

## HIV treatment outcomes and their associated factors among adolescents and youth living with HIV in Tanzania

\*Doreen Philbert<sup>1</sup>, Judith Msovela<sup>2</sup>, Dorica Burengelo<sup>1</sup>, Frank Eric Hassan<sup>1</sup>, Caritas Kitinya<sup>1</sup>, Grace Soka<sup>1</sup>, Gibson Kagaruki<sup>3</sup>, Francis N Donard<sup>1</sup>, Anath Rwebembera<sup>4</sup>, Boniface Silvan<sup>4</sup>, Mastidia Rutahiwa<sup>4</sup>, Casiana Sanga<sup>1</sup>, Theresia Mwombeki<sup>1</sup>, Amani Wilfred<sup>1</sup>, Mbazi Senkoro<sup>1</sup>, William Kisoka<sup>2</sup>, Sayoki Mfinanga<sup>1</sup>, Esther Ngadaya<sup>1</sup>, Godfather Kimaro<sup>1</sup> and Amos Kahwa<sup>1</sup>

<sup>1</sup>National Institute for Medical Research Muhimbili Research centre, Dar es Salaam, Tanzania

<sup>2</sup>National Institute for Medical Research, Headquarters, Dar es Salaam, Tanzania

<sup>3</sup>National Institute for Medical Research Tukuyu Research centre, Mbeya, Tanzania

<sup>4</sup>National AIDS Control Program

### Abstract

**Introduction:** Despite improvements in access to Ante-Retroviral therapy in Tanzania, low ART initiation rate, low retention rate, lower viral load suppression, high loss to follow up and death rate among adolescents and youth living with HIV remain a challenge. This study was conducted to identify factors affecting HIV treatment outcomes among adolescents and youths.

**Methods:** A cross-sectional study was done in seven regions in Tanzania. A total of 1124 in and out of school AYLHIV were interviewed using a semi-structured questionnaire.

### Results:

A total of 1120(99.6%) participants were on ART. Of those who were on ART, 606 (53.9%) participants had advanced HIV disease, 423(37.6 %) had switched to the second line of ART and 1761(7.7%) had a virological failure. After adjusting for confounders, death of both parents (APR= 1.3, 95%CI: 1.01-1.8); regions with high HIV prevalence (APR= 1.7, 95%CI: 1.2-2.3) and taking ARVs for three years and less (APR= 2.2, 95%CI: 1.4-3.6) were associated to have advanced HIV. Additionally, HIV regional prevalence level, level of perception, adherence status, ARV storage and supervision of ART use were independently associated with Virological failure.

**Conclusion:** This study has shown that despite an almost universal utilization of ART among adolescents and youth living with HIV unfavourable clinical ART outcomes such as advanced HIV disease, virological failure and ART switch to the second line remain a challenge, particularly among males and adolescents. Various factors at individual, community and health facility levels contribute to unfavorable ART clinical outcomes among AYLHIV. Therefore, an all-inclusive multidimensional and multi-stakeholders' approach is needed to ensure the availability of sustainable, effective and quality care and treatment services prioritizing AYLHIV.

**Keywords:** AYLHIV, ART clinical outcomes, Advanced HIV disease, Virological failure, ART switch

### Introduction

Although HIV affects all age groups, mirroring global trends, young people represent a growing share of PLHIV worldwide. In 2020 alone, 410,000 [194,000-690,000] young people between the ages of 10 to 24 were newly infected with HIV, of whom 150,000 [44,000-310,000] were adolescents between the ages of 10 and 19(UNICEF, 2021). In

Tanzania the UNAIDS estimated 1.6 million people living with HIV out of whom nearly 100,000 were adolescents and youth. Adolescent girls and young women accounted for approximately 55% of this group (UNAIDS, 2016).

\*Correspondence: [ddeogratias@yahoo.com](mailto:ddeogratias@yahoo.com)

Further, statistics show that there were 9,500 new HIV infections and 2,300 AIDS-related deaths in 2017 among adolescents and youth (UNAIDS, 2017).

According to the HIV Impact Survey of 2016-2017, the prevalence of HIV among girls aged 10-14 years was 0.3%, with a similar proportion among boys of the same age group (Tanzania Commission for AIDS (TACAIDS) Zanzibar AIDS Commission (ZAC), 2017). However, between the ages of 15-19, the prevalence of HIV among girls was reported to be at 1%, double that of boys (0.4%), with the same disparity in trends even among individuals between 20-24 years (Mavedzenge *et al.*, 2011). In 2018 the United Nations Children's Fund (UNICEF) estimated 92,000 and an HIV prevalence of 0.4% among children below 15 years of age.

In 2015, UNICEF and UNAIDS in partnership with other international health and development partners, launched "All In" to end the AIDS epidemic among adolescents and youth by 2030 (UNAIDS, 2017; UNICEF, 2021). This global initiative established the 2020 targets to end the AIDS epidemic among adolescents by 2030. To achieve this, it is critical to accelerating efforts to address the epidemic among adolescents. Available evidence indicates improvements in access to ART in Tanzania. However, analysis from unpublished local National ART treatment outcomes reported a low ART initiation rate (50%), low retention rate (65.4%, high loss to follow-up (32.4%) and a death rate of 2.3% among adolescents and youth aged between 10-19 and young people aged 20-24 years enrolled in the ART program from September 2014 to September 2017. Furthermore, data from THIS 2016-17 reported low access to HIV testing among adolescents and youth and young people (39%) (Tanzania Commission for AIDS (TACAIDS) Zanzibar AIDS Commission (ZAC), 2017) and also lower viral load suppression among adolescents and youth

compared to older age groups (Tanzania Commission for AIDS (TACAIDS) Zanzibar AIDS Commission (ZAC), 2017).

Despite the proven evidence of ART in improving the survival and quality of life of HIV patients, high mortality and poor treatment outcomes remain a challenge (Ayele *et al.*, 2015). Attaining the 90-90-90 targets urgently calls for the best approach to address these challenges. However, there is scanty evidence on factors contributing to poor treatment outcomes among AYLHIV. This study was therefore conducted to assess treatment outcomes and its determinant among adolescents and youth living with HIV. The information obtained will inform program and adolescent stakeholders on how best to address challenges impacting treatment outcomes among adolescents and youth living with HIV and AIDS.

## **Methods**

### **Study design and setting**

It was a cross-sectional study design that used a quantitative data collection method. The study was conducted in HIV care and treatment centers across seven regions with high, moderate and low HIV prevalence. They included Kilimanjaro, Mtwara, Simiyu, Dodoma, Iringa, Mbeya, and Dar es Salaam. Data were collected between June and July 2020. For quantitative data, we interviewed all consented/assented AYLHIV using a data open kit (ODK) installed in tablets. We used a facility checklist tool to abstract data from CTC registers for the period covering September 2017 to September 2019.

### **Study population**

The study involved adolescents and youth living with HIV aged 10-24 years receiving care at CTC, Adolescents and youth whose HIV status was not disclosed to them were excluded from the study.

### **Sampling procedures and sample size**

Purposive sampling was used to select the seven regions, having high, intermediate and low HIV prevalence, from 6 geographical zones

in the country. In each region, an urban and rural district was selected. Forty-two health facilities that provide ART services were included one hospital, one health center and one dispensary in each district.

From each health facility, a list of adolescents attending care and treatment centers (CTC) for HIV services who knew their HIV status was obtained from the facility in-charges. From this list, we identified in and out-of-school AYLHIV with age groups of 10-14, 15-19 and 20-24. The list contained the phone numbers of AYLHIV and their parents/guardians. We employed systematic sampling to select AYLHIV for appointments. All AYLHIV who responded and who consented/assented were enrolled for interview. A total of 1120 eligible participants were enrolled on the study.

#### **Standard and operational definition**

The main outcome variables were Advanced HIV disease, switching the second ART line (ART Switch) and Virological failure. Advanced HIV disease was defined as HIV at WHO clinical stages III and IV, ART Switch was when an individual took ART that was defined as 2<sup>nd</sup> line by the National guidelines and Virological failure was defined as failure to suppress viral load to less than 200 copies/ml. On the other hand, our explanatory variables were grouped into four domains namely i) demographic factors, ii) knowledge, perception and risk behaviors, iii) ART use and experiences, and iv) Access to ART services.

#### **Data management and analysis:**

Data were analyzed using STATA 15. Univariate and multivariable analysis were performed. The univariate analysis involved descriptive analysis of frequency distribution and percentages for key study variables whereas bivariate analysis was used to establish the statistical association between the dependent and the independent variables. In this paper, we have reported three HIV treatment outcomes including ART switch, virological failure and advanced HIV disease (WHO stage 3

and 4). All variables with p-value <0.2 in the unadjusted (bivariate) analysis were included in the multivariable model, but only variables which had a p-value <0.05 were retained in the final model and considered to be statistically significant. We used the Bloom technique to assess the overall HIV and AIDS knowledge level among AYLHIV. Using a total of 25 items (on HIV/AIDS definition, Transmission, prevention ARVs and their benefits and Opportunistic infection), overall knowledge was categorized as low for scores <60 per cent or 0–14; moderate for scores 60–79.9 per cent or 14–19; and high for scores 80-100 per cent or 20-25.

#### **Ethical considerations**

The study was granted ethical clearance from the National Health Research Ethics Review Committee (NathREC) of Tanzania (ref: NIMR/HQ/R.8a/Vol. IX/3434). Additionally, permission to conduct the study was sought from the relevant authorities in the selected regions, districts, facilities and communities. Written informed consent was obtained from each participant that was above 18 years of age and the parent/guardian of every adolescent that was below 18 years of age together with assent from each of these adolescents. Participation was voluntary allowing withdrawal at any time. No personal data were collected.

#### **Findings**

##### **Demographic characteristics of participants**

A total of 1,124 AYLHIV responded to a questionnaire giving a response rate of 91% (1124/1237). The findings showed that 56.8%(638) of participants were female, and 40.6% (n=456) were aged 15–19 years. The analysis also revealed that more than half, 58.4% (656) of respondents were in school. Of all the participants 54.6% (614) had primary school education. More than half of the AYLHIV resided in rural areas at the time of the study and over a third of participants (41.15%, n=428) had lost at least one parent.

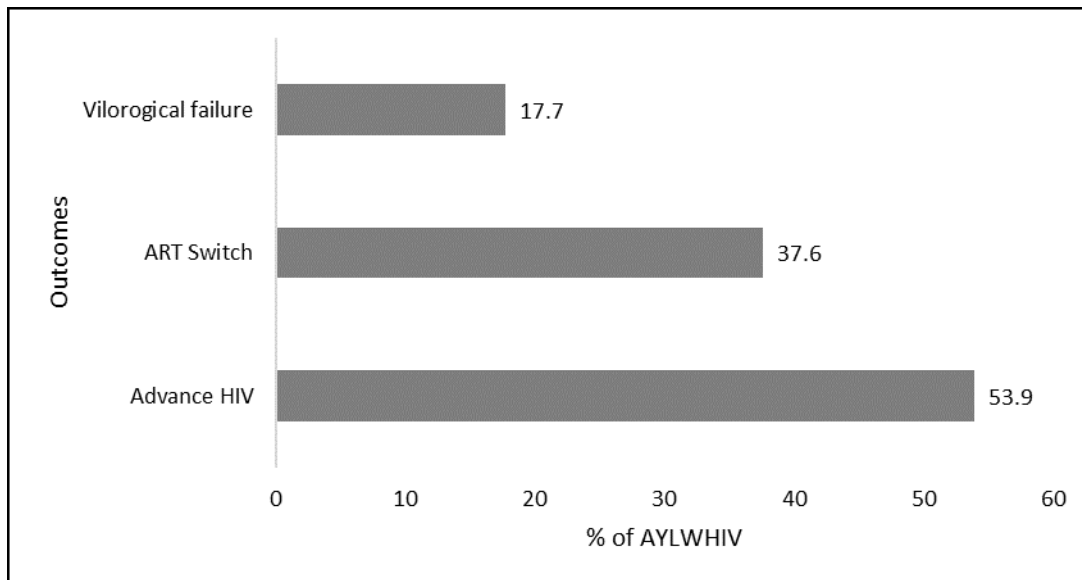
**Table 1: Sociodemographic characteristics of AYLHIV**

Characteristics		N(1124)	Percent
<b>Age</b>	10-14	373	33.20
	15-19	456	40.60
	20-24	295	26.20
<b>Sex</b>	Male	486	43.20
	Female	638	56.80
<b>School status</b>	In school	656	58.4
	Out of school	468	41.6
<b>Level of education</b>	Primary school	614	54.6
	Secondary school and above	510	40.6
<b>Residence</b>	Rural	630	56
	Urban	494	44
<b>Parents' status (missing 84)</b>	Both Alive	371	35.67%
	One alive	428	41.15
	Both deceased	236	22.69
	Don't Know	5	0.48

**Prevalence of undesirable clinical ART outcomes among AYLHIV**

Overall, out of 1,124 AYLHIV, 99.6 % (n=1,120) were on ART. Four AYLHIV had stopped using ART because of side effects, lack of enough knowledge on ARVs, forgetfulness and having

a large number of pills to take. As shown in Figure 1, overall, more than half of AYLHIV had advanced HIV disease (53.9%; n=606); almost a fifth, 17.7% (176) had a virological failure and over a third, 37.6 % (n=423) had ART switch the o second line.



**Figure 1: Prevalence of undesirable HIV treatment outcomes among AYLHIV**

**Factors associated with clinical outcomes among AYLHIV**

**Clinical outcomes by sociodemographic characteristics**

Demographic characteristics impact ART clinical outcomes differently as illustrated in Table 2. Advanced HIV was significantly higher among male AYLHIV, adolescents, those from urban settings and regions with high HIV prevalence; those who were schooling; in boarding schools, who had secondary or

college as their highest level of education and those who have lost both parents than the comparison groups. ART Switch to the second line was significantly associated with regions of low HIV prevalence, rural settings, AYLHIV in schools, those in boarding schools and who had secondary or college as their highest level of education. Further, there was a significant association of virological failure with adolescent AYLHIV, regions with high HIV prevalence and lower education.

**Table 2: Clinical Outcomes among AYLHIV by sociodemographic characteristics**

		Total	Advanced HIV disease	ART Switch	Virological failure
		n (%)	n (%)	n (%)	n (%)
		N=1124	N=606	N=423	N=176
Demographic characteristic	Variables				
Sex	Male	486(43.2)	285(58.6)**	198 (40.7)	84(19.2)
	Female	638(56.8)	321(50.3)	225 (35.3)	92(16.5)
Age group	10-19 y (adolescents)	829(73.7)	471(56.8)**	323(39.0)	148(19.6)**
	20-24 y (youths)	295(26.2)	135(45.8)	100 (33.9)	28(11.6)
HIV regional prevalence level	Low	650 (57.8)	314(48.3)	282 (43.4)***	78(13.1)
	High	474 (42.2)	292(61.6)***	141 (29.8)	98(24.4)***
Residence	Urban	630 (56.1)	365(57.9)**	258 (41.0)	94(16.3)
	Rural	494 (43.9)	241(48.8)	165 (33.4)**	82(19.6)
School status	Schooling	656 (58.4)	372(56.7)*	270 (41.2)**	103(17.2)
	Not schooling	468 (41.6)	234(50.0)	153 (32.7)	73(18.4)
School setting-day/boarding	Day	617(94.1)	343(55.6)	246(39.9)	98(17.4)
	Boarding	39(5.9)	29(74.4)*	24(61.5)**	5(13.2)
	Non/primary	668 (59.4)	340(50.9)	214 (32.0)	114(20.1)*

<b>Education of parents/guardians</b>	Secondary/college	456 (40.6)	266(58.3)*	209 (45.8)***	62(14.4)
<b>Parent status</b>	Both are alive	371(35.4)	181(48.8)	127(34.2)	45(13.8)
	One is dead	428(40.9)	247(57.7)	181(42.3)	73(19.1)
	Both are dead	248(23.7)	146(58.9)*	93(37.5)	44(19.5)

\* $p < 0.05$ , \*\* $p < 0.01$  and \*\*\* $p < 0.001$

### Knowledge, perception and risk behaviour associated with ART outcome among AYLHIV

Overall, 83% of AYLHIV had low knowledge of HIV. There was no statistically significant association between knowledge level of HIV and Advanced HIV, ART Switch and Virological failure. However, AYLIV with the highest level of knowledge of HIV had a higher proportion of advanced HIV and virological failure than the comparison groups. Experience of stigma was significantly associated with advanced HIV/AIDS, where AYLHIV who never experienced stigma had a higher proportion with advanced HIV/AIDS than those who experienced the same. Further virological failure was associated with a lack of training on HIV, those who didn't receive training had higher proportion of virological failure than their counterparts who received the training. Further, we explored risk behaviors related to HIV/AIDS and associated complications such as alcohol use, cigarette smoking, substance abuse, and engagement in sexually related behaviors. Nearly 78 per cent (n=880) of

AYLHIV interviewed were aware that unprotected sexual intercourse may put them at risk of pregnancy and contracting sexually transmitted diseases (STDs) such as syphilis, gonorrhoea and HIV; 27.4 per cent (n=308) reported to be sexually active, and 103 out of 308 had at least two sexual partners in the 12 months before the study. Nearly 6 per cent (n=78) of interviewees reported the use of alcohol, 0.4 per cent (n=4) reported the use of illicit drugs and 2.7 per cent (n=30) had smoked cigarettes. The number of older females who had engaged in risk behaviors was higher than the number of younger males and females who had engaged in similar risk behaviors. As shown in Table 3, there was no significant association between ART outcome with alcohol use, however, respondents who consumed alcohol had higher proportion of ART switches compared to non-alcohol users. Respondents who had multiple sexual partners had a significantly higher proportion of advanced HIV and ART switches than those who were not in sexual relationships.

**Table 3: Knowledge, perception & risk factors**

		Total	Advanced HIV disease	ART Switch	Virological failure,
		n (%)	n (%)	n (%)	n (%)
		N=1124	N=606	N=423	N=176
Characteristics	Variable				
Knowledge category	Low	934 (83.1)	508(54.4)	356 (38.1)	153(18.3)
	Moderate	166 (14.8)	82(49.4)	58 (34.9)	18(12.9)
	High	24 (2.1)	16(66.7)	9 (37.5)	5(22.7)
Received training	Yes	851 (75.7)	468(55.0)	319 (37.5)	122(16.2)
	No	273 (24.3)	138(50.5)	104 (38.1)	54(22.4) *
Level of perception	Negative	492 (43.8)	279(56.7)	204 (41.5)	76(17.2)
	Neutral	150 (13.4)	78(52.0)	51 (34.0)	34(26.2) *
	Positive	482 (42.9)	249(51.7)	168 (34.9)	66(15.6)
Experience of stigma	Never stigmatized	408 (36.3)	240(58.8) *	151 (37.0)	68(18.8)
	Ever stigmatized	716 (63.7)	366(51.1)	272 (38.0)	108(17.0)
Drinking alcohol	Yes	78(6.9)	35(44.9)	33(42.3)	10(15.2)
	No	1046(96.1)	571(54.6)	390(37.3)	166(17.8)
Number of sexual partners	None/one	1021(90.8)	561(55.0) *	382(37.4)	164(18.0)
	Multiple partners	103(9.2)	45(43.7)	41(39.8)	12(14.5)

\* $p < 0.05$

#### Clinical outcome and ART use and experiences

Among 1124 AYLHIV interviewed 58.5% had never disclosed their status. Over 80% (87 %, n=974) of AYLHIV who were using ART, used ART in a secret environment, whereas 8 % (n=89) did so in an open environment. Of the 1,120 AYLHIV using ART, 60 % (n=667) could recall when they had started ART. Regarding ART side effects, the majority of AYLHIV (n=651; 58.1 %) reported not having experienced any side effects. The majority (64.7 %, n=725) of AYLHIV reported storing the medications in their rooms while at home, 17.9

% (n=200) stored them in some other places in the house, 14.6 % (n=164) kept them in the possession of parents/guardians, and 1.4 % (n=14) kept ART in their backpacks. The majority (75.8 %, n=849) of AYLHIV were either taking their ART under the supervision of their guardians or 63.3%, n=709; under the parent's supervision, whereas 45.5 % (n=510) sometimes took their drugs under no supervision. On the other hand, the majority of AYLHIV in the boarding school environment (41%, n=16) used their matron's/patron's/ teacher's office to keep their ARVs, whereas 35.9 % (n=14) stored

ART drugs in their dormitory (cupboard/trunk), Only six AYLHIV reported walking around with ART in their backpack.

Table 4 highlights the association between various practices on ART use and unfavorable clinical outcome. Advanced HIV was significantly associated with open use of ART, a higher proportion of AYLHIV who used ARVs openly had advanced disease than those who used the medicine secretly. ART switch was significantly associated with not disclosing HIV status and secrete use of ART. Virological failure was significantly associated with the storage of ARV and taking ARV under supervision, AYLHIV whose parents kept the

ARV for them, had a higher proportion of virological failure than their counterparts who stored the ARV for themselves. Further, AYLHIV who were not supervised during ARV taking had a higher proportion of virological failure than those who were supervised in taking their ARVs.

There was no significant association between the experience of side effects and poor clinical ART outcomes however, AYLHIV who had experienced side effects a had higher proportion of advanced HIV and virological failure compared to those who had never experienced side effects.

**Table 4: Utilization of ART services and unfavourable clinical outcome**

		Total	Advanced HIV disease	ART Switch	Virological failure
		n (%)	n (%)	n (%)	n (%)
		N=1124	N=606	N=423	N=176
Characteristics	Variable				
<b>Disclosure status</b>	Ever disclosed	467 (41.6)	264(56.5)	150 (32.1)	76(18.6)
	Never disclosed	657 (58.5)	342(52.0)	273 (41.6) **	100(17.0)
<b>The environment on ART use</b>	Secretly	974(87.0)	511(52.5)	385(39.5) **	150(17.5)
	Public/openly	146(13.0)	95(63.3) *	38(25.3)	26(19.0)
<b>Adherence status</b>	Good	776 (69.3)	423(54.5)	293 (37.8)	112(16.4)
	Poor	344 (30.7)	179(52.0)	130 (37.8)	64(20.6)
<b>Experience of side effects</b>	No	1039(92.4)	555(53.4)	396(38.1)	159(17.3)
	Yes	85(7.6)	51(60.0)	27(31.8)	17(22.1)
<b>ARV storage</b>	Self-storage	939(83.5)	513(54.6)	349(37.2)	131(15.8)
	Parent/guardian/relative storage	185(16.5)	93(50.3)	74(40.0)	45(26.6) **
<b>Supervision of ART use</b>	Without supervision	510(45.5)	290(56.9)	192(37.7)	104(22.8) ***
	With supervision	610(54.5)	312(51.2)	231(37.9)	72(13.5)

\* $p < 0.05$ , \*\* $p < 0.01$  and \*\*\* $p < 0.001$

**Access to ART services and unfavourable clinical outcome**

Findings of health facilities assessment show that almost all facilities reported a lack of one or more components of youth-friendly services. Over 93 % (n=43) of facilities reported

the availability of staff trained on adolescent and youth-friendly services while adolescent and youth peer educators were present in over 87 % (n=40) of facilities. Over 87% (n=40) of facilities had considered extending HIV services to weekends and after-school hours,



which is an attribute of greater organizational accessibility and availability.

Among the 1,120 AYLHIV who were on ART, 87.1 % (n=975) reported that it was easy for them to get ART from the health facility in localities near their homes and 75.8 % (n=652) of AYLHIV who were in school did not report any difficulty in getting ART from the health facility while in school.

Table 5, indicates various ART accessibility factors affecting ART clinical outcomes among AYLHIV. Advanced HIV was significantly associated with duration of ARV use, space and privacy; the existence of strategy for keeping waiting hours short; availability of adolescent and youth support clubs and facility ownership. A significantly higher proportion of respondents who attended health facilities with adequate space and privacy; the presence of a strategy for keeping waiting hours short; the existence of youth support clubs; FBO owned facilities and at the hospital, level had advanced HIV than their respective comparison groups.

ART switch to the second line was significantly associated with the duration of ARV use, service hours for adolescent clinics, space and privacy, the existence of strategies for keeping waiting hours short, facility ownership and health facility level. A significantly higher proportion of respondents who attended a facility without adequate space and privacy; the presence of strategy for keeping waiting hours short; public-owned health facilities and health centre level had switched ART than their comparison groups. Virological failure was associated with hours for adolescent clinics; location; space and privacy; the existence of strategy for keeping waiting hours short; availability of adolescent and youth support clubs and health facility level. AYLHIV who attended health facilities without convenient hours for adolescent clinics; not in convenient locations; lacked adequate space and privacy; lacked strategy for keeping waiting hours short; lacked adolescent and youth support clubs and health centre level had a higher proportion of virological failure than their respective counterparts.

**Table 5: Service access and unfavourable clinical outcome**

		<b>Total</b>	<b>Advanced HIV disease</b>	<b>ART Switch</b>	<b>Virological failure</b>
		<b>n (%)</b>	<b>n (%)</b>	<b>n (%)</b>	<b>n (%)</b>
		<b>N=1124</b>	<b>N=606</b>	<b>N=423</b>	<b>N=176</b>
<b>Characteristics</b>	<b>Variable</b>				
<b>Time since initiated ART</b>	<3 years	138(25.1)	33(23.9)	32(23.2)	14(14.1)
	3+ years	411(75.1)	243(59.1)***	166(40.4)***	65(17.5)
<b>Convenient hours for adolescents clinics</b>	Yes	976(87.2)	538(55.1)	361(37.0)	149(16.9)
	No	143(12.8)	67(46.8)	62(43.4)	27(24.6)*
<b>Convenient location</b>	Yes	820(73.3)	452(55.1)	311(37.9)	99(13.3)
	No	299(26.7)	153(51.2)	112(37.5)	77(31.3)***
<b>Adequate space and privacy</b>	Yes	839(78.1)	485(57.8)***	336(40.1)	118(15.3)
	No	235(21.9)	93(39.6)	60(25.5)***	46(23.6)**
<b>Has a strategy for keeping waiting hours short</b>	Yes	1049(93.7)	584(55.7)***	414(39.5)***	155(16.6)
	No	70(6.3)	21(30.0)	9(12.9)	21(36.8)***
<b>Availability of adolescent and youth support clubs</b>	Yes	953(90.3)	534(56.0)**	362(38.0)	144(17.2)
	No	102(9.7)	42(41.2)	38(37.3)	27(29.0)**
<b>Service ever interrupted</b>	No	393(35.1)	204(51.9)	155(39.4)	61(18.0)

	Yes	726(64.9)	401(55.2)	268(36.9)	115(17.6)
<b>Facility ownership</b>	Public	1007(90.0)	532(52.8)	391(38.8)*	161(18.1)
	Private/FBO	112(10.0)	73(65.2)*	32(28.6)	15(14.8)
<b>Health facility level</b>	Dispensary	153(13.7)	72(47.1)	36(23.5)	24(19.7)
	Health centre	480(42.9)	237(49.4)	179(37.3)	95(21.9)**
	Hospital	486(43.4)	296(60.9)***	208(42.8)***	57(13.0)

\* $p < 0.05$ , \*\* $p < 0.01$  and \*\*\* $p < 0.001$

### Multivariate analysis results of factors associated with poor ART clinical outcome

Adjusting for other factors HIV regional prevalence level, parent living status, duration on ART, and facility ownership where services were received were independently associated with advanced HIV. AYLHIV from regions with higher HIV prevalence levels (APR= 1.7, 95%CI: 1.2-2.3), whose both parents are dead (APR= 1.3, 95%CI: 1.01-1.8) and those who were on ARV for at least three years (APR= 2.2, 95%CI: 1.4-3.6) were more likely to have advanced HIV than their respective comparison groups. Further, AYLHIV who attended FBO-owned facilities (APR=0.6, 95%CI: 0.4-0.9) were less likely to have advanced HIV disease than their counterparts receiving services at publicly owned facilities.

ART Switch was associated with the setting, education of parents/guardians and space and privacy for the provision of ART services.

AYLHIV from urban (APR=1.9, 95%CI: 1.3-2.8), whose parents or guardians have at least secondary education level (APR=1.7, 95%CI: 1.2-2.3) and those who attended a facility without adequate space and privacy (APR=5.4, 95%CI: 1.6-18.6) were more likely to switch to second-line ART than their comparison groups.

HIV regional prevalence level, level of perception, adherence status, ARV storage and supervision of ART use were independently associated with Virological failure. AYLHIV from regions with high HIV prevalence (APR=2.0, 95%CI: 1.5-2.7); those with poor perception of ART use (APR=1.6, 95%CI: 1.1-2.2); those with poor adherence (APR=1.4, 95%CI: 1.01-1.8); those whose parents or guardians stores ARV for them (APR=1.4, 95%CI: 1.1-1.9) and; those who were not supervised in taking ARV (APR=1.5, 95%CI: 1.1-2.0) were more likely to have virological failure than the comparison groups (Table 6).

**Table 6: Adjusted analysis of factors associated with undesirable treatment outcomes**

Characteristics	Variables	Advanced HIV disease	HIV ART Switch	Virological failure
		n (%) N=606	n (%) N=423	n (%) N=176
<b>Demographic factors</b>				
Sex	Male	1.1(0.8-1.3)	0.9(0.7-1.3)	
	Female	Ref	Ref	
Age group	10-19 y (adolescents)	1.3(0.7-2.2)	1.5(0.7-3.1)	Ref
	20-24 y (youths)	Ref	Ref	1.2(0.8-1.8)
HIV regional prevalence level	Low	Ref	1.2(0.8-1.8)	Ref
	High	1.7(1.2-2.3)**	Ref	2.0(1.5-2.7)***
Setting	Urban	1.3(1.0-1.6)	1.9(1.3-2.8)**	
	Rural	Ref	Ref	
School setting-day/boarding	Day	Ref	Ref	
	Boarding	1.3(0.8-2.0)	0.8(0.4-1.7)	
Education of parents/guardians	Non/primary	Ref	Ref	Ref
	Secondary/college	1.1(0.8-2.0)	1.7(1.2-2.3)**	0.9(0.7-1.3)
Parent status	Both are alive	Ref		
	One is dead	1.0(0.8-1.3)		
	Both are dead	1.3(1.01-1.8)*		
<b>Knowledge, perception &amp; risk factors</b>				
Level of perception	Negative		0.9(0.6-1.3)	1.2(0.9-1.6)
	Neutral		1.1(0.7-1.7)	1.6(1.1-2.2)**
	Positive		Ref	Ref
Experience of stigma	Never stigmatized	1.1(0.9-1.3)		
	Ever stigmatized	Ref		
Number of sexual partners	None/one	0.9(0.4-1.9)		
	Multiple partners	Ref		
<b>Utilization of ART</b>				
Disclosure status	Ever disclosed		Ref	
	Never disclosed		1.3(1.0-1.8)	
The environment on ART use	Private	Ref	1.4(0.7-3.0)	
	Public/openly	0.9(0.5-1.5)	Ref	
Adherence status	Good			Ref
	Poor			1.4(1.03-1.8)*
ARV storage	Self-storage			Ref
	Parent/guardian/relative storage			1.4(1.1-1.9)*

<b>Supervision of ART use</b>	Without supervision			1.5(1.1-2.0)*
	With supervision			Ref
<b>Service access</b>				
<b>Time since initiated ART</b>	<3 years	Ref	Ref	
	3+ years	2.2(1.4-3.6)**	1.4(0.8-2.5)	
<b>Convenient location</b>	Yes		0.8(0.5-1.3)	
	No		Ref	
<b>Adequate space and privacy</b>	Yes	1.0(0.7-1.5)	5.4(1.6-18.6)**	
	No	Ref	Ref	
<b>Availability of adolescent and youth support clubs</b>	Yes	1.6(0.9-3.1)		
	No	Ref		
<b>Facility ownership</b>	Public	Ref	1.1(0.6-2.0)	
	Private/FBO	0.6(0.4-0.9)*	Ref	
<b>Health facility level</b>	Dispensary	Ref	Ref	Ref
	Health centre	1.2(0.8-1.8)	1.3(0.8-2.3)	1.2(0.8-1.8)
	Hospital	1.5(1.0-2.2)	1.1(0.6-1.9)	0.7(0.5-1.1)

\* $p < 0.05$ , \*\* $p < 0.01$  and \*\*\* $p < 0.001$

## Discussion

This paper presents the magnitude and factors impacting ART clinical outcomes and out-of-school adolescents and youth living with HIV in Tanzania. Our study indicates that despite an almost universal utilization of ART among adolescents and youth living with HIV, a substantial proportion of AYLHIV had unfavorable clinical ART outcomes, whereby more than half (53.9%) had advanced HIV disease, almost a fifth (17.7%) had a virological failure and more than a third (37.6%) had ART switch to the second line.

The prevalence of the advanced disease among PLIHIV in the present study was about 54 percent, higher than the previously reported 40 percent of advanced HIV among patients on ART from South Africa, Kenya and Malawi (Chihana *et al.*, 2019). The difference in the prevalence could be related to the study setting, the present study was clinic-based in which clients might have presented to care while they are already in an advanced stage of the disease. The prevalence of virological failure and ART switch was 17.7 percent and 37.6 -per cent respectively. The prevalence of virological failure in our study is more

favourable than that reported previously in the country as well as in Kenya, for instance, 34 percent in Dodoma and 25.4-percent in Morogoro and 37 percent in Kenya (Muri *et al.*, 2017; Kadima *et al.*, 2019; Bitwale *et al.*, 2020). This points to some improvements in virological failure among adolescents and children.

Our findings indicate various factors impacting clinical outcomes at individual, community and health delivery levels. We find that the identified factors affect various outcomes differently, while some factors affect only a particular outcome, others impact more than one analyzed ART clinical outcomes. Advanced HIV disease was associated with male gender, adolescence, having one or both parents deceased, living in urban settings, the experience of stigmatization, open use of ART, long duration of ARV use, adequate space and privacy in health facilities visited; the existence of strategy for keeping waiting hours short; availability of adolescent and youth support clubs and public owned facility and attending in hospital. After adjusting for other factors HIV regional prevalence level, having lost a parent or both, longer duration on ART, and attending

a public owned facility were independently associated with Advanced HIV. Notably, attending clinics at hospital level, with adequate space and privacy; with a strategy for keeping waiting hours short; with adolescent and youth support clubs and a public owned facility were identified as factors associated with advanced HIV disease. There is no straightforward explanation for this finding. However, the fact that higher-level facilities serve as referral centres and mostly are public owned, they receive more patients with advanced HIV from lower facilities. This situation suggests a need for improvement of clinics in lower health facility levels to avoid overburdening higher facility levels. Our findings on gender disparity in advanced HIV are similar to previous studies in developing countries which showed that men present to care with advanced disease compared to women (Evans *et al.*, 2013; Mutasa-Apollo *et al.*, 2014; Lifson *et al.*, 2019). This observation calls for gender considerations while planning and implementing various interventions geared to improving the clinical outcomes of patients on ART.

ART Switch to the second line was significantly associated with regions of low HIV prevalence, rural settings, AYLHIV in schools, being in boarding schools, having at least a secondary level of education, not disclosing HIV status, secrete use of ART, not being supervised in taking ARV, parents keeping ARV, long duration of ARV use, inconvenient service hours for adolescent clinics, inadequate space and privacy in health delivery point, lack of strategies for keeping waiting hours short, public owned facility and health facility level. Further, factors such as rural settings, lower education of parents or guardians and inadequate space and privacy for the provision of ART services were independently associated with switching to the second line. Previous analysis shows different patient-level factors such as male sex and older age at ART initiation regimen were associated with an increased

likelihood of switching to the second line (Collins *et al.*, 2019).

The findings indicated that the factors associated with higher odds of virological failure in bivariate analysis were, adolescence, regions with high HIV prevalence and lower education level, inconvenient hours for adolescent clinics; inconvenient location of service delivery points; inadequate space and privacy; lack of strategy for keeping waiting hours short; lack of adolescent and youth support clubs and health center. Adjusting for other factors high HIV prevalence level, poor level of perception of ART use, adherence status, ARV storage and supervision of ART use were independently associated with Virological failure. These findings are inconsistent with some of the studies in Africa. For instance, studies in Zimbabwe and Tanzania have reported poor adherence to treatment, taking alcohol and non-disclosure of HIV status as associated with high odds of virologic failure (Muri *et al.*, 2017; Bitwale *et al.*, 2020).

#### **Conclusion and recommendations**

This study has shown that despite an almost universal utilization of ART among adolescents and youth living with HIV, unfavorable clinical ART outcomes such as advanced HIV disease, virological failure and ART switch to second-line remain a challenge, particularly among males and adolescents. Various factors at individual, community and health facility levels contribute to unfavorable ART clinical outcome among AYLHIV. Therefore, an all-inclusive multidimensional and multi-stakeholders' approach is needed to ensure the availability of sustainable, effective and quality care and treatment services prioritizing AYLHIV. The main limitation of our study is the design, as this was cross-sectional, and could not establish a causal relationship between the identified factors and the ART clinical outcome assessed. Additionally, since the study was clinic based, it might not represent all AYLHIV. However, since the study involved regions with varying HIV prevalence as well as fair zonal

representation and the use of mixed methods in data collection, we believe that the findings obtained are comprehensive and will be useful and applicable in diverse settings.

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