Tropical Medicine and International Health doi:10.1111/tmi.12736

VOLUME 21 NO 9 PP 1115–1123 SEPTEMBER 2016

Adherence clubs for long-term provision of antiretroviral therapy: cost-effectiveness and access analysis from Khayelitsha, South Africa

Funeka Bango[1,2], John Ashmore[2], Lynne Wilkinson[2,3], Gilles van Cutsem[2,3] and Susan Cleary[4]

1 *Provincial Department of Health, Western Cape Government, Cape Town, South Africa*
2 *Médecins Sans Frontières, Khayelitsha, South Africa*
3 *School of Public Health & Family Medicine, Centre for Infectious Disease Epidemiology & Research, University of Cape Town, Cape Town, South Africa*
4 *Health Economics Unit, School of Public Health and Family Medicine, University of Cape Town, Cape Town, South Africa*

Abstract

OBJECTIVES As the scale of the South African HIV epidemic calls for innovative models of care that improve accessibility for patients while overcoming chronic human resource shortages, we (i) assess the cost-effectiveness of lay health worker-led group adherence clubs, in comparison with a nurse-driven 'standard of care' and (ii) describe and evaluate the associated patient cost and accessibility differences.

METHODS Our cost-effectiveness analysis compares an 'adherence club' innovation to conventional nurse-driven care within a busy primary healthcare setting in Khayelitsha, South Africa. In each alternative, we calculate provider costs and estimate rates of retention in care and viral suppression as key measures of programme effectiveness. All results are presented on an annual or per patient-year basis. In the same setting, a smaller sample of patients was interviewed to understand the direct and indirect non-healthcare cost and access implications of the alternatives. Access was measured using McIntyre and colleagues' 2009 framework.

RESULTS Adherence clubs were the more cost-effective model of care, with a cost per patient-year of \$300 *vs.* \$374 and retention in care at 1 year of 98.03% (95% CI 97.67–98.33) for clubs *vs.* 95.49% (95% CI 95.01–95.94) for standard of care. Viral suppression in clubs was 99.06% (95% CI 98.82–99.27) for clubs *vs.* 97.20% (95% CI 96.81–97.56) for standard of care. When interviewed, club patients reported fewer missed visits, shorter waiting times and higher acceptability of services compared to standard of care.

CONCLUSIONS Adherence clubs offer the potential to enhance healthcare efficiency and patient accessibility. Their scale-up should be supported.

keywords cost-effectiveness analysis, access, long-term retention in care, viral suppression, antiretroviral therapy, task shifting

Introduction

In the last decade, substantial advancements have been made in the fight against HIV/AIDS in Africa [1]. The international response to scaling up antiretroviral therapy (ART) in resource-limited settings is one of the largest public health successes in history [2]. However, scale-up has put pressure on the ability of treatment programmes to expand and maintain care [3]. There is strong multisite evidence that larger ART programmes exhibit higher loss to follow-up (LTFU) of patients [4].

The focus is therefore shifting to quality of care and retention in care and viral suppression [5,6] despite health worker shortages, escalating case loads and overburdened health systems [7]. The universally supported Joint United Nations Programme on HIV/AIDS (UNAIDS) 90-90-90 targets for 2020 crystallise the current strategies on HIV: 90% of people with HIV will know their status, 90% of people with diagnosed HIV will receive sustained ART (a composite indicator of enrolment on and retention in ART care) and 90% of people on ART will have sustained viral suppression [8].

Recent reviews of studies on retention in care in the region show improvements on previously estimated rates. In 2007, a review of ART programmes in sub-Saharan Africa estimated 75% retention in care at 1 year of treatment [9]. In 2010, this rate was between 70% and 77% [2]. A recent study found 1-year retention rates across five African countries to be higher than expected, ranging from 77% in Malawi, to 82% in South Africa and 95% in Rwanda [10]. While rates seem to be improving, retention in care is complex and associated not only with the size of an ART programme but also with the factors such as mortality, treatment inaccessibility, low CD4 (cluster of differentiation 4) count at initiation, male sex, stigma and fear of disclosure and fear of side effects [11–13].

Viral suppression is an indicator of treatment success, leading to improved clinical outcomes and a greatly reduced risk of transmitting HIV. Access to viral load monitoring is being scaled up, albeit slower than necessary to meet the 90-90-90 targets [14]. While some countries, such as Rwanda and Botswana, have demonstrated that it is feasible to achieve high rates of viral suppression [15], innovative strategies are necessary to ensure high levels of viral suppression and retention in care of patients who are stable on ART, while freeing up healthcare worker's time to scale up enrolment on ART and increase quality of care, especially for severely ill patients.

South Africa is home to one-sixth of the world's HIV positive population [16] and the health system struggles to cope with increasing numbers of patients on ART [17]. As of 2013, South Africa had the biggest ART programme in the world with around 2.5 million people remaining on ART in the public sector [18]. This accomplishment has been attributed to the decentralisation of ART services to clinic level as and a task-shifting strategy known as 'NIMART' (Nurse Initiated and Managed ART) [19].

Despite these achievements, South Africa has struggled with increasing LTFU in recent years [5] due to a variety of factors including human resource shortages [20]. Congestion in clinics also presents a barrier to treatment access and adherence [21]. A qualitative study from South Africa showed that structural barriers to access and retention in care include long waiting hours at facility level and transportation costs [5].

In 2007, ARV services were under strain at Ubuntu Clinic, a peri-urban HIV/TB facility near Cape Town. Public sector ART was first provided at Ubuntu Clinic in 2001, and by 2007, 2561 clients were on ART. Through a partnership between Médecins Sans Frontières (MSF) and the Western Cape Department of Health (DOH), a pilot distribution strategy termed 'facility-based adherence clubs' was pioneered at the clinic. The aim was to ease clinic congestion and improve retention in care and adherence by making it more convenient for stable patients to collect their medication [22].

Since this time, adherence clubs have been scaled up dramatically. In 2013, the Global Fund to fight AIDS, Tuberculosis and Malaria committed US$ 15 million to scale up facility-based clubs in South Africa. However, while the effectiveness of clubs has been demonstrated [22], little published evidence is available about health service efficiency and accessibility. The aims of this study were, from a provider's perspective, (i) to assess the cost-effectiveness of clubs in comparison with usual care and (ii) to present perceived accessibility differences associated with each model of care.

Methods

Setting

The study was located at Ubuntu Clinic in Khayelitsha. Ubuntu is the largest HIV/TB facility in the Western Cape Province of South Africa, with 7517 patients remaining on treatment at the end of 2013. Khayelitsha is located 30 km from Cape Town and is the second largest township in the Western Cape with an estimated population of 500 000 people. The antenatal HIV prevalence was 37% in Khayelitsha in 2012.

The intervention

Clubs are lay health worker led and nurse supported. They are essentially four strategies combined into one: patient support groups, task shifting to lay workers, spaced appointment systems (where patients collect their drugs every 2 months instead of monthly) and fast-tracked or simplified clinical visits (no queuing for files, clinicians or waiting in line). These strategies are independently considered effective in addressing issues of retention in care [23,24].

The focus of the intervention at Ubuntu Clinic was on adult (≥18 years) stable patients. The five criteria used to define 'stable' were as follows: on treatment for 18 months or more, last CD4 count above 200 cells/μl, viral suppression (defined as two consecutive viral loads <400 copies per ml with the most recent not being older than 6 months), no ongoing drug side effects and no ongoing opportunistic infections.

These criteria had to be met at the time of enrolment, and patients had to have a consistent record of clinic attendance. The patients were voluntarily placed into clubs on a first-come-first-served basis. Groups of 25–30 patients were led by a lay counsellor ('club facilitator') who was trained to symptom screen and offer short educational sessions to the patients.

The day before a scheduled club, medication was prepacked and dispensed by the pharmacy. On the day of the club, patients were weighed, symptom screened and received basic health education along with their prepacked ART. Where a patient was symptomatic or had health complaints, he/she was prioritised for immediate consultation with a nurse. Clinical check-ups were annual and included CD4, viral load and creatinine monitoring. Drug scripting regulations required six monthly scripting. Patients who became clinically unstable, including viral load rebound, were removed from the club to return to nurse-led standard of care (SOC) for closer monitoring and enhanced adherence support but could return to club care once virally resuppressed.

Since this initiative was a pilot project, only a limited number of patients could be accommodated. This meant that there were still patients who met the club eligibility criteria under standard of care (SOC).

Standard of care

Standard of care was nurse driven and doctor supported. Patients queued to have their folders retrieved by administrative clerks on arrival for their monthly scheduled appointments. Patients then queued to be seen by a nurse who prescribed their medication and again at the pharmacy where their medication was individually dispensed. In Waiting Times Surveys conducted in similar settings, waiting times for patients range from 20 to 215 min [25].

Study design

Using a provider's perspective, a cost-effectiveness analysis was performed, comparing clubs to SOC. The provider cost analysis was a retrospective longitudinal study performed for the year 2011. In South Africa, patients can access ART for free in the public sector, without copayment, which means that the chosen perspective for the cost-effectiveness study is of relevance for decision-making in this context. The review period was chosen because clubs had been offered for a few years, thereby allowing a cost structure (economies of scale and scope) that would be representative of medium to longer-term scale-up scenarios. There were 6194 active patients on ART at Ubuntu Clinic; 5262 were in SOC and 932 were in clubs. Costs and utilisation of clinic visits were estimated for this group.

For the measures of effectiveness, estimates of retention in care and viral suppression were derived from a published study conducted in the same setting [22]. Briefly, eligible participants (following inclusion criteria outlined above) entered the effectiveness analysis at their first eligible visit after 1 November 2007 and exited at the date of outcome, date of censoring from follow-up, or on 28 February 2011. This approach generated 2829 individuals followed up for 8821 patient-years, of whom 502 were club patients with 1273 patient-years of follow-up. Additional details are available at [22].

For the access study, perceived accessibility to each model of care was assessed through interviewing 300 patients – 150 in each model. Given important differences between the two models from an accessibility perspective, we included typical patient costs (travel costs, lost income and opportunity costs of clinic attendance) in addition to a number of indicators of accessibility differences using an access evaluation framework developed by McIntyre *et al.* [26]. The framework conceptualises access as an interaction between three dimensions, namely *availability*, *affordability* and *acceptability* of healthcare services.

Data collection and analysis: cost-effectiveness study

Estimation of costs. Provider healthcare costs for each model of care were calculated per patient-year and were expressed in 2011 prices, converted to US dollars (US$ 1 = ZAR 7.56). These costs included human resources, initial training for all staff involved in the clubs, infrastructure (buildings), laboratory tests and ARVs. Human resource and infrastructure costs were allocated per visit – resulting in a unit cost per visit. When multiplied by an estimate of the utilisation of visits per patient-year, we estimated a cost per patient-year for these resources. These visit utilisation rates were obtained from the electronic medical records of the 6194 active patients on ART at Ubuntu Clinic in 2011, of whom 5262 were receiving SOC and 932 were in clubs.

For human resources, total cost to company was estimated from Western Cape Department of Health salary scales. Heads of Department were interviewed to estimate the time spent by relevant staff in each model of care. Nurses spent 88% of their time in SOC and 12% in the adherence clubs; pharmacy staff 80% and 20%; and the operational manager 77.5% and 22.5%, respectively.

For training and mentoring, the estimation of initial training costs included training of all the staff on the club organogram, which involves the costs of training the trainer, training materials, venue hire and catering as well as opportunity costs for the training time, which was 3 days for the club facilitator and 1 day for the rest of the club staff. These costs were treated as capital costs and annuitised for a 3-year investment period at an 8% discount rate. The costs were then divided equally across the club visits to create a cost per visit. Ongoing training and mentoring costs which comprised of a repeat training session as well as 6 months mentoring were also included as recurrent costs and were similarly allocated per visit.

Building costs were derived from measurements of rooms multiplied by standard costs per square metre and annuitised assuming a 30-year working life and 8% discount factor. Overheads were derived for 2011 from government's basic accounting system. As mentioned above, human resource, overhead and building costs were expressed as a unit cost per visit. This entailed summing them and dividing the total by the clinic headcount within each model of care over the same period of time. Within each model, the resulting cost per visit was multiplied by the respective visit utilisation rate to calculate the cost per patient-year.

The Department of Health 2013 tender price for fixed-dose combination (FDC) ARVs was used [27]. This was justified as the price of ARVs decreased dramatically since 2011 and the old price is less relevant for current policy. All patients were assumed to be on first line ARVs. Annual laboratory costs (CD4, viral load, creatinine) were taken from published sources [28]. As before, laboratory and ARV drug costs were allocated per patient-year. As the costs for each model of care were for only 1 year, no discounting was required.

Estimation of effectiveness. Estimates of retention in care and viral suppression at 1 year on ART were derived from a retrospective observational study that evaluated the effectiveness of clubs *vs.* SOC at the same clinic [22]. The study estimated adjusted hazard ratios of loss to care and virological rebound for the period 2007–2011. We used the crude rate of loss to care and virological rebound in patients who were eligible for clubs but remained in routine standard of care between November 2007 and February 2011, estimated adjusted rates for these same patients had they been in clubs by multiplying the crude rate with the adjusted hazard ratios of loss to care and virological rebound, calculated exact Poisson confidence intervals and derived retention in care and viral suppression at 1 year after meeting club entry criteria from those rates.

Sensitivity analyses. One-way sensitivity analyses were conducted on costs (halving/doubling base value), visit utilisation rates (halving/doubling base value) and retention in care (using exact Poisson confidence intervals as described above). This approach allowed for a full assessment of uncertainty using extreme values of costs and utilisation. This analysis was complemented by a threshold analysis to calculate the exact percentage increase or decrease in base values where cost neutrality would result between clubs and SOC, within the ranges explored in the one-way sensitivity analysis.

Data collection and analysis: access study

Data collection. A structured questionnaire-based approach was used to interview 300 patients about their access experiences. The questionnaire was adapted from a validated questionnaire by McIntyre *et al.* [26], where access is perceived as a combination of the affordability, availability and acceptability of services. To understand affordability, we asked patients about transport and other costs incurred in reaching the clinic during the current visit, any perceived/estimated income losses in seeking care that day, and about borrowing or selling assets to pay for care. For availability, questions included the convenience of clinic location and opening hours, availability of needed services, travelling time and waiting time, and for acceptability, we asked questions about stigma, integration of services, sufficiency of staff, cleanliness of facilities and perceived behaviour of staff. Demographic (age, gender), socio-economic (education, employment, characteristics of housing, access to services and ownership of various assets) and adherence information (self-reported duration on ARVs, missed doses and missed visits) were also collected to enable a fuller specification of the differences between clubs and SOC.

The questionnaire was translated into isiXhosa (the main language spoken in the study population) and was administered by four field workers. Informed consent was obtained from each participant, and no remuneration was offered.

Data and statistical analysis. Completed questionnaires for each model of care were checked for accuracy and separately captured into EpiData 3.1 and exported to STATA 12.0 for analysis. *P*-values were computed using Kruskal–Wallis comparison of means test for quantitative data and Pearson's chi-squared test for binary data. Linear and logistic regressions were used to assess the relationship between the intervention and access variables while controlling for age, sex, socio-economic status (SES) and adherence. SES was assessed by running a multiple correspondence analysis on several variables including: type of housing (roof, wall, floor), water source for drinking, type of toilet, power source for cooking, level of education, type of employment and ownership of various assets (see more details for methods [29]).

Ethics

The research was approved by the Ethics Committee at the University of Cape Town's Health Sciences Faculty as well as by the Western Cape Department of Health.

Results

Cost-effectiveness analysis

Healthcare utilisation. As mentioned, there were 6194 active patients on ART at Ubuntu Clinic in 2011. ART services for these patients included 54 212 visits for SOC and 5656 visits for the clubs, generating visit utilisation rates of 10.30 for SOC and 6.07 for clubs per patient-year.

Provider costs by intervention type. The provider cost per ARV clinic visit for each model of care is presented in Table 1. All costs were lower in the clubs compared to SOC. In the SOC model, 46% of the total human resource costs related to doctors and 23% to nurses. Annual costs for ARVs and laboratory investigations were included and are presented in Table 2.

Effectiveness. There were 348 patients lost to care and 214 with virological rebound during 7548 patient-years contributed by patients eligible for clubs but remaining in standard of care, resulting in a rate of loss to care of 4.61 per 100 person-years (95% CI 4.14–5.12) and a rate of virological rebound of 2.84 per 100 person-years (95% CI 2.47–3.24); thus, at 1 year after meeting club entry criteria, estimated retention in care was 95.49% (95% CI: 95.01–95.94) and viral suppression was 97.20% (95% CI 96.81–97.56) for standard of care. The adjusted hazard ratios were 0.43 (95% CI 0.21–0.91) for loss to care and 0.33 (95% CI 0.16–0.67) for virological rebound. Hence, we estimated adjusted rates among all patients eligible for clubs if they were to attend clubs at 1.99 per 100 person-years (95% CI 1.68–2.33) for loss to care and 0.94 per 100 person-years (95% CI 0.73–1.19) for virological rebound; thus, at 1 year in clubs, the adjusted retention in care was 98.03% (95% CI 97.70–98.33) and viral suppression was 99.06% (95% CI 98.82–99.27).

Table 1 Provider cost per visit, by intervention

	Club	SOC
Medical officer (Gr 2)		US$ 2.71
Medical officer (Gr 1)		US$ 2.37
Pharmacist (Gr 2)	US$ 2.08	US$ 0.87
Operations manager	US$ 1.37	US$ 0.49
Clinical nurse practitioner	US$ 1.89	US$ 1.45
Professional nurses	US$ 1.26	US$ 0.96
Admin clerks		US$ 1.48
Club facilitators (lay counsellors)	US$ 1.03	
Nurse assistants	US$ 0.22	US$ 0.17
Pharmacy assistants (Gr 1)	US$ 1.00	US$ 0.42
Ongoing club mentorship	US$ 0.53	
Overheads & infrastructure	US$ 6.93	US$ 7.12
Club initial training	US$ 0.21	
Total cost per visit	US$ 16.52	US$ 18.04

Table 2 Provider cost per patient-year for ARVs and laboratory investigations

ARVs	US$ 142
CD4 test(s)	US$ 10
Viral load test(s)	US$ 50
Creatinine test(s)	US$ 4

Cost-effectiveness. Based on the above provider costs, utilisation estimates and effectiveness, cost-effectiveness results were computed. The higher visit utilisation in SOC coupled with higher costs per visit resulted in a cost per patient-year of US$ 374 in comparison with US$ 300 in clubs, while patients in the club model were more likely to be retained in care and to achieve virological suppression. Together, these results suggest that the club model is more *cost-effective* than SOC (lower costs and higher effectiveness). Table 3 summarises these findings.

Sensitivity analysis. The full set of one-way sensitivity analyses is summarised using a Tornado Analysis (Figure 1). The x-axis summarises the incremental cost-effectiveness ratio (ICER – difference in costs divided by difference in effectiveness, using retention in care as the measure). At baseline values, the expected value of the ICER is shown in the figure to be the *negative* value of US$ 2909.57 per point increase in retention in care. The bars in the figure depict the value of the ICER for the sensitivity analyses undertaken. For most values, clubs remain cheaper than SOC, as shown by the predominantly negative values on the ICER. In threshold analysis, we calculated that a more than 75% increase in the club cost per visit or club visit utilisation or a more than 42% decrease in the SOC cost per visit or SOC visit utilisation would result in SOC becoming the less costly model.

Access study

Table 4 summarises demographic and socio-economic findings. Both groups were on average 40 years of age and predominantly women. Club patients had been on treatment for longer. Although not statistically

Table 3 Cost-effectiveness results (provider perspective)

Strategy	Cost	Incremental cost	Effectiveness (RIC) (%)	Effectiveness (VS) (%)	Incremental effectiveness (RIC)	Incremental effectiveness (VS)	ICER
Club	US$ 300		98.03	99.06			
Standard of care	US$ 374	US$ 74	95.49	97.20	−2.54%	−1.86%	Dominated*

RIC, retention in care; VS, viral suppression.
*Standard of care is absolutely dominated by ART Clubs given higher costs and lower effectiveness.

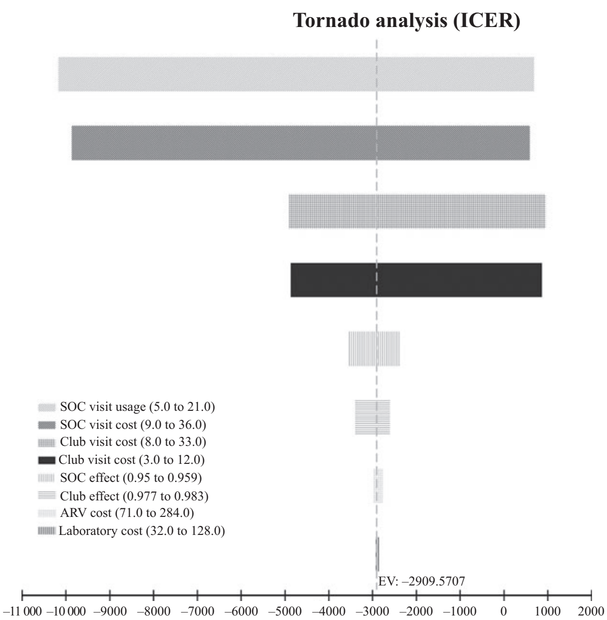

Figure 1 Tornado diagram summarizing sensitivity analysis findings within the cost-effectiveness analysis (provider perspective).

Table 4 Demographic and socio-economic characteristics of respondents enrolled in adherence clubs *vs.* standard of care

Variable	Club	SOC	*P*-value
Demographics			
Age (mean years)	40	40	0.893
Sex (% female)	79%	81%	0.667
Socio-economic status (% in poorest half)	47%	53%	0.248
Adherence			
Duration on ARVs (mean years)	6.85	5.16	<0.001
Ever missed taking ARVs (% yes)	33%	37%	0.469
Ever missed visit for HIV care (% yes)	19%	37%	<0.001

significant, a larger percentage of patients from SOC (53% *vs.* 47%) were in the poorest group (patients were grouped into two socio-economic categories). Significantly more patients in SOC (37%) reported missing a clinic appointment compared to club respondents (19%, $P < 0.001$).

While controlling for differences in age, sex, SES and adherence, we ran linear and logistic regressions to unpack the perceived accessibility of the alternative models of care (Table 5).

Availability. Ubuntu clinic was more likely to be the closest facility to the patient's home in SOC respondents, but the time spent waiting at the clinic was longer – at 176 min for SOC *vs.* 67 min for club respondents ($P < 0.001$). The average travelling time was reported to be 31 min in the SOC and 24 min in the club group ($P = 0.022$); 46% reported being able to walk to the facility in both groups. More club patients reported that all their HIV needs were met at the clinic in comparison with SOC (99% *vs.* 94%; $P = 0.041$).

Affordability. Affordability problems were raised by both groups, with 19% and 16% reporting borrowing money to pay for health care in the past month, in clubs and SOC, respectively. Although not statistically significant, 13% of patients in the SOC reported losing income while seeking care compared to 8% in the club. SOC respondents also reported higher out of pocket expenditure incurred during their current visit (US$ 1.46 *vs.* US$ 0.90). Because ART services are free to patients, these expenditures would typically include transport costs to reach the facility and possibly also include purchases of food while waiting at the clinic.

Acceptability. In both groups, patients reported that health facility staff were respectful (99% in clubs *vs.* 94% in SOC) and had time to listen to their needs (96% in clubs *vs.* 92% in SOC) while nevertheless feeling stigmatised by their HIV status (26% in clubs *vs.* 23% in SOC). There were two important differences regarding

Table 5 Access (availability, affordability, acceptability) differences by model of care

Variable	Club	SOC	Adjusted OR or coefficient (95% CI)	*P*-value
Availability				
Closest ARV clinic to home (% yes)	79%	90%	0.41 (0.21–0.79)	**0.008**
Opening hours convenient (% yes)	95%	93%	1.70 (0.63–4.56)	0.291
All HIV health needs are met at clinic (% yes)	99%	94%	8.92 (1.10–72.55)	**0.041**
Able to walk to clinic (% yes)	46%	46%	0.97 (0.61–1.55)	0.902
Time spent travelling to clinic (mean minutes)	25	31	−6.35 (−11.77 to −0.93)	**0.022**
Time spent at the clinic (mean minutes)	68	176	−109.70 (−132.49 to −86.92)	**<0.001**
Affordability				
In the past month, borrowed money to pay for health care (% yes)	19%	16%	1.25 (0.68–2.30)	0.463
In the past month, sold items to pay for health care (% yes)	4%	3%	1.33 (0.39–4.54)	0.651
Lost income in seeking care today (% yes)	9%	13%	0.61 (0.29–1.29)	0.196
Transport and similar payments for seeking care today (mean)	US$ 0.90	US$ 1.46	−4.17 (−15.45 to 7.11)	0.468
Acceptability				
Perceive stigma (% yes)	26%	23%	1.19 (0.70–2.04)	0.525
Prefer HIV clinic to be integrated with other services (% yes)	11%	19%	0.52 (0.26–1.02)	0.057
Sufficient health workers in clinic (% yes)	49%	35%	1.77 (1.11–2.82)	**0.016**
Staff are respectful (% yes)	99%	94%	4.53 (0.95–21.46)	0.057
Staff have time to listen to needs (% yes)	96%	92%	2.01 (0.72–5.59)	0.180
Facility is clean (% yes)	71%	56%	1.86 (1.15–3.02)	**0.012**

OR, odds ratio; CI, confidence interval. Bold font denotes statistical significance.

the acceptability dimension. While both groups generally felt that there were too few staff in the facility, 49% of club respondents felt there were enough staff *vs*. 34% in SOC ($P = 0.016$). The second difference was that 71% of club respondents felt that the facility was clean compared to 56% in SOC ($P = 0.012$).

Discussion

Using a provider perspective, this study presents the cost-effectiveness of adherence clubs, an alternative model of ART delivery differentiated to cater for the specific long-term needs of stable ART patients in a high burden setting. In conjunction, we have evaluated the perceived accessibility of each model of care by interviewing patients about their experiences. The analysis has two main conclusions: adherence clubs are cost-effective compared to SOC, and they have the potential to improve accessibility to ART. The combination of the cost-effectiveness and the access study is one of the key strengths of this analysis. Given the high burden of ART, understanding potential provider cost savings is important to decision makers in our setting, while our analysis of perceived accessibility provides added insight into the patient experience of accessing ART.

Few costing studies have been done on community models of ART [30]. We found only a handful that assessed the cost-effectiveness of task shifting and even fewer that evaluated task shifting to lay workers [31]. One other similar costing study, which compared lay health workers providing care at patients' homes to SOC, also found community-based care to be cost saving, at US$ 793 per patient-year compared with SOC at US$ 838 [32].

This analysis has important policy implications. If South Africa is to accomplish its aim of adopting the WHO's test and treat strategy [33], addressing human resource shortages is among the factors that needs urgent attention. Adherence clubs were cost-effective compared with standard of care with regard to achieving two of three of the UNAIDS 90-90-90 targets, namely retaining 90% of people tested for HIV on antiretroviral therapy and maintaining viral suppression in 90% of people on ART [8]. Within this context, clubs represent an important public health strategy as they have the potential to expand the capacity of the current health system while at the same time making it easier for patients to stay on effective treatment long term.

A further favourable feature of the adherence club model is that club meetings can be held anywhere. Our research suggests that it would be relatively simple to replicate or adjust the club approach to meet the requirements of other settings. It is also important to note that alternate community models of care such as 'community ARV groups' (CAGs), where patients take turns to collect their group's medication from the facility [34], may be more cost-effective in rural areas and also deserve further examination.

The outcomes of this study need to be considered in the light of the following limitations. Firstly, our access findings are influenced by recall bias. Secondly, interviews rather than a time and motion study were used to estimate human resource utilisation. Thirdly, different patient groups (drawn from the same setting) were used to measure provider costs, effectiveness and accessibility. While a randomised controlled study design would generate more rigorous findings, pragmatic and ethical considerations meant that clubs were initially offered as a pilot. We have adjusted for this in our analysis of effectiveness and through undertaking a range of sensitivity analyses.

In conclusion, adherence clubs offer the potential for enhanced retention in care, enhanced viral suppression, lower provider costs and improved accessibility when compared to routine clinic-based ART care. These important benefits strongly suggest that similar models of care should be considered for wide-scale implementation.

References

1. Ford N, Calmy A, Mills E J. The first decade of antiretroviral therapy in Africa. *Global Health* [Internet]. BioMed Central Ltd 2011: **7**: 33. (Available from: http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=3192657&tool=pmcentrez&rendertype=abstract).
2. Fox M P, Rosen S. Patient retention in antiretroviral therapy programs up to three years on treatment in sub-Saharan Africa, 2007–2009: systematic review. *Trop Med Int Heal* 2010: **15**(Suppl. 1): 1–15.
3. World Health Organization. *Retention in HIV Programmes: Defining the Challenges and Identifying Solutions*. World Health Organization: Geneva, 2011.
4. Grimsrud A, Balkan S, Casas E C *et al.* Outcomes of antiretroviral therapy over a 10-year period of expansion: a multicohort analysis of African and Asian HIV programs. *J Acquir Immune Defic Syndr* [Internet] 2014: **67**: e55–e66. (Available from: http://www.ncbi.nlm.nih.gov/pubmed/24977472).
5. Miller C M, Ketlhapile M, Rybasack-Smith H, Rosen S. Why are antiretroviral treatment patients lost to follow-up? A qualitative study from South Africa. *Trop Med Int Heal* [Internet] 2010: **15**: 48–54. (Available from: http://doi.wiley.com/10.1111/j.1365-3156.2010.02514.x).
6. Scanlon M L, Vreeman R C. Current strategies for improving access and adherence to antiretroviral therapies in resource-limited settings. *HIV/AIDS – Res Palliat Care* [Internet] 2013: **5**: 1–17. (Available from: http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=3544393&tool=pmcentrez&rendertype=abstract).
7. Kranzer K, Lewis J J, Ford N *et al.* Treatment interruption in a primary care antiretroviral therapy programme in South Africa: cohort analysis of trends and risk factors. *J Acquir Immune Defic Syndr* 2011: **55**: e17–e23.
8. UNAIDS. 90-90-90. An ambitious treatment target to help end the AIDS epidemic, 2014.
9. Rosen S, Fox M P, Gill C J. Patient retention in antiretroviral therapy programs in sub-Saharan Africa: a systematic review. *PLoS Med* 2007: **4**: 1691–1701.
10. Tagar E, Sundaram M, Condliffe K *et al.* Multi-country analysis of treatment costs for HIV/AIDS (MATCH): facility-level ART unit cost analysis in Ethiopia, Malawi, Rwanda, South Africa and Zambia. *PLoS One* [Internet] 2014: **9**: e108304. (Available from: http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=4229087&tool=pmcentrez&rendertype=abstract).
11. Clouse K, Pettifor A, Maskew M. Patient retention from HIV diagnosis through one year on antiretroviral therapy at a primary healthcare clinic in Johannesburg, South Africa. *J Acquir Immune Defic Syndr* [Internet] 2013: **62**: 22–27. (Available from: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3548953/).
12. Geng E H, Nash D, Kambugu A *et al.* Retention in care among HIV-infected patients in resource-limited settings: emerging insights and new directions. *Curr HIV/AIDS Rep* 2010: **7**: 234–244.
13. Mugglin C, Estill J, Wandeler G *et al.* Loss to programme between HIV diagnosis and initiation of antiretroviral therapy in sub-Saharan Africa: systematic review and meta-analysis. *Trop Med Int Heal* 2014: **17**: 1509–1520.
14. Lecher S, Ellenberger D, Kim A. Scale-up of HIV viral load monitoring – seven sub-Saharan countries. *MMWR Morb Mortal Wkly Rep* 2015: **64**: 1287–1290.
15. Elul B, Basinga P, Nuwagaba-Biribonwoha H *et al.* High levels of adherence and viral suppression in a nationally representative sample of HIV-infected adults on antiretroviral therapy for 6, 12 and 18 months in Rwanda. *PLoS One* 2013: **8**: 4–14.
16. Unaids. GLOBAL REPORT: UNAIDS report on the global AIDS epidemic 2013 [Internet]. Unaids, 2013; 198 p. (Available from: www.unaids.org/.../unaids/.../2013/gr2013/UNAIDS_Global_Report_2013.)
17. Mayosi B, Benatar S R. Health and health care in South Africa – 20 years after Mandela. *N Engl J Med* 2014: **371**: 1344–1353.
18. National Department of Health. District Health Information System (DHIS) Database, 2013.
19. UNAIDS. World Aids Day Report. World AIDS Day Report, 2012.
20. International Organization for Migration. Health Worker Migration in South and Southern Africa. The International Organization for Migration: Literature Review [Internet].

Pretoria, 2007. (Available from: http://medcontent.metapress.com/index/A65RM03P4874243N.pdf) [29 Oct 2014].

21. Nglazi M D, Kaplan R, Wood R, Bekker L-G, Lawn S D. Identification of losses to follow-up in a community-based antiretroviral therapy clinic in South Africa using a computerized pharmacy tracking system. *BMC Infect Dis* [Internet]. BioMed Central Ltd 2010: **10**: 329. (Available from: http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=3000400&tool=pmcentrez&rendertype=abstract).
22. Luque-Fernandez M A, Van C G, Goemaere E *et al.* Effectiveness of patient adherence groups as a model of care for stable patients on antiretroviral therapy in Khayelitsha, Cape Town, South Africa. *PLoS One* [Internet] 2013: **8**: e56088. (Available from: http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=3571960&tool=pmcentrez&rendertype=abstract).
23. Zachariah R, Ford N, Philips M *et al.* Task shifting in HIV/AIDS: opportunities, challenges and proposed actions for sub-Saharan Africa. *Trans R Soc Trop Med Hyg* [Internet] 2009: **103**: 549–558. (Available from: http://trstmh.oxfordjournals.org/cgi/doi/10.1016/j.trstmh.2008.09.019).
24. Horstmann E, Brown J, Islam F, Buck J, Agins B D. Retaining HIV-infected patients in care: where are we? Where do we go from here? *Clin Infect Dis* [Internet] 2010: **50**: 752–761. 100201102709029–000. (Available from: http://cid.oxfordjournals.org/lookup/doi/10.1086/649933).
25. Reagon G, Igumbor E. Strengthening health systems through training of health care providers in the conduct of routine waiting time and system efficiency surveys. *Stud Health Technol Inform* 2010: **160**(Pt 1): 590–594.
26. McIntyre D, Thiede M, Birch S. Access as a policy-relevant concept in low- and middle-income countries. *Heal Econ Policy Law* [Internet] 2009: **4**: 179–193. (Available from: http://www.journals.cambridge.org/abstract_S1744133109004836).
27. SAnews.gov.za. *One ARV Pill a Day: New Fixed Dose Combination ARVs [Internet]*. (Available from: http://www.sanews.gov.za/special-features-archive/fixed-dose-combination-arvs-everything-you-need-know) [22 Dec 2015].
28. Meyer-Rath G, Over M. HIV treatment as prevention: modelling the cost of antiretroviral treatment – state of the art and future directions. *PLoS Med* [Internet] 2012: **9**: e1001247. (Available from: http://journals.plos.org/plosmedicine/article?id=10.1371/journal.pmed.1001247).
29. Cleary S M, Birch S, Moshabela M, Schneider H. Unequal access to ART: exploratory results from rural and urban case studies of ART use. *Sex Transm Infect* [Internet] 2012: **88**: 141–146. (Available from: http://www.ncbi.nlm.nih.gov/pubmed/22345029) [17 Aug 2013].
30. Bemelmans M, Baert S, Goemaere E *et al.* Community-supported models of care for people on HIV treatment in sub-Saharan Africa. *Trop Med Int Heal* [Internet] 2014: **19**: 968–977.
31. Mdege N D, Chindove S, Ali S. The effectiveness and cost implications of task-shifting in the delivery of antiretroviral therapy to HIV-infected patients: a systematic review. *Health Policy Plan* [Internet] 2013: **28**: 223–236. (Available from: http://www.heapol.oxfordjournals.org/cgi/doi/10.1093/heapol/czs058).
32. Jaffar S, Amuron B, Foster S *et al.* Rates of virological failure in patients treated in a home-based versus a facility-based HIV-care model in Jinja, southeast Uganda: a cluster-randomised equivalence trial. *Lancet* 2009: **374**: 2080–2089.
33. Motsoaledi A. Health Department Budget Vote 2016/17, 2016.
34. Decroo T, Telfer B, Biot M *et al.* Distribution of antiretroviral treatment through self-forming groups of patients in Tete province, Mozambique. *J Acquir Immune Defic Syndr* 2011: **56**: e39–e44.

Corresponding Author Susan Cleary, Health Economics Unit, School of Public Health and Family Medicine, Faculty of Health Sciences, University of Cape Town, Observatory 7925, South Africa. Tel.: +27 21 406 6300; E-mail: susan.cleary@uct.ac.za

