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Time of the First Antiretroviral Treatment (ART) Default and Factors Associated to Early ART Default in the Test and Treat Context: Evidence from the West region of Cameroon

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Abstract

Antiretroviral Treatment (ART) retention continues to be a challenge in Sub-Saharan Africa. Understanding factors that contribute to default at the early stage of ART can contribute to avoid poor treatment outcomes. We conducted a retrospective cross-sectional study on adult patients who initiated ART treatment between October 2019 and September 2020 in 25 health facilities in the West region of Cameroon. Early ART default was defined as having default within the first three months of treatment. The mean age of the 2219 clients included in the analysis was 36.8 (SD:13.4), and 838 (36.5%) were male. The median time to the first ART default of the 629 (28.3%) participants who experienced at least one ART default within 12 months after their ART initiation was 5 months, and 41.2% of those defaults occurred within the first three months of ART. Male gender (AOR =1.3; 95%CI:1.1-1.7) and good health at initiation (AOR =1.7; 95%CI:1.3-2.2) were associated with a high risk of early default; while being followed up in a private facility (AOR =0.3; 95%CI:0.2-0.6) were associated with less risk of early default. The ART default at the early stage of HIV care is high in the West region of Cameroon and more frequent in the male gender and in patients with apparent good health at the time of ART initiation. Interventions should be identified and implemented to ensure continuity of ART treatment especially in males, in clients with good health at the time of ART initiation, and in clients on care in public health facilities.

***Keywords*:** *Antiretroviral Treatment, Cameroon, Early default, Test and treat.*

Introduction

By the end of 2020, HIV/AIDS was responsible for 680,000 deaths worldwide, and a total of 37.7 million people lived with HIV/AIDS 2020. Of these, only 27.5 million people had access to antiretroviral therapy (ART). Of those who had access to treatment, 66% were virally suppressed [1]. In order to achieve epidemic control of HIV, the 95-95-95 goal was developed by UNAIDS in 2014. It states that by 2030, 95% of people living with HIV will know their status, and of these, 95% will be put on antiretroviral treatment. Of those placed on ART, 95% will have suppressed viral loads [2]. In order to achieve viral suppression, it is important that people on ART take their recommended regimen without interruption as prescribed. Physicians ensure adherence to treatment by giving a limited supply of medication and scheduling appointments with clients during which their way of taking ART is evaluated, and their prescription renewed. Respect of these appointments is what is referred to as Retention in care.

This Retention is critical to epidemic control and leads to better ART adherence, enables drug

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and dose modifications, and reduces the risk of drug resistance. This improved follow-up due to good Retention enables viral suppression, and higher CD4 counts, which in turn reduce HIV transmission. This also reduces morbidity and mortality from HIV compared to patients who missed just a single visit over a period of two years [3-7].

Attaining good Retention has always been challenging in sub-Saharan Africa. In a recent systematic review of cohort studies in the region, one-third of every patient initiated on ART was declared lost to follow-up within three years of starting treatment [6]. These statistics show that one way of controlling the negative impact of HIV is to improve Retention in care.

In order to improve Retention, it is important to understand what factors contribute to low retention rates. These may vary depending on the locality in which the patient is found. According to literature, factors such as receiving care from a public care and treatment center, being a heterosexual male, having a mental illness, being black, living in a rural area, substance abuse, and younger age of HIV diagnosis all contribute to low retention rates [4, 8-10].

The negative effects of low Retention are further exacerbated when patients default early in their HIV care before any effective viral control can be obtained. Even though few studies have evaluated the predictors of early ART default [11, 12], additional knowledge is needed specifically in Sub-Saharan countries. Therefore, this study assessed the time from ART initiation to patients' first ART default and identified predictors of early ART default.

Methods

Study Design

This was a cross-sectional retrospective survey based on medical records. The data of clients newly tested HIV positive between October 2019 and September 2020 in 25 health facilities in the West region were extracted retrospectively from registers and clients' medical records and analyzed.

Setting

The study was done in the West region of Cameroon, a region located in the central-western portion of the Republic of Cameroon (Figure 1) with an estimated population of 2136430 inhabitants [13].

Figure 1. Divisions of West Cameroon

Health care is provided in the West region through 623 health facilities [13]. Alongside the conventional health facilities, the region has a large network of traditional health care practitioners. Among the 623 health facilities functioning in the region, 189 (30.33%) are providing care and treatment to HIV-positive people under the technical support of the Regional Technical Group again AIDS assisted by his technical and financial partners.

HIV is one of the major public health concerns in the region with an estimated 34,000 people living with the infection. The data reported in DHIS by the health facilities in charge of ARVs treatment show that 7,144 HIV-positive clients were newly identified, and 5,135 (72%) initiated ART in 2020, giving a total of 27,995 people on ART at the end of 2020 in the West region. In the same year, the 25 health facilities included in this study contributed to 72% of HIV cases identified, 80% of those newly initiated on ART, and 89% of the total clients on ART in the region. Table 1 present the characteristics of the 25 health facilities included in the study. These health facilities were tiered based on the number of PLHIV on ART; Tier 1 health facilities had > 2000 PLHIV on ART, Tier 2 health facilities had 1001 to 2000 PLHIV on ART, Tier 3 health facilities had 500 to 1000, and Tier 4 health facilities had < 500 PLHIV on ART.

The West region of Cameroon as the rest of the country, implements the test and treat strategy stipulating that all HIV positive clients should initiate ART as soon as they are ready, regardless of the CD4 count [14]. After ART initiation, the client should come to the facility once a month for an ARV refill until they become stable.

Table 1. Description of the Health Facilities Included in the Study

Characteristics	**Numbers (N = 25]**	**Percentages (%)**
Facility volume		
Tier 4	10	40
Tier 3	8	32
Tier 2	4	16
Tier 1	3	12
Facility Location		
Urban	6	24
Semi-urban	19	76
Facility Type		
Public	19	76
Private	2	8
Faith base	4	16
*Number of HIV clients on ART by December 2020		

Participants

The study was carried out in the 25 highest volume health facilities of the region. All the adult's clients who newly initiated ART between October 2019 and September 2020 and who completed their 12th month of treatment by the time of data collection were included in the analysis.

Variables of Interest

The dependent variable of interest in this study was early ART default which was defined as experiencing at least one ART default by the end of the 3rd month of ART. The ART defaulting was adapted from Cameroon HIV guidelines and was defined as the fact that a patient is more than 7 days, but less than or equal

to 30 days, late to his expected appointment [15]. The potential predictors of early ART default were socio-demographic, clinical and behavioral, and health facility-related characteristics of participants.

Data Collection and Analysis

The data on socio-demographic, health facility, baseline clinical, and behavioral characteristics were manually collected from the patients' charts on a designed Microsoft Excel sheet. The monthly appointment status of participants was extracted from the facility data management software and transferred into a Microsoft Excel sheet. The manual data abstraction was done by trained data clerks recruited from facilities involved in the study, under the control of two supervisors. Observed discrepancies were addressed by the study team before analysis and synchronization. The data pulling from the facility software were done by the study's data manager. The two data sets were therefore merged in a unique database by using the unique identifier (ART code). The main database was later transferred into IBM SPSS Statistics software version 24 for analysis. Prior to data analysis, data cleaning was done. Explanatory variables which had more than 25% missingness were excluded from the analysis. Missingness were assumed to be randomly distributed in the groups during bi-variate and multivariate analysis. We used the missing-indicator method, showing the proportion missingness for the different variables (if any) [16]. Descriptive statistics and graphs were generated to evaluate distributions of all study variables and to generate summary statistics, including means, standard deviations, frequencies, and percentages. A logistic regression model was used to compute crude and adjusted odds ratios (with their 95% confidence intervals), estimating the Association between the early default and the potential predictors. All the independent variables with a p-value less than 0.25 in the bivariate analysis were included in the multivariate models as well as age, sex, and time to ART initiation. The statistical Association was declared using adjusted odds ratios (AOR) with a 95% confidence interval (CI) at a p-value less than 0.05.

Ethical Considerations

Patients' records were anonymized and de-identified prior to analysis. The administrative authorization was obtained from the West Regional Delegation of public health, and the study protocol was approved by the Cameroon Baptist Convention Health Board Institutional Review Board (IRB study number: IRB2021-48).

Results

Description of Participants

From the 3797 clients initiated in the selected health facilities during the study period, 2219 (60.4%) were included in the analysis as indicated in Figure 2. A total of 1578 clients were excluded from the analysis for the following reasons: children less than 19 years (162), clients without a chart (582), clients < 12 months follow-up (824), and incomplete follow-up data (10). Socio-demographic, behavioral, clinical baseline and facilities' related characteristics of included patients are summarized in Table 2. The mean age of the clients included in the analysis was 36.8 (SD: 13.4), and 838 (36.5%) were male. A total of 1725 (77.7%) participants were on care in public health facilities, 249 (11.2%) were in private facilities, and 245 (11.1%) were followed up in faith-based facilities. The majority of participants (77.2%) were initiated on the same day of their HIV test, 17.9% and 4.9% were initiated 1 to 7 days and 8 days and more respectively after their HIV test giving a percentage of 95.1% of clients who were initiated on ART within the first week of their HIV test. At the treatment initiation, 1616 (72.8%) participants were classified as having a good general status, while 603 (27.2%) participants were declared to have an altered general status.

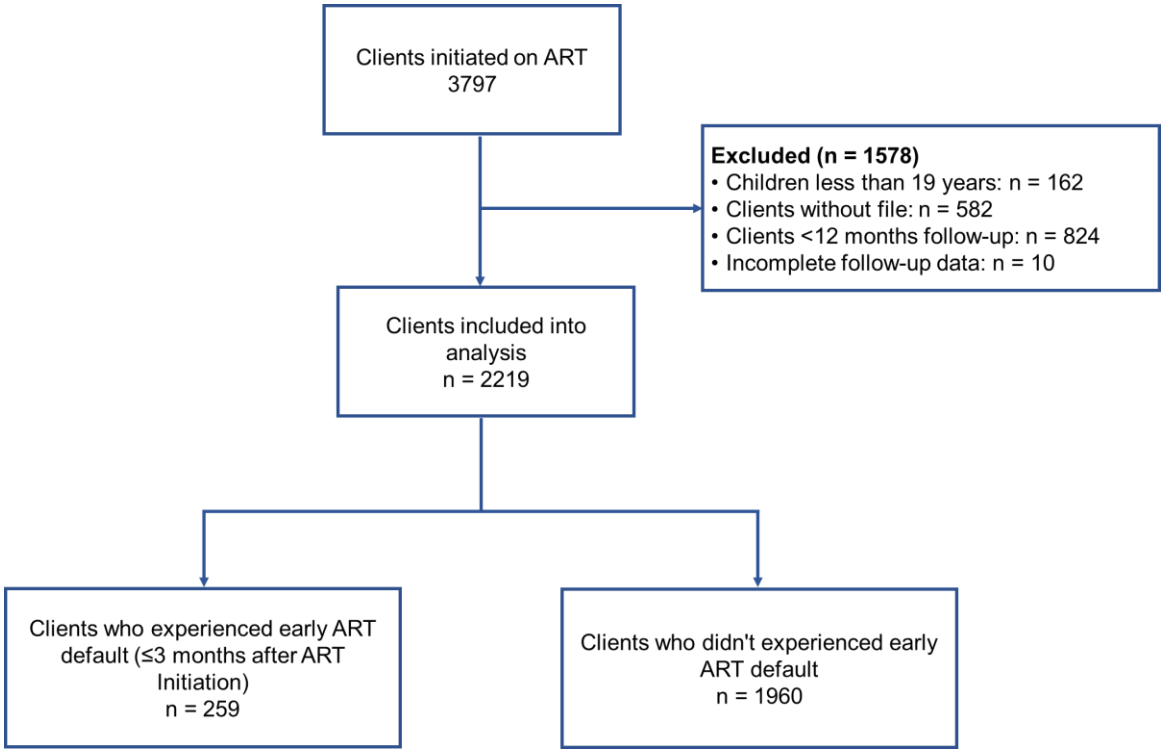

Figure 2. Clients who Experienced missed Appointment in the 25 Study Facilities, West Region Cameroon Flowchart

Time of the first ART default

At the end of 12 month follow-up, a total of 629 (28.3%) experienced at least one ART default. The mean age of those clients was 37.2 (SD 13.2) years, and 246 (39.1%) of them were male. The median time of the first ART default was 5 months. One hundred and thirty-two (21.0%) clients defaulted for the first time the first month after ART initiation. 73 (11.6%) and 54 (8.6%) participants experienced their 1st default at the 2nd and the 3rd month of their treatment, respectively (Figure 2).

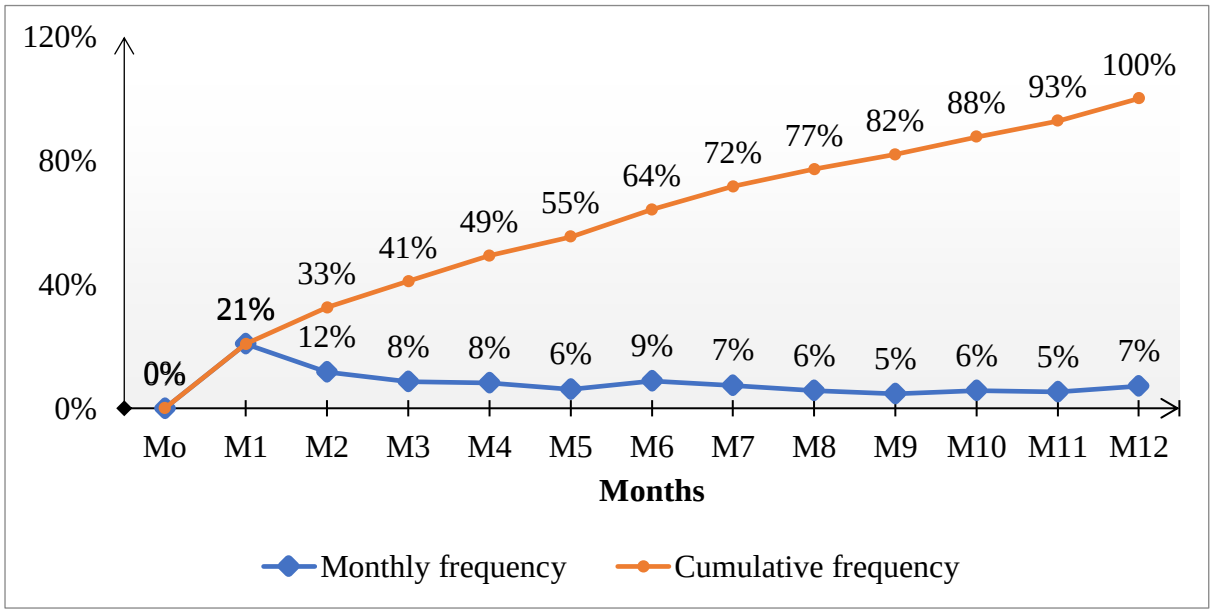

Figure 3. Monthly and Cumulative Frequencies of ART Defaults of the 629 Clients who Defaulted at least Once in 25 High Volume ART Clinics in the West Region of Cameroon

Early Missed ARVs Appointment and Factors Associated

A total of 259 (41.2%) participants experienced at least one ART default within the first 3 months of their ART. The multivariate analysis has shown that the male gender (AOR = 1.3; 95%CI: 1.1-1.7) and good general status at initiation (AOR = 1.7; 95%CI: 1.3-2.2) were independently associated with a high risk of early ART default while being followed-up in a private facility (AOR = 0.3; 95%CI: 0.2-0.6) were associated with less risk of experiencing early ART default.

Table 2. Health Facility, Socio-demographic, Baseline Clinical and Behavioral Characteristics of HIV Positives Clients on ART in the 25 Highest Volume Health Facility in West region of Cameroon

Characteristics (N = 2219)	**Frequency**	**Percentage (%)**
Age in years (Mean, SD)	36.9	13.3
Sex		
Male	810	36.5
Female	1409	63.5
Facility type		
Public	1725	77.7
Private	249	11.2
Faith base	245	11
Facility Location		
Urban	504	22.7
Semi-urban	1715	77.3
Facility Volume*		
Tier 4	513	23.1
Tier 3	740	33.3
Tier 2	498	22.4
Tier 1	468	21.1
Entry/Testing Points		
Outpatient	600	27
Index Testing	535	24.1
Community	710	32
Voluntary counselling and testing	114	5.1
TB	12	0.5
In Patient	64	2.9
Emergency Department	25	1.1
Blood Bank	2	0.1
Antenatal Care	56	2.5
Maternity	10	0.5
PCR	17	0.8
Not Documented	74	3.3
Occupational situation		
Job less	229	10.3
Active	1499	67.6
Retired	15	0.7
Not Documented	476	21.5

Marital status		
Bachelor	493	22.2
Concubine	259	11.7
Married monogamous	551	24.8
Married polygamous	144	6.5
Divorced	99	4.5
Widow	200	9
Not Documented	473	21.3
Level of study		
Primary	849	38.3
Secondary	750	33.8
University	127	5.7
Not Documented	493	22.2
Time to Initiation Group		
Same day	1714	77.2
A week	397	17.9
More than a week	108	4.9
WHO Clinical Stage		
Stage 1	1364	61.5
Stage 2	107	4.8
Stage 3	47	2.1
Stage 4	6	0.3
Not documented	695	31.3
Opportunistic infection		
Yes	140	6.3
No	2079	93.7
Sexually Transmitted Infections (STIs)		
Yes	92	4.1
No	2127	95.9
Tuberculosis		
Yes	51	2.3
No	2168	97.7
Blood Hypertension		
Yes	28	1.3
No	2191	98.7
Tenofovir, Lamivudine, and Dolutegravir (TLD) regimen		
No	724	32.6
Yes	1486	67
Not documented	9	0.4
Hepatitis		
Yes	12	0.5
No	2207	99.5
General Status		
Good	1616	72.8
Altered	603	27.2

Partner status		
Unknown	1671	75.3
Positive	375	16.9
Negative	173	7.8
Shared serology status		
Yes	1045	47.1
No	1174	52.9
Shared serology status with partner		
Yes	672	30.3
No	1547	69.7
Sero-discordant couple		
Unknown	1621	73.1
Yes	180	8.1
No	418	18.8
Systematic use of condoms		
Yes	297	13.4
No	1922	86.6
Number of sexual partners during the last 12 months		
0	200	9
1	1118	50.4
>1	287	12.9
Not documented	614	27.7
Alcohol consumption		
Yes	925	41.7
No	1294	58.3
Tobacco		
Yes	109	4.9
No	2110	95.1
Key Population		
Yes	135	6.1
No	2084	93.9

*Number of clients on Antiretroviral Treatment

Table 3. Univariate and Multivariate Analysis of Factors Association to early ART Default of Clients who Started HIV Care from October 2019 to September 2020 in the 25 High Volume Clinics in the West Region of Cameroon

Characteristic (N = 2319)	**Early ART default***		**Unadjusted Analysis**		**Adjusted Analysis**	
	Yes	**No**	**Crude OR**	**p**	**Adjusted OR**	**p**
Age; Mean (SD)	37.4 (13.8)	36.7 (13.3)	1.0 (0.9-1.1)	0,44	1.0 (0.9-1.1)	0,73
Gender						
Male	108 (41.7)	702 (35.8)	1.3 (1.0-1.7)	0.07	1.3 (1.1-1.7)	**0.04**
Female	151 (58.3)	1258 (64.2)	1		1	
Facility type						
Public	215 (83)	1510 (77)	1		1	
Private	9 (3.5)	240 (12.2)	0.3 (0.1-0.5)	**<0.001**	0.3 (0.1-0.5)	**<0.001**

Faith base	35 (13.5)	210 (10.7)	1.2 (0.8-1.7)	0,42	1.2 (0.8-1.7)	0,46
Period of initiation						
October-December 2019	29 (11.2)	237 (12.1)	1.0 (0.6-1.6)	0,95	0.9 (0.6-1.5)	0,75
January-March 2020	115 (44.4)	748 (38.2)	1.2 (0.9-1.8)	0,23	1.2 (0.8-1.7)	0,35
April-June 2020	62 (23.9)	548 (28)	0.9 (0.6-1.3)	0,64	0.9 (0.6-1.3)	0,54
July-September 2020	53 (20.5)	427 (21.8)	1		1	
Same day initiation						
No	63 (24.3)	442 (22.6)	1		1	
Yes	196 (75.7)	1518 (77.4)	0.9 (0.7-1.2)	0,52	0.9 (0.6-1.2)	0,39
General Status						
Good	205 (79.2)	1411 (72)	1.4 (1.2-2.1)	**0.02**	1.7 (1.3-2.2)	**0.01**
Altered	54 (20.8)	549 (28)	1		1	

*Antiretroviral default within the first 3 months of HIV care

Discussion

In this study which sought to assess the time from ART initiation to patients' first ART default and to identified predictors of early ART default, we found that about 28.3% of participants defaulted at least one within by the 12th months of HIV care and more than 40% of the default occurred within the first 3 months of treatment. Male gender, as well as apparent good heath at initiation, were predictors of early defaulting while being followed up in private health facilities were protective from early ART default.

The 28.3% default rate observed is similar to the 28.0% observed in a study carried out in Ethiopia [17] and different from the 12.8% observed in a study done in South Africa [18]. The difference observed may be due to the fact that contrary to our study, which focused on the newly initiated HIV clients, the study did in South Africa focused on clients relatively old on ART. In fact, studies have shown that worse HIV treatment outcomes occur mostly at the early stage of the treatment [17, 19]. This has been observed in this current study, where 41% and 64% of the defaults occurred by month 3 and month 6 after treatment initiation, respectively. In fact, initial clinic visits after ART initiation are critical for the success of a live-long treatment like ART. It helps to provide adequate counseling on the adherence to treatment, to established important preventive healthcare measures, and evaluate the response of the patient's organism to the ARVs [20], leading to a high risk of viral load suppressing, reduction of virological failure, antiretroviral resistance, morbidity, and mortality [11, 12, 21-24]. Implementation of existent strategies that can improve adherence to visits for ARVs pick-up [25] is needed to avoid treatment default, especially at the early stage of the ART.

This study showed that the early ART default was more frequent in the male gender, which corroborates with the findings observed in other resource-limited settings [26, 27]. That finding contrasts with the observations done in developed countries [11, 28]. That different may be due to the socio-demographic and cultural difference between settings. In fact, [29] a systematic review, concluded that in multiple studies from developed countries, the female gender often predicts lower adherence.

Contrary to other studies, we found no significant association between age and early default. With regards to age, it was shown that people aged 24 and below had lower retention rates [8]. Given that our mean age in both groups (36 and 37 years) was significantly higher than this, it is understandable that this variable couldn't predict early missed appointments.

In our study, attending private clinics was inversely associated with early treatment default. Private clinics kept patients in care better than any other type of health facility. This is similar

to what has been reported elsewhere [4, 8-10]. In Cameroon, private institutions have more oversight and strict management and, because of the better pay package, attract better-qualified staff. This leads to improved quality of care compared to other types of institutions and can explain better Retention. Additionally, public hospitals tend to be congested, and there is higher demand on their scarce resources, which also makes Retention difficult. Copying the good practices used in private health facilities will lead to better care in public facilities, which should improve the retention rate.

We also found that patients who were in apparent good health were more likely to default at the early stage of the treatment. This is similar to what has been shown by other authors [11, 30]. It can be understood that people who are in apparent good health do not feel the need for follow-up appointments, nor do they understand its importance. In the other hand, clients with altered conditions may receive more attention and counseling from health providers, which may facilitate their adherence. Adequate attention, appropriate education, and counseling are therefore needed in the sub-population of patients starting ART with the apparent good general condition.

We also found that the rate of non-disclosure of HIV was high (52%), and among people who defaulted at the early stage of the treatment, 69% had not informed their partners of their status. Although this was not statistically significant in our study, it adds to the idea that when HIV-infected patients share their status with a close one and have support, it improves adherence and outcome [31].

Conclusions

In the west region of Cameroon, the default rate within a year from the ART initiation was high. Most of them occurred at the early stage of HIV care, and male gender as well as having an apparent good heath were predictors of defaulting within the first 3 months of ART while being followed-up in a private facility was protecting from early defaulting. More attention should be therefore given to those high risk of default groups to achieve better Retention.

Competing Interests

The authors declare no competing interests.

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References

[1] UNAIDS 2020. Global HIV & AIDS statistics—Fact sheet [Internet]. 2021 [cited 2021 Nov 23]. Available from: https://www.unaids.org/en/resources/fact-sheet.

[2] 90-90-90: An ambitious treatment target to help end the AIDS epidemic. :40.

[3] Mugavero MJ, Lin H-Y, Willig JH, Westfall AO, Ulett KB, Routman JS, et al. Missed Visits and Mortality in Patients Establishing Initial Outpatient HIV Treatment. Clin Infect Dis Off Publ Infect Dis Soc Am. 2009 Jan 15;48(2):248–56.

[4] Tripathi A, Youmans E, Gibson JJ, Duffus WA. The impact of retention in early HIV medical care on viro-immunological parameters and survival: a statewide study. *AIDS Res Hum Retroviruses*. 2011 Jul;27(7):751–8.

[5] Haas AD, Zaniewski E, Anderegg N, Ford N, Fox MP, Vinikoor M, et al. Retention and mortality on antiretroviral therapy in sub-Saharan Africa: collaborative analyses of HIV treatment programmes. J Int AIDS Soc. 2018;21(2): e25084.

[6] 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* 1999. 2015 May 1;69(1):98–108.

[7] Carlos S, Burgueño E, Ndarabu A, Reina G, Lopez-del Burgo C, Osorio A, et al. Predictors of retention in the prospective HIV prevention OKAPI cohort in Kinshasa. Sci Rep. 2021 Mar 8;11(1):5431.
[8] Mugavero MJ, Lin H-Y, Willig JH, Westfall AO, Ulett KB, Routman JS, et al. Missed visits and mortality among patients establishing initial outpatient HIV treatment. Clin Infect Dis Off Publ Infect Dis Soc Am. 2009 Jan 15;48(2):248–56.
[9] Althoff KN, Buchacz K, Hall HI, Zhang J, Hanna DB, Rebeiro P, et al. U.S. trends in antiretroviral therapy use, HIV RNA plasma viral loads and CD4 T-lymphocyte cell counts among HIV-infected persons, 2000 to 2008. *Ann Intern Med*. 2012 Sep 4;157(5):325–35.
[10] Ulett KB, Willig JH, Lin H-Y, Routman JS, Abroms S, Allison J, et al. The therapeutic implications of timely linkage and early retention in HIV care. AIDS Patient Care STDs. 2009 Jan;23(1):41–9.
[11] Zhang Y, Dou Z, Sun K, Ma Y, Chen RY, Bulterys M, et al. Association between missed early visits and mortality among patients of china national free antiretroviral treatment cohort. *J Acquir Immune Defic Syndr* 1999. 2012 May 1;60(1):59–67.
[12] Nijhawan AE, Liang Y, Vysyaraju K, Muñoz J, Ketchum N, Saber J, et al. Missed Initial Medical Visits: Predictors, Timing, and Implications for Retention in HIV Care. AIDS Patient Care STDs. 2017 May;31(5):213–21.
[13] Digital N, Strategic H. The 2020 - 2024 national digital health strategic plan 1. 2020.
[14] Prevent HIV, test and treat all who support for country's impact.
[15] Operational guidelines for the implementation of the "test and treat" strategy in Cameroon [Internet]. [cited 2021 Dec 23]. Available from: https://differentiatedservicedelivery.org/Portals/0/adam/Content/4PguUuL3dU2mjDICEGsJFQ/File/Cameroon.pdf.
[16] Choi J, Dekkers OM, le Cessie S. A comparison of different methods to handle missing data in the context of propensity score analysis. *Eur J Epidemiol*. 2019 Jan 15;34(1):23–36.
[17] Deribe K, Hailekiros F, Biadgilign S, Amberbir A, Beyene BK. Defaulters from antiretroviral treatment in Jimma University Specialized Hospital, Southwest Ethiopia. *Trop Med Int Health TM IH*. 2008 Mar;13(3):328–33.
[18] Kranzer K, Lewis JJ, Ford N, Zeinecker J, Orrell C, Lawn SD, et al. Treatment Interruption in a Primary Care Antiretroviral Therapy Program in South Africa: Cohort Analysis of Trends and Risk Factors. *JAIDS J Acquir Immune Defic Syndr*. 2010 Nov 1;55(3): e17.
[19] Mody A, Glidden DV, Eshun-Wilson I, Sikombe K, Simbeza S, Mukamba N, et al. Longitudinal Care Cascade Outcomes Among People Eligible for Antiretroviral Therapy Who Are Newly Linking to Care in Zambia: A Multistate Analysis. *Clin Infect Dis Off Publ Infect Dis Soc Am*. 2020 Dec 17;71(10): e561–70.
[20] Hall HI, Tang T, Westfall AO, Mugavero MJ. HIV Care Visits and Time to Viral Suppression, 19 U.S. Jurisdictions, and Implications for Treatment, Prevention, and the National HIV/AIDS Strategy. Plos One. 2013 Dec 31;8(12): e84318.
[21] Sethi AK, Celentano DD, Gange SJ, Moore RD, Gallant JE. Association between adherence to antiretroviral therapy and human immunodeficiency virus drug resistance. *Clin Infect Dis Off Publ Infect Dis Soc Am*. 2003 Oct 15;37(8):1112–8.
[22] Robbins GK, Daniels B, Zheng H, Chueh H, Meigs JB, Freedberg KA. Predictors of Antiretroviral Treatment Failure in an Urban HIV Clinic. *J Acquir Immune Defic Syndr* 1999. 2007 Jan 1;44(1):30–7.
[23] Mugavero MJ, Amico KR, Westfall AO, Crane HM, Zinski A, Willig JH, et al. Early Retention in HIV care and viral load suppression: implications for a test and treat approach to HIV prevention. *J Acquir Immune Defic Syndr* 1999. 2012 Jan 1;59(1):86–93.
[24] Ridgeway K, Dulli LS, Murray KR, Silverstein H, Santo LD, Olsen P, et al. Interventions to improve antiretroviral therapy adherence among adolescents in low- and middle-income countries: A systematic review of the literature. *Plos One*. 2018 Jan 2;13(1): e0189770.
[25] Mbuagbaw L, Hajizadeh A, Wang A, Mertz D, Lawson DO, Smieja M, et al. Overview of systematic reviews on strategies to improve treatment initiation, adherence to antiretroviral therapy and retention in care for people living with HIV: Part 1. *BMJ Open*

[Internet]. 2020 Sep;10(9). Available from: /pmc/articles/PMC7513605/.

[26] Taylor-Smith K, Tweya H, Harries A, Schoutene E, Jahn A. Gender differences in Retention and survival on antiretroviral therapy of HIV-1 infected adults in Malawi. Malawi *Med J* [Internet]. 2010 [cited 2021 Dec 24];22(2). Available from: https://www.ajol.info/index.php/mmj/article/view/58794.

[27] Takarinda KC, Harries AD, Shiraishi RW, Mutasa-Apollo T, Abdul-Quader A, Mugurungi O. Gender-related differences in outcomes and attrition on antiretroviral treatment among an HIV-infected patient cohort in Zimbabwe: 2007–2010. *Int J Infect Dis.* 2015 Jan 1; 30:98–105.

[28] Benson C, Wang X, Dunn KJ, Li N, Mesana L, Lai J, et al. Antiretroviral Adherence, Drug Resistance, and the Impact of Social Determinants of Health in HIV-1 Patients in the US. AIDS Behav. 2020 Dec 1;24(12):3562–73.

[29] Puskas CM, Forrest JI, Parashar S, Salters KA, Cescon AM, Kaida A, et al. Women and Vulnerability to HAART Non-Adherence: A Literature Review of Treatment Adherence by Gender from 2000 to 2011. Curr HIV/AIDS Rep. 2011 Oct 12;8(4):277.

[30] Badenhorst DHS, Westhuizen CA van der, Britz E, Burger MC, Ferreira N. Lost to follow-up: Challenges to conducting orthopaedic research in *South Africa. S Afr Med J.* 2018 Oct 26;108(11):917–21.

[31] Dessie G, Wagnew F, Mulugeta H, Amare D, Jara D, Leshargie CT, et al. The effect of disclosure on adherence to antiretroviral therapy among adults living with HIV in Ethiopia: a systematic review and meta-analysis. *BMC Infect Dis.* 2019 Jun 17;19(1):528.