Efficacy of a lay health worker led group antiretroviral medication adherence training among non-adherent HIV-positive patients in KwaZulu-Natal, South Africa: Results from a randomized trial

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Abstract

There is a lack of theory-based randomized controlled trials to examine the effect of antiretroviral adherence in sub-Saharan Africa. We assessed the effectiveness of a lay health worker lead structured group intervention to improve adherence to antiretroviral therapy (ART) in a cohort of HIV-infected adults. This two-arm randomized controlled trial was undertaken at an HIV clinic in a district hospital in South Africa. A total of 152 adult patients on ART and with adherence problems were randomized 1:1 to one of two conditions, a standard adherence intervention package plus a structured three session group intervention or to a standard adherence intervention package alone. Self-reported adherence was measured using the Adult AIDS Clinical Trials Group adherence instrument prior to, post intervention and at follow-up. Baseline characteristics were similar for both conditions. At post-intervention, adherence information knowledge increased significantly in the intervention condition in comparison to the standard of care, while adherence motivation and skills did not significantly change among the conditions over time. There was a significant improvement in ART adherence and CD4 count and a significant reduction of depression scores over time in both conditions, however, no significant intervention effect between conditions was found. Lay health workers may be a useful adjunct to treatment to enhance the adherence information component of the medication adherence intervention, but knowledge may be necessary but not sufficient to increase adherence in this sample. Psychosocial informational interventions may require more advanced skill training in lay health workers to achieve superior adherence outcomes in comparison standard care in this resource-constrained setting.

Keywords: *medication adherence intervention (MAI), lay health worker, adherence, antiretroviral therapy, HIV/AIDS, South Africa*

Résumé

Il n'existe pas de recherches informées par une théorie de base permettant d'évaluer l'effet de l'accès au traitement antirétroviral en Afrique sub-saharienne. Nous avons évalué l'efficacité de l'intervention d'un groupe défini d'agents de santé pour améliorer l'accès au traitement antirétroviral (TAR) avec un échantillon d'adultes infectés par le VIH. Cette étude préliminaire a été réalisée en deux

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temps dans la clinique d'un hôpital de province en Afrique du Sud ou le taux de prévalence est élevé. Un échantillon de 152 patients adultes sous traitement antirétroviral ayant des problèmes d'accès a été étudié selon une formule 1:1. Pour y faire, nous avons établi deux conditions á savoir d'une part leur soumission á une procédure générale d'intervention pour faciliter l'accès. Cette dernière est suivie d'une intervention en trois phases d'une part et d'autre part une procédure générale d'intervention. L'accès volontaire a été mesuré grâce aux essais cliniques sur un groupe d'adultes ayant le SIDA, une méthode appliquée en trois périodes : une phase initiale, une phase d'intervention, et une phase post-intervention. Les caractéristiques de base étaient similaires pour les deux conditions. A la phase post-intervention, la connaissance des informations d'accès s'est considérablement améliorée par rapport au niveau initial des soins alors qu'on n'a pas constaté une quelconque amélioration pour la motivation d'accès et les compétences. Il y a eu par contre une amélioration significative de l'accès au TAR et à la numération des CD4 et une réduction significative des cas de dépression au cours des deux phases. Cependant aucun effet majeur n'a été identifié. On peut ainsi dire que les agents de santé peuvent être un complément utile au pour renforcer la composante d'information à l'intervention visant à faciliter l'accès à la médication (AMI), mais l'information peut être nécessaire mais non suffisante pour améliorer l'accès dans cet échantillon. Les informations Psychosociales d' interventions peuvent nécessiter une formation et des compétences plus avancées pour les agents de santé en vue d' atteindre des résultats supérieurs en matière de soins et de niveau d'accès par rapport au contexte de ressources limitées.

Mots clés: *Intervention d'adhérence à la médication (AMI), Agents de santé, Adhérence, Antirétrovirale Thérapie, VIH/SIDA, Afrique du Sud*

Introduction

The prevalence estimates of the total number of people living with HIV in 2011 was 5.38 million in South Africa and 1.06 million adults (15 years or more) were estimated on ART in 2010 (Statistics South Africa 2011). The clinical efficacy of antiretroviral therapies (ART) in suppressing HIV and improving survival rates for those living with HIV has been well documented (Lohse, Hansen, Gerstoft & Obel 2007; Vergidis, Falagas & Hamer 2009).

However, successful antiretroviral (ARV) treatment is dependent on sustaining high rates of adherence (correct dosage, taken on time and in the correct way – either with or without food). The minimum level of adherence required for ARVs to work effectively is 95% (Lima, Harrigan, Murray, Moore, Wood, Hogg, *et al.* 2008). Although more potent ARV regimens can allow for effective viral suppression at moderate levels of adherence (Bangsberg 2006), none or partial adherence can lead to the development of drug-resistant strains of the virus.

Although studies show that high levels of adherence are achievable in African countries (Mills, Nachega, Buchan, Orbinski, Attaran, Singh, *et al.* 2006), there is still an urgent need to develop additional practical and feasible interventions to improve treatment retention, increase and maintain these high levels of adherence in HIV patients on ART if treatment failure and resistance is to be avoided. Research to date has generated a growing set of interventions with demonstrated efficacy in improving ART adherence (Nachega, Mills & Schechter 2010). The first meta-analyses of this adherence intervention research have now been conducted, and their results are generally favourable. For example, a meta-analysis of 19 randomized controlled trials of ART adherence interventions found that participants who received an intervention were 1.5 times as likely to report 95% adherence and 1.25 times as likely to achieve an undetectable viral load as those in comparison conditions (Simoni, Pearson, Pantalone, Marks & Crepaz 2006). Amico, Harman and Johnson (2006) conducted a comprehensive quantitative review of published trials of ART interventions and found that interventions that specifically enrolled participants with known or anticipated problems with ART adherence demonstrated medium effects on adherence ($d = 0.62$, OR = 3.07), and that interventions that did not target their participants on similar criteria had quite small effects ($d = 0.19$, OR = 1.41). In a recent review on interventions to increase ARV adherence in sub-Saharan Africa, Bärnighausen, Chaiyachati, Chimbindi, Peoples, Haberer and Newell (2011) found that treatment supporters, directly observed therapy, mobile-phone text messages, diary cards, and food rations can effectively increase adherence in sub-Saharan Africa. Findings that some interventions were unlikely to have large or lasting effects and others were effective only in specific settings emphasize the need for more research, particularly for randomized controlled trials based on behavioural theories relevant to sub-Saharan Africa (Bärnighausen *et al.* 2011).

Adherence interventions that appear most promizing include those with cognitive behavioural (CB) strategies based on self-efficacy theory and those which include the training of pharmacists on adherence strategies (Simoni, Frick, Pantalone & Turner 2003). The behavioural interventions emphasize self-efficacy, i.e. belief in one's ability to engage in a behaviour as a function of choice, effort, and persistence (Bandura 1986). Self-efficacy is increased through social modelling opportunities, which increases motivation to initiate and maintain new behaviours (Bandura 1986). Group CB interventions provide a forum for modelling skills such as problem-solving, coping, and assertiveness, while promoting attitude and behaviour change through increased self-efficacy. CB interventions have been used to enhance patient responses to stressors and encourage active coping strategies to reduce the deleterious affective and behavioural sequelae of HIV infection (Antoni, Ironson, Helder, Lutgendorf, LaPerriere, Fletcher, *et al.* 1991; Ironson, Lydston, Weiss, LaPerriere, Tobin, Schneiderman, *et al.* 2005; Jones, Ishii, LaPerriere, Goldstein, Stanley, Antoni, *et al.* 2004; LaPerriere, Ironson, Antoni,

Jones, Devieux, Ishii, *et al.* 2005). Patients obtain knowledge, adopt group norms of behaviour and share concerns with peers, develop illness-management skills, improve coping and quality of life, and reduce anxiety and depression while increasing medication adherence (Jones, MacPherson-Baker, Lydston, Gousse, Brondolo, Camille, *et al.* 2007; Jones, Zulu, Mumbi, Chitalu, Vamos, Gomez, *et al.* 2009).

Resource-intensive interventions directed towards the individual (e.g. CB therapy, e.g. Safren, O'Cleirigh, Tan, Raminani, Reilly, Otto, *et al.* 2009) could be difficult to implement in sub-Saharan Africa because of large numbers of patients, restricted resources, and the public health approach to treatment (Bärnighausen *et al.*, 2011). Kenya, Chida, Symes and Shor-Posner (2011) found in a review that utilized community health workers to improve adherence to highly active antiretroviral therapy (ART) in the USA that 'Interventions that lasted at least 24 weeks, provided frequent contact with participants, and focused on medication management were associated with improved HAART adherence, as indicated by reduced HIV viral load and increased CD4 cell count' (1). In order to address staff shortages and improve adherence counselling for people on ART, the Zambia Prevention, Care and Treatment Partnership developed an innovative strategy of training community volunteers to provide adherence support and found that adherence counselling tasks can be shifted to lay cadres like adherence support workers without compromising the quality of counselling (Torpey, Kabaso, Mutale, Kamanga, Mwango, Simpungwe, *et al.* 2008). In South Africa, government estimates are 65,000, mostly HIV/TB care-related lay workers contribute their labour in the public health sector, outnumbering the main front-line primary health care providers and professional nurses (Schneider & Lehmann 2010).

In our study, the first of its kind in South Africa, we aimed to examine whether a lay health worker lead structured group intervention is effective in improving adherence to ART when combined with standard adherence intervention strategies in a cohort of HIV-infected adults.

Methods

Study setting and design

The study was conducted in Ladysmith Hospital located in the Uthukela District of KwaZulu-Natal. This site is a government accredited ART site and provides ARVs and ART clinic care free of charge. During the time of the study, the HIV clinic was providing ART treatment for more than 2500 patients.

The study compares the efficacy of a manualized CB group adherence intervention with the standard of care (e.g. provider medication directive). A total of 152 HIV+ individual on ART with an adherence problem were enrolled and randomly assigned to one of two time-matched conditions. (1) Medication adherence intervention (MAI) condition: led by a trained lay health worker and adherence counsellor, participants received three monthly 1 h sessions of medication information combined with problem-solving skills in an experiential/interactive group format. (2) Practitioner medical directive (standard of care): participants individually attend monthly one visit to review their health status with their medical practitioner (20 min, standard of care). MAI sessions are scheduled to coincide with regularly scheduled physician visits.

Sample and procedure

Based on a systematic review of evaluation studies on interventions to increase ARV adherence in sub-Saharan Africa (Bärnighausen *et al.* 2011), an adherence intervention effect of 20% was assumed. Therefore, a sample size of 64 per study group with 80% power, 5% significance, SD = 0.4, was needed. Participants ($N = 152$) were recruited from Ladysmith hospital (ART clinic) in KwaZulu-Natal, South Africa. Participants were randomized into study condition using a table of random numbers following their baseline assessment.

Health care providers from Ladysmith hospital (ART clinic) informed HIV+ men and women who were 18 years and above and new ARV medication users (6–24 months of ARV use, who have previously been prescribed and obtained medication) about the study during patients' clinic visits. Permission from the patient was then obtained to be approached by research staff, who then explained the study and conducted the informed consent process. Patients were also referred to the study recruiter by physicians if patients did not take at least one dose of ARV's in the past month. Physicians utilized patient records, including pharmacy medication refill data, to calculate missed appointments and especially missed medication refills. All participants were screened by a trained interviewer to ensure that the patient had an adherence problem. Following referral for screening, the trained interviewer asked the patient if they had missed one dose of ARV's in the past three months. If the patient answered 'Yes', screening of the patient continued but if the patient answered 'No', they were then thanked for their time and were not included in the study.

If patients were 18 years and above they were informed about the study by the clinic staff, and their permission was obtained to be approached by research staff, which further explained the study and conducted the informed consent process. In order to reduce potential attrition associated with HIV prevention studies, recruiters maintained a private database of participant contact information, including telephone, postal and home address. Patients were asked at the baseline interview to indicate whether the Human Sciences Research Council (HSRC) field worker could contact them during their clinic appointment and/or by telephone or at home or an alternative place of their choice. Following initial contact with prospective participants and briefing on the nature of the study, the HSRC field worker obtained informed consent and medical and social history to determine initial eligibility for the study.

Participants were scheduled for follow-up assessments 3 months after counselling. They received 60 South African Rand (approximately US$7 at the time of the study) to compensate for completing the baseline and returning to the clinic for the follow-up assessment. Following the 3-month follow-up, participants in the control condition were offered the experimental ART adherence intervention. All study procedures were approved by the HSRC Research Ethics Committee and the KwaZulu-Natal

Department of Health in South Africa as well as the Institutional Review Board of the Ladysmith Hospital.

All informed consent, assessment, and intervention materials were translated into Zulu. Psychosocial and behavioural, and health status (including CD4 counts and viral loads) data were collected during the course of the study via interviews, patient records, and questionnaires. Data were collected at three time-points: baseline, month 1[post-treatment], and 4 months from study entry. All interviews were conducted by trained interviewers who were study staff and not employed by the study clinic in South Africa. Participants who missed group sessions continued to be enrolled in the study, and were asked to arrive earlier for their next session where the intervention content of the missed session was briefly described. Participants are given a small amount of money 30 South African Rand (approximately US$4 at the time of the study) to help defray transportation to the clinic.

Study treatment: MAI

The protocol is designed to allow standardized administration for the enhancement of HIV medication adherence by healthcare providers. The MAI applied the interactive group format to maximize the number of participants reached and the impact of provider and peer support. Intervention components provide information, current levels of adherence and HIV-related knowledge and enhancement of motivation using a structured framework. All sessions were 1 h, once a month for 3 months; participants ($n = 10$ per session) selected their language of intervention participation and all groups were mixed gendered groups.

Session one

The initial MAI session evaluates and responds to knowledge about HIV and HIV-related medication (e.g. disease effects on the body, purpose of drug cocktails, issues related to medication side effects, the consequences of non-compliance, participant concerns related to HIV myths and rumours about treatment or disease). The session includes a video to stimulate discussion on ARVs, and provides an opportunity to assess current adherence, identify patient-specific barriers and discuss concerns participants may have about their medication. Questions regarding the 'appropriateness' of the medication regimen are referred to the participant's physician so as to restrict the health care workers to their scope of practice. Gaps or distortions in patient information are corrected to empower the patient to improve his or her medication adherence behaviour. The primary aim of each session is to fully educate the participant regarding their medication regimen and to increase social support with a buddy system. Emphasis is placed on honesty in the counselling session and with their regular medical providers.

Sessions two and three

These sessions target current adherence, medication resistance, identify patient-specific barriers and discuss concerns participants may have regarding medication. Patients are encouraged to share and problem solve with peers and the facilitator. The sessions are designed to identify problems and solutions, generating targeted strategies to enhance adherence. Misconceptions are corrected. Patients are encouraged to brainstorm potential questions for anticipated physician visits.

Standard of care

Provider visits are conducted every month and a 1 month supply of ARVs is provided. Visits are timed to coincide with intervention group sessions. Medical practitioner visits were 20 min and included physician (5 min), nurse (10 min), and pharmacist (5 min). Standard of care may have been longer in some cases if additional tests such as X-rays or others were required.

Conceptual and theoretical framework of the MAI

Existing adherence interventions have relied on a variety of overlapping theoretical models, e.g. Reasoned Action, Health Beliefs Model, Social Cognitive Theory, and Social Learning Theory. Drawing on constructs from the Health Beliefs Model (Rosenstock, Strecher & Becker 1994), the MAI (McPherson-Baker, Jones, Durán, Klimas & Schneiderman 2005; McPherson-Baker, Malow, Penedo, Jones, Schneiderman & Klimas 2000) focuses on patient self-regulation, the patient's beliefs about HIV, the effectiveness of ARVs and their efficacy in combating disease progression, addressing the barriers as well as the benefits to adherence, self-efficacy, patient-provider communication, and establishing a commitment to adherence. In addition, the intervention utilizes the Health Promotion Model's (Pender 1996) understanding of the reciprocal interaction between individuals and their environment (Bandura 1986), including factors of cognitive functioning, psychological distress and peer support. The primary interpersonal source of influence on health behaviours are peers and health care providers (Pender 1996), both of whom can provide emotional and informational support to patients on ARVs.

Measures

Patients were interviewed with an anonymous questionnaire that required information on sociodemographic characteristics, clinical history, and health-related characteristics and beliefs. Clinical data relating to date of HIV diagnosis, HIV acquisition and transmission risk factors, current CD4 cell count, viral load, opportunistic infections, HIV and non-HIV medications were obtained from the medical chart.

Adherence assessment

ARV treatment adherence was assessed by a self-reported adherence measure – the Adult AIDS Clinical Trials Group (AACTG) adherence instrument. The AACTG consists of nine questions that assess adherence from the previous 1 to 4 days, within the past week, prior to the interview. Respondents were asked to report the following for each of their ARV medications: (a) name of drug, (b) prescribed doses per day, (c) prescribed number of pills per dose, and (d) any special instructions with regard to food/liquid restrictions. Participants were then asked to state the number of pills and doses they took for each identified medication yesterday, the day before yesterday, and the previous Saturday. (To include only 1 weekend day, all interviews were conducted on Wednesdays, Thursdays, or Fridays.) Participants were also asked whether any of the doses taken on these days are taken off schedule, or late by 1 h or more. Finally, respondents are asked to report overall, within the past month, how often they took their medications using a 6-item response scale (1 = *never*, 6 = *all the time*) and to identify the last time they missed taking any

of their medications using a 6-item response scale (1 = *within the past week*, 6 = *never*). (Chesney, Ickovics, Chambers, Gifford, Neidig, Zwickl, *et al.* 2000). Self-reported adherence (4-day recall and weekend) was assessed three times (at baseline, post-intervention, and 6 months follow-up) and was dichotomized into those having missed or not having missed doses in the past 4 days and/or weekend (Chesney *et al.* 2000).

The *LifeWindows Information-Motivation-Behavioural Skills ART adherence questionnaire* (LW-IMB-AAQ) (Fisher, Fisher, Amico & Harman 2006; The LifeWindows Project Team 2006)

Each LW-IMB-AAQ item represents a barrier primarily falling within the I (Information), M (Motivation), or B (Behavioural Skills) constructs. Adherence information was assessed with five items. Example for an information item: 'I know what to do if I miss a dose of any of my HIV medications (for example, whether or not to take the pill(s) late)'. Responses to items include 'yes', 'no', or 'don't know' ('don't know' responses were keyed as incorrect responses). Adherence motivation was assessed with ten items. A 'motivation' sample item: 'I am worried that other people might realize that I am HIV+ if they see me taking my HIV medications'. Response options were 1 = strongly disagree to 5 = strongly agree. Behavioural skills were assessed with 14 items. An example of a behavioural skills item: 'How hard or easy is it for you to stay informed about HIV treatment?' Response options were 1 = cannot do at all to 5 = certain you can do.

Depression was assessed with the Beck Depression Inventory II (BDI-II; Beck, Ward, Mendelson, Mock & Erbaugh 1961; Beck & Beamesderfer 1974). The BDI-II, which takes into account insomnia vs. hypersomnia, and weight gain vs. weight loss, was utilized. The long form of the BDI is composed of 21 questions or items, each with four possible responses. Each response is assigned a score ranging from 0 to 3, indicating the severity of the symptom. Individual questions of the BDI assess mood, pessimism, sense of failure, self-dissatisfaction, guilt, punishment, self-dislike, self-accusation, suicidal ideas, crying, irritability, social withdrawal, body image, work difficulties, insomnia, fatigue, appetite, weight loss, bodily preoccupation, and loss of libido.

Data analysis

Data were entered and analysed using Statistical Package for the Social Sciences (SPSS) version 18.0 for windows (SPSS Inc., Chicago, IL, USA). The intervention arm was compared against the control arm for all primary analysis. Basic demographics and ART treatment characteristics were summarized using descriptive statistics. To test for intervention effects over time, we used repeated measures analysis of variance with a within subjects design of condition (2: Group MAI, standard of care) × time (baseline, post-intervention, and follow-up) for adherence. Missing data due to non-response were deleted on an analysis-by-analysis basis. We used an intent-to-treat analysis by including all participants who completed baseline assessments and were randomized to intervention conditions. Individual cell sizes vary due to missing values. Statistical significance was defined using the conventional value of $p < 0.05$.

Results

Retention and attrition of participants

A total of 152 patients enrolled in the study, completed baseline assessments, and were randomized to two conditions. Participants in the intervention group attended on average 2.3 sessions, with a range of 1–3 sessions. At the follow-up assessment 147 (96.7%) completed the assessment; five participants could not be followed-up, they could all not be located. There was a 3.9% (3/*n*) attrition in the intervention group and 2.6% in the control group (see Fig. 1).

Sample characteristics

The sample included 152 patients, 76 in the experimental and 76 in the comparison group. There were no significant differences of socio-demographic variables (sex, age, marital status, place of residence, formal education, employment status, and main household income) and health variables (time since HIV diagnosis, CD4 count, and BDI depression symptoms) in the experimental compared to the control group (see Table 1). HIV medications for 97 (63.8%) patients included lamivudine (3TC), stavudine (d4T) + efavirenz (stocrin), 53 (35.1%) lamivudine (3TC),

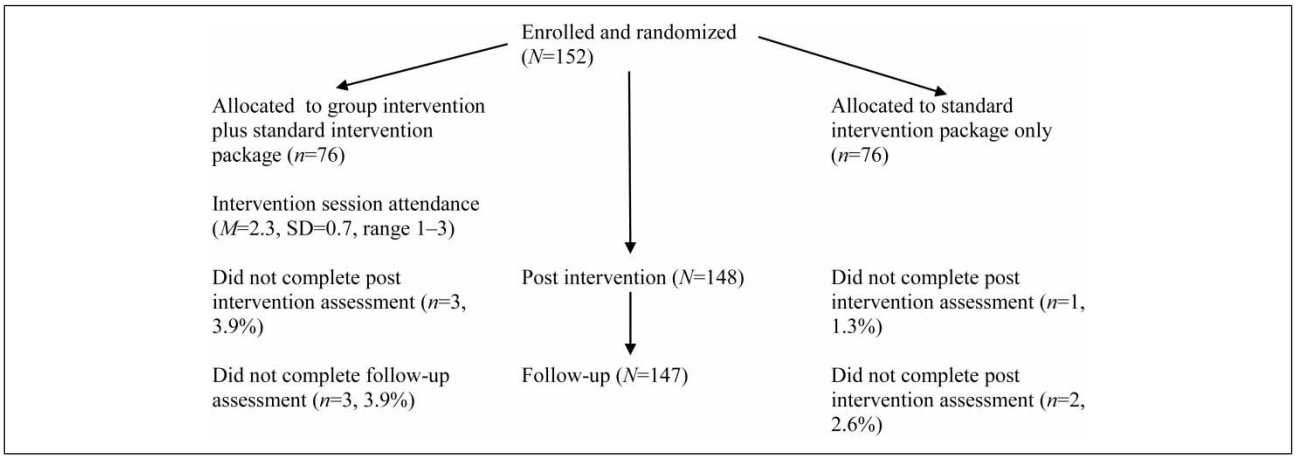

Fig. 1. Participant flow.

Table 1. Sample characteristics (N = 152).

	Intervention		Comparison				Total	
Variable	**N = 76 or M**	**% or SD**	**N = 76**	**% or SD**	**χ^2 or t-test**	**P**	**N or M**	**% or SD**
Sex								
Male	23	30.3	30	39.5	1.42	0.140	152	100
Female	53	69.7	46	60.5				
Age	36.6	9.4	37.1	9.8	−0.30	0.764	36.9	9.5
Education								
Grade 7 or less	15	19.7	18	24.0	1.12	0.571	33	21.9
Grade 8–11	42	55.3	35	46.7			77	51.0
Grade 12 or more	19	25.0	22	29.3			41	27.2
Married/cohabitating	7	9.3	12	16.0	1.51	0.220	19	12.7
Never married/separated/divorced/widowed	68	90.7	63	84.0			131	87.3
Residence								
Rural	33	43.4	33	43.4	0.00	1.000	66	43.4
Urban	43	56.6	43	56.6			86	56.6
Employed	17	22.4	23	30.7	1.34	0.248	40	26.5
Not employed	59	77.6	52	69.3			111	73.5
Main household income								
Formal salary	13	17.3	21	28.0	2.43	0.119	34	77.3
Not formal salary	62	82.7	54	72.0			116	22.7
Time since HIV diagnosis								
≤2 year	30	39.5	32	42.1	1.12	0.517	62	40.8
>2 years	46	60.5	44	57.9			90	59.2
CD4 count (cells/μL)	309	215	261	171	1.46	0.146	285	196
BDI-depression symptoms (range 0–63)	26.8	22.2	25.5	23.0	0.33	0.744	26.1	22.6

stavudine (d4T) + nevirapine, and 3 (2%) other (lopinavir, tenofovir). Fixed dose combination of ARVs was not available for patients on this programme during the time of the study.

Adherence related information and motivation outcomes

Analysis of variance between intervention conditions on the adherence information knowledge test scores at pre- and post intervention showed a significant increase in the intervention compared to the control group at follow-up. Adherence motivation and skills did not significantly change among the intervention conditions over time (see Table 2).

ART adherence and health outcomes

Analyses found a significant improvement of ART adherence and CD4 count and a significant reduction of depression scores over time in both intervention and control conditions; however, no significant intervention effect between intervention and control conditions was found. With higher ART adherence CD4 counts increased and depression symptom scores decreased. Again, no significant group × time interaction effect was observed for the total group for either measure (see Table 3).

Discussion

In this study, we aimed to assess how a lay health worker led group ARV medication adherence training might impact on adherence to ART in a cohort of HIV infected South African adults with adherence problems. Findings from our study show that having a group ARV medication adherence training as well as the control condition (standard care) impacts positively on ART adherence, which is broadly consistent with findings from the few published studies that have been conducted in sub-Saharan Africa (Kunutsor, Walley, Katabira, Muchuro, Balidawa, Namagala, *et al.* 2011; Sarna, Luchters, Geibel, Chersich, Munyao, Kaai, *et al.* 2008). Considering the fact that the intervention by the lay counsellors was as effective as that by the medical personnel, it creates the opportunity of strengthening the role of lay workers in chronic HIV care. With the human resource limitations in the delivery of ART in low-resource settings, the use of lay counsellors may be an effective intervention to sustain long-term ART in low-resource settings (Chang, Kagaayi, Nakigozi, Ssempijja, Packer, Serwadda, *et al.* 2010).

High levels of adherence were exhibited by both treatment groups which is consistent with previous and recent studies conducted in sub-Saharan Africa (Chang *et al.* 2010; Mugusi, Mugusi, Bakari, Hejdemann, Josiah, Janabi, *et al.* 2009; Nachega, Chaisson, Goliath, Efron, Chaudhary, Ram, *et al.* 2010; Pearson, Micek,

Table 2. Adherence related knowledge, motivation, and skills.

	Experimental motivational/skills (*N* = 76)		Control (*N* = 76)		ANOVA	
Adherence information	***N* or *M***	**% or SD**	***N* or *M***	**% or SD**	***F***	
Baseline (α 0.66)	28.9	4.6	28.5	3.8	4.00	0.048
Post-intervention (α 0.64)	28.5	3.8	27.1	4.5		
Three months follow-up (α 0.79)	30.2	7.5	28.5	3.1		
Adherence motivation						
Baseline (α 0.65)	29.3	5.0	29.2	4.8	0.78	0.379
Post-intervention (α 0.65)	29.0	4.9	28.8	4.5		
Three months follow-up (α 0.84)	31.2	6.3	30.5	4.4		
Adherence skills						
Baseline (α 0.66)	45.8	9.3	46.9	9.5	0.16	0.687
Post-intervention (α 0.61)	45.2	7.1	44.9	7.2		
Three months follow-up (α 0.68)	45.6	6.1	46.4	7.2		

Note: α = Cronbach's alpha.

Table 3. ART adherence, CD4 count, and depression scores.

	Experimental motivational/skills (*N* = 76)		Control (*N* = 76)		ANOVA	
ART adherence	***N* or *M***	**% or SD**	***N* or *M***	**% or SD**	***F***	***P***
Baseline	38	50.0	36	47.9	0.917	0.341
Post-intervention	66	91.3	63	84.1		
Three months follow-up	71	98.3	65	88.2		
CD4 count						
Baseline	308	217	264	170	0.675	0.412
Post-intervention	317	183	308	156		
Three months follow-up	384	186	368	196		
BDI depression score						
Baseline (α 0.96)	26.8	22.2	25.5	23.0	0.018	0.894
Post-intervention (α 0.96)	21.5	21.3	21.3	21.6		
Three months follow-up (α 0.86)	19.7	19.3	19.2	17.4		

Note: α = Cronbach's alpha.

Simoni, Hoff, Matediana, Martin, *et al.* 2007; Sarna *et al.* 2008). The intervention arm exhibited superior adherence but this was not statistically significant. Persistent adherence counselling in a clinic setting may be effective in improving adherence to ART. These findings suggest that intervention effects were reduced in this setting with possibly high levels of standard care. De Bruin, Viechtbauer, Schaalma, Kok, Abraham and Hospers (2010) found in a review on standard care impact on effects of highly active ART adherence interventions that the content of adherence care provided to control and intervention groups predicted viral load and adherence success rates in both conditions ($P < 0.001$ for all comparisons), with an estimated impact of optimal adherence care of 55 percentage points.

Further, the study found that depressive symptom levels significantly decreased in both group ARV medication adherence training and in standard care. Depression has been shown to be associated with HIV medication non-adherence (Gonzalez, Batchelder, Psaros & Safren 2011). It is possible that through the group intervention and standard care depressive symptoms reduced and thus could improve ART adherence.

Study limitations

ART adherence was only assessed by self-report though less objective than clinic-based pill count measure and Medication Event Monitoring System caps, it has been reported to overestimated adherence and yet a valid method of assessing medication

adherence that may be useful in clinical as well as research settings (Kalichman, Amaral, Swetzes, Jones, Macy, Kalichman, *et al.* 2009). Oyugi, Byakika-Tusiime, Charlebois, Kityo, Mugerwa, Mugyenyi *et al.* (2004) did not find a significant difference between patient-reported and objective measures of adherence in Uganda. We were not able to do adherence monitoring with more objective indicators such as immunological, virological, or clinical outcomes because of financial constraints particularly the cost of additional laboratory monitoring in this setting. The data was derived from a single site and so the results may not be generalizable to the whole country. Finally, the window of follow-up assessment in this study was short (3 months). Improved adherence might not persist over time, as found in some trials in Africa where a significant intervention effect in the first 6 months of the trial was not sustained in later phases (Bärnighausen *et al.* 2011). This suggest that evidence of effectiveness of adherence-enhancing interventions from studies of short duration might not be generalizable to the long-term and future studies should thus attempt to assess effectiveness for at least 1 year (Bärnighausen *et al.* 2011).

Conclusion

Our study findings highlight the importance of identifying patients with adherence problems and offer additional treatment support. The lay health worker structured group adherence intervention may be a practical, cost-effective and feasible strategy for enhancing adherence knowledge, and lay counsellors could be given a specific role with regards to intensified adherence support. However, knowledge may be necessary but not sufficient to increase adherence in patients. CB informational interventions may require more advanced skill training to achieve superior adherence outcomes in comparison standard care in this resource-constrained setting, and it may also be useful to intensify care provider interventions for ART patients with treatment problems.

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