

Retention in HIV Care and Acceptability of an Adolescent and Youth Focused Community-Based Differentiated Service Delivery Model in Ethiopia: A Comparative Mixed-Methods Study

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Abstract

Background

Adolescents and young people living with HIV (AYLHIV) aged 10–24 years continue to experience poorer outcomes across the HIV-care cascade than other age groups. Although differentiated service delivery models offer client-centered approaches to address structural and psychosocial barriers, evidence on adolescent and youth specific community-based models (AY-CDSDMs) in sub-Saharan Africa remains limited. We assessed the association between enrollment in AY-CDSDM and retention in HIV care and evaluated the model's acceptability among AYLHIV in Ethiopia.

Methods

We conducted a concurrent, comparative mixed-methods study in 20 purposively selected health facilities across eight high HIV burden regions of Ethiopia. Quantitative data were obtained through a retrospective review of medical records for 721 randomly selected AYLHIV aged 10–24 years who received HIV care between January 2024 and February 2025. We compared retention in care between those enrolled in AY-CDSDMs and those receiving conventional facility-based care. Multivariable logistic regression was used to identify factors associated with retention. Additionally, we conducted 54 key informant interviews and 11 focus group discussions to explore acceptability and implementation. Qualitative data were analyzed using inductive thematic analysis guided by the theoretical framework of acceptability.

Results

Among the 721 participants (mean age, 19 ± 3.4 years; 54% female), 359 (49.8%) were enrolled in AY-CDSDM and 362 (50.2%) received conventional facility-based care.

1. Introduction

1.1. Background

Adolescents and young people living with HIV (AYLHIV), defined as individuals aged 10–24 years, represent a uniquely vulnerable population within the global HIV response [1, 2]. Despite substantial progress in expanding access to antiretroviral therapy (ART) and advancing the global 95–95–95 targets, adolescents and young people continue to experience poorer outcomes across the HIV care continuum than both children and adults [3]. In 2024, an estimated 3.2 million adolescents and young people aged 15–24 years were living with HIV globally; however, only 59% were receiving ART, highlighting persistent gaps in treatment access, adherence, and viral suppression [4]. These disparities are driven by a complex interplay of structural, psychosocial, and developmental factors, including stigma, challenges related to HIV status disclosure, mental health challenges, limited access to adolescent-friendly services, and difficulties navigating the transition from pediatric to adult care systems [5–7]. Sub-Saharan Africa bears the greatest burden of adolescent HIV, where adolescents and young people are disproportionately affected due to entrenched social and economic inequities [8–10].

In response to these challenges, global HIV strategies have increasingly emphasized flexible, client-centered approaches to service delivery [11, 12]. The World Health Organization's guidance on differentiated service delivery (DSD) promotes the adaptation of HIV services to individual needs to reduce health system barriers, enhance treatment engagement, and improve long-term retention in care [11, 12]. Evidence from several high-burden countries indicates that DSD models such as multi-month dispensing, community-based ART refill groups, and peer-supported interventions can improve adherence and retention outcomes [11, 13, 14]. However, adolescents and young people remain underrepresented in the design, implementation, and evaluation of these models, and findings specific to this population remain mixed and inconclusive [15–17]. These gaps highlight the need for adolescent-responsive service delivery approaches that explicitly address developmental stage, psychosocial needs, and lived experiences [18].

In Ethiopia, adolescents and young people continue to face substantial challenges across the HIV care continuum. In 2023, more than 54,000 individuals aged 15–24 years were living with HIV nationally [19]. In Ethiopia, community-based differentiated service delivery initiatives have largely focused on adults and have not sufficiently addressed the developmental and psychosocial needs of AYLHIV, creating a critical gap in age-appropriate HIV care [20].

To address these gaps, Project HOPE, in collaboration with the Ethiopian Ministry of Health, introduced the AY-CDSM in December 2023. Implemented in selected high-burden health facilities across PEPFAR-supported regions, the model integrates peer-led psychosocial support, flexible group- and individual-based service delivery modalities, and a youth-friendly, client-centered approach tailored to the needs of AYLHIV aged 10–24 years [18]. While the design of the AY-CDSM aligns with global recommendations for adolescent-responsive HIV care, empirical evidence regarding its effectiveness particularly its effect on retention in care, treatment outcomes, and acceptability among adolescents and young people remains limited [15].

This manuscript presented a focused analysis of a broader evaluation of a pilot community-based differentiated service delivery model for AYLHIV in Ethiopia. It assessed the association between model enrollment and retention in HIV care and explored model acceptability from the perspectives of AYLHIV, caregivers, and service providers. The findings aim to inform national scale-up efforts, strengthen adolescent-focused HIV programming, and contribute to the global evidence base on optimizing differentiated HIV service delivery for AYLHIV.

1.2. Conceptual framework

The conceptual framework illustrates how the AY-CDSM influences two interrelated domains of acceptability and retention in care which together shape HIV care outcomes among AYLHIV.

Retention in care domain

Retention in care is influenced by a range of client-level, clinical, and service delivery factors, including treatment literacy, perceived quality of care, psychosocial support, comorbidities, and structural barriers such as transportation challenges, stigma, and scheduling constraints. These factors directly and indirectly affect appointment adherence, continuity of ART, and sustained engagement in care.

Acceptability domain: Model acceptability is conceptualized using the Theoretical Framework of Acceptability (TFA), which comprises seven constructs: affective attitude, perceived burden, ethicality, intervention coherence, opportunity costs, perceived effectiveness, and self-efficacy [15]. These constructs capture adolescents' and young

people's cognitive and emotional responses to the intervention and their willingness to engage with its components. Higher acceptability is expected to promote service uptake and adherence-related behaviors.

Interaction between domains

Acceptability and retention are dynamically interconnected. Greater acceptability may enhance sustained engagement, while positive service experiences reinforce acceptability. Through peer support, flexible service delivery modalities, and youth-friendly approaches, the AY-CDSDM is designed to strengthen both domains, thereby improving overall HIV care outcomes among AYLHIV (Fig. 1).

2. Methodology

2.1. Study Area and Setting

This study was conducted in 20 high HIV caseload pilot health facilities (8 health centers and 12 hospitals) and their surrounding catchment areas across eight high-burden regions of Ethiopia: Addis Ababa, Amhara, Oromia, Gambella, and the former Southern Nations, Nationalities, and Peoples' Region (SNNPR), which has recently been restructured into Sidama, Southwest Ethiopia, Central Ethiopia, and South Ethiopia.

These sites were purposively selected based on their high caseloads of AYLHIV and their strategic relevance for improving service accessibility. At pilot initiation (January 2024), 4,031 adolescents and young people were receiving ART at these facilities; of these, 2,693 (67%) were not enrolled in any DSD model. By June 2025, 682 adolescents and young people (25%; 682/2,693) had enrolled in the AY-CDSDM and were receiving community-based ART refills alternating with facility-based follow-up visits

2.2. Study Design

We used a concurrent triangulation mixed-methods design to assess retention in HIV care and the acceptability of the AY-CDSDM. This analysis is part of a broader evaluation of retention in care, treatment adherence, and viral suppression among AYLHIV in Ethiopia. Quantitative and qualitative data were collected concurrently and integrated at the analysis stage.

The quantitative component used a comparative cross-sectional design. We reconstructed time-to-event information retrospectively from routine medical records to compare retention among AYLHIV enrolled in AY-CDSDM versus those receiving conventional facility-based care.

The qualitative component explored the model's acceptability and implementation experiences through focus group discussions (FGDs) with adolescents and young people and key informant interviews (KIIs) with relevant stakeholders.

2.3. Study Population

The quantitative study population included AYLHIV aged 10–24 years who were enrolled in the AY-CDSDM between January 2024 and February 2025 or who received conventional HIV care during the same period at the same facilities

2.4. Sampling Units

For the quantitative component, sampling units consisted of AYLHIV who had been on ART for at least six months. The intervention group included adolescents and young people enrolled in the AY-CDSM, while the comparison group comprised peers receiving conventional care. Eligible participants were identified from ART clinic records and selected using simple random sampling.

For the qualitative component, participants were purposively selected to ensure diversity in roles and perspectives. These included ART focal-persons at pilot health facilities, local implementing partner (LIP) technical staff, adolescent and youth peer leaders, beneficiaries, caregivers, AYLHIV association members, and program managers at various levels of the health system, capturing both system- and community-level perspectives.

2.5. Inclusion / Exclusion criteria

Inclusion Criteria:

Intervention group

AYLHIV who were on ART for ≥ 6 months, enrolled in the AY-CDSM, and had received at least one community refill and one facility-based refill during the study period.

Comparison group

AYLHIV who had been on ART for ≥ 6 months, were not enrolled in the AY-CDSM or any other DSD model, and had clinical characteristics comparable to those enrolled in the AY-CDSM (including clinical stability and no history of adherence problems at the time of AY-CDSM initiation), and were receiving conventional facility-based care during the same period.

Exclusion Criteria:

Intervention group

Individuals not enrolled in the AY-CDSM; those with undocumented first community refill dates; those enrolled for < 3 months; and those with no subsequent facility visit following the initial community refill.

Comparison group

Individuals enrolled in any DSD model, those on ART for < 6 months, or those not meeting eligibility criteria comparable to AY-CDSM participants.

2.6. Sample size Determination

The sample size was calculated using a two-population proportion formula, assuming a retention rate of 90% among AY-CDSM participants ($p_1 = 0.90$) and 79% among those receiving conventional care ($p_2 = 0.79$). Using a 95% confidence level ($Z_{\alpha/2} = 1.96$) and 90% power ($Z_{\beta} = 1.28$), the minimum required sample size was 325 participants per group (total $N = 650$). After adjusting for a 10% incomplete record rate, the final sample size was 722 participants.

2.7. Sampling Strategy

For the quantitative component, a proportional allocation approach was used to distribute the sample across the 20 facilities based on the number of eligible clients in each group. Simple random sampling was then applied to

select participants from facility records. Each reviewed chart was assigned a unique identifier to prevent duplication.

For the qualitative component, a total of 54 key informants were purposively selected, including peer leaders (n = 6), caregivers (n = 5), prime LIP technical staff (n = 4), sub-awardee LIP technical staff (n = 13), healthcare workers/ART focal persons (n = 13), regional and Ministry of Health program managers (n = 9), Project HOPE staff (n = 2), and ASK US representatives (n = 2).

In addition, 11 FGDs with adolescents and young people were conducted, ensuring regional representation and thematic saturation across the 20 pilot sites.

2.8. Data collection procedures

Data collection was conducted by trained data collectors and supervisors who were independent of service delivery and routine supervision at the study sites. All data collectors had postgraduate public health training and prior experience in mixed-methods research. A five-day training covered the study objectives, ethical considerations, data collection procedures, and tool administration.

Quantitative data were extracted from ART records, client charts, and community refill registers using standardized, pretested tools digitized in CommCare (see the supplementary file). Qualitative data were collected using semi-structured interview guides translated into local languages (see the supplementary file). Regular debriefing sessions were conducted to ensure consistency and address emerging issues.

2.9. Data quality assurance

A pretest involving 5% of the sample was conducted to assess the clarity and feasibility of the data collection tools, and necessary revisions were made prior to the main data collection. During data collection, daily supervision and routine checks were performed to ensure completeness and adherence to study protocols.

For qualitative data, rigor was ensured through credibility, dependability, transferability, and confirmability. Multiple coders independently reviewed transcripts, followed by consensus discussions. Reflexivity and audit trails were maintained to minimize bias and enhance trustworthiness.

2.10. Data Processing and Analysis:

Quantitative data were validated in CommCare and exported to SPSS (version 20) and STATA (version 17) for analysis. Descriptive statistics were used to summarize participant characteristics. Associations between AY-CDSMD enrollment and retention in care were assessed using chi-square tests and binary logistic regression. Variables with $p < 0.2$ in bivariate analysis were included in multivariable models. Statistical significance was set at $p < 0.05$, and results were reported as adjusted odds ratios (AORs) with 95% confidence intervals (CIs). Model fitness was assessed using the Omnibus test ($p = 0.001$) and the Hosmer–Lemeshow goodness-of-fit test ($p = 0.987$).

Qualitative data from KIs and FGDs were audio-recorded, transcribed verbatim, and translated into English. Data were independently coded by multiple researchers and analyzed using inductive thematic analysis. Findings from FGDs were used to triangulate and refine results from KIs.

2.11. Study Variables

Dependent (outcome) variable: Retention in HIV care (binary: retained vs. not retained), determined based on attendance at scheduled ART refill appointments from AY-CDSM enrollment through the most recent refill visit.

Independent variables

Socio-demographic characteristics (age, sex, residence, marital status, education, religion, socioeconomic status) and clinical characteristics (ART duration, viral load, CD4 count, WHO clinical stage, opportunistic infections, and adherence status).

2.12. Operational Definition

Retained in care

Continued engagement in HIV care, defined as receiving ART refills as scheduled (community- or facility-based) from AY-CDSM enrollment through the most recent ART refill visit at the time of data collection.

Not retained in care

Missing scheduled refills, including individuals who were lost to follow-up, dropped, stopped treatment, died, or transferred out (without confirmation of continuation at another facility).

- **Lost to follow-up:** >28 days but < 3 months late for a scheduled refill
- **Dropped:** ≥3 months late for a scheduled refill

AY-CDSM enrollment

AYLHIV on ART for ≥ 6 months who voluntarily enrolled and received services through an AY-CDSM group.

Conventional care

Routine facility-based HIV services for AYLHIV on ART for ≥ 6 months and meeting eligibility criteria comparable to AY-CDSM participants, including ART refills, laboratory monitoring, clinical evaluation, adherence assessment, and comorbidity screening.

2.13. Ethical Considerations

Ethical approval

was obtained from the Ethiopian Public Health Association Institutional Review Board ((Ref. No, EPHA/OG/506/25, Date 29/7/2025). Participation in qualitative interviews was voluntary, and informed consent was obtained from all participants. For individuals aged < 18 years, assent and parental or guardian consent were obtained. Study objectives, procedures, and consent for audio recording were explained prior to data collection.

Confidentiality was ensured by removing all personal identifiers and de-identifying the data prior to analysis. The data were stored in password-protected systems accessible only to authorized personnel. The study was conducted in full compliance with the principles of the Declaration of Helsinki and relevant national guidelines for human research protection, while upholding the ethical principles of autonomy, confidentiality, beneficence, and non-maleficence to safeguard participants' rights and well-being.

3. Result

3.1. Socio-Demographic Characteristics

A total of 721 AYLHIV were included in the quantitative analysis. Slightly more than half were female (54%), with a mean age of 19 years (SD ± 3.4). Of these, 359 (49.8%) were enrolled in the AY-CDSDM, while 362 (50.2%) received conventional facility-based care. Over half of the participants (55%) were from Addis Ababa and Amhara regions.

The majority completed primary or secondary education (70%), were never married (84%), and were students (71%). Nearly half (44%) identified as Orthodox Christians. More than half (54%) lived in households with three or fewer members, while 34% lived with both parents (Table 1).

For the qualitative component, 54 key informants participated, representing diverse stakeholders, including peer leaders and caregivers (n = 11), implementing partner technical staff (n = 19), ART focal healthcare workers (n = 13), program managers (n = 9), and representatives of AYLHIV (n = 2). In addition, 11 FGDs were conducted with AYLHIV.

Table 1. Socio-demographic characteristics of AYLHIV in AY-CDSDM and conventional care at pilot facilities, Ethiopia (n=721)

<i>Variables</i>		<i>AY-CDSM</i>	<i>Conventional</i>	<i>Total</i>
		# AYLHIV, n (%)	# AYLHIV, n (%)	# AYLHIV, n (%)
<i>Sex</i>	Female	194 (54)	198 (55)	392 (54)
	Male	165 (46)	164 (45)	329 (46)
<i>Current age range</i>	10_14	15 (4)	63 (17)	78 (11)
	15-19	162 (45)	119 (33)	281 (39)
	20-24	182 (51)	180 (50)	362(50)
<i>Region</i>	Addis Ababa	79 (22)	150 (41)	229 (32)
	Amhara	121(34)	61 (17)	182 (25)
	Oromia	67 (19)	21 (60)	88 (12)
	Gambella	20 (6)	51(14)	71 (10)
	SNNPR	72 (20)	79 (22)	151(21)
<i>Educational status</i>	No Formal Education	6 (2)	21 (60)	27 (4)
	Primary education	103 (29)	104 (29)	207 (29)
	Secondary education	195 (54)	100 (28)	295 (41)
	University college	44 (12)	42 (12)	86 (12)
	Not Documented	11 (3)	95 (26)	106 (15)
<i>Current marital status</i>	Never Married	333 (93)	274 (76)	607 (84)
	Married	13 (4)	24 (7)	37 (5)
	Divorced	1 (0)	4 (1)	5 (1)
	Not mentioned	12 (3)	60 (17)	72 (10)
<i>Religion</i>	Orthodox	186 (52)	131 (36)	317 (44)
	Protestant	42 (12)	51 (14)	93 (13)
	Muslim	28 (8)	34 (9)	62 (9)
	Catholic	11 (3)	5 (1)	16 (2)
	Not mentioned	92 (26)	141 (39)	233 (32)
<i>Family size</i>	One to three	202 (56)	190 (53)	392 (54)
	Four or more	113 (32)	96 (26.2)	209 (29)
	Not Mentioned	44 (12)	76 (21)	120 (17)
<i>Living with</i>	Both parents	127 (35)	120 (33)	247 (34)
	One parent	131 (36)	115 (32)	246 (34)

	Guardian or charity	41 (11)	35 (10)	76 (11)
	Alone or peers or partner	30 (8)	32(9)	62 (9)
	Not mentioned	30 (8)	60 (17)	90 (12)
<i>Place of residence</i>	Urban	350 (97)	316 (87)	666 (92)
	Rural	9 (3)	46 (13)	55 (8)
<i>Current employment status</i>	Student	286 (80)	225 (62)	511 (71)
	unemployed	28 (8)	28 (8)	56 (8)
	Employed	23 (6)	13 (4)	36 (5)
	Not mentioned	22 (6)	96 (27)	118 (16)
<i>Having a mobile phone</i>	Yes	345 (96)	350 (97)	695(96)
	No	14 (4)	12 (3)	26(4)

3.2. Clinical characteristics of study participants

More than half of participants (370; 51%) had been on ART for over 10 years, with a mean duration of 11.4 years. The vast majority (706; 98%) were receiving dolutegravir-based regimens. Overall adherence was high, with 93.5% (674) demonstrating good adherence at the most recent ART refill visit; adherence was higher among AY-CDSMD participants (98.6%) compared with those receiving conventional care (88.4%).

Among participants eligible for viral load testing, viral suppression was 93.4% (578), with slightly higher suppression among AY-CDSMD participants (94.7%) than among those in conventional care (91.9%). Nearly all participants were classified as WHO clinical stage I (99.7%), had good functional status (97.6%), and had no documented opportunistic infections (99%) (Table 2)

Table 2. Clinical characteristics of AYLHIV in AY-CDSMD and conventional care at pilot facilities, Ethiopia (n=721)

Variables		# AY -CDSDM, n (%)	# Conventional, n (%)	# Total, n (%)
Duration of ART from recent visit in Years	1-5	38 (11)	57 (16)	95 (13)
	6-10	113 (31)	143 (40)	256 (36)
	11-15	142 (40)	104 (29)	246 (34)
	16-21	66 (18)	58 (16)	124 (17)
Type of ART regimen recently received	DTG based	357 (99)	349 (96)	706 (98)
	Non DTG based	2 (1)	13 (4%)	15 (2)
Base line CD4 count at start of ART	<200	47 (13.1)	45 (12.4)	92 (12.8)
	200-400	98 (27.3)	63 (17.4)	161 (23.3)
	401-1500	104 (29.0)	137 (37.8)	241 (33.4)
	>1500	10 (2.8)	13 (3.6)	23 (3.2)
	Not Doc	100 (28.9)	104 (28.7)	204 (28.3)
The recent viral load test result	Eligible for viral load testing	354 (98.6)	359 (99.2)	713 (98.9)
	Viral load test done and	323 (91.2)	296 (82.5)	619 (86.8)
	suppressed	306 (94.7)	272 (91.9)	578 (93.4)
	Low Level Viremia	14 (4.3)	13 (4.4)	27 (4.4)
	High viral load	3 (0.9)	11 (3.7)	14 (2.3)
Recent Treatment adherence status	Good	354 (98.6)	320 (88.4)	674 (93.5)
	Fair	2 (0.6)	10 (2.8)	12 (1.7)
	Poor	3 (0.8)	32 (8.8)	35 (4.9)
The recent treatment progress staging	Stage I	359 (100)	360 (99.4)	719 (99.7)
	Stage II	0	1 (0.3)	1 (0.1)
	Stage III	0	1 (0.3)	1 (0.1)
The recent functional status	Working	351 (97.8)	353 (97.5)	704 (97.6)
	Ambulatory	8 (2.2)	9 (2.5)	17 (2.4)
The recent OI screening status	Had no OI	356 (99.2)	358 (98.9)	714 (99.0)
	Had OI	3 (0.8)	4 (1.1)	7 (1.0)

3.3. Retention in care of AYLHIV in the AY-CDSDM and conventional groups

Overall, 699 participants were retained in HIV care from enrollment to the most recent ART refill visit, corresponding to a retention rate of 96.9% (95% CI: 96.5–97.3%). Of retained in care, 2.4% transitioned to other community and health facility models. Among those not retained, 1.7% interrupted care, and 1.4% were

transferred to other health facilities. Retention in care was higher among AY-CDSM participants (98.6%; 95% CI: 98.1–99.1%) compared with those receiving conventional care (95.3%; 95% CI: 94.8–95.8%) (Fig. 2).

3.4. Retention status among AY-CDSM and AYLHIV in conventional care from enrollment in AY-CDSM to the most recent ART refill visit by sociodemographic characteristics

Retention in care was high across both groups but consistently higher among AY-CDSM participants. Enrollment in the AY-CDSM was significantly associated with higher retention (98.6% vs. 95.3%; $\chi^2 = 6.65$, $p = 0.01$). Subgroup analyses showed higher retention among AY-CDSM participants across key socio-demographic strata, including those aged 15–19 years, females, individuals with secondary education, those never married, rural residents, students, and those living with guardians or partners (Table 3).

Table 3. Comparison of retention status among AYLHIV in AY-CDSM versus conventional care by socio-demographic characteristics, Ethiopia, (n=721).

<i>Clinical Variables</i>		<i>AY - CDSDM Retained in care, N (%)</i>	<i>Conventional Retained in care, N (%)</i>	<i>Total AYLHIV Retained in care, N (%)</i>	<i>X2 / P. VALUE</i>
<i>Region</i>	Addis Ababa	76 (96)	139 (93)	215 (94)	1.13/.29
	Amhara	119 (98)	58 (95)	177 (97)	1.62/.20
	Oromia	67 (100)	21 (100)	88 (100)	-
	Gambella	20 (100)	49 (96)	69 (97)	.81/.37
	SNNPR	72 (100)	78 (99)	150 (99)	.92/34
<i>Age range in years</i>	10 - 14	15 (100)	60 (95)	75 (96)	.74/.39
	15 - 19	160 (99)	112 (94)	272 (97)	4.78/.029*
	20 - 24	179 (98)	173 (96)	352 (97)	1.69/.19
<i>sex</i>	Female	191(98)	186 (94)	377 (96)	5.43/0.02*
	Male	163 (99)	159 (97)	322 (98)	1.33/0.25
<i>Education</i>	Primary	102 (99)	100 (96)	202 (98)	1.82/.18
	Secondary	191(98)	91 (91)	282 (96)	7.58/.006*
	University	44 (100)	41 (98)	85 (99)	1.06/.30
	No formal education & not documented	17 (100)	113 (97)	130 (98)	.45/.50
<i>Marital status</i>	Never Married	328 (98)	261(95)	589 (97)	5.49/.019*
	Married	13 (100)	23 (96)	36 (97)	.63/.43
	Divorced & Not Mentioned	13 (100)	61 (95)	74 (96)	.56/.46
<i>Religion</i>	Orthodox	183 (98)	121 (92)	304 (96)	7.09/.008*
	Catholic & Protestant	53 (100)	54 (96)	107 (98)	1.93/.17
	Muslim	27 (96)	33 (97)	60 (97)	.02/.89
	Not Mentioned	91 (99)	137 (97)	228 (98)	.81/.37
<i>Family size</i>	Three or less	198 (98)	179 (94)	377 (96)	3.86/.049*
	Four or more	113 (100)	93 (97)	206 (99)	.24/.622
	Not Mentioned	43 (98)	73 (96)	116 (97)	3.58/.058
<i>Living with</i>	Bothe parents	125 (98)	115 (96)	240 (97)	1.51/.22
	One parents	129 (98)	112 (97)	241 (98)	.36/.55
	Guardian / Charity / Partner	70 (99)	59 (88)	129 (93)	6.27/.012*
	Not Mentioned	30 (100)	59(98)	89(99)	.51/.48
<i>Residence</i>	Urban	345 (99)	302(96)	647(97)	.62/.43

	Rural	9 (100)	43(93)	52(95)	5,40/.02*
<i>Employment</i>	Student	284 (99)	213 (95)	497 (97)	10.15/.001*
	Employed	22 (96)	13 (100)	35 (97)	.58/.45
	Unemployed / Daily labor	26 (93)	25 (89)	51 (91)	.22/.64
	Not Mentioned	22 (100)	94 (98)	116 (98)	.47/.495
<i>Mobile</i>	Yes	340 (99)	334 (95)	674 (97)	5.78/.016*
	No	14 (100)	11 (92)	25 (96)	1.21/.27

Qualitative findings showed that the AY-CDSM model was perceived as effective among AYLHIV from diverse backgrounds due to its age specific and peer led design. Participants emphasized that services were tailored to distinct age groups, aligning care with adolescents' developmental needs.

As one key informant noted, "The adolescents and youths involved in this model are provided with care and support services tailored specifically to their age... The packages provided to those aged 10–14 is different from those for 15–19 and 20–24 years" Male, KII, Prime LIP, Addis Ababa.

The peer-based, community-oriented approach further improved participation and retention by fostering shared learning and reducing structural barriers such as transport and waiting time. This was reflected by a participant who stated, "It's better when we're in a group. When everyone shares their ideas like this, it works better" FGD, client, Bishoftu town.

3.5. Retention status among AY-CDSM and AYLHIV in conventional care from enrollment in AY-CDSM to the most recent ART refill visit by clinical characteristics

Overall Retention in care persisted high across all clinical categories. Consistently higher among participants enrolled in the AY-CDSM. Chi square analyses demonstrated statistically significant in AY-CDSM across several clinical characteristics, including ART duration (6–10 years), baseline CD4 count >400 cells/mm³, use of dolutegravir based regimens, WHO treatment progress Stage I, working functional status, and absence of opportunistic infections (Table 4).

Table 4. *Comparison of retention status among AYLHIV in AY-CDSM versus conventional care by selected clinical characteristics, Ethiopia, (n=721).*

<i>Clinical Variables</i>		<i>AY - CDSMD Retained in care, N (%)</i>	<i>Conventional Retained in care, N (%)</i>	<i>Total AYLHIV Retained in care, N (%)</i>	<i>X2 / P. VALUE</i>
<i>ART Duration in years</i>	1 - 5	37(97)	52(91)	89(94)	1.45/.23
	6 - 10	112(99)	135(94)	247(96)	4.13/.04*
	11 - 15	140(99)	103(99)	243(99)	.10/.75
	16 - 20	65(98)	55(95)	120(97)	1.32/.25
<i>Base line CD4 count</i>	< 200	45(96)	44(98)	89(97)	.30/.58
	200 - 400	97(99)	62(98)	159(99)	.10/.75
	> 400	113(99)	139(93)	252(95)	6.22/.013*
	Not Mentioned	99(99)	100(96)	199(98)	1.73/.19
<i>Recent Treatment adherence status</i>	Good	350(99)	311(97)	661(98)	2.52/.11
	Fair / Poor	4(80)	34(81)	38(81)	.003/.96
<i>The recent treatment progress staging</i>	T-Stage I	354(99)	343(95)	697(97)	6.72/.01*
	T-Stage II / III	0	2(100)	2(100)	-
<i>The recent functional status</i>	Working	346(99)	336(95)	682(97)	6.69/.01*
	Ambulatory	8(100)	9(100)	17(100)	-
<i>The recent OI screening status</i>	No	351(99)	341(95)	692(97)	6.68/.01*
	Yes	3(100)	4(100)	7(100)	

Qualitative findings corroborated with quantitative results, indicating that AYLHIV enrolled in the AY-CDSMD achieved comparable or higher retention than peers in conventional care, particularly among clinically stable adolescents. Improved retention was attributed to peer led discussions and psychosocial support that enhanced understanding of ART, viral load monitoring, and CD4 count. As one participant noted, “Before joining this group, I didn’t really understand much about viral load and CD4... But now, after being part of this group, I understand what viral load and CD4 are” FGD, client, Addis Ababa.

The model further reinforced consistent medication taking behaviors by clarifying treatment instructions and promoting standardized dosing routines. One adolescent explained, “After I joined this program, I was told that I must take my medicine at the same time every day... even if I go out with someone, I make sure to take my medicine” FGD, client, Addis Ababa.

Health providers highlighted that AY-CDSMD facilitates efficient clinical management of clinically stable adolescents by enabling extended ART refill intervals and reducing unnecessary facility visits. As one respondent noted, “Clients in the AY-CDSMD would be able to take their ART drugs at extended intervals, allowing health professionals to focus on those who need close follow-up and critical care” KII, Prime LIP, Amhara region.

3.6. Kaplan–Meier survival analysis retention curve among AY-CDSMD and AYLHIV in conventional care

Although the study was designed as a cross-sectional record review, the availability of retrospectively reconstructed time to event data enabled survival analysis. Kaplan–Meier analysis showed that retention in care remained generally stable over the follow-up period, with only modest differences between adolescents and youth enrolled in the AY-CDSDM model and those receiving conventional care (Fig.3). The incidence rate of non-retention was lower in the AY-CDSDM group (0.0009582) than in the conventional care group (0.0026521), indicating a higher risk of disengagement among participants receiving conventional care. However, this difference was not statistically significant (log rank test: $\chi^2 = 2.72$, $p = 0.0989$).

3.6. Predictors of retention in care among AY-CDSDM and AYLHIV in conventional care from enrollment in AY-CDSDM to the most recent ART refill visit in logistic regression analysis

Chi-square analyses identified sociodemographic and clinical factors associated with retention in care among adolescents and youth enrolled in the AY-CDSDM model and those receiving conventional care. Variables meeting predefined statistical thresholds and biological plausibility criteria were included in a multivariable logistic regression model.

After adjustment, enrollment in the AY-CDSDM model remained the only independent predictors of retention, with AYLHIV having significantly higher odds of being retained compared with those in conventional care (AOR = 3.56; 95% CI: 1.20–10.58; $p = 0.022$). No other variables were significantly associated with retention (Table 5).

Table 5: Bivariate and multivariable logistic regression of factors associated with retention in care among AYLHIV enrolled in AY-CDSDM and conventional care (n=721)

Selected socio demographic & Clinical Variables		AYLHIV Retained in care, N (%)	Binary logistic regression analysis	
			Bivariate	Multivariate
			COR (95% CI)	AOR (95% CI)
Model Type	AY-CDSDM		3.49(1.23-9.56)	3.56(1.20-10.58) *
	Conventional care		Ref	Ref
Region	Addis Ababa	215(94)	Ref	Ref
	Amhara	177(97)	2,31(0.81-6.52)	1.81(0.59-5.49)
	Oromia	88(100)	-	-
	Gambella	69(97)	2.25(0.50-10.13)	4.94(0.81-20.12)
	SNNPR	150(99)	9.77(1.27-75.08)	10.37(1.32-81.40)
sex	Female	377(96)	0.55(0.22-1.35)	0.65(0.25-1.70)
	Male	322(98)	Ref	Ref
Family size	Three or less	377(96)	Ref	Ref
	Four or more	206(99)	1.15(0.38-3.55)	0.50(0.13-1.94)
	Not Mentioned	116(97)	2.73(0.78-9.55)	3.16(0.78-12.79)
Living with	Both parents	240(97)	Ref	Ref
	One parents	241(98)	1.41(0.44-4.49)	1.87(0.54-6.44)
	Guardian / Charity / Partner	129(93)	2.60(0.32-21.40)	8.44(0.73-98)
	Not Mentioned	89(99)	0.42(0.15-1.15)	0.86(0.27-276)
Employment	Student	497(97)	Ref	Ref
	Employed	35(97)	0.99(0.13-7.72)	1.54(0.19-12.40)
	Unemployed / Daily labor	51(91)	0.287(0.10-0.83)	0.25(0.078-0.78)
	Not Mentioned	116(98)	1.63(0.37-7.29)	2.97(0.65-13.56)

*Significant association to in retention in multiple binary logistic regression analysis with $P < 0.05$. Ref=reference

The qualitative findings strongly reinforced the quantitative results, suggesting that participation in the AY-CDSDM model may have significantly improved retention in care among AYLHIV. Participants attributed sustained engagement to the model's youth centered, peer led structure, which fostered trust, open communication, and mutual support within age matched groups. As one participant explained, "Since we are the same age, it is not a problem. We talk freely... we also discuss the problems we faced related to taking our medications. Especially, since our peer leaders are in our age group, we feel comfortable with them and see them as friends; it is easier to talk to them than to health professionals" FGD, client, Mizan town.

Retention was further enhanced through the community-based delivery of ART services, which reduced structural barriers such as transportation costs, long waiting times, and conflicts with school or work schedules. One

participant noted, “We take our medication on Sundays at the community. We don’t miss our appointments because there’s no work on Sundays... taking it on Sundays through this service gave me more freedom” FGD, client, Addis Ababa.

Peer leaders also played a critical role in maintaining continuity of care through reminders, adherence support, and follow-up on missed visits. As one participant stated, “When our refill appointment approaches, [the peer leader] calls us two days in advance... if we cannot come, he will take it to a place that suits us” (FGD, client, Arba Minch). Participants further reported increased confidence and personal responsibility for treatment adherence, with one adolescent sharing, “This model has helped me build confidence. Now, I take responsibility for my medication on my own... the way I take my medication now compared to how I did before has completely changed” FGD, client, Hawassa.

3.7. Exploring AY-CDSMD Acceptability Using the Theoretical Framework of Acceptability

These findings show that the AY-CDSMD ART refill model was widely perceived as highly acceptable by AYLHIV, caregivers, healthcare providers, and program managers. Stakeholders described the model as relevant, convenient, and responsive to adolescents’ needs, highlighting a dynamic relationship between acceptability and retention in care. Greater acceptability appeared to enhance sustained engagement by reducing service-related burden and strengthening adolescents’ confidence and self-management, as further illustrated in the analysis below.

Affective Attitude: Participants expressed consistently positive emotional responses to the peer led, youth friendly structure, describing feelings of comfort, trust, and belonging. These positive emotions fostered voluntary participation and sustained engagement. As one adolescent explained, “This model has helped me build confidence. Now, I take responsibility for my medication on my own... it’s helped me grow” FGD, Client, Hawassa. Another emphasized the importance of peer connection: “We are all the same age, so we can talk, play, laugh, and have tea together... that is why we decided to join this program” FGD, Client, Arba Minch.

Burden: The model was widely perceived as reducing the effort required to access ART services through community-based refills, shorter waiting times, and fewer facility visits. Adolescents highlighted practical benefits, noting that “the model saved time and the cost of transport” FGD, Client, Hawassa, and “we don’t miss our appointments because there’s no work on Sundays” FGD, Client, Addis Ababa.

Ethicality: AY-CDSMD was viewed as ethically aligned with values of dignity, confidentiality, autonomy, and voluntariness. Clear explanations during enrollment strengthened trust among adolescents and caregivers. As one key informant noted, “Health care professionals explain to the adolescents and their parents that they would voluntarily join the model” Female, KII, Sidama. Caregivers observed growth in confidence and independence, stating, “Now he is not afraid... he takes out his medicine and takes it” Female caregiver, KII, Sodo.

Intervention Coherence: Participants demonstrated a strong understanding of the model’s purpose and procedures, largely due to effective communication by healthcare workers and peer leaders. One respondent explained, “It started with a clear explanation of all the benefits and activities they would participate in” Female, KII, Sidama. Adolescents also understood operational aspects, noting, “Our peer leader will bring it to us... he calls us two days in advance” FGD, Client, Arba Minch.

Opportunity Costs: Most adolescents perceived minimal opportunity costs, as decentralized refills and flexible schedules allowed them to maintain daily responsibilities. As one participant stated, “Even if we are at work, the

medication would be given at the community level, so it saves our time” FGD, Client, Mizan. However, distance remained a barrier for a minority: “There are people who come from far places... the distance prevents them from joining or staying in this program” FGD, Client, Gambella.

Perceived Effectiveness: Participants strongly believed the model improved adherence, psychosocial wellbeing, and engagement in care. Adolescents reported better medication taking behavior, with one noting, “After joining the group... I make sure to take my medicine” FGD, Client, Addis Ababa. Psychosocial support and stigma reduction were central to perceived effectiveness: “Most of our psychosocial sessions are about stigma and discrimination... the model has helped us a lot” FGD, Client, Gambella.

Self-Efficacy: Participation in AY-CDSDM enhances adolescents’ confidence in managing their treatment independently. Peer led learning improved knowledge and normalized shared experiences. As one adolescent stated, “Now, I take responsibility for my medication on my own” FGD, Client, Hawassa. Another added, “Before joining this group, I didn’t really understand much about viral load and CD4... now I understand” FGD, Client, Addis Ababa.

Overall, the integrated analytical synthesis of acceptability findings across all seven TFA domains was supported by quantitative results, which demonstrated that enrollment in AY-CDSDM was a significant predictor of retention in care, with AYLHIV having 3.7 times higher odds of being retained compared to those receiving conventional care.

4. Discussion

This comparative mixed methods study found exceptionally high retention in HIV care among AYLHIV in Ethiopia, with consistently higher retention among those enrolled in the AY-CDSDM compared with peers receiving conventional facility-based care. Enrollment in AY-CDSDM remained independently associated with higher odds of retention after adjustment for sociodemographic and clinical factors. Qualitative findings further demonstrated high acceptability of the model across all domains of the TFA.

The overall retention rate of 96.9% observed in this study exceeds most estimates reported for adolescents and young people in sub-Saharan Africa and within Ethiopia. Comparable retention levels have been reported in Namibia (94.1% at 12 months) and Uganda (96% at six months) [21,22], whereas substantially lower retention has been documented among youth in other Ugandan settings (65.7%) [23]. Systematic reviews estimate an average 12-month retention rate of approximately 80% in the region [6], underscoring that the level of retention observed in the present study is considerably higher than regional benchmarks. These differences likely reflect variations in study populations, follow-up duration, and the extent to which adolescent responsive service delivery approaches are implemented.

Retention observed in this study was also markedly higher than reported national estimates from Ethiopia. A pooled analysis of 45 studies reported a national retention rate of 70.65% [24], while facility-based studies in southern Ethiopia reported retention levels of approximately 82% [25]. The higher retention achieved in the present analysis may reflect recent programmatic improvements, including expanded access to ART, enhanced adherence counseling, and deliberate integration of adolescent friendly service components within differentiated service delivery models and also may be difference in follow-up duration. The focus on youth specific needs and community-based delivery approaches may be particularly influential in sustaining engagement among this population.

Notably, retention was consistently higher among AYLHIV enrolled in the AY-CDSDM compared with peers receiving conventional facility-based care. Enrollment in the AY-CDSDM remained the only independent predictor of retention in multivariable analysis. This finding highlights the central role of differentiated youth centered service delivery in promoting sustained engagement in care. The absence of significant associations with other sociodemographic or clinical factors may reflect the overall high level of clinical stability among study participants, which likely reduced variability and limited the detection of additional predictors. It is also plausible that factors such as education, employment, or family support operate as mediators of model enrollment rather than independent determinants of retention.

These results are consistent with growing evidence from sub-Saharan Africa demonstrating that DSDMs maintain retention outcomes among adolescents and youth [15]. Multi-country evaluations have reported retention rates exceeding 98.8% among adolescents enrolled in differentiated ART refill models in Tanzania and 99.5% in Zimbabwe [26,27]. Systematic reviews further indicate that differentiated approaches reduce structural barriers to care, enhance acceptability, and achieve higher retention compared with conventional facility-based HIV services [15,28]. Together, these findings support the effectiveness of community-based and client-centered ART delivery strategies in sustaining long-term engagement among AYLHIV.

Qualitative findings from this study complemented and enriched the quantitative results by explaining mechanisms through which the AY-CDSDM may enhance retention. Participants emphasized the importance of the model's youth centered, peer led design, which fostered trust, open communication, and shared learning within age-matched groups. The community-based delivery of ART reduced logistical barriers such as transportation costs, long waiting times, and conflicts with school or work schedules, thereby facilitating consistent appointment keeping and medication adherence. These findings align with evidence from Ethiopia demonstrating improved retention through community-based differentiated service delivery [29], as well as adolescent focused studies highlighting the value of peer support, safe spaces, and continuity of care mechanisms [5,6].

High acceptability of the AY-CDSDM was observed across all domains of the TFA. Adolescents reported positive affective attitudes driven by peer support, a sense of belonging, and reduced stigma. The decentralized and flexible nature of service delivery minimized perceived burden and opportunity costs, allowing adolescents to integrate HIV care into their daily lives with minimal disruption. Ethical acceptability was reinforced through voluntariness, confidentiality, and respect for autonomy, while clear communication by healthcare workers and peer leaders enhanced intervention coherence. Collectively, these factors were perceived to strengthen adherence, increase confidence in treatment management, and promote sustained engagement in care.

These findings are consistent with broader evidence from sub-Saharan Africa showing that adolescent centered DSDMs emphasizing decentralization, task shifting, and community engagement reduce barriers and promote more responsive HIV services [31]. Regional studies further demonstrate that peer led support groups and community ART delivery platforms enhance retention by providing supportive environments in which adolescents can address stigma, treatment challenges, and psychosocial stressors [32]. The observed improvements in self-efficacy and treatment literacy within this study echo qualitative research from Ethiopia describing the critical role of psychosocial support in addressing emotional distress, disclosure challenges, and social isolation among adolescents living with HIV [33].

Overall, the findings of this study underscore the importance of continued investment in adolescent specific differentiated service delivery approaches that combine community-based ART refills, peer led psychosocial support, and youth friendly service environments. By addressing both structural and psychosocial determinants of

disengagement, the AY-CDSM represents an effective strategy for improving retention and optimizing long-term HIV care outcomes among AYLHIV.

5. Strengths and Limitations of the Study

A major strength of this study is its comparative mixed-methods design, integrating quantitative and qualitative approaches with an adequate and diverse sample. This enabled triangulation, strengthened validity, and generated actionable evidence to improve services for AYLHIV, particularly toward achieving the second and third UNAIDS 95–95–95 targets through community-based models.

However, several limitations should be noted. The cross-sectional design limited assessment of retention from ART initiation; this was partially mitigated by applying standardized 18-month retention measures and Kaplan Meier analyses. Potential selection bias was addressed through comparable eligibility criteria and multivariable adjustment, although residual confounding may remain. Generalizability may be limited beyond pilot settings, mitigated by inclusion of diverse facilities. Social desirability bias was minimized through confidential interviews with independent data collectors. Prospective cohort studies are necessary to confirm long-term outcomes.

6. Conclusion and Recommendation

The study found high retention in HIV care among AYLHIV, with markedly better outcomes among AYLHIV enrolled in the AY-CDSM model compared with conventional care. By integrating community-based ART refills, peer led psychosocial support, and youth friendly service environments, the AY-CDSM model enhances acceptability, strengthens self-efficacy, and promotes sustained engagement in care. Qualitative evidence further demonstrates strong user acceptability driven by the model's convenience and its peer centered, community anchored design. However, for a minority of participants, the distance from meeting location remained a barrier to joining or continuing in the program. These findings indicate that the AY-CDSM effectively addresses key structural and psychosocial barriers faced by AYLHIV and represents a promising, scalable approach for improving retention and optimizing treatment outcomes in resource-limited settings.

Abbreviations

ART	Anti-retroviral Therapy
AY-CDSDM	Adolescent and Youth Community-Based Differentiated Service Delivery Models
AYLHIV	Adolescents and Young people Living with HIV
CD4	Cluster of Differentiation 4
DSD	Differentiated Service Delivery
FGD	Focus Group Discussion
HIV	Human Immune deficiency Virus
IIT	Interruption In Treatment
KII	Key Informant Interview
LIP	Local implementing partner
PEPFAR	President's Emergency Plan for AIDS Relief
SD	Standard Deviation
SPSS	Statistical Package for the Social Sciences
TFA	Theoretical Framework of Acceptability
TO	Transfer Out
UNAIDS	United Nations Program on HIV/AIDS
WHO	World Health Organization

Declarations

Ethics approval and consent to participate

Ethical approval was obtained from the Ethiopian Public Health Association Institutional Review Board ((Ref. No, EPHA/OG/506/25, Date 29 /7/2025). Participation in qualitative interviews was voluntary, and informed consent was obtained from all participants. For individuals aged <18 years, assent and parental or guardian consent were obtained. Study objectives, procedures, and consent for audio recording were explained prior to data collection.

Confidentiality was ensured by removing all personal identifiers and de-identifying the data prior to analysis. The data were stored in password-protected systems accessible only to authorized personnel. The study was conducted in full compliance with the principles of the Declaration of Helsinki and relevant national guidelines for human research protection, while upholding the ethical principles of autonomy, confidentiality, beneficence, and non-maleficence to safeguard participants' rights and well-being.

Consent for publication

Not applicable

Availability of data and materials

Due to the sensitive nature of programmatic information related to HIV services, the datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Competing Interests

The authors declare no financial, professional, or personal competing interests related to this manuscript and have no affiliations or involvement with any organization that could influence the work reported.

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Authors' contributions

Author 1 was responsible for the conceptualization and design of the study, performed the primary data analysis, drafted the manuscript, and led the overall development and finalization of the paper.

Author 2 provided primary guidance throughout the research, critically reviewed the manuscript at multiple stages, and approved the final version.

Authors 3–16 reviewed the manuscript at multiple stages and improved the content, structure, and clarity of the manuscript, helping to shape its final version. Finally, all authors read and approved the final manuscript.

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Figures

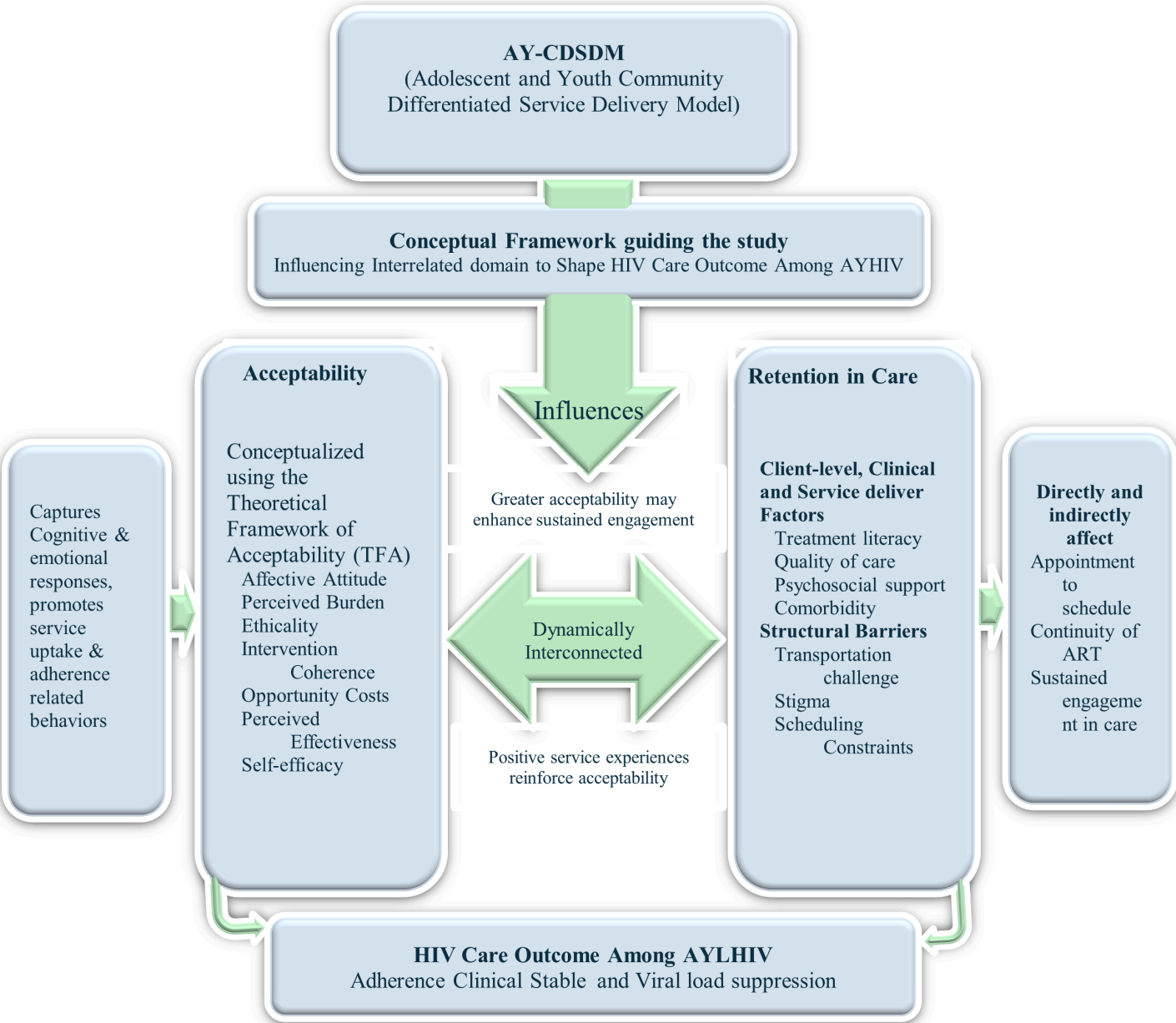


Figure 1
Conceptual framework that determines model effectiveness and health outcome among AYLHIV, in Ethiopia, 2025

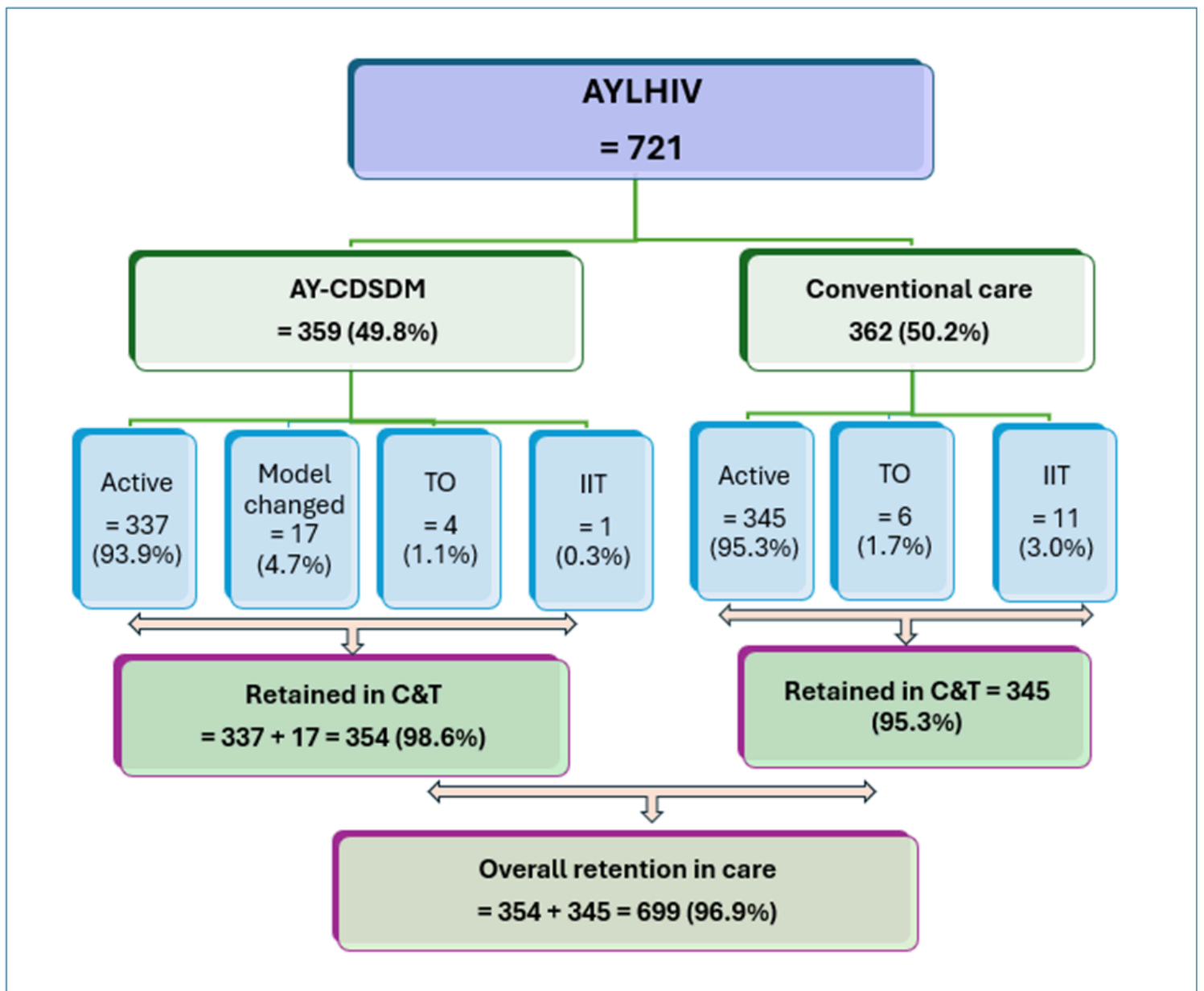


Figure 2

Retention in care of AY-LHIV in the AY-CDSMD and conventional groups, in Ethiopia, 2025

Abbreviation: IIT = Interruption in treatment, TO = Transfer out, Care and treatment = C&T

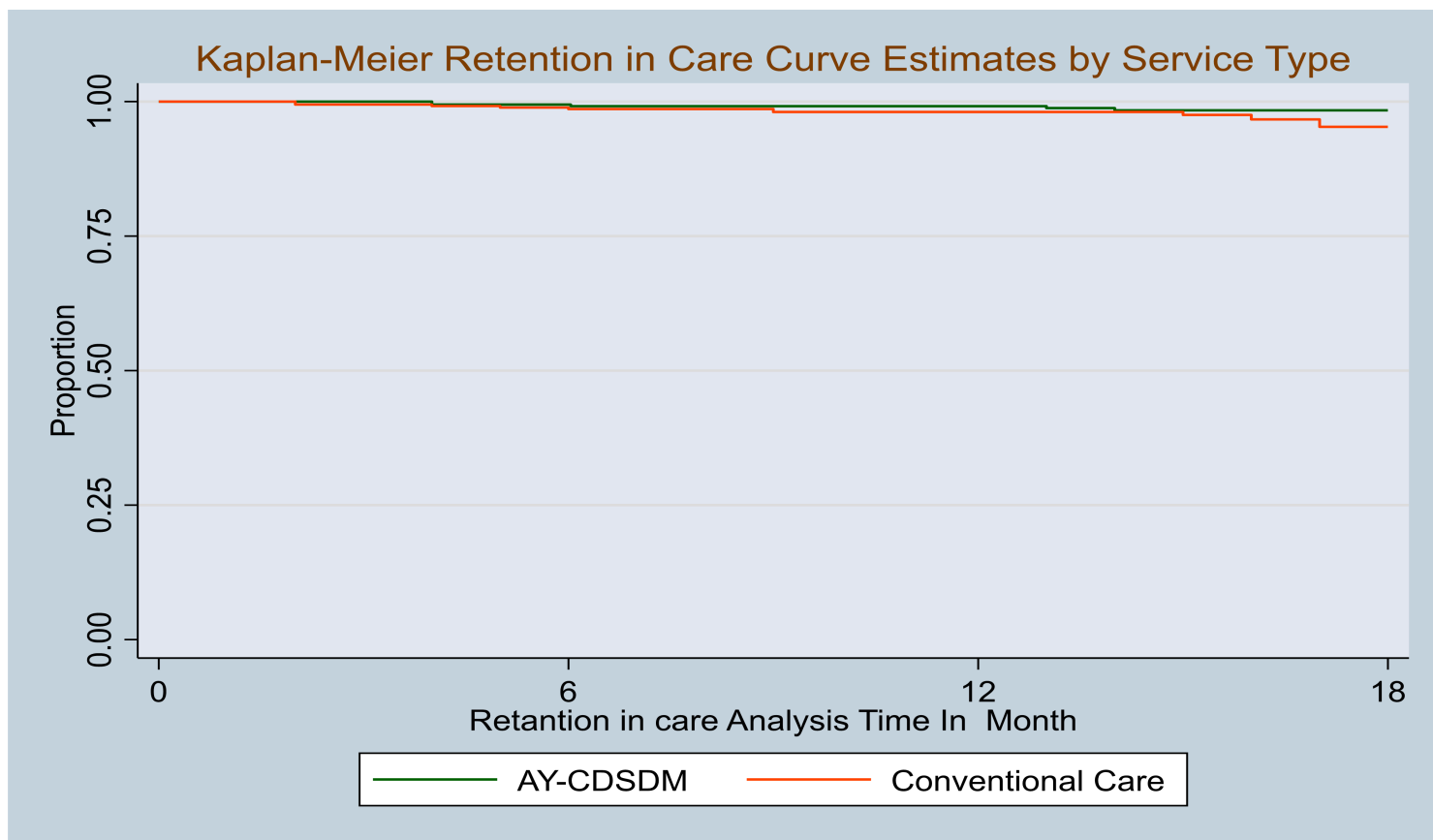


Figure 3

Kaplan-Meier retention curve for AY-CDSDM and Conventional care clients, in Ethiopia.

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- [SupplementaryInformationQuestionnairesforbothQuantitativeandQualitativeAYCDSDMAssessment.docx](#)