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Unacceptable attrition among WHO stages 1 and 2 patients in a hospital-based setting in rural Malawi: can we retain such patients within the general health system?

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ABSTRACT

A study conducted among HIV-positive adults in WHO clinical stages 1 and 2 was followed up at Thyolo District Hospital (rural Malawi) to report on: (1) retention and attrition before and while on antiretroviral treatment (ART); and (2) the criteria used for initiating ART. Between June 2008 and January 2009, 1633 adults in WHO stages 1 and 2 were followed up for a total of 282 person-years. Retention in care at 1, 2, 3 and 6 months for those not on ART ($n = 1078$) was 25, 18, 11 and 4% vs. 99, 97, 95 and 90% for patients who started ART ($n = 555$, $P = 0.001$). Attrition rates were 31 times higher among patients not started on ART compared with those started on ART (adjusted hazard ratio, 31.0, 95% CI 22–44). Ninety-two patients in WHO stage 1 or 2 were started on ART without the guidance of a CD4 count, and 11 were incorrectly started on ART with CD4 count $\geq$250 cells/mm^3. In a rural district hospital setting in Malawi, attrition of individuals in WHO stages 1 and 2 is unacceptably high, and specific operational strategies need to be considered to retain such patients in the health system.

1. Introduction

Malawi is a resource-poor country in southern Africa that started national antiretroviral therapy (ART) scale-up in early 2004. It has since shown that, using a simple standardised approach to ART delivery, treatment can be effectively delivered to large numbers of patients.[1,2] However, the main focus has been on HIV-positive individuals eligible for ART either on the basis of clinical criteria (WHO clinical stage 3 or 4) or advanced immunodeficiency (CD4 cell count <250 cells/mm^3), and limited attention has been paid to individuals with less advanced disease who are not yet eligible for ART. This is because the national priority has understandably focused on individuals who are at relatively higher risk of HIV-related morbidity and mortality. Patients with less advanced immune deficiency (in WHO clinical stages 1 and 2) are not followed up in a structured monitoring system. As a result, they tend to be lost from the general health system and return only when they become

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ill and seek care. Thus, by the time these individuals are initiated on ART, many have advanced immunodeficiency, which is one of the most important risk factors for early mortality.[3–8] Efforts to register and retain these patients in structured follow-up may allow earlier initiation of ART and ultimately a reduction in mortality rates.

There is very limited published information regarding the management and retention in care of HIV-infected patients in WHO clinical stages 1 and 2. In June 2008, registration and follow-up of patients in WHO clinical stages 1 and 2 was introduced at the out-patient department of Thyolo District Hospital, Malawi. We were interested to know: (1) about treatment outcomes of these patients stratified by who did and did not start ART; and (2) whether eligibility criteria for starting ART were being followed and whether this in turn influenced treatment outcomes. Therefore, among HIV-positive adults in WHO clinical stages 1 and 2 followed up at Thyolo District Hospital, we report on retention and attrition rates in relationship to whether ART was started or not, and whether eligibility criteria for starting ART were adhered to and whether this related to treatment outcomes.

2. Materials and methods

2.1. Study setting and population

This study was conducted in Thyolo District, one of the largest rural districts in Malawi, with 587 455 inhabitants. The district has one main public hospital and 29 health centres, the former being the site of this study.

HIV-positive adult patients are considered eligible for ART if they present in WHO clinical stage 3 or 4, or with a CD4 count <250 cells/mm^3 (irrespective of WHO staging).[9] These patients are seen and managed in a dedicated HIV/AIDS clinic, which is situated within the premises of the general out-patient department (GOPD) but has a separate waiting area, specialised staff and additional resources.[9]

Before June 2008, HIV-positive individuals not eligible for ART (i.e. those presenting in WHO stages 1 or 2 with CD4 >250 cells/mm^3) were not followed up in a structured manner and were essentially lost from the general health services. From 1 June 2008, registration of such patients was introduced with the intent to enhance monitoring and follow-up at the Thyolo Hospital general out-patient clinics. This study included all such newly registered patients in WHO stages 1 and 2 on follow-up between 1 June 2008 and 9 January 2009.

2.2. Protocol and management of WHO stage 1 and 2 patients

Table 1 shows the key differences in protocol and management of patients in WHO stages 1 and 2 compared with those in WHO stages 3 and 4 at both the pre-ART stage and after having started ART. Patients in WHO stages 1 and 2 (pre-ART) are managed at the GOPD, which has no dedicated infrastructure, patient circuits or specialised staff. Furthermore, in contrast to the dedicated HIV/AIDS and ART clinics (offering care to HIV-infected patients in WHO stages 3 and 4 or those on ART), the GOPD offers care to all types of patients, and is currently overloaded (Table 1).

At presentation, all HIV-positive patients in WHO stages 1 and 2 undergo clinical assessment, and have their CD4 cell count and weight measured. These patients are given appointments to return 2–4 weeks later to collect their CD4 count and to attend their first counselling session. This 2–4 week delay is because of high caseload, limited CD4 capacity at laboratory level and priority for CD4 counting given to patients in WHO stages 3 and 4. Unlike the case with WHO stages 3 and 4 patients, there is no counselling on first contact to raise awareness and highlight the importance of return visits. The follow-up appointment for those in WHO stages 1 and 2 is scheduled on the basis of their CD4 count results. Those with a CD4 count <250 cells/mm^3 are referred to the dedicated HIV/AIDS clinic for ART. The services for these patients once started on ART are similar to those in WHO stages 3 and 4 (Table 1). For the remaining patients: those with CD4 counts of 250–350 cells/mm^3 are requested to return three months later; those with a CD4 count of 351–500 cells/mm^3 are requested to return six months later; and those with a CD4 count >500 cells/mm^3 are requested to return one year later. Patients who fail to return for their CD4 counts cannot be booked for their next visit and will eventually be declared lost to follow-up, as priority has been given to trace those lost to follow-up on ART.

2.3. Outcomes of HIV-positive patients in WHO clinical stages 1 and 2

Outcomes for patients in stages 1 and 2 have been tracked on a monthly basis as follows: alive and being followed up (if not on ART) or alive and on ART; lost to follow-up (patient who has not returned for one month or more after their scheduled follow-up appointment); died (patient who has died for any reason); stopped treatment (patient who has been started on ART and has stopped treatment for any reason); transferred out (patient who has transferred out permanently to another treatment facility).

2.4. Data collection and statistical analysis

Structured forms were used to collect data on WHO clinical stage, CD4 cell count and weight at presentation and at each follow-up visit. These data were entered and stored in the FUCHIA database system (FUCHIA, Epicentre, Paris, France). Data collected from 1 June 2008 were collated, and outcomes for patients in stages 1 and 2 who had either started or not yet started ART during the follow-up period were analysed on 10 February 2009. Patients were considered to be 'retained' if they were still alive and under follow-up or if they had been formally transferred out to another facility.

When a patient is registered as being in WHO stage 1 or 2, he/she is given an appointment 2–4 weeks later and then at systematic time periods thereafter based on CD4 count level, as described above in the subsection on protocol for management. If a patient's scheduled follow-up appointment fell after the date of data analysis (10 February 2009), he/she was considered as being still alive and on follow-up and thus retained in care. 'Attrition' was defined

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Table 1
Management of patients in WHO stages 1 and 2 compared with patients in WHO stages 3 and 4, Thyolo District, Malawi

		WHO stages 1 and 2	WHO stages 3 and 4
Pre-ART	Site of care at hospital	GOPD	Specific HIV/AIDS and ART clinic
	Clinic resources	No dedicated infrastructure or specialised staff All types of patients seen together (HIV positive and negative)	Dedicated infrastructure and staffing available Only HIV-positive patients seen
	Caseload in attending clinic[a]		
	No. available clinicians	2	7
	Average no. patients/clinician/day	375	26
	Patient triage (flow organisation)	Absent	Present
	Patient waiting time	Relatively long	Relatively short
	Patient status	Generally healthy and asymptomatic	Symptomatic and generally ill
	ART eligibility	Eligible only if CD4 count <250 cells/mm^3 (CD4 dependent)	If CD4 count is unavailable: eligible on clinical grounds If CD4 count is available: WHO stage 3 with CD4 <350 cells/mm^3 and all WHO stage 4 irrespective of CD4 count
	CD4 count	Patient asked to return to hospital for CD4 results 2–4 weeks after registration	CD4 count performed on same day
	Additional visit	Required	Not required
	Counselling		
	Timing	Patient required to return 2–4 weeks later for counselling	First counselling session done on day of registration by a trained counsellor Available and integrated into HIV/AIDS clinic services; there is direct contact with counsellors
	Counsellors	Not integrated into GOPD services; first contact is with a clinician and not a counsellor	Counselling sessions (group) also done at community level with PLWA involvement
	Decentralised follow-up		
	Health centres	Still being developed; no formalised feedback system	Formalised through a referral and feedback system
	Community support system		
	Monitoring and reporting		
	Use of software or paper-based systems	Started in June 2007	Started in 2003 at the beginning of the programme
	Availability at hospital and health centres	Only at hospital level; if patients are decentralised (to health centres or the community), there could be a lack of feedback on outcomes	Implemented at all health facilities
Started on ART	Site of care at hospital	Dedicated HIV/AIDS and ART clinic	Dedicated HIV/AIDS and ART clinic
	Dedicated clinic resources	Dedicated infrastructure and staffing available	Dedicated infrastructure and staffing available
	Decentralised follow-up and support		
	Health centres	Formalised through a referral and feedback system	Formalised through a referral and feedback system
	Community		
	Monitoring and reporting of outcomes	Reporting compulsory and done monthly	Reporting compulsory and done monthly
	Tracing		
	Lost to follow-up Ascertainment of deaths	Actively done through health workers and community groups	Actively done through health workers and community groups

ART: antiretroviral treatment; GOPD: general outpatient department; PLWA: people living with HIV/AIDS.
[a] 2008 figures.

as deaths and losses to follow-up and stopped treatment (if on ART). Differences between groups were compared using the χ^2 test for categorical variables and the Wilcoxon rank-sum test for continuous variables. Cumulative incidences of attrition were determined using the Kaplan–Meier method and compared using the Cox–Mantel (log-rank) test. A Cox proportional hazard model was constructed to estimate the hazard ratio of attrition and loss to follow-up, comparing those started on ART with those not started on ART.

The level of significance was set at $P = 0.05$ or less, and 95% CI were used throughout. Data were analysed using the Stata/IC 10.0 software (Stata Corp., College Station, TX, USA).

3. Results

3.1. Characteristics of the study population

Between 1 June 2008 and 9 January 2009, there were 2502 newly registered HIV-positive patients at Thyolo District Hospital. Among these, 1792 (72%) presented in WHO stages 1 and 2, 441 (18%) in WHO stage 3 and 269 (11%) in WHO stage 4. Of the patients in WHO stages 1 and 2, there were 157 children aged less than 15 years and two patients with incomplete dates of termination of observation, who were excluded from the analysis. Table 2 shows the sociodemographic features and clinical and

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Table 2
Characteristics of HIV-positive adults in WHO stages 1 and 2, Thyolo District, Malawi ($n = 1633$)

Variable	n (%)
Total	1633
Sex	
Female	1076 (65.9)
Male	557 (34.1)
Age (years)	
<35	868 (53.1)
≥35	765 (46.9)
Age (years); median (IQR)	34 (28–40)
Baseline CD4 cell count (cells/mm^3)	
<50	97 (6.0)
50–249	584 (35.7)
250–349	226 (13.8)
≥350	436 (26.7)
Unknown	290 (17.8)
WHO stage 1	119 (7.3)
WHO stage 2	171 (10.5)
Baseline CD4 cell count (cells/mm^3); median (IQR)	246 (133–414)

IQR: interquartile range.

immunological status at baseline of the 1633 adult patients in WHO stages 1 and 2 who were included in the study.

3.2. Retention and attrition in patients in WHO stages 1 and 2 in relationship to whether or not ART was started

Table 3 shows treatment outcomes for all patients in WHO stages 1 and 2 according to whether or not they started ART. Outcomes were significantly worse among those not started on ART compared with those who started treatment. From the time of the first visit, retention at 1, 2, 3 and 6 months was significantly lower for patients not yet started on ART ($n = 1078$) compared with patients who started ART ($n = 555$): 25, 18, 11 and 4% vs. 99, 97, 95 and 90% ($P = 0.001$).

Patients were followed up for a total period of 282 person-years (PY), during which time there were 10 ascertained deaths and 858 losses to follow-up. Attrition rates were 31 times higher among patients not yet on ART compared with those started on ART after controlling for age, sex and CD4 count at baseline (adjusted hazard ratio, 31.0, 95% CI 21.9–44.0) (Figure 1). Attrition rates for patients not yet on ART were attributable almost entirely to loss to follow-up (99.6%). Of the 824 losses to follow-up reported among those patients not yet started on ART, 781 (95%) patients never returned for their CD4 count and first counselling appointment 2–4 weeks after registration at the GOPD (cumulative incidence of loss to follow-up 122/10 PY, 95% CI 113–131/10 PY). Among those patients whose first appointment was scheduled at least one month before the study analysis date ($n = 1428$), 257 (44%) in WHO stage 1 and 387 (46%) in WHO stage 2 returned to receive their CD4 counts.

Table 3
Outcomes for HIV-positive adults in WHO stages 1 and 2 according to whether or not they started antiretroviral treatment (ART), Thyolo District, Malawi ($n = 1633$)

Outcome	Not on ART ($n = 1078$) n (%)	On ART ($n = 555$) n (%)	P-value[a]	Total ($n = 1633$)
Alive	253 (23.5)	498 (89.7)	<0.001	751
Dead	1 (0.1)	9 (1.6)	<0.001	10
Lost to follow-up	824 (76.4)	34 (6.1)	<0.001	858
Transferred out	0	14 (2.5)	<0.001	14

[a] χ^2 test comparing outcomes of those not on ART with those on ART.

3.3. Criteria used to start ART in patients in WHO stages 1 and 2 and relationship to treatment outcomes

There were 681 patients in WHO stages 1 and 2 who presented with known baseline CD4 count <250 cells/mm^3, and in theory should have started on ART. Of these, 437 (64%) were started on ART [median time to ART initiation = 33 d, interquartile range (IQR) 21–44 d]. The great majority of these patients ($n = 403$) were still alive and on ART at the end of the study, and attrition was low with 27 (6.2%) patients lost to follow-up and seven (1.6%) dead. The other 244 patients were not started on ART for reasons that cannot be elaborated from available data. Of these patients, only 77 (32%) were still alive and being followed up at the analysis date (median follow-up time = 38 d, IQR 18–50 d) and 167 (68%) were lost to follow-up.

There were 952 patients in WHO stages 1 and 2 who presented with either a known baseline CD4 count ≥250 cells/mm^3 ($n = 662$) or who had no CD4 count performed ($n = 290$) and who in theory should not have started on ART at this time. Among the 662 patients with known baseline CD4 ≥250 cells/mm^3, 636 (96%) never started ART during follow-up. Among the 26 that did start ART, 15 fulfilled ART eligibility during the follow-up but 11 still had CD4 count ≥250 cells/mm^3 at the time of ART initiation, which is not in line with existing Malawi ART guidelines. Among the 290 patients with no CD4 count measured at baseline, 198 (68%) never started ART during follow-up. The remaining 92 (32%) patients started on ART: two of these patients progressed to WHO stage 3 during follow-up and were thus eligible for ART, whereas the remaining 90 patients (who were started on ART) were still in WHO stages 1 and 2 and were still in the absence of a CD4 count at ART initiation.

4. Discussion

To our knowledge, this is one of the first studies from a resource-limited setting to report on retention and attrition among HIV-infected individuals in WHO stages 1 and 2.

The first major finding was the very high early loss to follow-up observed in the group not yet placed on ART. We believe this can be attributed to what is still a suboptimal system in place to manage and follow up such patients, which now needs to be reinforced. Considering the initial difficulties of launching the ART programme in Thyolo, as elsewhere in Malawi, the initial priority was understandably to place HIV-infected patients in WHO stages 3 and 4 on ART, as these were at the highest risk of death.

The fact that most patients in WHO stages 1 and 2 were lost to follow-up in the first months of registration suggests that the lack of retention might be due to: a protocol that did not encourage retention (overloaded clinics, need for return for CD4 counts, lack of first-contact

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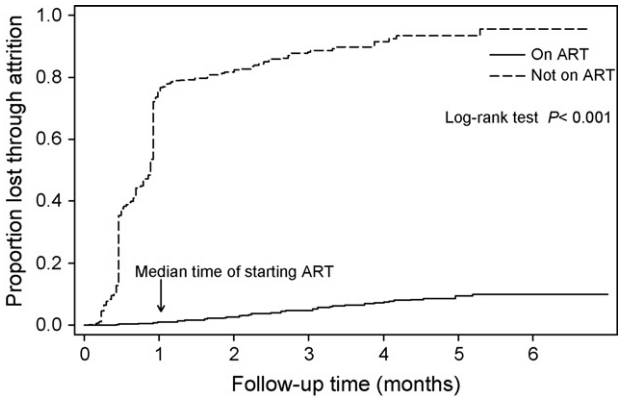

Figure 1. Cumulative incidence of attrition (loss to follow-up and deaths) among patients in WHO stages 1 and 2 according to whether or not they started antiretroviral treatment (ART), Thyolo District, Malawi.

counselling); lack of emphasis from health workers about the need for retention; lack of adequate training of health workers on the patient circuit; lack of interest from healthy or untreated patients; lack of a rationale for them to return in the scheduled time periods; inactive tracing systems; and so on. Possible suggestions to reduce this loss to follow-up are summarised in Table 4. Some of the main challenges and ways forward are discussed below.

First, WHO stages 1 and 2 patients are integrated into the general out-patient clinics, which are heavily overloaded with patients who have all types of other diseases, and which function with limited staff. By contrast, patients in WHO stage 3 or 4 or with CD4 count <250 cells/mm^3 (eligible for ART) are seen in the relative luxury of a dedicated ART clinic with staff and services focused entirely on HIV/AIDS. Patients in stages 1 and 2 are thus unavoidably subjected to long waiting times, and in view of their relatively better health status (when compared with other ill patients with different ailments) probably come to be regarded as a second-class priority. There is clearly a need to increase human resources at the GOPD, both for counselling and follow-up of the additional caseload related to patients in WHO stages 1 and 2. At the very least, sharing of existing human resources with the dedicated HIV/AIDS clinic would seem logical.

Second, provision of counselling services at first contact in order to raise awareness and market the importance of return visits is not implemented and is thus a 'lost

Table 4
Suggestions for improving pre-antiretroviral treatment (ART) management and follow-up of patients in WHO stages 1 and 2, Thyolo District, Malawi

Issue	Suggestions/possible ways forward
Resources	
- Improve clinician resources to cope with high caseload at GOPD	■ Increase number of clinicians at the GOPD to cope with the caseload ■ Consider rotation of staff between the well-staffed ART clinic and GOPD ■ Consider task-shifting for management of patients in WHO stages 1 and 2 to nurses and PLWA ■ Improve patient flow for WHO stages 1 and 2 patients at GOPD and introduce a fast-flow circuit as these patients are essentially asymptomatic
CD4 counts	
- Facilitate laboratory capacity for CD4 counting	■ Increase laboratory capacity for CD4 counting (CD4 count machine and staffing)
- Avoid an additional patient visit to hospital only for CD4 count results	■ Make CD4 count results available at nearest health centre, community site or PLWA group closest to patient's residence
Counselling	
- Use the first 'contact opportunity' to increase awareness on the importance of continued follow-up and the available package of prevention and care	■ Ensure that all patients in WHO stages 1 and 2 are offered group counselling at the time of registration ■ Introduce task-shifting for counselling through active participation of PLWA groups or expert patients in the GOPD activities
Geographic access	
- Increase geographical access for counselling, care and follow-up	■ Consider decentralised registration, care and follow-up at health centres or preferably at the community level
Monitoring, reporting and tracing of patients	
- Improve monitoring and reporting	■ Adapt the existing paper-based monitoring system to monitor and report on follow-up and outcomes of patients in WHO stages 1 and 2 ■ Ensure that this system is functional at all decentralised sites with recording of transfer-outs and referrals
- Improve tracing system for patients lost to follow-up	■ Use existing tracing system with community involvement for reporting and tracing of patients declared lost to follow-up

GOPD: general out-patient department; PLWA: people living with HIV/AIDS.

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opportunity'. Raising awareness of the existing packages of care for patients in WHO stages 1 and 2 at first contact is vital and would include: co-trimoxazole preventive therapy for patients in stage 2; isoniazid preventive therapy; prevention of mother-to-child transmission for women of childbearing age; education on prevention of sexual transmission; condom promotion and distribution; scheduled assessment of CD4 cell counts; the potential opportunity to start ART earlier;[10] nutrition support where required; and the possibility of being followed up at community level through patient support groups and community nurses. A possible way forward might be to offer group counselling sessions for WHO stages 1 and 2 patients in the community and at the GOPD through task-shifting to existing people living with HIV/AIDS (PLWA) groups, community volunteers and expert patients.[11–14] If these services were to be offered, there is a higher probability that continued follow-up visits would take place.

Third, a crucial point in the management protocol for patients in WHO stages 1 and 2 is the additional return visit to collect the CD4 count result 2–4 weeks after registration. The great majority (95%) of loss to follow-up occurred at this point in time. It is likely that the lack of counselling services at the first contact within the GOPD, coupled with what is perceived to be an overloaded clinic, is to blame. The opportunity costs, particularly transport costs,[15] of returning to the clinic might outweigh the perceived benefits. Thus, opportunities to decentralise WHO stages 1 and 2 patients need to be explored, as this would both lighten the current burden on the GOPD and, for patients who live far away, reduce the opportunity costs related to travel, which in turn would make follow-up appointments easier.

Decentralisation of services is taking place and can be further strengthened to peripheral health centres and also to the community, as the 29 existing peripheral health centres in Thyolo are already overloaded with patients and face shortages of health staff. WHO stages 1 and 2 patients are mainly being seen at the community level, where a specific care, follow-up and tracing system could operate through associations of people living with HIV/AIDS, PLWA support groups and home-based care volunteers.[10,12,16–20] This would open greater opportunities for community counselling, awareness-raising and patient empowerment. Thyolo has launched an initiative called 'improved health posts', which in brief are sites at community level managed by community associations, patient support groups and a full-time community nurse trained in HIV/AIDS care and care of other chronic illnesses. HIV testing and counselling, group counselling activities, screening and staging, tuberculosis sputum collection, co-trimoxazole refill, nutrition support, management of opportunistic infections and ART drug refills are currently done at such sites. Blood collection and transport to the district laboratory for CD4 counting and feedback of results has recently been added to the package. Currently there are five such sites, with plans underway to expand this initiative to 13 sites, geographically distributed throughout the district. HIV-infected patients in WHO stages 1 and 2 are actively linked to this initiative, which might prove more acceptable by avoiding the need for return visits to the hospital.

Finally, existing patient tracing systems, including community-based mechanisms using PLWA groups, volunteers and home-based care programmes,[10,12,16–20] are not activated to trace and encourage these pre-ART patients to attend their follow-up visits. Community involvement in Thyolo has previously been shown to reduce loss to follow-up rates and has made reliable ascertainment of deaths possible.[10] One of the current problems related to tracing is that the Malawi treatment master card system,[9] the pillar of Malawi's HIV/AIDS monitoring and evaluation system, is restricted to patients 'on ART'. As a result, patients in WHO stages 1 and 2 and not yet on ART go unmonitored and their outcomes undeclared. Therefore, when a patient is lost to follow-up, this is not reported and no action is taken. It is essential to adapt the existing master card system (or preferably introduce a similar but simpler card system) to also allow monitoring and tracing of patients not yet on ART, particularly at community level.

The second major finding was that mistakes were made in the routine setting about who did and did not require ART. Patients eligible for ART were not started on therapy and patients not eligible *were* started on ART. The associated public health implications of unnecessary treatment, exposure to ART-related toxicity and possible poor adherence to therapy in relatively healthy patients raises the potential risk of drug resistance development. Eleven patients were wrongly started on ART with CD4 count $\geq$250 cells/mm^3, and this practice is an indication of inattention by clinicians and may reflect possible shortcomings in terms of clinician training and ongoing supervision. These are currently being corrected.

In the analysis of patient outcomes, we applied the same strict definition of loss to follow-up (failure to show up one month after scheduled appointment date) to patients in WHO stages 1 and 2 not requiring ART as we did to patients eligible for ART. However, if a stage 1 patient with a high CD4 count fails to return within one month of the scheduled appointment date, this has very different clinical implications compared with a patient on ART failing to return within that time. This definition might therefore be unnecessarily strict, and the definition of standardised outcomes for pre-ART patients warrants broader discussions and expert consensus. A study from Malawi that reported on the 'true outcomes' of patients lost to follow-up after being placed on ART showed that 65% of such patients were ascertained to be dead or had stopped ART, 27% could not be traced and only 8% were still on ART and had actually transferred to other clinics.[21] This finding, coupled with the fact that median survival (without ART) in patients with AIDS in Africa is less than one year,[22] would also imply that the relative contribution of deaths within loss to follow-up is likely to be very different for patients in WHO stages 1 and 2 not eligible for ART compared with patients with more severe immune deficiency.

The strengths of this study are that: (1) a relatively large number of individuals were included; (2) the data are from a program setting and therefore are likely to be representative of the operational reality on the ground; and (3) these findings highlight a number of important programme-related shortcomings that can be addressed and corrected. The limitations of the study are that: (1)

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the follow-up period is relatively short and, with staggered entry occurring during this observational study, we do not know if patients not yet requiring ART and declared lost to follow-up do eventually return many months or years later (longer follow-up data would be helpful); (2) although a registration system (through the FUCHIA software) was introduced at the hospital level, a proportion of patients might have subsequently continued their follow-up at a different site, i.e. community or health centre. However, data on this was not captured in the hospital FUCHIA system. This lack of a data link with decentralised sites might have resulted in possible overestimation of losses to follow-up; (3) CD4 counts were not available for all patients; and (4) we do not know the reason(s) why a considerable proportion of individuals in WHO stages 1 and 2 who were eligible for ART (244 with CD4 counts <250 cells/mm^3) did not start ART. This merits further investigation and specific research.

In conclusion, in a rural district hospital setting in Malawi, attrition of individuals in WHO stages 1 and 2 is high, and specific operational strategies need to be considered to retain such patients in the health system.

Authors' contributions: KT-S, RZ, MMas, MMan, BM, OP and ADH were involved with the study conception and design; MMas, BM, MMan, TvdA, MB and OP were involved with the field implementation and supervision; KT-S, RZ, MMas, MMan, TvdA, MB and OP were involved with data analysis and interpretation, which were improved by AB, BM, OP and ADH; KT-S and RZ drafted the first version of the manuscript and all co-authors were involved with critical revision; BM, AB, TvdA, MB and ADH considerably improved the intellectual content. All authors read and approved the final version. RZ is guarantor of the paper.

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Conflicts of interest: None declared.

Ethical approval: General measures are employed at the Thyolo District Hospital out-patient department and the ART clinic facilities to ensure patient confidentiality, consent for HIV testing, and counselling and support for those who receive a positive HIV test result. The data in this study did not include patient identifiers. The Malawi National Health Science Research Committee provides general oversight and approval for the collection and use of routine programmatic data for monitoring and evaluation, and does not require a formal submission for ethical approval for the type of study conducted in this paper.

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