having a favorable program outcome (ie, retention in care with a suppressed viral load) compared to having an unfavorable program outcome (ie, attrition, retention with an unsuppressed viral load) [26]. For this analysis we excluded individuals who transferred out of the program to a different treatment site, and we classified the viral loads of retained individuals who lacked a viral load result as unsuppressed. Last, we compared absolute change in

CD4 count among individuals who were retained at 1 year using a linear regression model. For all analyses, depression was modeled as a binary variable: individuals with a mean score >1.75 were defined as depressed [19, 20].

To account for missing covariate data, we performed multivariable analyses on datasets multiply imputed using covariate and outcome data. Imputation was conducted using Markov chain Monte Carlo methods (SAS MI Procedure) [27], and effect estimates were pooled across data sets. We constructed multivariable regression models using a backward selection approach. Specifically, all potential confounders (shown in Table 1) were simultaneously included in the model and removed one at a time. A variable was retained in the final model only if exclusion altered the estimate for the model of care variable by $>10\%$ in either direction.

RESULTS

Baseline characteristics of 610 study participants are shown in Table 1. Individuals who received the clinic-based model of ART delivery demonstrated more advanced World Health Organization HIV stages and greater immune suppression relative to individuals who received community-based accompaniment. On the other hand, individuals who received community-based accompaniment generally appeared worse off in terms of psychosocial, access-to-care, and socioeconomic variables.

Treatment outcomes during the first year of ART are shown in Figure 1. Death before 1 year was relatively rare in this cohort ($n = 22$ [7.2%] in the clinic-based care group; $n = 13$ [4.3%] in the community-based accompaniment group). Ten (3.3%) individuals at the clinic-based care sites and 3 (1%) at the community-based sites defaulted or were lost to follow-up before 1 year. Fifteen participants (7 from a clinic-based site and 8 from the community-based accompaniment site) transferred out of the program prior to 1 year.

Attrition From Care

In a univariable Cox analysis, receiving community-based accompaniment was associated with half the rate of attrition from care before 1 year of ART, relative to receiving clinic-based care (hazard ratio [HR], 0.49; 95% confidence interval [CI], .27–.89; $P = .02$; Table 2). The multivariable model included 4 additional covariates: CD4 count (treated as linear), depression, physical health quality of life subscore, and food insecurity score. After adjustment for these variables, community-based accompaniment was strongly associated with a lower risk of attrition from care during the first year of ART (HR, 0.17; 95% CI, .09–.35; $P < .0001$; Table 2).

Table 1. Characteristics of Study Population (N = 610, Unless Otherwise Noted)

Variable	Clinic-Based Care (n = 306)	Community-Based Accompaniment (n = 304)
Age, y, median (range)	37 (21–63)	37 (21–80)
Female sex	201 (66)	175 (58)
Civil status		
Never married	12 (4)	16 (5)
Married or living with partner	175 (57)	176 (58)
Divorced or separated	25 (8)	35 (12)
Widowed	94 (31)	74 (25)
Baseline CD4 count, median (range)	218 (0.0–349.0)	241.5 (18.0–350.0)
Body mass index (n = 606), median (range)	21.4 (13.4–31.2)	20.3 (13.3–31.6)
WHO HIV stage (n = 609)		
1	44 (14)	73 (24)
2	90 (30)	106 (35)
3	164 (54)	117 (38)
4	7 (2)	8 (3)
Tuberculosis treatment at ART start (n = 608)	8 (3)	15 (5)
ART regimen (n = 607)		
d4T, 3TC, NVP	211 (69)	187 (62)
ZDV, 3TC, NVP	57 (19)	96 (32)
d4T, 3TC, EFV	9 (3)	9 (3)
ZDV, 3TC, EFV	27 (9)	11 (4)
Bactrim prophylaxis (n = 603)	302 (100)	301 (100)
Able to read	234 (76)	173 (57)
Time to clinic (n = 604)		
<30 min	106 (35)	23 (8)
30–60 min	109 (36)	39 (13)
1–2 h	80 (26)	106 (36)
>2–3 h	9 (3)	81 (27)
>3 h	2 (1)	49 (16)
Food insecurity score (n = 601), median (range)	16 (0–27)	14 (0–27)
Food insecurity category (n = 601)		
None	29 (10)	23 (8)
Mild	15 (5)	9 (3)
Moderate	32 (10)	110 (37)
Severe	229 (75)	154 (52)
Depression (n = 601)	83 (27)	200 (68)
Mental health subscale (n = 597), median (range)	60 (5–100)	44 (0–100)
Physical health subscale (n = 598), median (range)	100 (0–100)	58.3 (0–100)
Social support score (n = 603), median (range)	13 (8–40)	18 (8–40)

Data are presented as No. (%) unless otherwise specified.

Abbreviations: 3TC, lamivudine; ART, antiretroviral therapy; d4T, stavudine; EFV, efavirenz; HIV, human immunodeficiency virus; NVP, nevirapine; WHO, World Health Organization; ZDV, zidovudine.

Retention With Viral Load Suppression

This analysis was conducted among the 595 individuals who were not transferred out of the program prior to 1 year of ART. Among the 547 participants who were still receiving treatment at 1 year, 17 (3.1%) lacked a 12-month viral load (9 in the clinic-based arm and 8 in the community-based accompaniment arm). Of those with a viral load, 23 in the clinic-based

arm and 20 in the community-based accompaniment arm demonstrated a viral load >200 copies/ μ L. Eighty-five percent (95% CI, 81%–89%) in the community-based accompaniment program, and 79% (95% CI, 74%–83%) in the clinic-based program had a favorable program outcome (ie, 1-year retention with viral suppression) (risk ratio [RR], 1.08; 95% CI, 1.01–1.15; $P = .04$; Table 2). After adjustment for baseline CD4

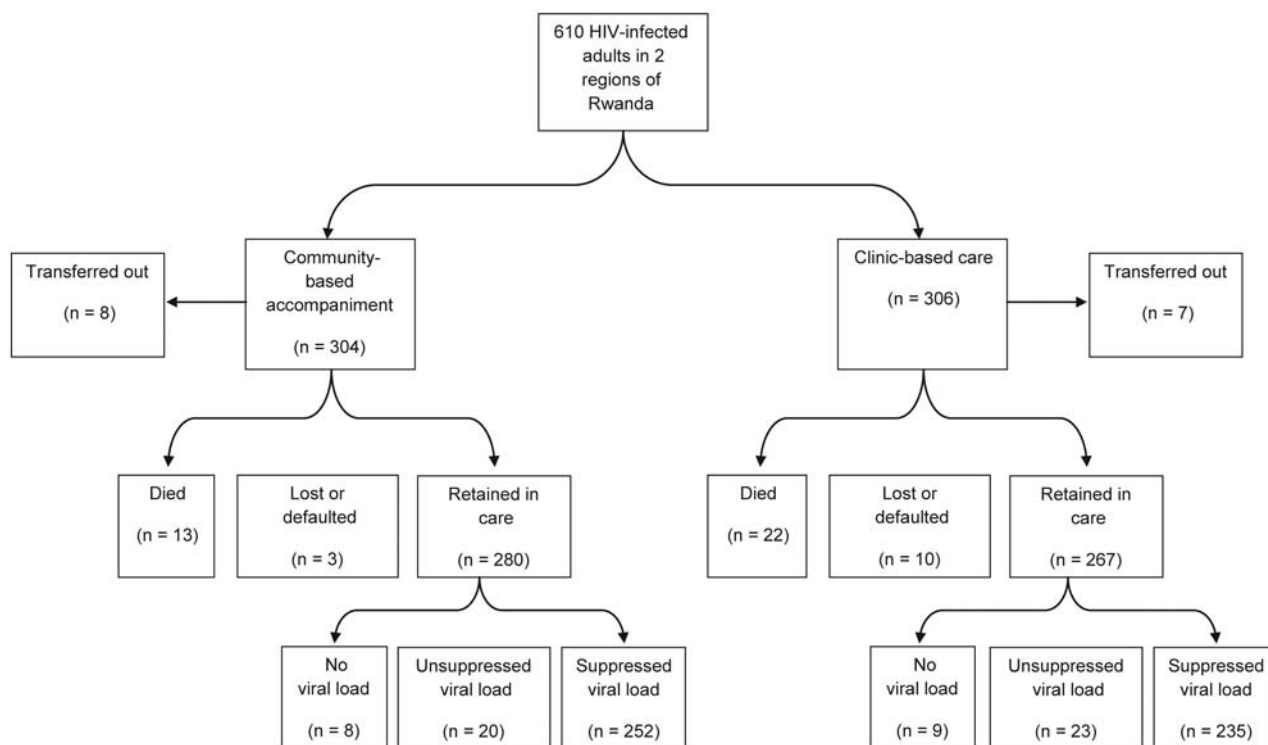


Figure 1. Study enrollment and treatment outcomes during the first year of antiretroviral therapy. Abbreviation: HIV, human immunodeficiency virus.

count, depression, social support score, physical health subscore, and travel time to the clinic, individuals who received community-based accompaniment had a 15% greater risk of being retained with a suppressed viral load at 1 year, relative to participants who received clinic-based care (RR, 1.15; 95% CI, 1.03–1.27; $P = .01$; Table 2).

Change in CD4 Counts

Five hundred twenty-eight individuals had a 12-month CD4 count (96.5% of those on treatment). Of these, one individual with an extreme outlying value for CD4 count change was excluded. Among the remaining 527 individuals, CD4 counts increased by a median of 141 cells/ μ L (interquartile range

Table 2. Association Between Community-Based Accompaniment and Selected Antiretroviral Treatment Outcomes

Outcome	Estimate	Univariable Estimate (95% CI)	<i>P</i> Value	Multivariable Estimate (95% CI)	<i>P</i> Value	Baseline Variables Adjusted for in Multivariable Analysis
Time to attrition from care (N = 610)	Hazard ratio	0.49 (.27–.89)	.02	0.17 (.09–.35)	<.0001	CD4 count, depression, physical health score, food insecurity score
Favorable program outcome (ie, retention with viral load suppression) ^a (n = 595)	Risk ratio	1.08 (1.01–1.15)	.04	1.15 (1.03–1.27)	.01	CD4 count, depression, social support score, physical health score, and clinic travel time
Change in CD4 count (n = 528)	Difference in change	40.1 (14.7–66.5)	0.002	21.7 (–16.9 to 60.3)	.27	Age, sex, depression, physical health score, mental health score, clinic travel time, social support score, literacy, WHO HIV disease stage

Abbreviations: CI, confidence interval; HIV, human immunodeficiency virus; WHO, World Health Organization.

^a Individuals who were retained and achieved viral load suppression at 1 year were classified as having a favorable program outcome. Those who did not meet this definition due to death, loss to follow-up, or retention with an unsuppressed viral load were classified as having an unfavorable outcome at 1 year.

[IQR], 79–211 cells/ μ L) among individuals who received clinic-based care and by 188 cells/ μ L (IQR, 86–293 cells/ μ L) among individuals who received community-based accompaniment. In univariable analysis, community-based accompaniment was associated with a greater increase in CD4 count at 1 year (difference in CD4 count change, 40.1 cells/ μ L [95% CI, 14.7–66.5]; $P = .002$; Table 2). This association was not significant after adjustment for covariates (21.7 cells/ μ L [95% CI, –16.9 to 60.3]; $P = .27$; Table 2).

DISCUSSION

The addition of community-based accompaniment to the Rwanda national model for ART delivery was associated with a lower rate of attrition and a higher probability of retention with a suppressed viral load at 1 year, as compared to the well-functioning Rwanda national model alone, a clinic-based model with fewer patient support elements. The most striking observation was the lower rate of attrition among individuals receiving accompaniment, which we hypothesize is the result of the multifaceted, comprehensive nature of the delivery model. The overall finding that community-based accompaniment was associated with a higher probability of retention rate with viral load suppression at 1 year mirrors results from a similar comprehensive community-based accompaniment program in Peru [13] and is consistent with results from other randomized and observational studies that have demonstrated improved outcomes among individuals on ART who receive community-based adherence and psychosocial support [28–30]. The cost of community-based accompaniment (estimated at US\$630 per patient per year for the first year and US\$340 per year thereafter; unpublished data, Beth Collins, Clinton Foundation HIV/AIDS Initiative, October 2006) and other comprehensive, integrated care delivery strategies must be weighed against those of second-line therapy for individuals who acquire resistance and for their potential contacts. Consideration must also be given to the possibility that the benefits of accompaniment reach well beyond those examined in this paper and include improvements to individual overall physical and mental health, and indirect benefits to family and community members.

It is noteworthy that, although we found a statistically significant benefit associated with community-based accompaniment relative to the national model alone, both models of ART delivery produced excellent outcomes with 92% (280/304) and 87% (267/306) of patients retained in the community-based accompaniment and clinic-based programs, respectively (Figure 1). Furthermore, among patients retained in care at 1 year, the viral load suppression percentage exceeded 90% in both programs. Certainly the well-organized general health system and strong Rwanda MOH support for the HIV

program contribute to the success of both ART delivery models. Since January 2004, the government of Rwanda has been committed to universal free access to HIV care and agreed-upon standards of HIV care. The government has backed these commitments with increased health spending and health system strengthening in human resources, infrastructure, medical commodities, and services [31].

While the benefits of the community-based accompaniment are evident from this study, the relative size of the benefit is likely related to the background retention and adherence rates of the program in which it operates. Furthermore, although high levels of adherence can be maintained over time [32], multiple studies have found that adherence declines over time as individuals begin to feel better from ART [5, 33, 34]. In settings where adherence tends to decrease over time, we would expect the relative benefit of community-based accompaniment to increase with longer durations of ART. Therefore, the size of the benefit associated with community-based accompaniment observed in this study may be attenuated relative to that which would have been observed had we followed participants for a longer period after ART initiation [35].

We identified baseline differences between the 2 populations under study. Because we collected extensive demographic, clinical, psychosocial, and socioeconomic data, we were able to comprehensively test for confounding and adjust for important baseline differences during the analysis phase. Although we cannot rule out the existence of unmeasured confounding, we do not believe this potential bias contributed to our finding that community-based accompaniment was associated with improved outcomes. In general, patients receiving community-based accompaniment appeared to be worse off in terms of socioeconomic and psychosocial characteristics that have predicted poor ART outcomes in previous studies [5, 36, 37]. If there was an additional risk factor for poor outcomes for which we did not account in the current study, and this risk factor, like others, was more prevalent in the community-based accompaniment group, failure to control for this variable would attenuate, not inflate, the relationship between accompaniment and the outcome. It is noteworthy that, at baseline, individuals receiving community-based accompaniment reported higher social support and were less likely to have severe food insecurity. Increasing social support and alleviating food insecurity were 2 key goals of accompaniment. Because baseline interviews were conducted within a month of ART initiation, some participants had already received social support and nutritional support for a short period of time, and this may explain these observed differences.

We selected the comparison arm based on its established, well-functioning ART program and similarity to the accompaniment program in terms of its decentralized care, district hospital, laboratory facilities, and distance to the capital.

Importantly, both programs provided HIV treatment and care according to Rwanda MOH national guidelines. Nonetheless, we did not assess quality of care in the 2 programs and therefore cannot quantitatively confirm that care was identical across sites. One relevant difference between the 2 programs was the implementation of a more aggressive tuberculosis screening protocol that included chest radiograph for all patients, which was implemented in the region providing community-based accompaniment [38]. Targeted human resource support was also provided to Partners In Health–supported clinics for the provision of all health services, which included HIV care.

Recent data indicate that a variety of singular interventions, including treatment supporters, directly observed therapy, mobile-phone text messages, diary cards, and food rations, can effectively increase adherence [14]. Community-based accompaniment combines several of these elements in an integrated model designed to comprehensively address multiple established risk factors for suboptimal adherence and to improve overall mental and physical health [39]. From a research perspective, one consequence of this integrated approach is that we are unable to demarcate the relative contributions of each element of accompaniment.

In conclusion, the results of this study demonstrate that community-based accompaniment is a successful model for ART delivery and suggest that, when added to a clinic-based program lacking in patient support mechanisms, it may improve treatment outcomes. Successful HIV delivery models will undoubtedly vary across programs and cultures [40]; however, prioritizing programmatic elements that enable good adherence and ensure high-quality care will improve individual health outcomes and may also slow the emergence of drug-resistant HIV strains while preserving the effectiveness of first-line regimens. Maintaining these supports and high quality of care as programs age and expand will remain a critical challenge, and resources must be made available to strengthen existing programs that are not achieving high rates of retention and viral load suppression. Most important, these findings indicate that with sufficient commitment and high-quality care, achieving outcomes of retention with suppressed viral load exceeding 80% is an attainable goal for HIV programs and that additional interventions that address the complex barriers to adherence in resource-poor settings may allow us to surpass these rates.

Notes

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