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REVIEW

Can community health workers improve adherence to highly active antiretroviral therapy in the USA? A review of the literature

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Objectives

Highly active antiretroviral therapy (HAART) has transformed HIV infection into a manageable chronic illness, yet AIDS mortality among ethnic minorities persists in the USA. HAART nonadherence is associated with increased HIV viral load, low CD4 cell count and racial disparities in HIV outcomes. While there is no universal consensus on how to improve medical adherence in HIV-positive populations, the community health worker (CHW) model is emerging as an effective strategy to overcome barriers to HAART adherence. Although utilized in international settings, there is little evidence regarding the effects of CHWs on HIV outcomes in the USA.

Methods

We performed a comprehensive search from May 2010 to November 2010 to identify studies carried out in the USA that utilized CHWs to improve HAART adherence and measured HIV viral loads and CD4 cell counts to assess intervention effects. Sixteen studies met the inclusion criteria and were reviewed for this article. All studies reported clinical HIV outcomes.

Results

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.

Conclusions

Compared with current standards of care, CHW programmes may offer a practical and cost-effective alternative to improve HAART adherence, which may lead to reduced HIV viral load and increased CD4 cell counts among HIV-positive populations in the USA.

Keywords: community health worker, health disparities, highly active antiretroviral therapy adherence, HIV/AIDS, USA

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Introduction

Highly active antiretroviral therapy (HAART) can transform HIV/AIDS from a fatal diagnosis to a manageable chronic illness [1,2]. Although adherence to HAART may significantly improve health status and prolong healthy years of life, AIDS continues to be a leading cause of death among African-Americans and Hispanic populations in the USA [3–9]. Multi-level barriers are known to affect HAART compliance and may contribute to racial disparities in health outcomes and AIDS mortality [10]. The negative effects of poor HAART adherence on clinical outcomes have been documented consistently, and it is crucial to develop strategies to improve adherence [2]. The community health worker (CHW) model is emerging as an effective peer intervention to overcome barriers to adherence and thus improve medication compliance among people living with HIV/AIDS.

Although there is no universal consensus about the most effective way to improve or sustain HAART adherence, the United States Department of Health and Human Services (USDOH) did publish guidelines on this topic in 2009.

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This was a positive development responsive to prior research that reported that many health professionals provide minimal adherence interventions and counselling [11]. The USDOH recommendations advised providers to assess barriers to adherence at every visit, and, if needed, to pick an intervention from a list of those that had demonstrated effectiveness and would best suit individual patient needs [12]. However, these guidelines do not promote a general standard of care regarding adherence strategies other than assessment, and are subjective because they are reliant upon the provider's interpretation.

The CHW model has been demonstrated to be an effective peer intervention to overcome barriers to HAART adherence in resource-poor settings, but is not currently utilized on a standard basis in the USA [13]. Considered 'natural helpers' by peers in local neighbourhoods, CHWs provide home-based support that focuses on patients' health status in a multitude of ways. Examples include providing education on social support resources and personalized assistance with overcoming barriers to HAART adherence [14]. Barriers that may impact medication compliance include depression and other psychiatric illnesses [15,16], active drug or alcohol use [15–17], social stability [18] and degree of social support [19].

Several articles have described how the CHW model is currently and successfully implemented outside the USA to improve HAART adherence in disadvantaged areas, yet few have focused on the CHW model in the USA [13,14,20–23]. To enhance our understanding of the utility of CHWs in improving HAART adherence in the USA, we reviewed programmes that relied on this approach to improve biological HIV outcomes. We then used the strengths, limitations and results of the studies to make recommendations for employing the CHW model to reduce disparities in US communities.

The CHW model: overview

The CHW model aims to connect those who need medical care with payers and providers of health services [24]. Multiple terms are used interchangeably to describe CHWs, including lay health worker, community health promoter, outreach worker and peer health educator [24]. The United States Department of Health and Human Services defines CHWs as lay members of communities who work in association with a local health care system and usually share ethnicity, language, socioeconomic status and life experiences with the community members they serve [25]. The World Health Organization (WHO) offers another widely accepted definition of CHWs:

> 'Community health workers should be members of the communities where they work, should be selected by the communities, should be answerable to the communities for their activities, should be supported by the health system but not necessarily a part of its organization, and have shorter training than professional workers' [24].

It is widely recognized that basic functions of CHWs include delivery of culturally appropriate health education, assistance with accessing health services, provision of direct services (such as medication administration or observation of medication ingestion), and peer support [13,24,25]. The range of services provided by CHWs therefore varies and is personalized based on individual needs and socio-environmental determinants. The patient may require weekly home visits, education about his or her disease, assistance with obtaining benefits, reminders to take medications, accompaniment to medical appointments, and/or medication administration. Several studies have found that CHWs are effective at delivering directly observed therapy (DOT), which involves daily visits to provide medication or observe ingestion of medicine [26–30].

History

The idea of formally using community members to provide basic health services has existed internationally for at least 50 years. The Chinese barefoot doctors of the 1960s and 1970s and the Thailand Village Health Volunteers (an initiative that was officially implemented nationwide in 1977) are well-known examples of early programmes [24]. Over the last several decades, training lay persons to address health issues such as respiratory illnesses, maternal and child health and malaria has become a more common community health practice in some areas of the world [28]. In addition, in developing nations, CHWs are often employed to reduce morbidity and mortality from infectious illnesses; successful programmes include the work of Socios en Salud in Peru and Partners in Health in Peru and Haiti [27,31,32].

Partners in Health has been particularly effective at assessing the results of their interventions in order to advocate for the use of CHWs. For example, since 1990, Partners in Health has shown that the 'accompagnateur' (CHW) model reduced mortality from tuberculosis [13] in rural Haiti. As HIV prevalence increased, coinfection with tuberculosis and HIV also became more common in Haiti. Zanmi Lasante responded by expanding their CHW programmes to increase access to HIV education, testing and home-based care provided by an accompagnateur [13]. Socios en Salud were also able to demonstrate that CHWs could effectively cure multi drug resistant tuberculosis (MDRT) in the most challenging circumstances. They then were able to utilize the CHW model to achieve similar benefits in those with HIV infection [32].

The CHW model and HIV

Since the early work assessing the impact of CHWs in the context of coinfection with tuberculosis and HIV, several international studies have shown that the CHW model improves HAART adherence and associated HIV outcomes in diverse international communities [13,20–22]. Use of the CHW model to improve medical adherence among HIV-infected populations in the USA, however, has not been funded or studied on a large-scale basis, nor has the efficacy of this modality in the USA been clearly established. This review seeks to provide more information regarding the feasibility of implementing the CHW model in the USA.

Methods

Between May 2010 and November 2010, a comprehensive review of relevant articles was conducted in MEDLINE. We defined the inclusion criteria as follows: the study was written in English; reported biological HIV outcomes (either viral load or CD4 cell count); was conducted in the USA; and assessed the use of CHWs, outreach workers or peer educators to support improved adherence to HAART medications in HIV-infected populations. While other variables may be associated with the level of medication compliance, CD4 cell count and viral load were selected as the most objective assessments of HAART adherence and HIV outcomes; we therefore focused on studies that reported these measures. Medical subject heading (MESH) terms included 'community health aide(s)', 'village health worker(s)', barefoot doctor(s)', 'community worker(s)', 'HIV', 'human immunodeficiency virus(es)', 'AIDS', 'Acquired Immunologic Deficiency Syndrome' and 'Acquired Immunodeficiency Syndrome(s)'. The 'language' limit was applied. There was no limit regarding date of publication. This search resulted in 26 studies that were based in North America. Of these 26 studies, 16 (involving a total of 2067 participants) met our inclusion criteria for this analysis. Table 1 presents details of each of the 16 studies reviewed for this article, describing the purpose, sample population, duration, intensity and results of each study. Table 2 summarizes the 10 CHW studies that were excluded from our review, including reasons for exclusion.

Results

General characteristics of CHW interventions

All study interventions focused on outcomes in the HIV-positive individuals (rather than provider or health services), and all studies described a CHW approach to improving medication adherence. The length of intervention ranged from 5 weeks to 12 months. Effects of the intervention on HIV viral load and CD4 cell count were reported for each study.

Ten of the 16 articles reviewed targeted specific populations such as women, injecting drug users, individuals who were beginning a new HAART regimen, or persons with a documented history of medical nonadherence. Seven studies were randomized controlled trials (RCTs); one study did not have a control group but included historical controls. Seven articles reported findings from one-armed intervention studies and one article described outcomes from only the intervention group within a larger RCT.

Sample sizes ranged from 9 to 966; race was reported for 1985 participants, or approximately 96% of the total population of the studies. Of the participants included in the studies, African-Americans accounted for 53%, Hispanics for 25% and people of White ethnicity for 16% of participants.

Effects of CHW interventions

The CHW model contributed to measurable HIV viral load suppression and/or improved CD4 cell count in the majority (13 of 16) of the studies reviewed. Seven of the studies reported significant findings ($P<0.05$). In two of the three studies that did not find evidence to support the efficacy of the CHW model, alternative HAART adherence interventions were compared with the CHW model.

Successful CHW programmes and recommendations for practice

Thirteen studies reported improved HIV outcomes resulting from the CHW model, and in all except one study [33] DOT was implemented, which requires daily or near-daily contact with a CHW. Of the studies in which DOT was provided, only one did not find that the CHW model improved outcomes [34]. It is important to note that the latter study compared DOT not with standard of care, but with experimental models of case management. More frequent CHW contact over a longer period of time was also associated with improved outcomes. This association between the frequency of CHW contact and outcomes may suggest a dose–response relationship between CHW exposure and improvements in HAART adherence.

Duration of intervention

Although interventions of at least 24 weeks were more likely to show significant effects than shorter trials, some studies reported improved outcomes with even brief exposure to the CHW model. Khanlou's [35] 6-week intervention demonstrated the benefits of short-term exposure to the CHW model. Significant outcomes

Table 1 Summary of the 16 studies included in the review

Reference	Purpose	Intervention	Demographics	Design	Outcomes	Duration of Intervention	Age of Participants
Altice *et al.* [26]	To determine if directly observed HAART is superior to self-administered HAART in improving CD4 cell count and viral load among HIV-positive substance users	Outreach workers delivered directly observed therapy every day at a predetermined location. Participants were given a beeper to remind them to take other doses	41 HIV-infected drug users in New Haven, CT: 58% Black, 19% Hispanic and 22% White	Randomized controlled trial	Directly observed HAART led to improved HAART adherence and retention (compared with self-administered therapy), increased virological success ($P = 0.02$), and increased CD4 cell count ($P = 0.002$)	24 weeks	Median age 42.7 years in the intervention arm; 44.9 years in the control arm
Macalino *et al.* [36]	To determine if directly observed HAART can increase CD4 cell counts and decrease viral load in HIV-positive injecting drug users	Outreach workers observed participants take HAART at a location of the participant's choice every day. The frequency of visits was tapered over time	87 HIV-positive substance users in Rhode Island: 31% White, 30% Black, 24% Hispanic and 15% other	Randomized controlled trial	Modified directly observed HAART led to decreased viral loads ($P = 0.02$) and increased CD4 cell counts ($P = 0.01$) among HAART-experienced patients but not HAART-naïve patients	48 weeks; analysis limited to 12 weeks	Mean age 42.4 years
Marino *et al.* [37]	To determine if providing peer support to HIV-positive individuals improves HAART adherence	HIV-positive peers and participants met twice a month in a group setting to identify barriers to HAART adherence and care. During sessions they generated strategies to overcome barriers to care. The peers also called participants individually three times per week	9 HIV-positive patients who had a history of nonadherence. The ethnicities of the patients were not reported	Randomized controlled trial	Peers without high levels of education can provide social support to others. No statistics were performed	Average length of participation in the study was 11 months (range 9 months–3 years)	Mean age 48 years
Mitty *et al.* [38]	To determine the long-term impact of modified directly observed HAART on HAART adherence, CD4 cell count and viral load	A near-peer outreach worker administered directly observed therapy every day	15 HIV-positive patients in Providence, Rhode Island. Seven were White, three were Black and four were Hispanic	Letter to the editor	27% of participants self-reported missing doses after intervention compared with 77% previously. Nine charts were reviewed: a majority of participants had increased CD4 levels and had maintained an undetectable viral load at the time of follow-up interviews. No statistics were performed	24 weeks	Mean age 44 years
Purcell *et al.* [34]	To determine if peer mentoring is more effective at reducing risk behaviours and improving medical outcomes than a video intervention	Individuals either (1) participated in peer-led biweekly sessions that focused on utilization of HIV care, adherence, and risk behaviours or (2) watched a video that focused on issues relevant to HIV-positive injecting drug users, and then took part in a facilitated discussion	966 HIV-positive injecting drug users in Baltimore, Miami, San Francisco and New York: 65.8% Black, 15.3% Hispanic, 9.1% White and 7.5% other	Randomized controlled trial	No significant differences were found between the interventions. Both led to decreased risk behaviours ($P < 0.01$) and increased adherence (not significant) at 6 months ($P = 0.03$) and 12 months ($P = 0.01$). There was no change in utilization of health care for either group	5 weeks	At least 18 years old; mean age 42.4 years
Simoni *et al.* [39]	To determine the efficacy of a peer-led social support intervention in enhancing HAART adherence	HIV-positive peers and participants met twice a month in a group setting to identify barriers to HAART adherence and care. During sessions they generated strategies to overcome barriers to care. The peers also called participants individually three times per week	136 HIV-positive patients on HAART in the Bronx, NY: 46% African American, 44% Hispanic, 6.6% White and 2.9% other	Randomized controlled trial	There were no significant differences in HIV viral load or adherence to HAART between the intervention and control groups	12 weeks	At least 18 years of age

Table 1 (Contd.)

Reference	Purpose	Intervention	Demographics	Design	Outcomes	Duration of Intervention	Age of Participants
Smith-Rohrberg *et al.* [40]	To determine the impact of co-located medical services, case management, and substance abuse referrals (DAART-Plus) in subjects receiving directly observed HAART	Outreach workers in a community health care van met participants at predetermined locations and delivered directly observed therapy. A beeper was given to participants to remind them to take other doses. Social support and case management services were also provided	72 HIV-positive injecting drug users in New Haven, CT: 59.7% Black, 23.6% Hispanic and 16.7% White	Intervention cohort within a randomized controlled trial	Among individuals who received directly observed HAART, the utilization of on-site medical and case management services was independently associated with improved virological outcomes. Achieving virological success at 6 months was associated with high medical services utilization ($P = 0.02$) and with the use of case management services ($P = 0.04$). Both services resulted in a reduction in viral load ($P = 0.02$)	24 weeks	Median age 42.5 years
Visnegarwala *et al.* [41]	To determine if either directly observed HAART or an adherence coordination health care team improves HIV viral load suppression compared with standard of care	Participants received services from (1) a care management team consisting of a social worker, peer caseworker and pharmacist, or (2) a case manager who provided education and assessed for social needs/provided social services, or (3) a peer who delivered daily directly observed therapy and provided positive reinforcement	54 HIV-positive women who were either antiretroviral-naïve or initiating a new regimen in Houston, TX: 83% African American	Controlled trial (not randomized)	In a three-way comparison at 4–8 months, the directly observed therapy group had significantly better viral load suppression (85%) compared with the adherence coordination service (54%) and standard of care (36%) ($P = 0.003$). In a two-way comparison, directly observed therapy was superior to standard of care ($P < 0.001$) and the adherence coordination service, but the latter difference was of borderline significance ($P = 0.08$). The mean increase in CD4 count was 193 cells/μL in the directly observed therapy group, 262 cells/μL in the adherence coordination services group, and 115 cells/μL in the standard of care group ($P = 0.05$)	24 weeks	Median age 40 years
Williams *et al.* [33]	To determine if a community-based home visit intervention among HIV-positive patients improves HAART adherence	A nurse and community support worker made home visits weekly (with declining frequency) for 12 months. During visits they discussed barriers to adherence and proposed solutions. All participants in the study were provided with a medication event-monitoring system cap for 4 weeks	171 HIV-positive adults in CT. The majority had a past or current history of substance abuse. 35% were African American, 19% Hispanic, 42% White and 4% other	Randomized controlled trial	A larger proportion of subjects in the intervention group demonstrated adherence >90% compared with the control group at each time-point after baseline ($P = 0.02$). A statistically significant effect on viral load or CD4 cell count was not seen, but there was a statistically significant association between >90% adherence and an undetectable viral load over time ($P = 0.03$)	48 weeks	Age not reported
Wohl *et al.* [42]	To determine the impact of directly observed HAART *vs.* intensive adherence case management *vs.* standard of care on viral load	Participants either (1) received once-daily directly observed therapy for 6 months with outreach worker inquiry about social issues and subsequent referral to clinic staff, or (2) met weekly with a case manager who focused on barriers to adherence and care	250 HIV-positive patients in Los Angeles who had not had extensive adherence problems/treatment failures: 64% Hispanic, 24% African American, 6% White, 4% Asian and 2% other	Randomized controlled trial	No significant differences were found between the groups in terms of viral load suppression or increase in CD4 cell count ($P > 0.05$)	24 weeks	Median age between 30 and 39 years
Mitty *et al.* [43]	To determine if community-based directly observed HAART improves CD4 cell count or viral load	Near-peer outreach workers delivered directly observed therapy at a location of the participant's choice every day. The frequency of visits was tapered over time	69 HIV-positive patients in Providence, Rhode Island who were either nonadherent to treatment or substance users. 41% White, 27% Black, 22% Latino and 10% other	Prospective cohort	Directly observed HAART led to a decrease in viral load and a modest increase in CD4 cell count. No statistics were performed	48 weeks. Analysis limited to 24 weeks	Mean age 38 years; median age 43 years

Table 1 (Contd.)

Reference	Purpose	Intervention	Demographics	Design	Outcomes	Duration of Intervention	Age of Participants
Behforouz *et al.* [13]	To determine if community health promoters and directly observed HAART improve access to care and adherence to HAART	Community health promoters delivered home-based medical and social support services (including directly observed therapy) every day	15 HIV-positive patients with a demonstrated history of HAART nonadherence in Boston, MA. The ethnicities of the patients were not reported	Prospective cohort	Patients had a high rate of adherence and viral load suppression, and also an overall increase in CD4 cell count. No statistics were performed	24 weeks; 48 weeks for seven patients	Age not mentioned
Behforouz *et al.* [14]	To determine if community-based directly observed HAART is feasible and if it improves health outcomes	Trained directly observed therapy workers delivered HAART every day, while health promoters provided social services and education once a week	15 HIV-positive patients in Boston, MA. All were non-White	Prospective cohort	The decreases in median viral load from baseline at 6 and 12 months were $\log_{10}$ 2.6 copies/mL ($P = 0.001$) and $\log_{10}$ 2.96 copies/mL ($P = 0.02$). The median CD4 count among the 15 participants increased (not significant) from 83 cells/μL at baseline to 106 cells/μL at 6 months ($P = 0.11$) and 192 cells/μL at 12 months ($P = 0.22$)	48 weeks	Age not reported
Macalino *et al.* [29]	To determine if adherence is improved by a community-based programme of directly observed HAART among persons with substance use disorders and a history of HAART failure	A near-peer outreach worker delivered directly observed therapy every day. The frequency of visits was tapered over time	25 HIV-positive patients with substance use disorders in Providence, Rhode Island: 32% African American, 40% White and 28% Latino	Prospective cohort	Most patients observed a majority of HAART doses. 17 patients had biological data available. Of these, 47% had viral load suppression at 2–3 months and 70% had suppression at 3–6 months. Median CD4 count increase at the end of follow-up was 65 cells/μL. No statistics were performed	24 weeks	Mean age 40.8 years
Khanlou *et al.* [35]	To determine if community-based directly observed HAART is feasible and if it improves CD4 cell count/decreases viral load in a noncontrolled setting	A volunteer provided directly observed therapy on weekdays; at weekends participants used a medication event monitoring system cap	14 HIV-positive patients in Los Angeles, CA. The ethnicities of the patients were not reported	Prospective cohort	6 weeks of intervention resulted in improvements in CD4 cell counts and viral loads at 6 months. In an intent-to-treat analysis, by 12 and 24 weeks CD4 counts had increased by 77 cells/μL ($P < 0.05$) and 37 cells/μL ($P < 0.05$), respectively. Decreases in viral load from baseline at 12 and 24 weeks were $\log_{10}$ 0.5 copies/mL ($P < 0.05$) and $\log_{10}$ 0.1 copies/mL ($P > 0.05$). In an on-treatment analysis: By 12 and 24 weeks CD4 counts increased by 71 cells/μL ($P < 0.05$) and 65 cells/μL ($P < 0.05$). Decreases in viral load from baseline at 12 and 24 weeks were $\log_{10}$ 1.2 copies/mL ($P < 0.05$) and $\log_{10}$ 0.7 copies/mL ($P < 0.05$)	6 weeks	Age not reported
Stenzel *et al.* [44]	To determine if modified directly observed HAART is successful in improving HAART adherence and suppressing viral load	An outreach worker provided directly observed therapy every week day and discussed problems with medications. The frequency of visits was tapered over time. Medication issues were related to the participant's provider	37 HIV-positive patients with poor adherence in Providence, Rhode Island: 24% White, 31% African American and 38% Hispanic	Prospective cohort	Mean CD4 cell count increased by 17% at 3 months and 21% at 12 months. At 3 months, 47% achieved a viral load <400 copies/mL and at 12 months 56% achieved a viral load <400 copies/mL. 26 patients were followed for virological suppression after completion/discontinuation of directly observed therapy. 13 completers were compared with 13 noncompleters. The mean decrease in viral load from baseline was 0.43 $\log_{10}$ copies/mL for the noncompleters compared with 1.28 $\log_{10}$ copies/mL for the completers ($P = 0.09$)	48 weeks for half of the participants; 16 weeks for the other half	At least 18 years old; mean age 38 years

DAART, directly administered antiretroviral therapy; HAART, highly active antiretroviral therapy.

Table 2 Summary of the studies excluded from the review

Reference	Purpose	Reason for exclusion
Deering *et al.* [20]	To determine if a peer intervention will increase access and adherence to HAART	Study located outside of the USA
Rueda *et al.* [23]	To conduct a systematic review of the literature on the effectiveness of patient support and education to improve HAART adherence	Not all studies used community health workers, and not all studies were located in the USA
Simoni *et al.* [21]	To summarize the literature on behavioural interventions to promote HAART adherence	Studies were not all located in the USA
Altice *et al.* [26]	To assess adherence outcomes in directly observed HAART compared with standard of care	No biological outcomes
Shelton *et al.* [45]	To determine if HIV case managers improve adherence to HAART	No biological outcomes
Amico *et al.* [46]	To conduct a quantitative review of published trials on HAART adherence interventions	Not all studies used community health workers; not all studies reported biological outcomes
Ivers *et al.* [22]	To summarize the literature on HAART programmes in resource-poor settings	Studies were not all located in the USA
Wohl *et al.* [47]	To determine if treatment support programmes improve adherence to HAART	No biological outcomes
Altice *et al.* [48]	To develop a directly observed HAART programme for HIV-infected drug users	The intervention used a community outreach van but did not specifically utilize community health workers
Broadhead *et al.* [49]	To determine if injecting drug users can carry out the work of professional outreach workers effectively	No biological outcomes

HAART, highly active antiretroviral therapy.

achieved during the intervention were also present at the 12-month follow-up point. Seven interventions lasted approximately 24 weeks, and successful outcomes were reported for six of these. The long-term studies (48 weeks) also showed significant effects of the CHW intervention.

Intervention activities

The most successful intervention strategies associated with improved adherence behaviours were peer education focused on medication management and daily observation of patients taking HAART in the home. While each successful trial focused primarily on medical management skills, several common characteristics also existed among these trials that may have influenced outcomes. These included intensity of CHW exposure, duration of intervention and access to additional adherence interventions.

Discussion

We reviewed published studies focused on CHW programmes designed to improve HAART adherence among people living with HIV/AIDS in the USA. Our findings indicate that the CHW model offers promise to address the socio-cultural and environmental barriers to HAART adherence and the achievement of equitable HIV outcomes. Such findings mirror those of earlier studies of CHW programmes in international communities. The studies utilizing DOT demonstrated the most significant effects, suggesting a positive dose–response relationship. Although DOT has also historically been administered by credentialed health professionals, this strategy is often cost-prohibitive for many health systems. Our findings imply that DOT can be effectively implemented by CHWs in the USA and may be an economically feasible alternative. As growing evidence links this model to improved clinical outcomes in HIV infection and other chronic conditions, a comparison between the cost-effectiveness of the CHW model and that of the DOT model in the USA would be a worthwhile focus for future research endeavours.

Despite the promise of the CHW model, few studies have described CHW interventions addressing HAART adherence in the USA, and even fewer have reported the results of randomized controlled trials. Our literature search yielded many articles that provided important information about the effects of the CHW model on HAART adherence but were excluded from this review because they were not conducted in the USA or did not report biological HIV outcomes. As a result, only 16 studies met our inclusion criteria. This reflects the general paucity of CHW programmes in the USA. In addition, compared with CHW programmes in international communities, studies in the USA generally included fewer participants. The resulting limited number of participants in US studies, and specifically in those included in our review, makes it difficult to generalize these results to the larger general population of the USA.

Yet another aspect of these studies that limits the generalizability of the findings is that the populations studied were highly specific, small groups of patients (e.g. substance abusers), with differences among the studies in the demographic characteristics of the patient groups (e.g. in geographical origin, age and ethnicity). Because of the relatively low numbers of subjects and published studies, it was not possible to compare only studies that were homogeneous in terms of these variables. This highlights the need for future multisite studies with consistent methodologies to determine how geographical and population differences influence outcomes.

While all of the studies included in this review used biological markers as outcome measurements, the characteristics of the interventions varied, and each study utilized CHWs in unique ways. However, because of the relative dearth of studies in the USA on this subject, it was not possible to find an adequate number of studies with identical interventions to compare. It is therefore difficult to determine which specific CHW activities are most effective at improving adherence. Multiple studies with identical use of CHWs must be carried out in the future to further assess which CHW strategies are most efficacious.

Another limitation of our review is that many of the articles provided limited details about the specific CHW services. For example, one programme for which a significant benefit was not observed implemented a clinic-based CHW model that required participants to travel to receive medications, rather than receiving medications in the home. Lack of benefit in this study indicates that the CHW model may be more effective when services are implemented at home. Knowing which specific strategies are most beneficial in terms of outcomes will help to further determine the most effective CHW models.

Regarding geography, 14 of the 16 studies in this review were conducted in four large American cities (Boston, Providence, New Haven and Los Angeles). As a result, it is possible that many of the subjects had been enrolled in other studies either concurrently or consecutively. The eligibility of study participants is often determined by specific inclusion criteria. This can limit the number of available subjects for study and also makes specific individuals particularly good research candidates. As a result, it is possible that subjects in our review were exposed to multiple interventions. Potential repeated exposure to HAART adherence interventions could certainly influence the outcomes of the studies included in this review.

A key component of the CHW model relies on building trust between participants and CHWs [19]. In our review, a short duration of intervention was associated with poorer outcomes, which may suggest that a longer time is needed to establish a therapeutic bond. In addition to the length of intervention, the intensity, as specified by visits per week by CHWs, may also have an impact on outcomes. The effects of gradual de-escalation from daily to weekly to maintenance are unknown. As cost-effectiveness is a concern with any health system intervention, it is important that studies explore this issue in the future. Effective maintenance processes may reduce the CHW's daily burden of work with individual patients, thereby allowing more participants to receive services for a longer duration. This may also provide an effective structure for supporting participants to develop the skills required to adhere to HAART and to make the transition to independence. Balancing maintenance phase strategies to improve outcomes and minimize failures should be a focus of future research trials.

The CHW model has been successfully implemented in many parts of the world, yet information regarding its efficacy in the USA is sparse. This review highlights examples of successful programmes and explores deficiencies in others. Multicentred studies in diverse geographical locations are needed to further identify how health practitioners may utilize CHWs effectively. Recent health care reform legislation includes detailed information on CHWs and allocates funding for further CHW studies. Perhaps, with the passage of this legislation, the health care community will be able to begin work on such studies that may determine the most cost-effective way to deliver high-quality care. Towards this end, the CHW model is emerging as a promising strategy for both health care practitioners and patients to successfully improve HIV outcomes in a productive, practical and efficient manner.

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