Original Article

Effect of Differentiated Service Delivery Model on Retention to Care among People Living with HIV in Rwanda: A Retrospective Cohort Analysis

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Cite as: Sebeza J, Ramadhan H, Riedel JD, Memiah P, Lavoie MC, Negussie D, Tuyishime S, Nshogoza RG, Muiruri C, Stafford K. Effect of Differentiated Service Delivery Model on Retention to Care among People Living with HIV in Rwanda: A Retrospective Cohort Analysis. Rwanda J Med Health Sci. 2025;8(1): *6-16.* https://dx.doi.org/10.4314/rjmhs.v8i1.1

Abstract

Introduction
The differentiated service delivery (DSD) model, characterized by early antiretroviral therapy (ART) initiation, is supported by peer educators to enhance treatment adherence to improve retention in care among People Living with HIV (PLHIV). The study assessed effect of the DSD model on retention among PLHIV in Kigali City, Rwanda.

Methods
A retrospective cohort study design was used to evaluate the effect of the DSD model on retention by comparing pre- and post-DSD cohorts of 976 ART-naïve PLHIV aged ≥ 17 years who initiated ART between 2014 and 2019. To assess the effect of the DSD model on retention, we used multivariable logistic regression models to estimate the adjusted odds ratio (aOR) and the corresponding 95% confidence intervals (CI). Covariates, namely demographics, body weight, immunological status, and adherence, were included in the multivariable model.

Results
Of 976 participants evaluated, 903 participants (92.5%) were retained in care. While the DSD model did not significantly affect retention in care [aOR = 1.11, (95% CI: 0.67 – 1.85), p = 0.675)], adherence ≥ 90% was strongly associated with higher retention [aOR = 2.20, (95% CI: 1.31–3.68), p = 0.003).

Conclusion
These findings align with the latest literature, showing comparable retention patterns before and after introducing the DSD.
Rwanda J Med Health Sci 2025;8(1):6-16

Keywords: Retention, differentiated service delivery model, adherence, HIV, Rwanda

Introduction

In June 2016, the World Health Organization (WHO) updated the global guidelines for HIV treatment by approving lifelong ART for PLHIV regardless of CD4 count.[1] This approach is called treat all or test-and-treat and is supported by various studies which have proven that early initiation of antiretroviral therapy (ART) leads to better retention in clinical care in comparison to late initiation. Furthermore, the approach aims at achieving universal coverage of ART while streamlining the operational demands of HIV programming.[1]

Starting July 1, 2017, the Rwanda Ministry of Health aligned HIV prevention, treatment and care guidelines with WHO standards through the Differentiated Service Delivery (DSD) model, ensuring prompt ART initiation within seven days and customized patient appointments. The DSD model aims to reduce service-related costs without additional strain on healthcare costs.[2] Under the DSD model, at 18 months of follow-up, patients are categorized as established on ART or stable (two consecutive viral loads below 200 copies/ml and ≥90% adherent, among other criteria) and unestablished on ART or unstable (when not meeting stable criteria). Stable patients enjoy less intensive services for up to six months, while unstable receive more intensive services. Peer educators offer moral and psychological support to PLHIV enhancing treatment adherence and retention monthly in specific catchment areas between visits to health facilities.[3]

As stated previously, one of the components of the DSD model is the early initiation of ART following HIV diagnosis.[1] There has been conflicting evidence on loss to follow-up (LTFU) under the umbrella of early ART initiations. While some studies showed early ART initiation is associated with LTFU, others found no association.[4-5] A systematic review explored 37 DSD models from 11 African countries, with only 28% of the models comparing clinical outcomes with standard of care. This review showed that retention and viral load suppression were similar for the programs that used DSD models compared to standard of care. However, retention estimates were higher for the DSD models that did not provide comparison groups.[6] A study conducted in Mozambique after introducing the DSD model reported a 12-month retention rate of 82.2%, and the DSD model was associated with an increased likelihood of retention compared to the standard of care.[7]

Maintaining retention in care is paramount for PLHIV to consistently receive treatment, aiding in viral load suppression and epidemic control. Suboptimal and poor rates of retention are associated with viral load rebound following viral load suppression,[8] and viral load rebound is a known risk factor for treatment failure,[9] and increases the risk of HIV transmission, and morbidity and mortality for individual patients. Poor retention can potentially undermine the Joint United Nations Programme on HIV/AIDS (UNAIDS)'s bold goals to ensure that 95% of individuals living with HIV are aware of their status, 95% of those aware are receiving treatment, and 95% of those on treatment achieve viral load suppression.[10] In this study, we explored the impact of the DSD model on long-term retention patterns beyond 12 months among PLHIV before and after the rollout of the DSD model in Rwanda.

Methods

Study Design and Setting

We used a retrospective cohort study design to assess the impact of a DSD model of care among PLHIV in Kigali, Rwanda. The study was conducted in 28 health centres in Kigali City, providing HIV testing, counselling, and ART.

Study population and eligibility criteria

The study population included two cohorts of adult PLHIV aged 17 years or older who were ART-naïve and either initiated ART before the DSD model ("unexposed" to intervention) or after the introduction

of DSDM ("exposed" to intervention). The first cohort received the traditional standard of care, initiated ART based on their CD4 count, with an extended counselling period and clinical follow-up appointments for medication pick-up every one to three months. The cohort consisted of PLHIV, who initiated ART between February 1st and April 30th, 2014, and were followed for 24 months until April 30, 2016. The second cohort of PLHIV was exposed to the DSD model, initiated ART regardless of their CD4 count within one to seven days, without extended counselling sessions, and had clinical follow-up appointments for drug pick-up every three to six months. This cohort consisted of PLHIV, who initiated ART between Feb 1 and April 30, 2017, and were followed for 24 months until Apr 30, 2019. The PLHIV who were younger than 18 years, and not on ART.

Sample size and sampling procedures

There was no consistent retention data beyond 12 months since the inception of DSDM in Rwanda. Data from other East African countries reported 12-month lower retention rates ranging between 89.7% - 89.9% in Uganda and Kenya after test and treatment.[11] Prior data from Rwanda showed a 12-month retention rate of 94% after test and treatment.[12] It was assumed that the retention rate beyond 12 months would be reduced to 89% after DSDM. To detect a 5% percent retention rate beyond 12 months among PLHIV before and after the initiation of test and treat, at an alpha of 0.05, we needed at least 976 patients.

Data Collection instruments, procedures, and quality control

Data were collected from May to July 2022. Qualified nurses and data managers already practising in HIV clinics performed chart abstraction. We trained these data collectors to ensure they comprehended and adhered to principles of privacy and confidentiality. A data collection template designed for adults which was initially used by the AIDSRelief program to assess patient retention and viral load retention, was modified and employed to gather patient demographics and clinical data. This included ART-related data such as initiation date, regimens, side effects and adherence to appointments and drugs.[13]

Definition of Variables

The primary outcome was retention, defined as patients known to be alive and on treatment from initiation on ART up to 24 months of follow-up and having sought care within six months before the study.[14,15] Loss to follow-up was defined as missing a scheduled ART clinic appointment by over 90 days with no documented cause.[15,16] Adherence was based on self-report as indicated in the patient files and measured based on the 30-day recall. It was calculated as the proportion of pills taken to the number prescribed within 30 days.[17] Adherence levels of at least 90% were considered adherent, while less than 90% was considered non-adherent.[18]

The main exposure of interest was the DSD model. We defined patients exposed to the DSD model as those initiated on ART regardless of their CD4,[1] without an extended counselling period, and unexposed to DSD for those who initiated ART based on CD4 count with extended counselling periods. Other variables were evaluated, including age, gender, HIV disclosure status, WHO stages, baseline CD4 count, body mass index, and treatment adherence.

Data processing, study variables and Statistical analysis

Our primary objective was to determine the effect of the DSD model on 24-month retention among PLHIV receiving ART in selected Kigali City facilities in Rwanda. The prevalence and 95% confidence intervals (CI) at a significance level (alpha) of 0.05 for retention were computed as a proportion of persons sampled We compared categorical participant characteristics by the status of retention using the chi-square or Fisher's exact tests where appropriate for continuous variables. The effect of the DSD model on retention was assessed using logistic regression models. First, we fit bivariate logistic regression models.

Then, all variables that were significantly associated with outcome, along with factors that are plausibly associated with outcome, were included in the final multivariable models. Dummy variables were created for missing data. All analyses were conducted in SAS 9.4 (Cary, NC).

Ethical considerations

Data collection was conducted by qualified and already practising nurses and data managers in HIV Clinics. Data collectors were trained on privacy and confidentiality. No patient identifiers were used. The database was double-entry password-protected datasheets. Only research team members had access to the database, which will be destroyed six months after the last publication. The University of Rwanda, College of Medicine and Health Sciences Institutional Review Board approved the study, and ethical clearance was obtained from the Rwanda National Ethics Committee under Approval Notice No. IRB # 00001497 of IORG0001100. We used anonymized patient files kept by the health facilities. Rwanda Biomedical approved the use of patient files. Rwanda National Ethics waived the patient consent since the patients 'files were de-identified.

Results

General characteristics of the study population

A total of 976 participants were evaluated, 461(47.5%) initiated ART after the introduction of the model. The median age was 37 years [interquartile range (IQR) 32-43 years, and 648 (66.4%) were females. A total of 427 (43.7%) had no formal education. At baseline, 658 (67.4%) had CD4 count of ≥200c/mm3 , and 619 (63.4%) had an adherence assessment of ≥ 90%. Overall, and 92,5% were retained in care, 588 (60.3%) had ever disclosed their HIV status. (Table 1).

Table 1. Characteristics of people living with HIV receiving care from 28 facilities in Rwanda 2014-2019

Characteristics	All	Retained	LTFU	p-value
	n = 976	n (903)	n = (73)	
	n (%)	n (%)	n (%)	
DSD				
No	510 (52.5)	469 (52.2)	41 (56.2)	0.419
Yes	461 (47.5)	429 (47.8)	32 (43.4)	
Missing	5 (0.05)			
Age, median (IQR)	37 (32 – 43)	37 (32 – 43)	36.5 (32 – 44)	
Age				
17 – 24	24 (2.5)	22 (2.4)	2 (2.7)	0.418
25 – 34	328 (33.6)	301 (33.3)	27 (37.0)	
35 – 44	412 (42.2)	387 (42.9)	25 (34.2)	
45 – 54	131 (13.4)	117 (13.0)	14 (19.1)	
≥55	81 (8.3)	76 (8.5)	5 (6.8)	
Gender				
Female	648 (66.4)	598 (66.3)	50 (68.5)	0.702
Male	327 (33.5)	304 (33.7)	23 (31.5)	
Missing	1 (0.1)	1	0	
Education				
No education	427 (43.7)	386 (44.0)	41 (57.7)	0.126
Primary	418 (42.8)	395 (45.0)	23 (32.4)	
Secondary	97 (9.9)	90 (10.3)	7 (9.9)	
Tertiary	7 (0.7)	7 (0.8)	0 (0.0)	
Missing	27 (2.8)	25	2	

Abbreviations: DSD indicates the differentiated care model; BMI indicates body mass index; WHO indicates World Health Organization; HIV indicates Human immunodeficiency virus; LTFU lost to follow up

Table 1. Continued

Characteristics	All	Retained	LTFU	p-value
	n = 976	n (903)	n = (73)	
	n (%)	n (%)	n (%)	
HIV status disclosed				
No	384 (39.3)	359 (39.9)	25 (34.7)	0.388
Yes	588 (60.3)	541 (60.1)	47 (65.3)	
Missing	4 (0.4)	3	1	
BMI				
Underweight	104 (10.6)	92 (10.9)	12 (18.2)	0.237
Normal weight	576 (59.0)	535 (63.2)	41 (62.1)	
Overweight	178 (18.2)	167 (19.7)	11 (16.7)	
Obese	55 (5.6)	53 (6.3)	2 (3.0)	
Missing	63 (6.4)	55	7	
Initial WHO stage				
I	737 (75.5)	686 (85.4)	51 (77.3)	**0.036***
II	91 (9.3)	84 (10.5)	7 (10.6)	
III	38 (3.9)	30 (3.7)	8 (12.1)	
IV	3 (0.3)	3 (0.4)	0 (0.0)	
Missing	107 (11.0)	100	7	
Recent WHO stage				
I	799 (81.9)	746 (85.3)	53 (74.7)	**0.006***
II	100 (10.2)	92 (10.6)	8 (11.3)	
III	44 (4.5)	34 (3.9)	10 (14.1)	
IV	3 (0.3)	3 (0.3)	0 (0.0)	
Missing	30 (3.1)	28	2	
Adherence				
< 90%	248 (25.4)	215 (26.8)	33 (51.6)	**<0.001**
≥ 90%	619 (63.4)	588 (73.2)	31 (48.4)	
Missing	109 (11.2)	100	9	
Initial CD4 count				
< 200	158 (16.2)	143 (18.9)	15 (25.9)	0.194
≥ 200	658 (67.4)	615 (81.1)	43 (74.1)	
Missing	160 (16.4)	144	16	

Abbreviations: DSD indicates the differentiated care model; BMI indicates body mass index; WHO indicates World Health Organization; HIV indicates Human immunodeficiency virus; LTFU lost to follow up

Factors associated with retention: Bivariate analysis

On bivariate analysis, compared to those without formal education, those who had primary education had increased odds of being retained in care (OR = 1.79;95%CI, 1.06 – 3.06) (Table 2). Participants who had an adherence assessment of ≥ 90% had higher odds of being retained in care compared to those who had an adherence assessment of < 90% (OR=2.53 95%CI (1.56 – 4.10) (Table 2). Other factors associated with retention included baseline and recent WHO staging, with those with WHO stage III demonstrating lower odds of being retained in care. There was no statistically significant difference in retention among PLHIV-initiated ART before and after the rollout of the DSD.

Factors associated with retention: multivariable analysis

On multivariable analysis, the association between adherence and retention in care persisted, with those who had an adherence assessment of ≥ 90% having higher odds of being retained in care compared to those with an adherence assessment of < 90% (aOR=2.20 95%CI (1.31 – 3.68) (Table 2). There was no statistically significant difference in patient retention before and after the introduction of the DSD model (aOR=1.11 95%CI (0.67 – 1.85).

Table 2. Factors associated with retention among people living with HIV from 28 facilities in Rwanda, 2014–2019

Characteristics	Bivariate			Multivariable	
	Retained n (%)	OR (95% CI)	p-value	aOR (95% CI)	p-value
DSD					
No	469 (92.0)	1			
Yes	429 (93.1)	1.17 (0.72 – 1.90)	0.517	1.11 (0.67 – 1.85)	0.675
Age					
17 – 24	22 (91.7)	1		1	
25 – 34	301 (91.8)	1.01 (0.23 – 4.54)	0.986	0.83 (0.18 – 3.87)	0.814
35 – 44	387 (93.9)	1.40 (0.31 – 6.32)	0.656	1.36 (0.29 – 6.40)	0.699
45 – 54	117 (89.3)	0.76 (0.16 – 3.58)	0.728	0.70 (0.14 – 3.47)	0.662
≥55	79 (93.8)	1.38 (0.25 – 7.62)	0.710	1.41 (0.24 – 8.34)	0.700
Gender					
Female	598 (92.3)	1		1	
Male	304 (93.0)	1.10 (0.66 – 1.84)	0.707	1.19 (0.67 – 2.11)	0.546
Education					
No education	386 (90.4)	1		1	
Primary	395 (94.5)	**1.79 (1.06 – 3.06)**	**0.029**	1.36 (0.77 – 2.39)	0.292
Secondary	90 (92.8)	1.35 (0.59 – 3.09)	0.484	1.04 (0.44 – 2.47)	0.931
Tertiary	7 (100.0)	–		–	
HIV status disclosed					
No	359 (93.5)	1		1	
Yes	541 (92.0)	0.83 (0.50 – 1.36)	0.453	0.99 (0.59 – 1.69)	0.984
BMI					
Underweight	92 (88.5)	1		1	
Normal weight	535 (92.9)	1.67 (0.64 – 2.97)	0.078	1.57 (0.86 – 2.87)	0.140
Overweight	167 (93.8)	1.95 (0.90 – 4.23)	0.096	1.79 (0.80 – 4.03)	0.157
Obese	53 (96.4)	3.40 (0.77 – 15.1)	0.107	3.5 (0.66 – 14.0)	0.152
Initial WHO stage					
I	686 (93.1)	1		1	
II	84 (92.3)	0.89 (0.39 – 2.00)	0.770	1.12 (0.28 – 4.42)	0.874
III	30 (78.9)	**0.28 (0.12 – 0.63)**	**0.002**	0.95 (0.17 – 5.21)	0.955
IV	3 (100.0)	–		–	
Recent WHO stage					
I	746 (93.4)	1		1	
II	92 (92.0)	0.82 (0.38 – 1.77)	0.609	0.88 (0.24 – 3.23)	0.847
III	34 (77.3)	**0.24 (0.11 – 0.51)**	**<0.001**	0.29 (0.06 – 1.36)	0.116
IV	3 (100.0)	–		–	
Adherence					
< 90%	215 (86.7)	1		1	
≥ 90%	588 (95.0)	**2.53 (1.56 – 4.10)**	**<0.001**	**2.20 (1.31 – 3.68)**	**0.003**
Initial CD4 count					
< 200 c/mm^3	143 (90.5)	1		1	
≥ 200 c/mm3	615 (93.4)	1.49 (0.92 – 2.42)	0.109	1.26 (0.75 – 2.12)	0.377

Abbreviations: OR indicates odds ratio; aOR indicates adjusted odds ratio; CI indicates confidence intervals; DSD indicates differentiated care model; BMI indicates body mass index; WHO indicates World Health Organization; HIV indicates Human immunodeficiency virus

Discussion

The study aimed to explore the effect of the DSD model on long-term retention patterns beyond 12 months among PLHIV before and after the rollout of the DSD model in Rwanda. Our analysis of data of people living with HIV from 28 health centres in Kigali, Rwanda, revealed an overall retention of 92.5% at 24 months of follow-up. Among those who initiated ART before the rollout of DSD, retention was 92%, and for those who initiated ART after the rollout of DSD, retention was 93%. Although there have been contradicting findings on the effect of the DSD model on retention.[6, 19 -20],there was no statistically significant difference observed before and after the implementation of DSD in our study.

Participants who self-reported adherence of ≥90% had increased odds of being retained compared to those who self-reported adherence of <90%. There have been reported concerns among healthcare workers regarding the decreased frequency of patient monitoring or visits at the ART clinic that might contribute to lower retention among people living with HIV who initiate ART under the DSD model compared to the pre-DSD period.[21] This is particularly relevant as patients often contemplate the benefits of ART drugs,especially since a significant proportion of them are enrolled while still asymptomatic.[22] However, some Sub-Saharan African countries, such as Kenya, Mozambique, Tanzania, Zambia, Kenya, and Uganda, have reported increased patient retention on ART after adopting DSD models compared to before the DSD model.[7,23-24] Our findings are consistent with a recent systematic review that evaluated 37 DSD models in Sub-Saharan Africa. This review reported high retention in HIV programs under DSD models. However, for HIV programs that also reported comparison groups, retention rates were roughly equivalent to those in conventional care models.[6] The study findings indicate that the DSD model can contribute to attaining the UNAIDS 95-95-95 targets while aligning with the envisioned objectives of the "treat all" approach.[10] Our findings showed that immediate initiation of ART following a positive diagnosis in Rwanda does not compromise long-term retention. Periodic evaluation of the DSD model on other outcomes is critical for early detection of shortcomings and for promptly intervening.

We also found that a high baseline and recent WHO staging were associated with decreased odds of being retained compared to having a low baseline WHO stage. Participants with high baseline and recent WHO stage demonstrated lower odds of being retained in care. This finding is contrary to the study, which showed that asymptomatic PLHIV are unlikely to remain in care as they generally do not perceive the complication risk, such as opportunistic infections, compared to those who are severely ill, such as those with high WHO-stage or low CD4 count. [22] Although this argument is intuitive, the low likelihood of retention among people with advanced HIV infection can be explained differently. Sicker participants are also likely to die and hence contributing to low retention compared to those who were asymptomatic. Our study finding is consistent with other studies that showed healthier cohorts of PLHIV were more likely to be retained than those with advanced HIV conditions as defined by lower CD4 counts (< 200 cells /mm3, and WHO stage III and IV).[27-29] Interventions to reduce the number of people presenting with advanced HIV infection are paramount to improve retention. Such intervention could include setting CD4 counts monitoring frequencies, cryptococcal antigen and Tuberculosis (TB) testing, and availing bedside or point-of-care test kits for admitted patients. [30] In addition, community sensitization, and bedside teaching, initiating the WHO-recommended therapies for TB and Cryptococcal meningitis are crucial to ensuring that providers are equipped to manage advanced HIV disease.[31]

There was a substantial correlation between adherence and retention in care, as individuals with a reported adherence of ≥ 90% exhibited greater odds of being retained in care compared to those with an adherence of < 90%. The success of HIV treatment is significantly influenced by the extent to which individuals adhere to ART. The effect of adherence to ART on retention is extensively documented in ART programs and adherence is the primary obstacle ART programs encounter globally.[25- 26] Adherence offers structural and supportive intervention to mitigate the impact of loss to follow-up. Thus, interventions geared towards improving treatment adherence should be the cornerstone of treatment guidelines. Therefore, the association between adherence and retention highlights the importance of adherence-focused interventions in Rwanda's treatment guidelines, reflecting a strategic approach to mitigating the impact of HIV transmission and ensuring the sustained success of ART programs in the country.

Study Limitation

We acknowledge a few study limitations. Our research included individuals aged 17 years or older within the urban setting of Kigali. It is important to note that these results cannot be generalized to rural settings or special populations such as children, adolescents, or key populations. While retrospective cohort analysis is commonly used in assessing adherence to ART,[32] it is difficult to rule out recall bias, especially in self-reported adherence as used in this study. Despite notable deficiencies of self-reported adherence, it has been extensively used and well correlated with outcomes, including retention and viral load suppression.[25, 32] This study remained important as we evaluated the impact of the DSD model on retention using a large sample size from ideal routinely collected clinic data.

Conclusions

The proportions of PLHIV retained in care were comparable before and after the rollout of the DSD model in Rwanda. Supporting continued use of the DSD model can be underscored because, besides not compromising retention, the DSD model is known for other potential benefits, such as reducing the burden on the healthcare workforce in Rwanda.

Funding

None

Conflict of interest

The authors have no conflict of interest to declare.

Authors contribution

Conceptualization: JS

Methodology: HO, DJR, KS, and JS

Formal analysis and investigation: HO

Writing - original draft preparation: JS, and HO

Writing - review and editing: PM, MCL, GR, and ST

Supervision: DS, DJR, and KS

JS wrote the first draft of the manuscript and all authors commented on previous versions. All authors read and approved the final manuscript.

References

1. WHO. Consolidated guidelines on the use of antiretroviral drugs for treating and preventing HIV infection. *Geneva, Switzerland: World Health Organization;* 2016. https://apps.who.int/iris/bitstream/handle/10665/208825/ 9789241549684 _eng.pdf;jsessionid= E90C74EFE806AA7EB5273E885C28B7A1? sequence=1. Accessed 20 August 2020

2. Belay YA, Yitayal M, Atnafu A, Taye FA. Barriers and facilitators to the implementation and scale up of differentiated service delivery models for HIV treatment in Africa: a scoping review. *BMC Health Serv Res* . 2022 Nov 28;22(1):1431. Available from: https://doi.org/10.1186/s12913-022-08825-2
3. Rwanda Biomedical Center. National Guidelines for Prevention and Management for HIV.Edition 2020. *Rwanda Ministry of Helath;* 2020. https://www.prepwatch.org/wp-content/uploads/2022/08/Rwanda-National-HIV-Guidelines-for-Prevention-Management-of-HIV-2020.pdf. Accessed 20 August 2023
4. Huang YC, Yang CJ, Sun HY, Lee CH, Lu PL, Tang HJ, et al. Comparable clinical outcomes with same-day versus rapid initiation of antiretroviral therapy in Taiwan. *Int J Infect Dis*. 2024 Mar 1;140:1–8. https://doi.org/10.1016/j.ijid.2023.12.012
5. Labhardt ND, Brown JA, Sass N, Ford N, Rosen S. Treatment Outcomes After Offering Same-Day Initiation of Human Immunodeficiency Virus Treatment—How to Interpret Discrepancies Between Different Studies. *Clin Infect Dis.* 2023 Oct 15 [cited 2024 Jan 25];77(8):1176–84. Available from: https://doi.org/10.1093/cid/ciad317
6. Long L, Kuchukhidze S, Pascoe S, Nichols BE, Fox MP, Cele R, et al. Retention in care and viral suppression in differentiated service delivery models for HIV treatment delivery in sub-Saharan Africa: a rapid systematic review. *J Int AIDS Soc*. 2020 Nov 1;23(11):e25640. https://doi.org/10.1002/jia2.25640
7. Uetela DAM, Augusto O, Hughes JP, Uetela OA, Gudo ES, Chicumbe SA, et al. Impact of differentiated service delivery models on 12-month retention in HIV treatment in Mozambique: an interrupted time-series analysis. *Lancet HIV*. 2023 Oct 1;10(10):e674–83. Available from: https://doi.org/10.1016/S2352-3018(23)00184-4
8. Timothy N Crawford. Poor retention in care one-year after viral suppression: a significant predictor of viral rebound. *AIDS Care*. 2014 May 21;26(11):1393–9. doi: 10.1080/09540121.2014.920076
9. Genberg BL, Lee Y, Rogers WH, Willey C, Wilson IB. Stages of change for adherence to antiretroviral medications. *AIDS Patient Care STDs*. 2013 Oct;27(10):567–72. doi: 10.1089/apc.2013.0126
10. Joint United Nations Programme on HIV/AIDS (UNAIDS). The path that ends AIDS: UNAIDS Global AIDS Update 2023. *UNAIDS*; 2023. https://thepath.unaids.org/wp-content/themes/unaids2023/assets/files/2023_report.pdf. Accesed 25 august 2023
11. Lillian B. Brown, Monica Getahun, Carol S. Camlin. Factors predictive of successful retention in care among HIV-infected men in a universal test-and-treat setting in Uganda and Kenya: A mixed methods analysis. *PloS One*. 2019 Jan 23;14(1):e0210126.doi: 10.1371/journal.pone.0210126. eCollection 2019
12. Ibiloye O, Decroo T, Eyona N, Eze P, Agada P. Characteristics and early clinical outcomes of key populations attending comprehensive community-based HIV care: Experiences from Nasarawa State, Nigeria. *PloS One* . 2018 Dec 20;13(12):e0209477–e0209477. doi: 10.1371/journal.pone.0209477. eCollection 2018
13. Riedel DJ, Stafford KA, Memiah P, Coker M, Baribwira C, Sebeza J, et al. Patient-level outcomes and virologic suppression rates in HIV-infected patients receiving antiretroviral therapy in Rwanda. *Int JSTD AIDS* . 2018 Apr 5;29(9):861–72. https://doi.org/10.1177/0956462418761695
14. Mugavero MJ, Davila JA, Nevin CR, Giordano TP. From Access to Engagement: Measuring Retention in Outpatient HIV Clinical Care. *AIDS Patient Care STDs*. 2010 Oct 1;24(10):607–13. https://doi.org/10.1089/apc.2010.0086

15. Nsanzimana S, Semakula M, Ndahindwa V, Remera E, Sebuhoro D, Uwizihiwe JP, et al. Retention in care and virological failure among adult HIV+ patients on second-line ART in Rwanda: a national representative study. *BMC Infect Dis* . 2019 Apr 5;19(1):312. https://doi.org/10.1186/s12879-019-3934-2
16. Kiplagat J, Mwangi A, Keter A, Braitstein P, Sang E, Negin J, et al. Retention in care among older adults living with HIV in western Kenya: A retrospective observational cohort study. *PLOS ONE.* 2018 Mar 28;13(3):e0194047. https://doi.org/10.1371/journal.pone.0194047
17. Bongfen, Mbuwir Charlotte, Kwasi Torpey, John Ganle, Ankomah Augustine. Measuring adherence to ARVs among HIV-positive adolescents in Cameroon: a comparative assessment of self-report and medication possession ratio methods. *Pan Afr Med J.* 2021 Nov 10;40(148). doi: 10.11604/pamj.2021.40.148.27994
18. O'Halloran Leach E, Lu H, Caballero J, Thomas JE, Spencer EC, Cook RL. Defining the optimal cut-point of self-reported ART adherence to achieve viral suppression in the era of contemporary HIV therapy: a cross-sectional study. *AIDS Res Ther.* 2021 Jun 26;18(1):36. https://doi.org/10.1186/s12981-021-00358-8
19. Amzel A, Srivastava M, Isavwa A, Sanders J, Tumbare E, Membe I, et al. Community-Based Interventions to Reach 95-95-95 for Children and Adolescents: An Exploratory Programmatic Review From Lesotho. *J Acquir Immune Defic Syndr.* 2018 Aug;78 Suppl 2:S81–7. https://doi.org/10.1097/qai.0000000000001735
20. Bwire GM, Njiro BJ, Ndumwa HP, Munishi CG, Mpondo BC, Mganga M, et al. Impact of differentiated service delivery models on retention in HIV care and viral suppression among people living with HIV in sub-Saharan Africa: A systematic review and meta-analysis of randomised controlled trials. *Rev Med Virol.* 2023 Nov 1;33(6):e2479.https://doi.org/10.1002/rmv.2479
21. Prust ML, Banda CK, Callahan K, Nyirenda R, Chimbwandira F, Kalua T, et al. Patient and health worker experiences of differentiated models of care for stable HIV patients in Malawi: A qualitative study. *PLOS ONE.* 2018 Jul 19;13(7):e0196498. https://doi.org/10.1371/journal.pone.0196498
22. X Gao , D P Nau, S A Rosenbluth, V Scott, C Woodward. The relationship of disease severity, health beliefs and medication adherence among HIV patients. *AIDS Care.* 2020 Jan 8;12(4):387–98. doi: 10.1080/09540120050123783.
23. Wilson Owino Opudo, D.Magu, Kinaro Zack, Elizabeth Mitaki Mong'are. Assessing health outcomes of ART Differentiated Care Models in Migori County, Kenya. *African Journal of Health Sciences.* 2023;Vol. 36:224–333. DOI:10.4314/ajhs.v36i3.5
24. Jo Y, Jamieson L, Phiri B, Grimsrud A, Mwansa M, Shakwelele H, et al. Attrition from HIV treatment after enrollment in a differentiated service delivery model: A cohort analysis of routine care in Zambia. *PLOS ONE.* 2023 Mar 14;18(3):e0280748. https://doi.org/10.1371/journal.pone.0280748
25. Stricker SM, Fox KA, Baggaley R, Negussie E, de Pee S, Grede N, et al. Retention in Care and Adherence to ART are Critical Elements of HIV Care Interventions. *AIDS Behav.* 2014 Oct 1;18(5):465–75. https://doi.org/10.1007/s10461-013-0598-6
26. Muhula S, Gachohi J, Kombe Y, Karanja S. Interventions to improve early retention of patients in antiretroviral therapy programmes in sub-Saharan Africa: A systematic review. *PLOS ONE* . 2022 Feb 9;17(2):e0263663. https://doi.org/10.1371/journal.pone.0263663
27. Mayasi N, Situakibanza H, Mbula M, Longokolo M, Maes N, Bepouka B, et al. Retention in care and predictors of attrition among HIV-infected patients who started antiretroviral therapy in Kinshasa, DRC, before and after the implementation of the 'treat-all' strategy. *PLOS Glob Public Health.* 2022. Mar 11;2(3):e0000259. https://doi.org/10.1371/journal.pgph.0000259

28. Janssen S, Wieten RW, Stolp S, Cremers AL, Rossatanga EG, Klipstein-Grobusch K, et al. Factors Associated with Retention to Care in an HIV Clinic in Gabon, Central Africa. *PLOS ONE.* 2015 Oct 16;10(10):e0140746. https://doi.org/10.1371/journal.pone.0140746
29. Abebe Moges N, Olubukola A, Micheal O, Berhane Y. HIV patients retention and attrition in care and their determinants in Ethiopia: a systematic review and meta-analysis. *BMC Infect Dis.* 2020 Jun 22; 20(1). https://doi.org/10.1186/s12879-020-05168-3
31. Musengimana G, Umugisha JP, Habinshuti P, Anderson T, Mukesharurema G, Remera E, et al. Characteristics and clinical outcomes of patients presenting with advanced HIV disease in the "treat all" era: a retrospective cohort study from rural Rwanda. *BMC Infect Dis*. 2022 Aug 25;22(1):706. Available from: https://doi.org/10.1186/s12879-022-07692-w
32. Costa J de M, Torres TS, Coelho LE, Luz PM. Adherence to antiretroviral therapy for HIV/AIDS in Latin America and the Caribbean: Systematic review and meta-analysis. *J Int AIDS Soc*. 2018 Jan 1;21(1):e25066. https://doi.org/10.1002/jia2.25066