BMJ Open

The effect of Community ART Groups on retention-in-care among patients on ART in Tete Province, Mozambique: a cohort study

Journal:	*BMJ Open*
Manuscript ID	bmjopen-2017-016800
Article Type:	Research
Date Submitted by the Author:	13-Mar-2017
Complete List of Authors:	Decroo, Tom; MSF OCB, Medical Department Telfer, Barbara; Medecins Sans Frontieres Das Dores, Carla; Direccao Provincial de Saude, Tete, Mocambique White, Richard; Norwegian Institute of Public Health, Department of Health Statistics; Norwegian Institute of Public Health, Department of Infectious Disease Epidemiology Dos Santos, Natacha; Medecins Sans Frontieres Mkwamba, Alec; Medecins Sans Frontieres Dezembro, Sergio; Medecins Sans Frontieres Joffrisse, Mariano; Medecins Sans Frontieres Ellman, Tom; Medecins Sans Frontieres Metcalf, Carol; Medecins Sans Frontieres
Primary Subject Heading:	HIV/AIDS
Secondary Subject Heading:	Patient-centred medicine
Keywords:	HIV, community participation, health services accessibility, peer support, treatment outcome

The effect of Community ART Groups on retention-in-care among patients on ART in Tete Province, Mozambique: a cohort study

Tom Decroo[1,a], Barbara Telfer[1], Carla Das Dores[2], Richard A White[3], Natacha Dos Santos[1], Alec Mkwamba[1], Sergio Dezembro[1], Mariano Joffrisse[1], Tom Ellman[4], Carol Metcalf[4]

[a] Corresponding author : tomdecroo2@gmail.com

1 Médecins Sans Frontières, Tete, Mozambique

2 Direcção Provincial de Saúde Tete, Moçambique

3 Department of Infectious Disease Epidemiology and Modelling, Norwegian Institute of Public Health, Oslo, Norway

4 Médecins Sans Frontières, Southern Africa Medical Unit, Cape Town, South Africa

Abstract

Objectives: Estimate the effect of participation in Community ART Groups (CAG) versus individual care on retention-in-care on antiretroviral therapy (ART).

Design: Retrospective cohort study.

Setting: High levels of attrition (death or loss-to-follow-up (LTFU) combined) on ART indicate that delivery models need to adapt in sub-Saharan Africa. In 2008, patients more than six months on ART began forming CAG, and took turns to collect ART refills at the health facility, in Tete Province, Mozambique,.

Participants: 2406 adult patients, retained-in-care for at least six months after starting ART, during the study period (date of CAG introduction at the health facility-30 April 2012).

Methods: Data up to 30 April 2012 was collected from patient records at eight health facilities. Survival analysis was used to compare retention-in-care among patients in CAG and patients in individual care, with joining a CAG treated as an irreversible time-dependent variable. Multivariable Cox regression was used to estimate the effect of CAG on retention-in-care, adjusted for age, sex, and health facility type, and stratified by calendar cohort.

Results: Twelve-month and 24-month retention-in-care from the time of eligibility were respectively 89.5% and 82.3% among patients in individual care and 99.1% and 97.5% among those in CAGs (p <0.0001). CAG members had a greater than five-fold reduction in risk of dying or being lost-to-follow-up (adjusted hazard ratio [aHR]: 0.18, 95% CI: 0.11-0.29).

Conclusions: Among patients on ART, retention-in-care was substantially better among those in CAGs than those in individual care. This study confirms that patient-driven ART distribution through CAGs results in higher retention-in-care among patients who are stable on ART.

Key words: HIV; community participation; health services accessibility; peer support; treatment outcome

Strengths and limitations of this study

- Community ART Groups (CAG) were piloted first in Tete province, Mozambique. The effect of participation in CAG versus individual care on retention-in-care on ART was not yet assessed in this pilot project.
- A large number of patients, with diverse characteristics, were included in the analysis. The findings are representative of "real life" programmatic conditions.
- Another strength is that through our methodological approach we minimized the potential for survival bias by starting follow-up 6 months after ART initiation in order to exclude patients who had not yet stabilized on ART; and treating CAG status as a time-dependent variable to ensure that retention-in-care prior to joining a CAG was taken into account.
- However, the applied exclusion criteria may have resulted in some selection bias, making the findings less generalizable. Moreover, patients who opted to join a CAG and those who remained in individual care may have differed with respect to factors which we did not take into consideration in the analysis.

Introduction

Currently an estimated 36.7 million people are living with HIV (PLHIV), of whom 17 million were on antiretroviral therapy (ART) at the end of 2015.[1] Will it be feasible to achieve the UNAIDS target of having 73% of all PLHIV on ART and virologically-suppressed by 2020? Such an unprecedented undertaking will require innovative approaches, especially in sub-Saharan Africa (SSA), where the HIV burden is the highest, and health workforce gaps and other challenges hamper response.[2] In addition, high levels of attrition (death or loss-to-follow-up (LTFU) combined) undermine the proven benefits of early treatment for individuals and the prevention of onward transmission of HIV.[3] A recent systematic review reported attrition rates in ART programs in African countries of 18%, 24%, and 31% after six months, one year, and two years of ART, respectively.[3] Distance to health facilities, transport costs, long waiting times at the health facilities, work responsibilities, and family commitments have been reported as reasons for defaulting treatment.[4] ART delivery closer to patients' homes is effective at improving retention-in-care.[4]

To enrol and retain millions of PLHIV on ART, health systems have had to adapt during the past decade. Several policies have been implemented to increase the capacity of understaffed health systems. Treatment has been decentralized from specialized HIV clinics to peripheral primary health care facilities.[5] Tasks have been shifted from doctors to nurses, from nurses to lay health-workers, and from lay health-workers to patients.[6] Additionally, in some countries delivery models have become increasingly patient-centered, allowing patients to combine lifelong ART refills with a normal social and economic life.[4,7]

Mozambique is one of the countries that have adopted a patient-centered ART delivery model. However, despite decentralization of ART provision, starting in 2006, LTFU rates remained unacceptably high.[8,9] Strategies, such as home visits to patients LTFU, had been unsuccessful in bringing patients back to

care.[10] Patients reported long distances, lack of information, queuing at health facilities, and stigma associated with regular clinic attendance, as barriers to retention-in-care.[11]

To overcome these barriers associated with the standard, clinic-based, individual-care approach to ART delivery, and drawing on published accounts of patient involvement in chronic disease care,[12] the Health Directorate of Tete Province and Médecins Sans Frontières proposed that clinically stable patients on ART be given the option of forming peer groups and becoming involved in ART delivery and monitoring.

Patients on ART are given the option of joining a peer group, or remaining in clinic-based individual care, and can move between the two models of care, according to their preference. These peer groups are named Community ART Groups (CAGs). To join a CAG, patients are required to be at least 15 years old, and to have been on ART for at least six months, and to be stable on treatment. Each CAG has a maximum of six members. Members take turns to travel to the clinic to collect monthly ART refills for all group members. Every month, before the CAG representative attends the health facility to collect the ART refills, the group meets in their community to discuss each member`s current health and treatment status and any travel plans. The CAG representative whose turn it is to collect the monthly ART refills has a clinical consultation and reports on the status of the other group members (retained on ART in the group, died, travelled, etc.). This information is recorded on a group monitoring card, which is kept in the clinic, and updated each month. CAG members are advised to make unscheduled visits to the health facility between ART refill appointments if they develop health problems, as do other patients who develop health problems during the intervals between scheduled appointments. Giving patients a high level of autonomy, the CAG model is the most patient-driven, community-based ART delivery model described to date.[13]

The CAG model has previously been described in more detail.[14] CAG members reported several benefits including time and cost savings. They reported that less frequent clinic visits was associated with reduced

experiences of stigma in the community, and viewed the CAG as a protective environment where they could share treatment experiences confidentially. Patients considered counsellors, lay health-workers trained in the basics of HIV care and psychosocial care, to be approachable. These counsellors played an important role in forming and monitoring CAGs.[15] Four year retention-in-care was 92%.[16] Despite this high retention-in-care on ART among patients in CAGs, these previous studies did not assess the relative effectiveness of the CAG model and the standard, clinic-based, individual care approach in retaining patients on ART, in Tete province, where CAG were piloted. We conducted a study to estimate the effect of the CAG model relative to standard individual care, on retention-in-care among patients on ART.

Methods

Study design

We conducted a retrospective cohort study using programme data.

Study setting

Mozambique has a population of 23.9 million inhabitants, of whom more than 70% live in rural areas.[17] HIV prevalence among sexually-active people is estimated to be 10.5%. Over 1.5 million people in Mozambique are living with HIV.[18] The government began providing ART in 2003.[9] Due to an extreme shortage of human resources and limited infrastructure, it took more than a decade to attain 50% ART coverage, according to the ART eligibility criteria in effect at the time. By the end of 2015, ART coverage was about 53%.[18]

The rural Province of Tete, in Mozambique, has a population of two million. An estimated 36% of the population has access to a health facility within 30 minutes of their home.[17] The province has 105 health facilities, spread across 15 districts. By mid-2012 only 32 of the 105 (30.5%) facilities in Tete Province offered ART.[9] Decentralization of ART provision towards peripheral clinics, in order to increase accessibility of ART, has been hampered by infrastructural constraints, a shortage of medically-qualified staff, organizational challenges, and a lack of regulation to push for task-shifting from nurses to lay health-workers.[19]

Of the 32 facilities in Tete Province that were providing ART in 2012, 12 (37.5%) implemented the CAG model in 2008 or 2009. Differences in the management of patients in standard individual care and those in CAGs are summarized in Table 1.

Study sites and population

Of 12 health facilities that had implemented the CAG model by the end of 2009, eight (Manje, Changara, Songo, Chitima, Mutarara, Moatize, Zobue, and Boroma) were included in this study. The other four facilities were excluded because the majority of patients on ART (>80%) were enrolled in CAGs, leaving few patients in standard individual care to serve as a comparison group.

Patients included in the study were known to be 15 to 59 years of age at ART commencement and had started ART 6 or less months prior to or after the CAG model was introduced at the health facility . In order to minimize survival bias, patients who started ART more than 6 months before the CAG model was introduced at the health facility that they were attending, and patients who transferred to the health facility more than 6 months after starting ART, were excluded from the analysis. Patients younger than 15 years, 60 years and older, with an unknown age at ART initiation, were also excluded from the analysis. Patients who remained in care for less than 6 months after starting ART were excluded because patients are required to be stable on ART in order to be eligible to join a CAG, and mortality is highest in the first 6 months after starting ART.[20,21]

Study period

The start of the study period varied by health facility, starting on the date that the first CAGs were formed at the facility. Patients at all 8 study facilities were followed-up until the end of April 2012. For the purpose of this analysis, patients entered the cohort on the date on which they became eligible to join a CAG, defined as 6 months after starting ART.

Data collection and definition of variables

Patient-files and clinic-held copies of CAG cards were used as data sources. Data was abstracted during the second half of 2012 and 2013, and entered into a Microsoft Access database. CAG monitoring tools and processes have been described elsewhere.[14]

The information collected included patient socio-demographic characteristics (sex, age at ART initiation, date of ART initiation, CD4 results, date of joining a CAG, and date of returning to individual care, if applicable), treatment outcomes and dates. The following treatment outcomes were recorded: retained-in-care at the end of the study period (30 April 2012), dead, lost to follow-up (LTFU), and transferred out. LTFU was defined as being more than 2 months overdue for the most recent appointment or scheduled ART refill. Health facilities were categorized as peri-urban or rural based on the geographical setting in which they are located. The two peri-urban facilities (Moatize and Songo) have medical specialists, a referral laboratory and radiology facilities available, and the rural facilities (Manje, Changara, Chitima, Mutarara, Zobue, and Boroma) are primary health care facilities run by nurses.

Data analysis

The analysis was performed using Stata Version 14 (StataCorp, College Station, Texas, USA).

Some numeric variables were categorized to facilitate the analysis. Median and interquartile ranges (IQR) were calculated for numeric variables and proportions for categorical variables.

Survival analysis was used to compare retention-in-care among patients in CAG and patients in individual care. Joining a CAG was treated as an irreversible time-dependent variable, with patients included in the "not in a CAG" group until they joined a CAG, and in the CAG group from the date that they joined a CAG. CAG members who returned to individual care (n = 11), were retained in the CAG group in the survival analyses. Univariable and multivariable Cox regression were used to estimate crude hazard ratios (HRs)

and adjusted hazard ratios (aHR) for attrition. The aHRs were adjusted for age, sex, and health facility type, and stratified by calendar period of ART initiation (six-month intervals).

Patients who remained in care at the end of the study period had their follow-up censored on 30 April, 2012. Patients who were LTFU, or who died during the study period, were considered as having experienced the outcome event (attrition), with the outcome date defined as the most recent date of contact with the health facility, either in the form of an individual clinic visit, or an ART refill collected by another CAG member on the patient's behalf. Patients who were transferred to another facility were censored on the date of transfer.

Ethics

This study was approved by the Ethics Review Board of Médecins Sans Frontières (Geneva, Switzerland) and the Mozambican National Bioethics Committee (Comite Nacional De Bioetica para a Saúde).

Results

During the study period, between 1 February 2008 and 30 April 2012, 9,266 patients were provided with ART in the eight health facilities. Of these patients, 2,406 were included in the analysis and 6,860 were excluded for reasons shown in Figure 1.

Of the 2,406 patients who satisfied the inclusion criteria, 901 (37.5%) joined a CAG during the study period (Table 2). Patients who joined a CAG were also more likely to be female (CAG: 70.3%; 631/901; non-CAG: 59.9%; 883/1505), and attending a rural clinic (CAG: 64.8%; 584/901; non-CAG: 57.3%; 862/1505). Patients who joined a CAG had a longer follow-up time (median: 26 months, IQR: 18 to 33 months) from the date that they entered the cohort and the end of the study (30 April 2012) than those who did not join a CAG (median: 16 months, IQR: 7 to 27 months).

CAG patients joined a CAG after a median of 8.3 (IQR 3.6 to 16.7) months from the time of eligibility (6 months after starting ART). Overall, 279 out of 2406 (12%) patients died or were LTFU by the end of the study period (30 April, 2012).

Overall, 12-month retention-in-care (RIC) from the date of eligibility was 90.8% (95%CI: 89.5% to 92.0%) and 24-month RIC was 86.0% (95%CI: 84.2% to 87.6%). RIC was significantly greater among patients in CAGs than those not in CAGs (stratified log-rank test: p <0.0001) (Figure 2). Twelve-month RIC was 99.1% (95% CI: 97.3 to 99.7%) among those in CAGs and 89.5% (95% CI: 87.9 to 90.8%) among those not in CAGs (Table 3).

Adjusted for age, gender, health facility type, and stratified by calendar period of ART initiation, patients in CAG had a more than five-fold lower rate of attrition (aHR: 0.18, 95% CI: 0.11 – 0.29) (Table 3). The risk of attrition was higher among patients younger than 25 years compared to those aged 30 – 39 years

(aHR: 1.65, 95%CI: 1.17 –2.32); and among males compared to females (aHR: 1.80, 95%CI: 1.41 – 2.30) (Table 3).

Discussion

We found that RIC among patients in CAGs was substantially higher than among patients in individual care. After adjustment for age, gender, health facility type, and after stratification by calendar period of ART initiation, patients in CAG were more than five times less at risk to die or to be LTFU. Other studies on RIC in CAG and individual care showed similar findings. Reports of high retention-in-care in CAG in Tete province informed CAG pilots, in Mozambique, and in Lesotho. The Mozambique national pilot showed 91.4% and 82.9% RIC in CAG and individual care, respectively. This study included patients from 68 health facilities in 7 different provinces (not Tete province), a mix of urban and rural, and high and low volume ART clinics.[22] The MSF supported pilot in Lesotho showed 98.7% and 90.2% RIC in CAG and individual care, respectively.[23]

Overall, 12-month RIC from the date of eligibility (6 months after starting ART) was 90.8% and 24-month RIC was 86.0%. These findings are similar to what is reported by other studies conducted in Mozambique. In a study conducted in rural Mozambique, two-year attrition among patients more than 12 months on ART was 16.2%.[24] Another Mozambican study showed late attrition rates (after 6 months on ART) of 15 patients per 100 person-years in urban clinics, and 23 patients per 100 person-years in rural clinics.[8] A systematic review analyzed data from eight Mozambican studies and found attrition of 17% at 6 months, 28% at 12 months, and 44% at 24 months.[3]

A strength of this study is the large number of patients, with diverse characteristics included in the analysis. Another strength is that all the study facilities gave patients the option between individual, clinic-based care and CAG, thus enabling the models of care to be compared under “real life” programmatic conditions. Therefore our findings are representative of the reality of the program in Tete. Another strength is our methodological approach. Patients entered the cohort after being on ART for 6 months, thus excluding patients who had not yet stabilized on ART. Among patients on ART, attrition has

been found to be highest immediately after ART initiation, gradually declining over the following year.[3] We minimized the potential for survival bias by excluding patients who had started ART more than 6 months before CAGs were introduced at the facility; starting follow-up 6 months after ART initiation in order to exclude patients who had not yet stabilized on ART; treating CAG status as a time-dependent variable to ensure that retention-in-care prior to joining a CAG was taken into account; and stratifying the Cox regression analyses by calendar period of entry into the cohort to take into account potential interaction between CAG status and calendar period with respect to attrition. Finally, we adhered to the STROBE guidelines for cohort studies.

However, there are also limitations to this study. The exclusion criteria that we chose may have resulted in some selection bias, making the findings less generalizable. Moreover, patients who opted to join a CAG and those who remained in individual care may have differed with respect to hidden confounding factors which we did not take into consideration in the analysis. Potential confounders for which we were unable to adjust in the analysis, due to a lack of data, include distance of the patients' homes from the clinic, psychosocial characteristics, and health prognosticators such as CD4. There may thus be some residual confounding in the estimated risk of attrition associated with CAG status and the other factors (age, sex, facility type) that we considered in the analysis. Moreover, due to the very nature of the CAG model as described in Table 1, ascertainment of being LTFU was likely more accurate among those in CAG compared with those who remained in standard, individual care, which may have resulted in measurement bias. Finally, we were unable to use viral suppression as an outcome because routine viral load monitoring was not available during the study period. Although we found high retention-in-care among patients in CAGs, we were unable to assess adherence to treatment. Further research is needed to compare viral load outcomes of patients in individual care.

The finding that attrition may be reduced by a patient-driven ART distribution model has important implications, especially in rural contexts. The high retention-in-care among patients who joined CAGs can be attributed to a combination of factors including: a reduced time spent travelling to and from the facility and queuing at the facility; reduced health care-related transport costs; and enhanced information-sharing within the community and between the community and health-care workers.[15] Peer support and higher levels of self-efficacy have been identified as important enablers of successful lifelong HIV care.[25] Peer support enhances utilization of health care services, and has a positive effect on quality of life.[26] Rasschaert et al found that relationships between patients and healthcare providers changed profoundly after the CAG model was implemented. CAG members were perceived by clinic and community staff as co-providers because they took responsibility for medical tasks, served as a channel of communication between community members and healthcare providers, and reduced the workload of healthcare workers, especially in rural health facilities.[27]

In 2008, when the CAG model was introduced, clinicians and healthcare workers were concerned about whether medical tasks such as ART distribution could be delegated to patients. The results of this study confirm that ART distribution can be delegated to patients, and demonstrates that patients can take responsibility for their lifelong HIV care, especially when supported by their peers. Earlier studies have shown the benefit of involving patients in peer-to-peer activities without remuneration, including counselling, tracing of patients LTFU, administrative tasks in health facilities, and income-generation projects.[28,29]. But none of these community-based ART delivery models was driven by the voluntary engagement of PLHIV, motivated by their own health needs. Other community-based ART delivery models in Uganda and Kenya, have introduced ART delivery to patients' homes by paid lay healthcare workers, who are recognized and accountable as formal healthcare workers, and equipped with motorbikes and cell phones.[30-32]

To achieve and sustain high ART coverage, health programs need to differentiate and adapt to the specific needs of different subgroups, including virologically suppressed patients on ART, clinically unstable patients, HIV/TB co-infected patients, and adolescents.[33,34] For those stable on ART less frequent clinic visits and out-of-clinic ART refill are recommended to reduce maximally the burdens on patients and rationalize the use of the scarce health workforce.[35]

Currently CAG are rolled out nationally in Mozambique, and in neighboring countries such as Lesotho, Zimbabwe, and Malawi.[22,23] In Tete Province the daily management of CAG strongly depended of facility-based lay counsellors.[15,26] Adaptation of this patient-driven delivery model, which was rooted in the rural community of central Mozambique, will be needed to be adapted to local contexts, needs of specific patient groups, available resources and national policies.

Conclusion

RIC was substantially higher among patients on ART in CAG than among those in individual care. Exclusion of the first six months on ART from the follow-up period, and the exclusion of patients who had been on ART for more than 6 months at the time that CAGs became available at the facility that they were attending, reduced the potential for survival bias but, as the study was observational in design, residual or unmeasured confounders may have contributed to the differences observed. Nevertheless this study confirms that patient-driven ART distribution through CAGs results in high RIC, and supports the Mozambique Ministry of Health in rolling out CAG nationally.

Acknowledgements: Special thanks to all the Mozambican staff, CAG focal points, and CAG members.

Authors' contributions: BT, TE, CM, CDD, and TD conceived the study and designed the study protocol. NDS, SD, MJ collected the data. Data analysis was conducted by CM, RW, and TD. TD wrote the first draft of the paper. All co-authors contributed to the subsequent draft and approved the final version.

Data sharing statement: Data can be made available upon request to the corresponding author.

Funding: This research received no specific grant from any funding agency in the public, commercial, or non-profit sectors.

Competing interests: None declared.

Ethics approval: This study was approved by the Ethics Review Board of Médecins Sans Frontières (Geneva, Switzerland) and the Mozambican National Bioethics Committee (Comite Nacional De Bioetica para a Saúde).

References

1 UNAIDS. *Fact sheet 2016.* UNAIDS, 2016. http://www.unaids.org/en/resources/fact-sheet

2 World Health Organization. *March 2014 supplement to the 2013 consolidated guidelines on the use of antiretroviral drugs for treating and preventing HIV infection. Recommendations for a public health approach.* World Health Organization, 2014. http://www.who.int/hiv/pub/guidelines/arv2013/arvs2013upplement_march2014/en/

3 Fox MP, Rosen S. Retention of Adult Patients on Antiretroviral Therapy in Low- and Middle-Income Countries: Systematic Review and Meta-analysis 2008-2013. *J Acquir Immune Defic Syndr* 2015;69(1):98–108.

4 Govindasamy D, Ford N, Kranzer K. Risk factors, barriers and facilitators for linkage to antiretroviral therapy care: a systematic review. *AIDS* 2012;26(16):2059–67.

5 Kredo T Ford N, Adeniyi FB, Garner P. Decentralising HIV treatment in lower- and middle-income countries. *Cochrane Database Syst Rev* 2013; (6):CD009987.

6 Callaghan M, Ford N, Schneider H. A systematic review of task-shifting for HIV treatment and care in Africa. *Hum Resour Health* 2010;8:8.

7 Duncombe C, Rosenblum S, Hellmann N, *et al*. Reframing HIV care: putting people at the centre of antiretroviral delivery. *Trop Med Int Health* 2015; 20(4):430–47.

8 Lambdin BH, Micek MA, Sherr K, , *et al.* Integration of HIV care and treatment in primary health care centers and patient retention in central Mozambique: a retrospective cohort study. *J Acquir Immune Defic Syndr* 2013; 62(5):e146–52.

9 Ministry of Health Mozambique. Global AIDS Response Progress Report for the Period 2010 - 2011, Mozambique. Ministry of Health Mozambique, 2012. http://www.unaids.org/sites/default/files/country/documents//file,94670,es..pdf

10 Caluwaerts C, Maendaenda R, Maldonado F, *et al*. Risk factors and true outcomes for lost to follow-up individuals in an antiretroviral treatment programme in Tete, Mozambique. *Int Health* 2009;1(1):97–101.

11 Posse M, Baltussen R. Barriers to access to antiretroviral treatment in Mozambique, as perceived by patients and health workers in urban and rural settings. *AIDS Patient Care STDS* 2009; 23(10):867–75.

12 Kober K, Van Damme W. Expert patients and AIDS care. A literature review on expert patient programmes in high-income countries, and an exploration of their relevance for HIV/AIDS care in low-income countries with severe human resource shortages. 2008. http://www.eldis.org/fulltext/kober-vandamme.pdf

13 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 Health* 2014; 19(8):968–77.

14 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(2):e39–44.

15 Rasschaert F, Telfer B, Lessitala F, *et al*. A qualitative assessment of a community antiretroviral therapy group model in Tete, Mozambique. *PLoS One* 2014; 9(3):e91544.

16 Decroo T, Koole O, Remartinez D, *et al*. Four-year retention and risk factors for attrition among members of community ART groups in Tete, Mozambique. *Trop Med Int Health* 2014;19(5):514–21.

17 World Health Organization. *WHO Country Cooperation Strategy 2009-2013. Mozambique.* World Health Organization, 2009. http://www.who.int/countryfocus/cooperation_strategy/ccs_moz_en.pdf

18 UNAIDS. *AIDSinfo.* UNAIDS, 2016. Available at http://aidsinfo.unaids.org/

19 Decroo T, Panunzi I, das Dores C, Maldonado F, Biot M, Ford N, Chu K. Lessons learned during down referral of antiretroviral treatment in Tete, Mozambique. J Int AIDS Soc. 2009 May 6; 12:6. doi: 10.1186/1758-2652-12–6.

20 Lawn SD, Harries AD, Anglaret X, , *et al.* Early mortality among adults accessing antiretroviral treatment programmes in sub-Saharan Africa. AIDS. 2008 Oct 1; 22(15):1897-908. doi: 10.1097/QAD.0b013e32830007cd.

21 Gupta A, Nadkarni G, Yang W, *et al*. Early Mortality in Adults Initiating Antiretroviral Therapy (ART) in Low- and Middle-Income Countries (LMIC): A Systematic Review and Meta-Analysis. *PLoS One* 2011;6(12):e28691.

22 Jobarteh K, Shiraishi RW, Malimane I, *et al*. Community ART Support Groups in Mozambique: The Potential of Patients as Partners in Care. *PLoS One*. 2016;11(12):e0166444.

23 Vandendyck M, Motsamai M, Mubanga M, et al. Community-based ART resulted in excellent retention and can leverage community empowerment in rural Lesotho, a mixed method study. *HIV/AIDS Res Treat Open J* 2015;2(2):44–50.

24 Wandeler G, Keiser O, Pfeiffer K, *et al*. Outcomes of antiretroviral treatment programs in rural Southern Africa. *J Acquir Immune Defic Syndr* 2012;59(2):e9–16.

25 Langebeek N, Gisolf EH, Reiss P, *et al*. Predictors and correlates of adherence to combination antiretroviral therapy (ART) for chronic HIV infection: a meta-analysis. *BMC Med*. 2014; 12:142.

26 Bateganya MH, Amanyeiwe U, Roxo U, *et al*. Impact of support groups for people living with HIV on clinical outcomes: a systematic review of the literature. *J Acquir Immune Defic Syndr* 2015;68(S3):S368–74.

27 Rasschaert F, Decroo T, Remartinez D, *et al*. Sustainability of a community-based anti-retroviral care delivery model - a qualitative research study in Tete, Mozambique. *J Int AIDS Soc* 2014;17:18910.

28 Wouters E, Van Damme W, van Rensburg D, *et al*. Impact of baseline health and community support on antiretroviral treatment outcomes in HIV patients in South Africa. *AIDS* 2008;22:2545–2248.

29 Zachariah R, Teck R, Buhendwa L, *et al*. How can the community contribute in the fight against HIV/AIDS and tuberculosis? An example from a rural district in Malawi. *Trans R Soc Trop Med Hyg* 2006;100(2):167–75.

30 Weidle PJ, Wamai N, Solberg P, *et al*. Adherence to antiretroviral therapy in a home-based AIDS care programme in rural Uganda. *Lancet* 2006;368:1587–94.

31 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(9707):2080-9.

32 Wools-Kaloustian KK, Sidle JE, Selke HM, *et al*. A model for extending antiretroviral care beyond the rural health centre. *J Int AIDS Soc* 2009;12:22.

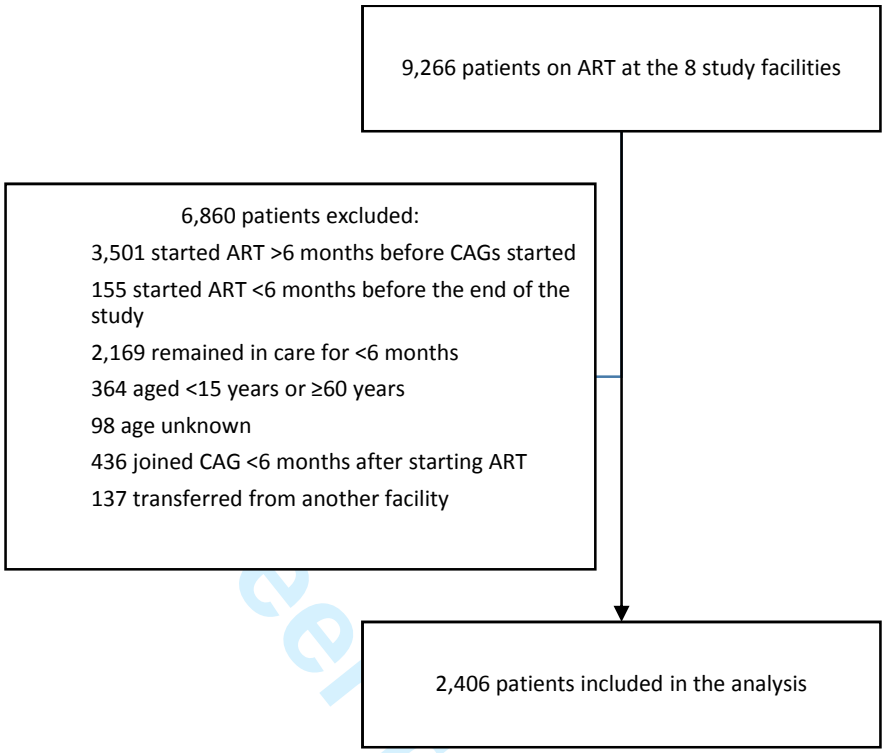
33 Grimsrud A, Bygrave H, Doherty M, *et al*. Reimagining HIV service delivery: the role of differentiated care from prevention to suppression. *J Int AIDS Soc* 2016;19(1):21484.

34 Phillips A, Shroufi A, Vojnov L, *et al*. Sustainable HIV treatment in Africa through viral-load-informed differentiated care. *Nature* 2015;528(7580):S68–76.

35 World Health Organization. *Factsheet. HIV treatment and care. What's new in service delivery?* World Health Organization, 2015.

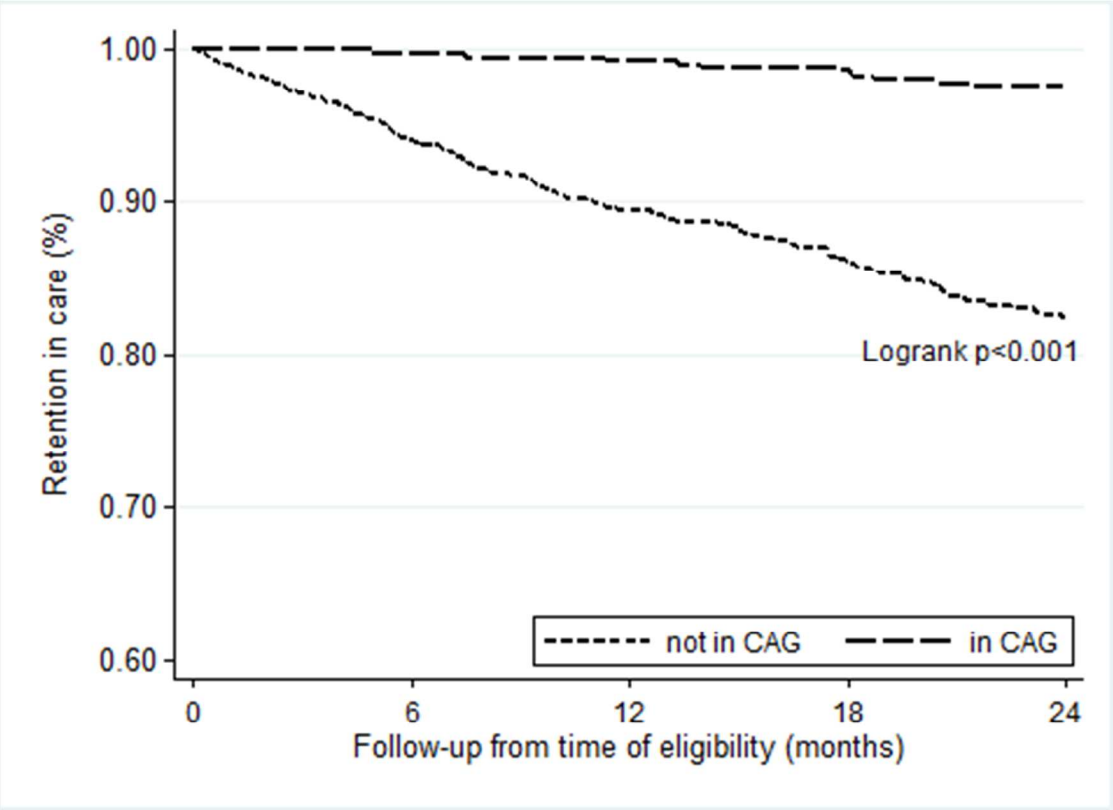
http://apps.who.int/iris/bitstream/10665/204461/1/WHO_HIV_2015.46_eng.pdf?ua=1

Figure 1: Study flow diagram: inclusion of patients on ART in the study



CAG: Community ART groups; ART: antiretroviral therapy

Figure 2 Retention-in-care by CAG status among 2406 patients on ART, between 2008 and 2012, in Tete, Mozambique



ART: antiretroviral therapy; CAG: Community ART Group

Table 1. Description of individual clinic-based care and the CAG model, between 2008 and 2012, in Tete, Mozambique

	Individual clinic-based model	Community ART group model
Providers	Health authorities and clinicians	Health authorities, clinicians and patients
Location for ART delivery	Health facility	Health facility and community
Involvement of patient	Passive	Active
Target group	All patients with HIV	Patients stable on ART
Voluntary counselling and testing	Voluntary or referred by clinician	Voluntary or referred by clinician or CAG members
Pre-ART patients	No monitoring	Social network of CAG extends into broader community and creates link with pre-ART patients
ART Initiation	Clinical officer/ medical doctor	Clinical officer/ medical doctor
ART refill	All patients must come to the clinic monthly for ART refills, with/without a consultation by a nurse and/or counsellor. Stable patients have a consultation every 6 months.	One member of each CAG comes to the clinic monthly on a rotational basis, has a consultation with a nurse and/or counsellor, and collects ART refills for all members of the group
Indirect cost of ART	Each patient bears the cost of transport to/from the clinic Each month several hours in the queue	Cost of transport to/from the clinic shared among all members of the CAG One patient in queue for 6 CAG members. CAG representatives are prioritized, because they are perceived as co-providers
Monitoring of patients on ART	No monitoring of patients between clinic visits, no information on the health status or whereabouts of patients between clinic visits, or on their adherence to treatment	CAG members actively prevent loss to follow-up, and monitor the health status and whereabouts of group members through informal and formal monitoring, using a group card. Information on the status of all members in the group is reported monthly to the health facility by the CAG representative.
Active search (tracing and recapture)	When a patient is identified as late or lost to follow-up: • No or few resources for tracing patients • Often the physical address of the patient is incorrect or missing • Distance to the house of the patient can be too far for physical tracing to be feasible Therefore true outcomes of patients LTFU are difficult to ascertain.	CAG members trace other group members in the community immediately if the member misses a meeting. Information is obtained through the social network of other patients, family, and neighbours. CAG members are usually aware when another group member is non-adherent or stops taking ART and can usually maintain contact with other members through family networks when travelling outside the area.
Reasons for non-adherence or LTFU	No systematic understanding or addressing of the problem	Reasons known in detail and systematically through the social network, and reported to the health care workers

ART: antiretroviral therapy; CAG: Community ART Group; LTFU: lost to follow-up

Table 2: Characteristics of patients included in the analysis, by CAG status

	Did not join a CAG	Joined a CAG	Total cohort
Total (n, column %)	1505 (100)	901 (100)	2406 (100)
Sex [a] (n, column %)			
Female	883 (59.9)	631 (70.3)	1514 (63.1)
Male	617 (41.1)	267 (29.7)	884 (36.9)
Age at ART initiation (years) (median, IQR)	32 (26 – 39)	33 (27 – 40)	32 (27 – 39)
Health facility type (n, column %)			
Peri-urban	643 (42.7)	317 (35.2)	960 (39.9)
Rural	862 (57.3)	584 (64.8)	1446 (60.1)

CAG: Community ART Group

[a] 8 (0.3%) patients did not have their sex recorded.

Table 3: Retention in care from the time of eligibility to join a CAG, and factors associated with retention in care, among 2406 patients on ART, between 2008 and 2012, in Tete, Mozambique

Characteristic	12-month RIC % (95% CI)	24-month RIC % (95% CI)	HR (95% CI)	aHR (95% CI)
All (n = 2,406)	90.8 (89.5 – 92.0)	86.0 (84.2 – 87.6)	—	—
CAG status				
Not in a CAG (n = 2,406)	89.5 (87.9 – 90.8)	82.3 (79.9 – 84.5)	1.00 (reference)	1.00 (reference)
In a CAG (n = 901)	99.1 (97.3 – 99.7)	97.5 (95.4 – 98.6)	0.17 (0.10-0.28)	0.18 (0.11 – 0.19)
Age (years)				
15 – 24 (n = 371)	87.7 (83.5 – 90.9)	81.4 (75.9 – 85.8)	1.52 (1.09-2.11)	1.65 (1.17 – 2.32)
25 – 29 (n = 515)	92.7 (89.9 – 94.7)	87.1 (83.0 – 90.2)	0.98 (0.71-1.36)	1.04 (0.75 – 1.45)
30 – 39 (n = 945)	90.8 (88.6 – 92.6)	87.3 (84.6 – 89.6)	1.00 (reference)	1.00 (reference)
40 – 59 (n = 575)	91.2 (88.3 – 93.4)	85.8 (82.0 – 88.8)	1.09 (0.80-1.49)	0.98 (0.72 – 1.34)
Sex				
Female (n = 1,514)	92.4 (90.8 – 93.7)	88.9 (86.9 – 90.7)	1.00 (reference)	1.00 (reference)
Male (n = 854)	88.2 (85.6 – 90.3)	80.8 (77.4 – 83.8)	1.78 (1.41 – 2.26)	1.82 (1.42 – 2.33)
Facility type				
Peri-urban (n = 960)	90.9 (89.2 – 92.3)	85.6 (83.3 – 87.7)	1.00 (reference)	1.00 (reference)
Rural (n = 1,446)	90.8 (88.5 – 92.6)	86.6 (83.7 – 89.0)	0.97 (0.76 – 1.25)	0.90 (0.70 – 1.16)
Cohort				
2008 (n = 148)	93.1 (87.5 – 96.2)	88.0 (81.4 – 92.4)	1.00 (reference)	—
Jan – Jun 2009 (n = 229)	92.5 (88.1 – 95.2)	85.1 (79.7 – 89.2)	1.27 (0.77 – 2.10)	—
Jul – Dec 2009 (n = 389)	93.7 (90.8 – 95.7)	88.8 (85.1 – 91.6)	0.94 (0.57 – 1.56)	—
Jan – Jun 2010 (n = 352)	92.4 (89.0 – 94.8)	87.4 (83.3 – 90.5)	1.06 (0.63 – 1.78)	—
Jul – Dec 2010 (n = 382)	92.2 (88.9 – 94.5)	84.4 (80.2 – 87.8)	0.95 (0.55 – 1.64)	—

RIC: Retention in care; CI: Confidence interval; HR: Hazard ratio; Adjusted hazard ratio. Hazard ratios were adjusted for the other variables shown, and stratified by calendar cohort in 6-month categories;

[a] CAG status was a time-dependent variable. Patients were in the "not in CAG" group until they joined a CAG.

[b] Cohorts were defined as the semesters of each year within the study period (restricted to 2010 to allow for at least 12 months follow-up), and patients were categorized into each cohort by date at which they became eligible for the study (i.e. date at which they reached 6 months on ART).The multivariable Cox regression was stratified by cohort, so aHR's were not determined.

STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cohort studies*

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4-6
Objectives	3	State specific objectives, including any prespecified hypotheses	6
Methods			
Study design	4	Present key elements of study design early in the paper	7
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	7-10
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up	8
		(*b*) For matched studies, give matching criteria and number of exposed and unexposed	NA
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	9
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	*9*
Bias	9	Describe any efforts to address potential sources of bias	8
Study size	10	Explain how the study size was arrived at	5,6
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	9-10
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	9-10
		(*b*) Describe any methods used to examine subgroups and interactions	9-10
		(*c*) Explain how missing data were addressed	8
		(*d*) If applicable, explain how loss to follow-up was addressed	9
		(*e*) Describe any sensitivity analyses	NA
Results			

Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	11, Figure 1
		(b) Give reasons for non-participation at each stage	Figure 1
		(c) Consider use of a flow diagram	Figure 1
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	11, Table 2
		(b) Indicate number of participants with missing data for each variable of interest	Figure 1
		(c) Summarise follow-up time (eg, average and total amount)	11
Outcome data	15*	Report numbers of outcome events or summary measures over time	11
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	11-12, Table 3
		(*b*) Report category boundaries when continuous variables were categorized	Table 2
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	NA
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	NA
Discussion			
Key results	18	Summarise key results with reference to study objectives	13
Limitations			
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	13
Generalisability	21	Discuss the generalisability (external validity) of the study results	14
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	17

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

BMJ Open

The effect of Community ART Groups on retention-in-care among patients on ART in Tete Province, Mozambique: a cohort study

Journal:	*BMJ Open*
Manuscript ID	bmjopen-2017-016800.R1
Article Type:	Research
Date Submitted by the Author:	08-Jun-2017
Complete List of Authors:	Decroo, Tom; MSF OCB, Medical Department Telfer, Barbara; Medecins Sans Frontieres Das Dores, Carla; Direccao Provincial de Saude, Tete, Mocambique White, Richard; Norwegian Institute of Public Health, Department of Health Statistics; Norwegian Institute of Public Health, Department of Infectious Disease Epidemiology Dos Santos, Natacha; Medecins Sans Frontieres Mkwamba, Alec; Medecins Sans Frontieres Dezembro, Sergio; Medecins Sans Frontieres Joffrisse, Mariano; Medecins Sans Frontieres Ellman, Tom; Medecins Sans Frontieres Metcalf, Carol; Medecins Sans Frontieres
Primary Subject Heading:	HIV/AIDS
Secondary Subject Heading:	Patient-centred medicine
Keywords:	HIV, community participation, health services accessibility, peer support, treatment outcome

The effect of Community ART Groups on retention-in-care among patients on ART in Tete Province, Mozambique: a cohort study

Tom Decroo[1,a], Barbara Telfer[1], Carla Das Dores[2], Richard A White[3], Natacha Dos Santos[1], Alec Mkwamba[1], Sergio Dezembro[1], Mariano Joffrisse[1], Tom Ellman[4], Carol Metcalf[4]

[a] Corresponding author : tomdecroo2@gmail.com

1 Médecins Sans Frontières, Tete, Mozambique

2 Direcção Provincial de Saúde Tete, Moçambique

3 Department of Infectious Disease Epidemiology and Modelling, Norwegian Institute of Public Health, Oslo, Norway

4 Médecins Sans Frontières, Southern Africa Medical Unit, Cape Town, South Africa

Abstract

Objectives: Estimate the effect of participation in Community ART Groups (CAG) versus individual care on retention-in-care on antiretroviral therapy (ART).

Design: Retrospective cohort study.

Setting: High levels of attrition (death or loss-to-follow-up (LTFU) combined) on ART indicate that delivery models need to adapt in sub-Saharan Africa. In 2008, patients more than six months on ART began forming CAG, and took turns to collect ART refills at the health facility, in Tete Province, Mozambique,.

Participants: 2406 adult patients, retained-in-care for at least six months after starting ART, during the study period (date of CAG introduction at the health facility-30 April 2012).

Methods: Data up to 30 April 2012 was collected from patient records at eight health facilities. Survival analysis was used to compare retention-in-care among patients in CAG and patients in individual care, with joining a CAG treated as an irreversible time-dependent variable. Multivariable Cox regression was used to estimate the effect of CAG on retention-in-care, adjusted for age, sex, and health facility type, and stratified by calendar cohort.

Results: Twelve-month and 24-month retention-in-care from the time of eligibility were respectively 89.5% and 82.3% among patients in individual care and 99.1% and 97.5% among those in CAGs (p <0.0001). CAG members had a greater than five-fold reduction in risk of dying or being lost-to-follow-up (adjusted hazard ratio [aHR]: 0.18, 95% CI: 0.11-0.29).

Conclusions: Among patients on ART, retention-in-care was substantially better among those in CAGs than those in individual care. This study confirms that patient-driven ART distribution through CAGs results in higher retention-in-care among patients who are stable on ART.

Key words: HIV; community participation; health services accessibility; peer support; treatment outcome

Strengths and limitations of this study

- Community ART Groups (CAG) were piloted first in Tete province, Mozambique. The effect of participation in CAG versus individual care on retention-in-care on ART was not yet assessed in this pilot project.
- A large number of patients, with diverse characteristics, were included in the analysis. The findings are representative of "real life" programmatic conditions.
- Another strength is that through our methodological approach we minimized the potential for survival bias by a) starting follow-up 6 months after ART initiation in order to exclude patients who had not yet stabilized on ART, and b) treating CAG status as a time-dependent variable to ensure that retention-in-care prior to joining a CAG was taken into account.
- However, the applied exclusion criteria may have resulted in some selection bias, making the findings less generalizable. Moreover, patients who opted to join a CAG and those who remained in individual care may have differed with respect to factors which we did not take into consideration in the analysis.

Introduction

Currently an estimated 36.7 million people are living with HIV (PLHIV), of whom 17 million were on antiretroviral therapy (ART) at the end of 2015.[1] The World Health Organization (WHO) endorses the 90-90-90 UNAIDS targets: by 2020, 90% of people living with HIV should know their HIV status. Of those, 90% should be on ART, and 90% of people on ART should be virologically suppressed. Or, when combined as a single indicator, 73% of all PLHIV should be virologically suppressed.[2]

Will it be feasible to achieve 73% of all PLHIV on ART and virologically-suppressed by 2020? Such an unprecedented undertaking will require innovative approaches, especially in sub-Saharan Africa (SSA), where the HIV burden is the highest, and health workforce gaps and other challenges hamper response.[3] In addition, high levels of attrition (death or loss-to-follow-up (LTFU) combined) undermine the proven benefits of early treatment for individuals and the prevention of onward transmission of HIV.[4] A recent systematic review reported attrition rates in ART programs in African countries of 18%, 24%, and 31% after six months, one year, and two years of ART, respectively.[4] Distance to health facilities, transport costs, long waiting times at the health facilities, work responsibilities, and family commitments have been reported as reasons for defaulting treatment.[5] ART delivery closer to patients' homes is effective at improving retention-in-care.[5]

To enrol and retain millions of PLHIV on ART, health systems have had to adapt during the past decade. Several policies have been implemented to increase the capacity of understaffed health systems. Treatment has been decentralized from specialized HIV clinics to peripheral primary health care facilities.[6] Tasks have been shifted from doctors to nurses, from nurses to lay health-workers, and from lay health-workers to patients.[7] Additionally, in some countries delivery models have become increasingly patient-centered, allowing patients to combine lifelong ART refills with a normal social and economic life.[5,8]

Mozambique is one of the countries that have adopted a patient-centered ART delivery model. However, despite decentralization of ART provision, starting in 2006, LTFU rates remained unacceptably high. One study showed an overall attrition rate of 37 per 100 person-years.[9] Another Mozambican study showed that half of those who started ART were either dead or LTFU at 3 years follow-up.[10] Strategies, such as home visits to patients LTFU, had been unsuccessful in bringing patients back to care.[11] Patients reported long distances, lack of information, queuing at health facilities, and stigma associated with regular clinic attendance, as barriers to retention-in-care.[12]

To overcome these barriers associated with the standard, clinic-based, individual-care approach to ART delivery, and drawing on published accounts of patient involvement in chronic disease care,[13] the Health Directorate of Tete Province and Médecins Sans Frontières proposed that clinically stable patients on ART be given the option of forming peer groups and becoming involved in ART delivery and monitoring.

Patients on ART are given the option of joining a peer group, or remaining in clinic-based individual care, and can move between the two models of care, according to their preference. These peer groups are named Community ART Groups (CAGs). Giving patients a high level of autonomy, the CAG model is the most patient-driven, community-based ART delivery model described to date.[14] Lay counsellors played an important role in forming and monitoring CAGs.[15] The CAG model has previously been described in more detail.[16]

Four year retention-in-care was 92%.[17] Despite this high retention-in-care on ART among patients in CAGs, these previous studies did not assess the relative effectiveness of the CAG model and the standard, clinic-based, individual care approach in retaining patients on ART, in Tete province, where CAG were piloted. We conducted a study to estimate the effect of the CAG model relative to standard individual care, on retention-in-care among patients on ART.

Methods

Study design

We conducted a retrospective cohort study using programme data.

Study setting

Mozambique has a population of 23.9 million inhabitants, of whom more than 70% live in rural areas.[18] HIV prevalence among sexually-active people is estimated to be 10.5%. Over 1.5 million people in Mozambique are living with HIV.[19] The government began providing ART in 2003.[20] . By the end of 2015, ART coverage was about 53%.[19]

The rural Province of Tete, in Mozambique, has 105 health facilities, spread across 15 districts. By mid-2012 only 32 of the 105 (30.5%) facilities in Tete Province offered ART.[20] Decentralization of ART provision towards peripheral clinics, in order to increase accessibility of ART, has been hampered by infrastructural constraints, a shortage of medically-qualified staff, organizational challenges, and a lack of regulation to push for task-shifting from nurses to lay health-workers.[21]

Community ART Groups

Community ART Groups (CAGs) are peer groups in which members take turns to travel to the clinic to collect monthly ART refills for all group members. To join a CAG, patients are required to be at least 15 years old, and to have been on ART for at least six months, and to be stable on treatment. Each CAG has a maximum of six members. Members take turns to travel to the clinic to collect monthly ART refills for all group members. Every month, before the CAG representative attends the health facility to collect the ART refills, the group meets in their community to discuss each member`s current health and treatment status and any travel plans. The CAG representative whose turn it is to collect the monthly ART refills has a clinical consultation and reports on the status of the other group members (retained on ART in the

group, died, travelled, etc.). This information is recorded on a group monitoring card, which is kept in the clinic, and updated each month. The group monitoring card includes the name of the CAG, the names of the CAG members, their ART regimen, and the monthly pill count.[16] CAG members are advised to make unscheduled visits to the health facility between ART refill appointments if they develop health problems, as do other patients who develop health problems during the intervals between scheduled appointments.

Of the 32 facilities in Tete Province that were providing ART in 2012, 12 (37.5%) implemented the CAG model in 2008 or 2009. Differences in the management of patients in standard individual care and those in CAGs are summarized in Table 1.

Study sites and population

Of 12 health facilities that had implemented the CAG model by the end of 2009, eight (Manje, Changara, Songo, Chitima, Mutarara, Moatize, Zobue, and Boroma) were included in this study. The other four facilities were excluded because the majority of patients on ART (>80%) were enrolled in CAGs, leaving few patients in standard individual care to serve as a comparison group.

Patients included in the study were known to be 15 to 59 years of age at ART commencement and had started ART 6 or less months prior to or after the CAG model was introduced at the health facility. In order to minimize survival bias, patients who started ART more than 6 months before the CAG model was introduced at the health facility that they were attending, and patients who transferred to the health facility more than 6 months after starting ART, were excluded from the analysis. Patients younger than 15 years, 60 years and older, with an unknown age at ART initiation, were also excluded from the analysis. Patients who remained in care for less than 6 months after starting ART were excluded because patients are required to be stable on ART in order to be eligible to join a CAG, and mortality is highest in the first 6 months after starting ART.[22,23]

Study period

The start of the study period varied by health facility, starting on the date that the first CAGs were formed at the facility. The CAG starting dates were respectively 23/08/2008, 24/09/2008, 10/10/2008, 8/01/2009, 13/05/2009, 15/09/2009, 16/09/2009, and 14/12/2009 for health facility Zobue, Manje, Changara, Boroma, Moatize, Songo, Mutarara, and Chitima. Patients at all 8 study facilities were followed-up until the end of April 2012. For the purpose of this analysis, patients entered the cohort on the date on which they became eligible to join a CAG, defined as 6 months after starting ART.

Data collection and definition of variables

Patient-files and clinic-held copies of CAG cards were used as data sources. Data was abstracted during the second half of 2012 and 2013, and entered into a Microsoft Access database. CAG monitoring tools and processes have been described elsewhere.[16]

The information collected included patient socio-demographic characteristics (sex, age at ART initiation, date of ART initiation, CD4 results, date of joining a CAG, and date of returning to individual care, if applicable), treatment outcomes and dates. For patients in CAG the source for the treatment outcome and date was the CAG card and the patient-file. All other variables were solely retrieved from the patient-files. The following treatment outcomes were recorded: retained-in-care at the end of the study period (30 April 2012), dead, lost to follow-up (LTFU), and transferred out. LTFU was defined as being more than 2 months overdue for the most recent appointment or scheduled ART refill. Similarly, CAG members who didn't collect the scheduled ART refill within their CAG were defined as LTFU. Health facilities were categorized as peri-urban or rural based on the geographical setting in which they are located. The two peri-urban facilities (Moatize and Songo) have medical specialists, a referral laboratory and radiology facilities available, and the rural facilities (Manje, Changara, Chitima, Mutarara, Zobue, and Boroma) are primary health care facilities run by nurses.

Data analysis

The analysis was performed using Stata Version 14 (StataCorp, College Station, Texas, USA).

Some numeric variables were categorized to facilitate the analysis. Median and interquartile ranges (IQR) were calculated for numeric variables and proportions for categorical variables.

Survival analysis was used to compare retention-in-care among patients in CAG and patients in individual care. Joining a CAG was treated as an irreversible time-dependent variable. Patients were "not in a CAG", until they joined a CAG, and "in a CAG" from the date that they joined a CAG. CAG members who returned to individual care (n = 11), were retained in the CAG group in the survival analyses. Univariable and multivariable Cox regression were used to estimate crude hazard ratios (HRs) and adjusted hazard ratios (aHR) for attrition. The aHRs were adjusted for age, sex, and health facility type, and stratified by cohort (calendar period of ART initiation, by six-month intervals). Cohorts were restricted to 2010 to allow for at least 12 months follow-up.

Patients who remained in care at the end of the study period had their follow-up censored on 30 April, 2012. Patients who were LTFU, or who died during the study period, were considered as having experienced the outcome event (attrition), with the outcome date defined as the most recent date of contact with the health facility, either in the form of an individual clinic visit, or an ART refill collected by another CAG member on the patient's behalf. Patients who were transferred to another facility were censored on the date of transfer.

Ethics

This study was approved by the Ethics Review Board of Médecins Sans Frontières (Geneva, Switzerland) and the Mozambican National Bioethics Committee (Comite Nacional De Bioetica para a Saúde).

Results

During the study period, between 1 February 2008 and 30 April 2012, 9,266 patients were provided with ART in the eight health facilities. Of these patients, 2,406 were included in the analysis and 6,860 were excluded for reasons shown in Figure 1.

Of the 2,406 patients who satisfied the inclusion criteria, 901 (37.5%) joined a CAG during the study period (Table 2). Patients who joined a CAG were also more likely to be female (CAG: 70.3%; 631/901; non-CAG: 59.9%; 883/1505), and attending a rural clinic (CAG: 64.8%; 584/901; non-CAG: 57.3%; 862/1505). Patients who joined a CAG had a longer follow-up time (median: 26 months, IQR: 18 to 33 months) from the date that they entered the cohort and the end of the study than those who did not join a CAG (median: 16 months, IQR: 7 to 27 months).

CAG patients joined a CAG after a median of 8.3 (IQR 3.6 to 16.7) months from the time of eligibility (6 months after starting ART). Overall, 279 out of 2406 (12%) patients died or were LTFU by the end of the study period.

Overall, 12-month retention-in-care (RIC) from the date of eligibility was 90.8% (95%CI: 89.5% to 92.0%) and 24-month RIC was 86.0% (95%CI: 84.2% to 87.6%). RIC was significantly greater among patients in CAGs than those not in CAGs (stratified log-rank test: p <0.0001) (Figure 2). Twelve-month RIC was 99.1% (95% CI: 97.3 to 99.7%) among those in CAGs and 89.5% (95% CI: 87.9 to 90.8%) among those not in CAGs (Table 3).

Adjusted for age, gender, health facility type, and stratified by calendar period of ART initiation, patients in CAG had a more than five-fold lower rate of attrition (aHR: 0.18, 95% CI: 0.11 – 0.29) (Table 3). The risk of attrition was higher among patients younger than 25 years compared to those aged 30 – 39 years

(aHR: 1.65, 95%CI: 1.17 –2.32); and among males compared to females (aHR: 1.80, 95%CI: 1.41 – 2.30) (Table 3).

Discussion

We found that RIC among patients in CAGs was substantially higher than among patients in individual care. After adjustment for age, gender, health facility type, and after stratification by calendar period of ART initiation, patients in CAG were more than five times less at risk to die or to be LTFU. Other studies on RIC in CAG and individual care showed similar findings. Reports of high retention-in-care in CAG in Tete province informed CAG pilots, in Mozambique, and in Lesotho. The Mozambique national pilot showed 91.4% and 82.9% RIC in CAG and individual care, respectively. This study included patients from 68 health facilities in 7 different provinces (not Tete province), a mix of urban and rural, and high and low volume ART clinics.[24] The MSF supported pilot in Lesotho showed 98.7% and 90.2% RIC in CAG and individual care, respectively.[25] CAG members reported several benefits including time and cost savings. They reported that less frequent clinic visits was associated with reduced experiences of stigma in the community, and viewed the CAG as a protective environment where they could share treatment experiences confidentially.[15,25]

Overall, 12-month RIC from the date of eligibility (6 months after starting ART) was 90.8% and 24-month RIC was 86.0%. These findings are similar to what is reported by other studies conducted in Mozambique. In a study conducted in rural Mozambique, two-year attrition among patients more than 12 months on ART was 16.2%.[26] Another Mozambican study showed late attrition rates (after 6 months on ART) of 15 patients per 100 person-years in urban clinics, and 23 patients per 100 person-years in rural clinics.[9] A systematic review analyzed data from eight Mozambican studies and found attrition of 17% at 6 months, 28% at 12 months, and 44% at 24 months.[4]

A strength of this study is the large number of patients, with diverse characteristics included in the analysis. Another strength is that all the study facilities gave patients the option between individual, clinic-based care and CAG, thus enabling the models of care to be compared under “real life”

programmatic conditions. Therefore our findings are representative of the reality of the program in Tete. Another strength is our methodological approach. Patients entered the cohort after being on ART for 6 months, thus excluding patients who had not yet stabilized on ART. Among patients on ART, attrition has been found to be highest immediately after ART initiation, gradually declining over the following year.[4] We minimized the potential for survival bias by excluding patients who had started ART more than 6 months before CAGs were introduced at the facility; starting follow-up 6 months after ART initiation in order to exclude patients who had not yet stabilized on ART; treating CAG status as a time-dependent variable to ensure that retention-in-care prior to joining a CAG was taken into account; and stratifying the Cox regression analyses by calendar period of entry into the cohort to take into account potential interaction between CAG status and calendar period with respect to attrition. Finally, we adhered to the STROBE guidelines for cohort studies.

However, there are also limitations to this study. The exclusion criteria that we chose may have resulted in some selection bias, making the findings less generalizable. Moreover, patients who opted to join a CAG and those who remained in individual care may have differed with respect to hidden confounding factors which we did not take into consideration in the analysis. Potential confounders for which we were unable to adjust in the analysis, due to a lack of data, include distance of the patients' homes from the clinic, psychosocial characteristics, and health prognosticators such as CD4. There may thus be some residual confounding in the estimated risk of attrition associated with CAG status and the other factors (age, sex, facility type) that we considered in the analysis. Moreover, due to the very nature of the CAG model as described in Table 1, ascertainment of being LTFU was likely more accurate among those in CAG compared with those who remained in standard, individual care, which may have resulted in measurement bias. Finally, we were unable to use viral suppression as an outcome because routine viral load monitoring was not available during the study period. Although we found high retention-in-care

among patients in CAGs, we were unable to assess adherence to treatment. Further research is needed to compare viral load outcomes of patients in CAGs and patients in individual care.

The finding that attrition may be reduced by a patient-driven ART distribution model has important implications, especially in rural contexts. The high retention-in-care among patients who joined CAGs can be attributed to a combination of factors including: a reduced time spent travelling to and from the facility and queuing at the facility; reduced health care-related transport costs; and enhanced information-sharing within the community and between the community and health-care workers.[15] Peer support and higher levels of self-efficacy have been identified as important enablers of successful lifelong HIV care.[27] Peer support enhances utilization of health care services, and has a positive effect on quality of life.[28] Rasschaert et al found that relationships between patients and healthcare providers changed profoundly after the CAG model was implemented. CAG members were perceived by clinic and community staff as co-providers because they took responsibility for medical tasks, served as a channel of communication between community members and healthcare providers, and reduced the workload of healthcare workers, especially in rural health facilities.[29]

In 2008, when the CAG model was introduced, clinicians and healthcare workers were concerned about whether medical tasks such as ART distribution could be delegated to patients. The results of this study confirm that ART distribution can be delegated to patients, and demonstrates that patients can take responsibility for their lifelong HIV care, especially when supported by their peers. Earlier studies have shown the benefit of involving patients in peer-to-peer activities without remuneration, including counselling, tracing of patients LTFU, administrative tasks in health facilities, and income-generation projects.[30,31]. But none of these community-based ART delivery models was driven by the voluntary engagement of PLHIV, motivated by their own health needs. Other community-based ART delivery models in Uganda and Kenya, have introduced ART delivery to patients' homes by paid lay healthcare

workers, who are recognized and accountable as formal healthcare workers, and equipped with motorbikes and cell phones.[32-34]

To achieve and sustain high ART coverage, health programs need to differentiate and adapt to the specific needs of different subgroups, including virologically suppressed patients on ART, clinically unstable patients, HIV/TB co-infected patients, and adolescents.[35-36] For those stable on ART less frequent clinic visits and out-of-clinic ART refill are recommended to reduce maximally the burdens on patients and rationalize the use of the scarce health workforce.[37]

Currently CAG are rolled out nationally in Mozambique, and in neighbouring countries such as Lesotho, Zimbabwe, and Malawi.[24-25] In Tete Province the daily management of CAG strongly depended of facility-based lay counsellors.[15,29] Adaptation of this patient-driven delivery model, which was rooted in the rural community of central Mozambique, will be needed to be adapted to local contexts, needs of specific patient groups, available resources and national policies.

Conclusion

RIC was substantially higher among patients on ART in CAG than among those in individual care. Exclusion of the first six months on ART from the follow-up period, and the exclusion of patients who had been on ART for more than 6 months at the time that CAGs became available at the facility that they were attending, reduced the potential for survival bias but, as the study was observational in design, residual or unmeasured confounders may have contributed to the differences observed. Nevertheless this study confirms that patient-driven ART distribution through CAGs results in high RIC, and supports the Mozambique Ministry of Health in rolling out CAG nationally.

Acknowledgements: Special thanks to all the Mozambican staff, CAG focal points, and CAG members.

Authors' contributions: BT, TE, CM, CDD, and TD conceived the study and designed the study protocol. NDS, SD, MJ collected the data. Data analysis was conducted by CM, RW, and TD. TD wrote the first draft of the paper. All co-authors contributed to the subsequent draft and approved the final version.

Data sharing statement: All the available collected data were included in the study. The dataset can be made available on demand.

Funding: This research received no specific grant from any funding agency in the public, commercial, or non-profit sectors.

Competing interests: None declared.

Ethics approval: This study was approved by the Ethics Review Board of Médecins Sans Frontières (Geneva, Switzerland) and the Mozambican National Bioethics Committee (Comite Nacional De Bioetica para a Saúde).

References

1 UNAIDS. *Fact sheet 2016.* UNAIDS, 2016. http://www.unaids.org/en/resources/fact-sheet

2 UNAIDS. *90-90-90: an ambitious treatment target to help end the AIDS epidemic*. Switzerland, Geneva: UNAIDS, 2014. http://www.unaids.org/sites/default/files/media_asset/90-90-90_en_0.pdf

3 World Health Organization. *March 2014 supplement to the 2013 consolidated guidelines on the use of antiretroviral drugs for treating and preventing HIV infection. Recommendations for a public health approach.* World Health Organization, 2014. http://www.who.int/hiv/pub/guidelines/arv2013/arvs2013upplement_march2014/en/

4 Fox MP, Rosen S. Retention of Adult Patients on Antiretroviral Therapy in Low- and Middle-Income Countries: Systematic Review and Meta-analysis 2008-2013. *J Acquir Immune Defic Syndr* 2015;69(1):98–108.

5 Govindasamy D, Ford N, Kranzer K. Risk factors, barriers and facilitators for linkage to antiretroviral therapy care: a systematic review. *AIDS* 2012;26(16):2059–67.

6 Kredo T Ford N, Adeniyi FB, Garner P. Decentralising HIV treatment in lower- and middle-income countries. *Cochrane Database Syst Rev* 2013; (6):CD009987.

7 Callaghan M, Ford N, Schneider H. A systematic review of task-shifting for HIV treatment and care in Africa. *Hum Resour Health* 2010;8:8.

8 Duncombe C, Rosenblum S, Hellmann N, *et al*. Reframing HIV care: putting people at the centre of antiretroviral delivery. *Trop Med Int Health* 2015; 20(4):430–47.

9 Lambdin BH, Micek MA, Sherr K, *et al.* Integration of HIV care and treatment in primary health care centers and patient retention in central Mozambique: a retrospective cohort study. *J Acquir Immune Defic Syndr* 2013; 62(5):e146–52.

10 Wandeler G, Keiser O, Pfeiffer K, *et al*. Outcomes of antiretroviral treatment programs in rural Southern Africa. *J Acquir Immune Defic Syndr* 2012; 59(2):e9–16.

11 Caluwaerts C, Maendaenda R, Maldonado F, *et al*. Risk factors and true outcomes for lost to follow-up individuals in an antiretroviral treatment programme in Tete, Mozambique. *Int Health* 2009;1(1):97–101.

12 Posse M, Baltussen R. Barriers to access to antiretroviral treatment in Mozambique, as perceived by patients and health workers in urban and rural settings. *AIDS Patient Care STDS* 2009; 23(10):867–75.

13 Kober K, Van Damme W. Expert patients and AIDS care. A literature review on expert patient programmes in high-income countries, and an exploration of their relevance for HIV/AIDS care in low-income countries with severe human resource shortages. 2008. http://www.eldis.org/fulltext/kober-vandamme.pdf

14 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 Health* 2014; 19(8):968–77.

15 Rasschaert F, Telfer B, Lessitala F, *et al*. A qualitative assessment of a community antiretroviral therapy group model in Tete, Mozambique. *PLoS One* 2014; 9(3):e91544.

16 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(2):e39–44.

17 Decroo T, Koole O, Remartinez D, *et al*. Four-year retention and risk factors for attrition among members of community ART groups in Tete, Mozambique. *Trop Med Int Health* 2014;19(5):514–21.

18 World Health Organization. *WHO Country Cooperation Strategy 2009-2013. Mozambique.* World Health Organization, 2009. http://www.who.int/countryfocus/cooperation_strategy/ccs_moz_en.pdf

19 UNAIDS. *AIDSinfo.* UNAIDS, 2016. Available at http://aidsinfo.unaids.org/

20 Ministry of Health Mozambique. Global AIDS Response Progress Report for the Period 2010 - 2011, Mozambique. Ministry of Health Mozambique, 2012. http://www.unaids.org/sites/default/files/country/documents//file,94670,es..pdf

21 Decroo T, Panunzi I, das Dores C, Maldonado F, Biot M, Ford N, Chu K. Lessons learned during down referral of antiretroviral treatment in Tete, Mozambique. J Int AIDS Soc. 2009 May 6; 12:6. doi: 10.1186/1758-2652-12–6.

22 Lawn SD, Harries AD, Anglaret X, , *et al.* Early mortality among adults accessing antiretroviral treatment programmes in sub-Saharan Africa. AIDS. 2008 Oct 1; 22(15):1897-908. doi: 10.1097/QAD.0b013e32830007cd.

23 Gupta A, Nadkarni G, Yang W, *et al*. Early Mortality in Adults Initiating Antiretroviral Therapy (ART) in Low- and Middle-Income Countries (LMIC): A Systematic Review and Meta-Analysis. *PLoS One* 2011;6(12):e28691.

24 Jobarteh K, Shiraishi RW, Malimane I, *et al*. Community ART Support Groups in Mozambique: The Potential of Patients as Partners in Care. *PLoS One*. 2016;11(12):e0166444.

25 Vandendyck M, Motsamai M, Mubanga M, et al. Community-based ART resulted in excellent retention and can leverage community empowerment in rural Lesotho, a mixed method study. *HIV/AIDS Res Treat Open J* 2015;2(2):44–50.

26 Wandeler G, Keiser O, Pfeiffer K, *et al*. Outcomes of antiretroviral treatment programs in rural Southern Africa. *J Acquir Immune Defic Syndr* 2012;59(2):e9–16.

27 Langebeek N, Gisolf EH, Reiss P, *et al*. Predictors and correlates of adherence to combination antiretroviral therapy (ART) for chronic HIV infection: a meta-analysis. *BMC Med*. 2014; 12:142.

28 Bateganya MH, Amanyeiwe U, Roxo U, *et al*. Impact of support groups for people living with HIV on clinical outcomes: a systematic review of the literature. *J Acquir Immune Defic Syndr* 2015;68(S3):S36874.

29 Rasschaert F, Decroo T, Remartinez D, *et al*. Sustainability of a community-based anti-retroviral care delivery model - a qualitative research study in Tete, Mozambique. *J Int AIDS Soc* 2014;17:18910.

30 Wouters E, Van Damme W, van Rensburg D, *et al*. Impact of baseline health and community support on antiretroviral treatment outcomes in HIV patients in South Africa. *AIDS* 2008;22:2545–2248.

31 Zachariah R, Teck R, Buhendwa L, *et al*. How can the community contribute in the fight against HIV/AIDS and tuberculosis? An example from a rural district in Malawi. *Trans R Soc Trop Med Hyg* 2006;100(2):167–75.

32 Weidle PJ, Wamai N, Solberg P, *et al*. Adherence to antiretroviral therapy in a home-based AIDS care programme in rural Uganda. *Lancet* 2006;368:1587–94.

33 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(9707):2080-9.

34 Wools-Kaloustian KK, Sidle JE, Selke HM, *et al*. A model for extending antiretroviral care beyond the rural health centre. *J Int AIDS Soc* 2009;12:22.

35 Grimsrud A, Bygrave H, Doherty M, *et al*. Reimagining HIV service delivery: the role of differentiated care from prevention to suppression. *J Int AIDS Soc* 2016;19(1):21484.

36 Phillips A, Shroufi A, Vojnov L, *et al*. Sustainable HIV treatment in Africa through viral-load-informed differentiated care. *Nature* 2015;528(7580):S68–76.

37 World Health Organization. *Factsheet. HIV treatment and care. What's new in service delivery?* World Health Organization, 2015.
http://apps.who.int/iris/bitstream/10665/204461/1/WHO_HIV_2015.46_eng.pdf?ua=1

Figure 1: Study flow diagram: inclusion of patients on ART in the study

(Uploaded separately)

CAG: Community ART groups; ART: antiretroviral therapy

Figure 2 Retention-in-care by CAG status among 2406 patients on ART, between 2008 and 2012, in Tete, Mozambique

(Uploaded separately)

ART: antiretroviral therapy; CAG: Community ART Group

Table 1. Description of individual clinic-based care and the CAG model, between 2008 and 2012, in Tete, Mozambique

	Individual clinic-based model	Community ART group model
Providers	Health authorities and clinicians	Health authorities, clinicians and patients
Location for ART delivery	Health facility	Health facility and community
Involvement of patient	Passive	Active
Target group	All patients with HIV	Patients stable on ART
Voluntary counselling and testing	Voluntary or referred by clinician	Voluntary or referred by clinician or CAG members
Pre-ART patients	No monitoring	Social network of CAG extends into broader community and creates link with pre-ART patients
ART Initiation	Clinical officer/ medical doctor	Clinical officer/ medical doctor
ART refill	All patients must come to the clinic monthly for ART refills, with/without a consultation by a nurse and/or counsellor. Stable patients have a consultation every 6 months.	One member of each CAG comes to the clinic monthly on a rotational basis, has a consultation with a nurse and/or counsellor, and collects ART refills for all members of the group
Indirect cost of ART	Each patient bears the cost of transport to/from the clinic Each month several hours in the queue	Cost of transport to/from the clinic shared among all members of the CAG One patient in queue for 6 CAG members. CAG representatives are prioritized, because they are perceived as co-providers
Monitoring of patients on ART	No monitoring of patients between clinic visits, no information on the health status or whereabouts of patients between clinic visits, or on their adherence to treatment	CAG members actively prevent loss to follow-up, and monitor the health status and whereabouts of group members through informal and formal monitoring, using a group card. Information on the status of all members in the group is reported monthly to the health facility by the CAG representative. Periodically meetings between CAG members and counsellors are held either in the community or the health facility, which help to ascertain treatment outcomes.
Active search (tracing and recapture)	When a patient is identified as late or lost to follow-up: • No or few resources for tracing patients • Often the physical address of the patient is incorrect or missing • Distance to the house of the patient can be too far for physical tracing to be feasible Therefore true outcomes of patients LTFU are difficult to ascertain.	CAG members trace other group members in the community immediately if the member misses a meeting. Information is obtained through the social network of other patients, family, and neighbours. CAG members are usually aware when another group member is non-adherent or stops taking ART and can usually maintain contact with other members through family networks when travelling outside the area.
Reasons for non-adherence or LTFU	No systematic understanding or addressing of the problem	Reasons known in detail and systematically through the social network, and reported to the health care workers

ART: antiretroviral therapy; CAG: Community ART Group; LTFU: lost to follow-up

Table 2: Characteristics of patients included in the analysis, by CAG status

	Did not join a CAG	Joined a CAG	Total cohort
Total (n, column %)	1505 (100)	901 (100)	2406 (100)
Sex [a] (n, column %)			
Female	883 (59.9)	631 (70.3)	1514 (63.1)
Male	617 (41.1)	267 (29.7)	884 (36.9)
Age at ART initiation (years) (median, IQR)	32 (26 – 39)	33 (27 – 40)	32 (27 – 39)
Health facility type (n, column %)			
Peri-urban	643 (42.7)	317 (35.2)	960 (39.9)
Rural	862 (57.3)	584 (64.8)	1446 (60.1)

CAG: Community ART Group

[a] 8 (0.3%) patients did not have their sex recorded.

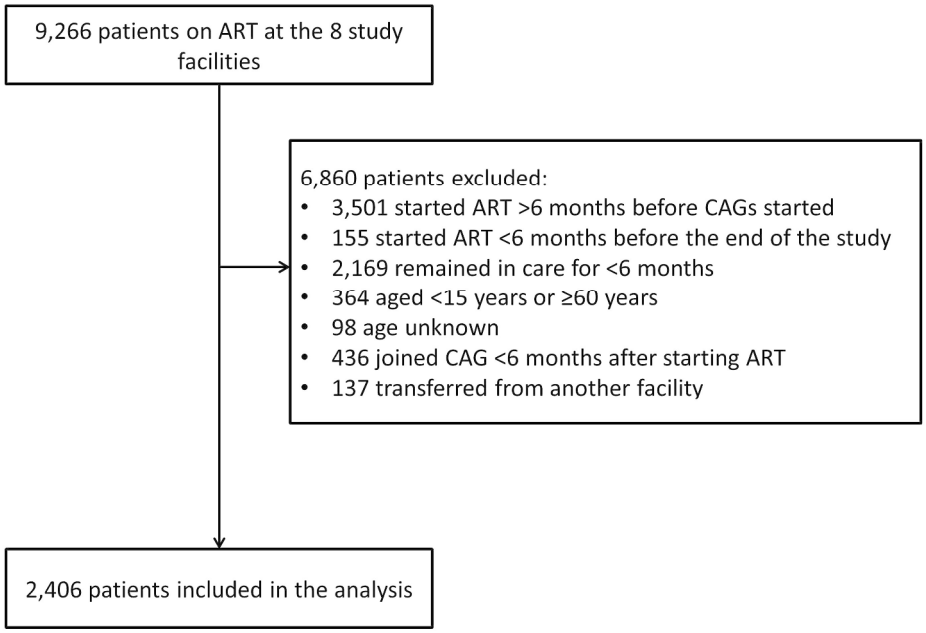
Table 3: Retention in care from the time of eligibility to join a CAG, and factors associated with retention in care, among 2406 patients on ART, between 2008 and 2012, in Tete, Mozambique

Characteristic	12-month RIC % (95% CI)	24-month RIC % (95% CI)	HR (95% CI)	aHR (95% CI)
All (n = 2,406)	90.8 (89.5 – 92.0)	86.0 (84.2 – 87.6)	—	—
CAG status				
Not in a CAG (n = 2,406)	89.5 (87.9 – 90.8)	82.3 (79.9 – 84.5)	1.00 (reference)	1.00 (reference)
In a CAG (n = 901)	99.1 (97.3 – 99.7)	97.5 (95.4 – 98.6)	0.17 (0.10-0.28)	0.18 (0.11 – 0.19)
Age (years)				
15 – 24 (n = 371)	87.7 (83.5 – 90.9)	81.4 (75.9 – 85.8)	1.52 (1.09-2.11)	1.65 (1.17 – 2.32)
25 – 29 (n = 515)	92.7 (89.9 – 94.7)	87.1 (83.0 – 90.2)	0.98 (0.71-1.36)	1.04 (0.75 – 1.45)
30 – 39 (n = 945)	90.8 (88.6 – 92.6)	87.3 (84.6 – 89.6)	1.00 (reference)	1.00 (reference)
40 – 59 (n = 575)	91.2 (88.3 – 93.4)	85.8 (82.0 – 88.8)	1.09 (0.80-1.49)	0.98 (0.72 – 1.34)
Sex				
Female (n = 1,514)	92.4 (90.8 – 93.7)	88.9 (86.9 – 90.7)	1.00 (reference)	1.00 (reference)
Male (n = 854)	88.2 (85.6 – 90.3)	80.8 (77.4 – 83.8)	1.78 (1.41 – 2.26)	1.82 (1.42 – 2.33)
Facility type				
Peri-urban (n = 960)	90.9 (89.2 – 92.3)	85.6 (83.3 – 87.7)	1.00 (reference)	1.00 (reference)
Rural (n = 1,446)	90.8 (88.5 – 92.6)	86.6 (83.7 – 89.0)	0.97 (0.76 – 1.25)	0.90 (0.70 – 1.16)
Cohort				
2008 (n = 148)	93.1 (87.5 – 96.2)	88.0 (81.4 – 92.4)	1.00 (reference)	—
Jan – Jun 2009 (n = 229)	92.5 (88.1 – 95.2)	85.1 (79.7 – 89.2)	1.27 (0.77 – 2.10)	—
Jul – Dec 2009 (n = 389)	93.7 (90.8 – 95.7)	88.8 (85.1 – 91.6)	0.94 (0.57 – 1.56)	—
Jan – Jun 2010 (n = 352)	92.4 (89.0 – 94.8)	87.4 (83.3 – 90.5)	1.06 (0.63 – 1.78)	—
Jul – Dec 2010 (n = 382)	92.2 (88.9 – 94.5)	84.4 (80.2 – 87.8)	0.95 (0.55 – 1.64)	—

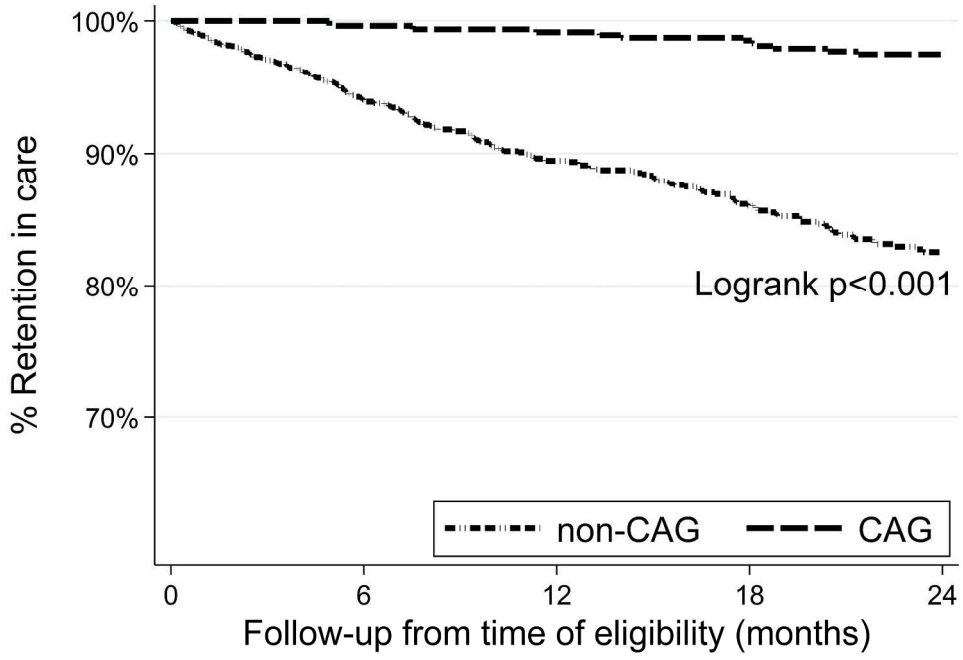
RIC: Retention in care; CI: Confidence interval; HR: Hazard ratio; Adjusted hazard ratio. Hazard ratios were adjusted for the other variables shown, and stratified by calendar cohort in 6-month categories;

[a] CAG status was a time-dependent variable. Patients were in the "not in CAG" group until they joined a CAG.

[b] Cohorts were defined as the semesters of each year within the study period (restricted to 2010 to allow for at least 12 months follow-up), and patients were categorized into each cohort by date at which they became eligible for the study (i.e. date at which they reached 6 months on ART).The multivariable Cox regression was stratified by cohort, so aHR's were not determined.



254x190mm (300 x 300 DPI)



254x190mm (300 x 300 DPI)

STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cohort studies*

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4-6
Objectives	3	State specific objectives, including any prespecified hypotheses	6
Methods			
Study design	4	Present key elements of study design early in the paper	7
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	7-10
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up	8
		(*b*) For matched studies, give matching criteria and number of exposed and unexposed	NA
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	9
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	*9*
Bias	9	Describe any efforts to address potential sources of bias	8
Study size	10	Explain how the study size was arrived at	5,6
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	9-10
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	9-10
		(*b*) Describe any methods used to examine subgroups and interactions	9-10
		(*c*) Explain how missing data were addressed	8
		(*d*) If applicable, explain how loss to follow-up was addressed	9
		(*e*) Describe any sensitivity analyses	NA
Results			

Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	11, Figure 1
		(b) Give reasons for non-participation at each stage	Figure 1
		(c) Consider use of a flow diagram	Figure 1
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	11, Table 2
		(b) Indicate number of participants with missing data for each variable of interest	Figure 1
		(c) Summarise follow-up time (eg, average and total amount)	11
Outcome data	15*	Report numbers of outcome events or summary measures over time	11
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	11-12, Table 3
		(*b*) Report category boundaries when continuous variables were categorized	Table 2
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	NA
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	NA
Discussion			
Key results	18	Summarise key results with reference to study objectives	13
Limitations			
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	13
Generalisability	21	Discuss the generalisability (external validity) of the study results	14
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	17

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.