Understanding why and how youthfriendly health services improve viral load suppression among adolescents and young people living with HIV in Nigeria: realist evaluation with qualitative comparative analysis

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ABSTRACT

To cite: Badejo O, Nöstlinger C, Wouters E, *et al.* Understanding why and how youth-friendly health services improve viral load suppression among adolescents and young people living with HIV in Nigeria: realist evaluation with qualitative comparative analysis. *BMJ Glob Health* 2023;**8**:e012600. doi:10.1136/ bmjgh-2023-012600

Handling editor Seye Abimbola

 Additional supplemental material is published online only. To view, please visit the journal online (http://dx.doi.org/10. 1136/bmjgh-2023-012600).

Received 17 April 2023 Accepted 4 September 2023



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Correspondence to Dr Okikiolu Badejo; okikolubadejo@gmail.com **Introduction** Youth-friendly health service (YFHS) approaches are essential to better outcomes for young people. We evaluated attainment of viral load suppression among young people living with HIV (YPLHIV) enrolled in an HIV treatment programme implementing YFHS models in Nigeria.

Methods A realist evaluation using qualitative and quantitative programme data from 10 implementing health facilities. We used qualitative information to explore how and why viral load suppression was attained across different settings and quantitative data to describe patterns and associations between youthfriendly structures and processes of care, care retention and viral load suppression. To consolidate the theories, we used qualitative comparative analysis to identify the necessary and sufficient conditions for attaining viral load suppression, using 30 YPLHIV as cases.

Results Between baseline (2018) and study-end (May 2022), viral load suppression coverage increased in 8 of the 10 study facilities. The number of facilities with viral load suppression coverage ≥90% rose from two to seven, while one facility remained unchanged, and another had a decline in coverage. Among the 30 selected YPLHIV cases, 18 had viral load suppression during the first test and 24 at the second test. However, viral load suppression attainment varied in different contexts. We identified the different YFHS interventions and key mechanisms that influenced viral load suppression in different contexts.

Conclusion YFHS interventions can improve young people's engagement with HIV services, but their effectiveness depends on specific mechanisms and contextual factors influencing their response to interventions. By exploring how and why viral load suppression was attained in different contexts, the findings will improve the design and implementation of strategies to improve outcomes in young people, which will be relevant for achievement of global goals to eliminate HIV by 2030.

WHAT IS ALREADY KNOWN ON THIS TOPIC

- ⇒ Youth-friendly health service (YFHS) approaches can support adolescents and young people to achieve better health outcomes.
- ⇒ The rapid explosion in YFHS implementation strategies has come with several challenges, including a lack of consensus in defining, operationalising and evaluating YFHS.
- \Rightarrow This has led to significant knowledge and practice gaps regarding YFHS' most effective strategies and how to scale them up.

WHAT THIS STUDY ADDS

⇒ The findings contribute to a better understanding of YFHS by identifying fundamental mechanisms that explain the effectiveness of different YFHS strategies in different contexts, leading to a simpler and betterorganised knowledge of YFHS.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

- \Rightarrow Study findings can lead to a greater consensus on how YFHS should be defined, implemented and assessed.
- \Rightarrow This can enable YFHS practitioners to identify better, different or additional YFHS strategies that can trigger key mechanisms to achieve better outcomes.
- ⇒ Findings can also enable YFHS practitioners and policy-makers to develop evidence-based and context-appropriate minimum service packages that could help address the needs of young people at scale.

INTRODUCTION

Youth (adolescent) friendly health services (YFHSs) are a promising approach aimed at improving health outcomes in young people (adolescents aged 10–19 years and young

adults aged 15–24 years)¹² in line with the third Sustainable Development Goal of healthy lives and well-being for all.³ Despite these efforts, significant gaps remain in meeting the YFHS' objectives to be accessible, acceptable, equitable, appropriate and effective.¹⁴ Since being formalised by the WHO in 2012, YFHSs have been implemented through a multidisciplinary approach incorporating different care components, including clinical, behavioural, digital and others, into a comprehensive package of person-centred health services.^{5–8} However, challenges remain regarding its definition, implementation and evaluation.⁴⁹

YFHS is a complex intervention that involves multiple actors, including young people and providers, who interact within constantly changing social environments, which can lead to both intended and unintended outcomes.^{5 7 10 11} However, this complexity has not been fully accounted for in much of the existing research on YFHS, which often relies on predictive designs or controlled experiments that assume linearity and predictability. Complementary approaches better suited to uncertainty and generative causality are needed to overcome this limitation. Theory-based approaches such as realist evaluation (RE) are valuable because they connect intervention components, contextual factors and mechanisms to the outcomes produced. They provide a framework to conceptualise and explain the relationships and pathways involved. In this study, we adopted a RE framework, incorporating quantitative and qualitative approaches, to understand how YFHS interventions influenced viral load (VL) outcomes among young people living with HIV (YPLHIV) in Nigeria.

Nigeria provides an appropriate setting because YFHS is being scaled up to improve outcomes among YPLHIV.^{12–17} Although Nigeria's HIV prevalence of 1.4% is at its lowest since 1991,¹⁸ challenges and unmet needs still hinder progress towards achieving the national HIV goals, disproportionately affecting young people. Only 31% of young people aged 15–24 are aware of their HIV status, compared with the national average of 46.9%. While over 90% of known YPLHIV are on antiretroviral therapy (ART), only 31.2% of known YPLHIV aged 20–24 years have VL suppression, lower than the national average of 43.1% in adults 15–64 years.¹⁸

The implementation of YFHS in Nigeria has been slow,¹⁶ ¹⁹ but recent progress has been made to integrate youth-friendly models into routine health services through the National Standards and Minimum Service Package for Adolescent and YFHS.¹⁵ ¹⁷ The guideline provides an up-to-date minimum package of services and quality standards to operationalise youth-friendly services in healthcare settings in Nigeria. The Government of Nigeria, with support from the US President's Emergency Plan for AIDS Relief (PEPFAR), has been scaling up the Operation Triple Zero (OTZ) model of YFHS to address unmet needs for HIV services for young people. OTZ involves young people as active partners by committing to three goals: zero missed appointments, zero missed

medication and zero VL. The scale up of OTZ and other YFHS models is strengthening the policy and practice of YFHS in the country.

METHODS

Intervention description

We conducted this study within a network of PEPFARfunded healthcare facilities using youth-friendly models to deliver HIV services in a large HIV treatment programme managed by APIN Public Health Initiatives Ltd/Gte (APIN). APIN's YFHS models specifically included differentiated service delivery (DSD), which comprised in-facility models like fast-track and multimonth dispensing, as well as out-of-facility models such as adolescent refill clubs, community pharmacy ART refill programmes (CPARPs), community ART refill clubs and community ART refill groups.¹²⁻¹⁴ Moreover, the programme adopted the OTZ peer-support model, which involved linking facilities to community support networks made up of peers, community-based organisations, civil society groups, economic support and legal resources to enhance the integration of YPLHIV into their communities. A detailed description of the programme intervention components is shown in online supplemental table 1, which maps the programme's interventions to the national standards and minimum package for YFHS.¹⁵

Study design: RE with qualitative comparative analysis

This study employed a four-stage RE methodology.^{20 21} RE is a theory-driven approach to understand how, why and under what circumstances outcomes happen. Using RE principles, we developed a programme theory by incorporating prior research, stakeholder insights and programme expertise to outline the intended change processes for the YFHS intervention. Based on context-mechanism-outcome (CMO) configurations, the programme theory outlines patterns and causal chains related to YFHS interventions. We developed this initial programme theory in the first two stages of our study.

In the third stage, we tested the programme theory using a multiple case study of 10 purposively selected health facilities implementing YFHS. We collected quantitative and qualitative data to comprehensively test or refine CMO configurations (CMOc), considering variations in facility profiles and YFHS implementation levels.

In the fourth stage, we used qualitative comparative analysis (QCA) to consolidate findings from the third stage.^{22–24} QCA is an analytical technique within our RE framework that enabled a systematic cross-case analysis of realist context conditions, mechanisms and outcomes. This allowed us to identify the necessary and sufficient conditions while maintaining the generative perspective of CMOc from a realist sense.^{23 25} The cases in the QCA included purposively selected YPLHIV who were enrolled in treatment at the 10 healthcare facilities mentioned earlier. Figure 1 presents the overall study design, which involves a four-stage process described in detail below.



Figure 1 Study design and stages. ANOVA, analysis of variance; CMO, context–mechanism–outcome; CMOc, CMO configurations; IPT, initial program theory. Adapted from Gilmore et al³²

Stage1: theory of change

Using the APIN programme's intervention logic model, we developed a theory of change (ToC). We developed the ToC through meetings with relevant APIN programme coordinators at the national and state levels, during which relevant programme and national policy guidance documents were jointly reviewed. The process also drew on OB's experience from programming and research coordination roles in PEPFAR HIV programmes in Nigeria. Figure 2 summarises the ToC with the different programme elements and pathways to outcomes. However, although the ToC provided a framework to develop theory, it only focused on tangible interventions and could not explain the programme outcomes regarding latent, generative mechanisms of realist theories. To address this limitation, it was essential to refine the ToC.

Stage 2: initial programme theory

In this stage, we expanded our ToC by adding specific mechanisms that could influence the outcomes, using the concept of 'mechanism spaces'²⁶ which refer to areas within a ToC where various causal mechanisms are

thought to function. This is a practical way to combine ToC with RE approaches.^{26 27} We identified mechanisms by reviewing the literature on realist and systematic reviews of interventions to improve adherence and VL suppression in YPLHIV.⁵ We then incorporated candidate mechanisms into the ToC to generate a preliminary initial programme theory which included all the essential elements of a realist theory, including the context, interventions, mechanisms and outcomes. We summarise this preliminary initial program theory (IPT) in figure 3.

Stage 3: testing the preliminary IPT

In this stage, we employed a multiple case study²⁸ approach to test the preliminary IPT from the previous stage, using a mixed-methods approach that involved both qualitative and quantitative methods.^{20 21} The steps we followed in this process are described below.

Case selection

We purposively selected 10 health facilities in Benue State, Nigeria, from the APIN-supported secondary and tertiary facilities network. The selection was based on Primary

Tertiary

Public

profit

linkages



C2: Local community: Stigma, resource limitation, lack of support resources, harmful social or gender norms,

Figure 3 Preliminary initial programme theory. PHC, primary healthcare centre. Adapted from Ibilove et al ⁵⁷

Participant recruitment

YPLHIV were recruited through their care providers, who introduced the study to caregivers of YPLHIV under 18 years of age and directly to older YPLHIV during clinic days or facility-based OTZ peer-group meetings. Eligible participants needed to have received full HIV status disclosure, be on treatment for at least 12 months, and have had at least two VL test results at least 1 year apart. Healthcare providers were identified by contacting the hospital administrator or designated adolescent/youth focal person of each health facility and had to have at least 6 months of experience in HIV service delivery. Facility managers or HIV programme managers were approached for survey administration.

Data collection

We conducted semistructured interviews with selected YPLHIV, their caregivers and service providers within each facility to gain insight into their perspectives and experiences related to various aspects of care. We interviewed one healthcare provider and two young person per facility (total of 30 interviews) using interview guides developed based on our emerging understanding of the CMOs from the previous stage. Interviews were conducted in private rooms within health facilities, ensuring confidentiality and high-quality audio recording. Participants provided written informed consent/assent, and parental consent was obtained for YPLHIV aged 10–17 years. Transcripts were pseudonymised to protect privacy.

Quantitative data collection focused on two main areas: (1) availability of youth-friendly structures and processes in each facility and (2) facility-level outcome data on retention in care and VL suppression. We developed a scored facility assessment tool based on the nine standards of the National Minimum Service Package for Adolescent and YFHS. The tool assessed various domains of facility-level youth-friendly structures and processes. We pilot tested it with programme managers and coordinators, incorporating their feedback and initial results to make modifications. Additionally, we abstracted VL and clinic appointment data, including records of peersupport group monthly attendance. Survey data were transferred from paper copies to electronic forms in a password-protected storage device.

Analysis

In this stage, we followed an exploratory sequential approach to data analysis.³¹ We used qualitative data to explore how and why YPLHIV achieved VL suppression under different circumstances. We used quantitative data to describe patterns and associations between care structures/processes, adherence and VL suppression, guided by the qualitative findings. Triangulating both data sources, we used Excel software for qualitative data coding and analysis, using inductive and deductive techniques to explore previously identified CMOs and emerging new themes. Two investigators (OB and CN) performed initial coding. CMOc were first explored

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within each health facility (and cluster), then synthesised into a more generalisable programme theory. To do this, we created a table with headers for each CMO element, noting instances observed in transcripts with supporting evidence (quotes or data). Retroductive logic was used to identify causal relationships in each table through CMOc.³² CMOcs in each cluster were refined or combined based on similarities and differences. For example, if two within-cluster transcripts (YPLHIV1 and YPLHIV2) had the same CMOc 'A+B=C', we combined them into one CMOc with two data sources (YPLHIV1 and YLPHIV2). Emerging patterns across clusters were synthesised into the refined initial programme theory (IPT).

Quantitative facility assessment data were exported from Excel to Stata V.17 for data cleaning and analysis. Summary measures of interest were calculated based on emerging CMOs for retention in care and VL suppression, guided by qualitative themes. Pearson correlation was used to analyse associations between youth-friendly structures, processes and outcomes, exploring interfacility variations.

The authorship group reviewed, revised and agreed on the CMOc and initial programme theory (IPT) based on coded qualitative and quantitative data summaries.

Stage 4: consolidating the IPT

Next, we used QCA to consolidate the IPT to identify the necessary and sufficient combinations of context conditions, mechanisms and outcomes that might explain attainment and variation in the attainment of outcomes.³³ We used the QCA technique to focus our theories on the key or most plausible causal conditions and explanations while maintaining RE's complex notions of causality and a holistic, generative perspective. Using QCA this way enabled us to extend the empirical support of realist theory in a controlled manner by transferring ideas from a few cases to several cases.^{22–24}

We conducted another round of interviews with 30 newly and purposively recruited YPLHIV from the previous 10 health facilities, using the same recruitment strategy and study procedure from the previous stage. YPLHIV, who required their parents'/caregivers' consent to complete questionnaires, were excluded to ensure data accurately reflected the perspectives and experiences of young people themselves. The QCA procedures we followed are described below.

Data collection

Interview guides were modified from the previous stage to reflect the evolving understanding of the theoretical proposition. We also administered standardised questionnaires, including the Situational Motivation Scale (SIMS),³⁴ to understand YPLHIVs' motivation for adherence behaviour^{35 36} Berger's HIV stigma questionnaire,³⁷ HIV treatment self-efficacy assessment tool (HIV-ASES),³⁸ the Assessment of Capacity to Consent to Treatment (ACCT) questionnaire and WHO's guidance document on assessing adolescents' autonomous decision-making in healthcare settings.^{39 40} Participants' VL results were retrieved from medical records.

Operationalisation and calibration of conditions

We used the Generic Membership Evaluation Template to transform qualitative data into numerical values following an indirect calibration method.⁴¹ Anchors were applied to each condition to determine a case's membership level in that condition, ranging from binary or crisp sets (eg, present/absent) to multilevel or fuzzy sets. For instance, a four-value fuzzy used the following anchors: 1 (fully present), 0.67 (more present than absent), 0.33 (more absent than present) and 0 (fully absent). Membership levels in conditions were determined by assessing the intensity and positive/negative valence of participant responses to predetermined dimensions of that condition. More details about the calibration strategy for qualitative data can be found in online supplemental material.

For data from standardised questionnaires, specific procedures were employed. For example, the ACCT questionnaire assessed decision-making capacity for HIV treatment, evaluating four abilities: understanding, appreciation, reasoning and expressing a choice. Adequate decision-making capacity was determined if a participant scored higher than 2 SD below the group mean in each ability, which we calibrated using crisp-set 0 (inadequate) and 1 (adequate). HIV-ASES questionnaire assessed self-efficacy, considering it adequate if the participant scored higher than the median group value, calibrated using crisp-set 0 (no self-efficacy).

The two conditions (decision-making capacity and HIV treatment self-efficacy) were combined into a super condition known as 'agency' during analysis, representing the 'personal ability to act and make free and informed choices to pursue a specific goal'.⁴² The Berger HIV stigma scale assessed self-perceived HIV-related stigma and was calibrated using a three-value fuzzy set: 1 (severe stigma, score 81-120), 0.51 (mid-level stigma, score 81-120) and 0 (low/no stigma, score 40-80). Lastly, questions from the SIMS questionnaire were adapted to evaluate intrinsic and extrinsic motivation dimensions related to HIV adherence behaviour. Scores for each type of motivation were averaged and calibrated using a three-value fuzzy set: 0 (average score 1-3, no internal/ external motivation), 0.51 (average score 4-5, moderate internal/external motivation) and 1 (average score 6-7, high internal/external motivation).

All facility-level data collection (including the third stage) occurred from October 2020 to May 2022.

Operationalisation and calibration of outcome

VL results were collected at two time points: one near the YFHS programme's start in 2018 and the other at the study's end in May 2022. We considered a YPLHIV to have the outcome if they achieved viral suppression (less than 1000 copies/mL, per national protocol)⁴³ at the second time point, regardless of their status at the

first time point. This was calibrated using crisp-set 1 (outcome) and 0 (no outcome).

We used established techniques⁴² to simplify the analysis to reduce the list of potential causal conditions from earlier synthesised CMOcs. This involved removing conditions that lacked variation across cases and those correlating with other conditions, removing conditions with low necessity scores (≤ 0.40), indicating less importance for the outcome, and combining related conditions into super conditions. This reduction minimised the challenge of limited diversity, where some combinations of conditions lacked empirical cases.⁴⁴

Constructing and analysing the truth table

We created a Truth table in Excel with calibrated values for all conditions per case. The table was then imported into the fuzzy-set QCA software (fsQCA).⁴⁵ The output provided the necessity and sufficiency of each condition. A condition is considered necessary if it must be present for the outcome to occur. In our analysis, we set a necessity threshold of 0.9, meaning the condition must be present in at least 90% of instances when the outcome occurred. A condition is sufficient if it can produce the outcome on its own. We assessed sufficiency using consistency scores, indicating the frequency at which a condition or combination of conditions led to the outcome. A minimum consistency score of 0.8 is typically considered sufficient.⁴⁵

Patient involvement statement

YPLHIV supported participant recruitment into the study through the OTZ peer-support group and their contacts. The OTZ peer-support group lead in one of the study facilities made valuable inputs and suggested modifications to the interview guides during the pilot of data collection instruments. He is listed in the acknowl-edgement.

Reporting

We followed the recommended reporting guidelines for realist evaluation (RAMESES II) and qualitative (Consolidated Criteria for Reporting Qualitative Research) studies.^{46 47}

RESULTS

Figures 2 and 3 show the summary of ToC (stage 1) and preliminary IPT (stage 2). Here, we present stages 3 and 4 results, where we refined and consolidated the preliminary IPT.

Participant characteristics

In the third stage, we recruited 34 participants across the 10 health facilities, comprising 7 adolescent programme coordinators, 6 care providers (doctors or nurses) and 20 YPLHIV or their caregivers. In the fourth stage, we recruited 30 YPLHIV, 18 had VL suppression at baseline and 24 at the second VL result. Participant characteristics are shown in table 1.

	er viewees/respondents r	by Study Stuges				
Stage 3 (n=34)			Stage 4 (n=3	0)		
Level of facility	Type of facility (n=10)	Respondents	Age		Sex	
Tertiary	Public (1)	Programme	15–19 years	16 (53%)	Female	16 (53%)
	coordinator(1), 20–24 years doctor/nurse (1) YPLHIV (2)		20–24 years	14 (47%)	Male	14 (47%)
Programme coordinator (5),	Public (7)	Secondary	Self-reported mode of HIV		15–19 years	16 (53%) 14 (47%) 20–24 years 1 (7%) 6 (43%) 0 4 (29%) 3 (21%)
care doctor, nurse,			transmission	Blood transfusion	years years 2 (13%) 1 (7%) 0 6 (43%) 2 (13%) 0	
worker) (3)			by age group	Heterosexual transmission		
YPLHIV (14)				Intravenous injection	2 (13%)	0
				Perinatal transmission	9 (56%)	16 (53%) 14 (47%) 20–24 years 1 (7%) 6 (43%) 0 4 (29%) 3 (21%)
				Unknown	3 (19%)	3 (21%)
Community health worker/adherence counsellors (2) YPLHIV(2)	Private for-profit (1)		No with viral load suppression	The first test (baseline)	18	
Private not-for- profit(1)	Nurse (1), community health worker(1) YPLHIV (2)			The second test (follow-up)	24	
YPLHIV, young people	e living with HIV.					

Table 1 List of interviewees/respondents by study stage

Key outcome: VL suppression

For stage 3, whereas only two facilities were at performance cluster C (viral suppression coverage $\geq 90\%$) at baseline, seven facilities were in this cluster after over 1 year, including the two that were at performance cluster A (viral suppression coverage <75%) and five others that were at performance cluster B (viral suppression coverage 75%–89%). See table 2 for more details on the profiles of the 10 facilities. Most facilities increased VL suppression coverage except two (F6 and F10), with F6 unchanged and F10 reduced. In stage four, whereas 18 of the 30 recruited YPLHIV had VL suppression at the first VL test, 24 YPLHIV had VL at the second. See table 1 for other characteristics of YPLHIV recruited in stage 4.

How and why did YPLHIV attain VL suppression within youth friendly services?

Cooperative engagement

This configuration posits that in the context of high stigma, low privacy and confidentiality(C), retention in care and viral suppression (O) improves with better implementation of tailored/differentiated services (I) through less stigmatising care channels that improve cooperative engagements (M) between young people and their providers to address adherence barriers.

Interview participants reported relatively high levels of community-level HIV stigma despite stigma reduction interventions, sometimes fuelled by breaches in privacy and confidentiality within health facilities. They described how introducing flexible/differentiated services provided YPLHIV with non-stigmatising channels to access services, which has improved engagement and cooperation between YPLHIV and care providers.

Ok, I must confess that we have really softened care provision for them in this facility, we have really made it easy for quite a lot of them [...] now waiting time has been seriously reduced by the fact that you do not have to queue to see the doctors; [...] adolescents only come pick drugs twice a year because we have case managers or community-groups who can deliver their drugs at home, [...] unless you have been identified as non-adherent or your viral load has not been suppressed. Now confidentiality breaches and stigma are very very down the ladder in this facility; they (young people) now see us (care providers) as family, but we are still a work in progress... (HCP 1, F5)

Quantitative analysis of facility assessment scores supported these qualitative observations. We analysed the relationship between retention rates, availability of flexible/differentiated care and levels of privacyconfidentiality in the 10 facilities. Overall, we found no correlation between retention rates and availability of differentiated services (r=0.03; p=0.23) across the 10 facilities regardless of privacy-confidentiality levels. However, a strong positive correlation was found between retention rates and availability of differentiated services (r=0.89; p=0.04) in the subgroup of six facilities where differentiated services were low or moderately available, largely mediated by privacy and confidentiality level. In contrast, the remaining four facilities, where differentiated services were fully implemented or available, with high privacy-confidentiality levels, showed a weak correlation between retention rates and differentiated services

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Table 2	Profiles of study I	healthcare facilities								
Code	Performance cluster (baseline)	Performance cluster (follow- up)	Rural/ urban	Level of care	Type of outlet	Ownership type	YPLHIV enrolled (baseline)	YPLHIV enrolled (follow-up)	Viral Ioad suppression coverage (baseline)	Viral load suppression coverage (follow-up)
F5	A	C	Urban	Tertiary	Specialist setting	Public	624	614	73%	91%
F2	A	O	Rural	Secondary	Generalist setting	Private for- profit	85	87	65%	97%
F4	В	O	Urban	Secondary	Generalist setting	Public	141	143	89%	92%
F9	В	в	Urban	Secondary	Generalist setting	Public	298	282	86%	87%
F7	В	O	Urban	Secondary	Generalist setting	Private not for profit	359	345	88%	%06
Ē	В	O	Rural	Secondary	Generalist setting	Public	223	221	84%	97%
F8	В	в	Rural	Secondary	Generalist setting	Private for- profit	50	58	86%	89%
F3	O	O	Urban	Secondary	Generalist setting	Public	88	67	%06	95%
F10	В	в	Rural	Secondary	Generalist setting	Private not for profit	118	113	87%	84%
F6	O	U	Rural	Secondary	Generalist setting	Public	199	201	%06	%06
Performe YPLHIV, y	ance cluster by viral lo young people living w	ad suppression cover ith HIV.	rage: cluster	A=<75%, cluster E	3=75%-89%, clı	uster C=90%-100%				





(r=0.48; p=0.10). In alignment with the configuration, these quantitative findings indicate that even small improvements in differentiated service availability (I) can significantly enhance cooperative engagement (M) and improve retention (O) in facilities with privacy and confidentiality challenges (C). The finding is illustrated in figure 4.

Extrinsic motivation

This configuration posits that in areas with limited resources (C), financial and material support (I) linked to care is important to motivate (M) socioeconomically disadvantaged YPLHIV to remain in care (O) through positive reinforcement, which can lead to the attainment of VL suppression (O)

Participants reported that positive adherence behaviour change among YPLHIV required consistent external motivation (eg, financial, material support or linkage to vocational work) to overcome structural barriers to care. Some providers recalled specific examples where adherence behaviour and retention improved when the provision or continuation of tangible incentives became conditional on adherence milestones, such as completed quarterly clinic attendance, 6 or 12 monthly VL testing, and attending all treatment adherence sessions.

For adherence support? Like now this support group that they are doing for us is helping us, especially we girls [...] they help us with money [...] to take care of ourselves so that we will not go to boys to beg money or go around following boys. Since this support started, they used to encourage us to stay away from sex or be conscious about the type of people we stay with (have sex). This support group has helped my life; now I have stopped all those behaviours that I used to do to harm myself. (YPLHIV 3, F7)

Our facility assessment showed that all facilities provided incentives. However, there were reported shortages and inconsistencies in the availability of resources. Additionally, the extent to which available resources could fulfil the needs of enrolled YPLHIV varied across the different facilities.

We analysed how facility-level changes in VL suppression coverage were associated with the coverage of incentives for YPLHIV facing socioeconomic disadvantages, with lack of education used as a proxy indicator. The results showed a strong association between changes in VL suppression coverage and the proportion of enrolled YPLHIV with no education (r=-0.84, p=0.03). Facilities with a lower proportion of enrolled YPLHIV with no education, and therefore, more likely to have better incentive coverage, exhibited a significant increase in VL suppression coverage. On the other hand, facilities with higher proportions of YPLHIV without education, and thus less likely to achieve better incentive coverage, showed comparatively smaller improvements in VL suppression, as shown in table 3. This finding supports the theory that external motivation through incentives is important in overcoming adherence-related barriers to VL suppression.

Agency and enhanced self-efficacy

This configuration posits that when health workers support YPLHIV to provide treatment support to each other through problem-solving and role-modelling (I), more YPLHIV with multiple support needs (C) will enhance their treatment self-efficacy (M) and adopt positive adherence behaviour that leads to improved VL suppression (O).

Participants gave specific instances where role modelling by influential YPLHIV within peer networks has increased the adoption of positive adherence behaviour by other YPLHIV. The peer-support groups emphasise self-managed care, allowing young individuals to define treatment goals, develop strategies, and be accountable for their care. Examples were also provided where peersupport networks increased YPLHIV participation and advocacy.

... and also, in the OTZ group [...] though, I am not too good about Facebook and all these social media, but then, I do see all those things posted [...] sometimes they advise little adolescents on how to take their medication,

10

21

40

50

60

N/A

N/A

N/A

N/A

Table 3 education

F2

F5

F1

F10

F8

F4

F7

F9

F6

F3

Facility code

Change in viral load

+32%

+18%

+12%

- 4%

+3%

+2%

+2%

+1%

+5%

0

suppression coverage

Proportion of enrolled Viral load suppression Viral load suppression YPLHIV who have no coverage at baseline coverage at follow-up education (%) (%) (%) 97 65 73 91 85 97 88 84 86 89 90 92 88 90 86 87 90 90 90 95 N/A: education records not available. YPLHIV, young people living with HIV. concerning sex education, or maybe HIV information, so Empowerment like that I got educated. And now I know how I can manage myself, to deal with stigma and HIV disclosure ... (YPLHIV

Facility-level changes in viral load suppression coverage by proportion of treatment enrolled YPLHIV with no

2, F3) However, our quantitative facility assessment showed a weak association between facility-level participation in peer network (OTZ) and changes in VL suppression coverage(r=0.18; p=0.61). While most facilities reported increased VL suppression coverage, there was no significant increase in OTZ participation month-on-month. Moreover, the VL suppression coverage increase was not associated with the average monthly attendance proportion among enrolled YPLHIV in OTZ, as shown in figure 5. This suggests that while OTZ might play a role in achieving VL suppression, it may not be essential, as other factors likely contributed significantly to the

observed improvements in VL suppression rates.

YPLHIV who have specific individual needs can be encouraged to seek and continue medical treatment if healthcare services help them to take control of their health and improve their self-management skills. Though this empowerment, YPLHIV will feel more confident in managing their health, leading to better adherence to treatment and suppression of the VL.

We do contact tracing, like, for example, this boy in school whom I talk to on the phone, I told him to get a diary and "tick everything as you take your drugs and send the diary to me on the phone" [...]" After a while, he was able to monitor himself without even my supervision. IDI healthcare provider (HCP005)

Participants highlighted the effectiveness of supporting YPLHIV in developing personalised adherence strategies





tailored to their specific barriers, encouraging YPLHIV to work proactively towards improved adherence behaviour. Putting YPLHIV in control of their care proved to be a more effective approach to promoting behaviour change. Initially, health workers provided the necessary knowledge and skills for self-monitoring and reinforced the skills through supportive supervision.

Refined programme theory

After combining the four CMOcs, we formulated the refined initial programme theory: 'YPLHIV are more likely to adhere to treatment and achieve VL suppression if they are motivated by intrinsic or extrinsic factors. Extrinsic motivation can be provided by linking financial and material support to clinical care for socioeconomically disadvantaged YPLHIV, reinforcing positive treatment behaviours. Intrinsic motivation can be achieved by offering care services that address individual needs, are tailored to YPLHIV preferences or are driven by peers. This will lead to increased self-efficacy, sense of control, agency and trust, which can help YPLHIV overcome barriers to adherence and VL suppression'.

What are the necessary and sufficient conditions for attaining VL suppression?

We synthesised the following final list of eight conditions from our refined IPT: (1) stigma, (2) respectful care, (3) privacy-confidentiality, (4) peer support, (5) material support, (6) differentiated services, (7) agency and (8) extrinsic motivation. We categorised stigma, respectful care and privacy-confidentiality as context conditions; peer support, material support and differentiated services as interventions; and agency and extrinsic motivation as mechanisms.

Pathways to viral suppression

Using fsQCA, we identified privacy and confidentiality as necessary conditions and four distinct sufficient combinations of conditions or pathways to VL suppression. We obtained a solution consistency of 0.81 and coverage of 0.36, indicating that these pathways consistently lead to VL suppression in cases where they occur and jointly explain 36% of all observed cases of VL suppression. These pathways are shown in table 4 and described below.

Pathway 1 showed attainment of VL suppression in the absence of respectful care and the presence of stigma, financial/material support, participation in a peer network and utilisation of differentiated services with privacy-confidentiality and a high level of Agency. Pathway 2 showed VL suppression in the presence of respectful care, privacy-confidentiality, financial/material support, participation in a peer network, high extrinsic motivation and absence of agency. Pathway 3 showed attainment of VL suppression in the presence of respectful care, privacy-confidentiality, financial/material support, utilisation of differentiated services with high extrinsic motivation and agency. Pathway 4 showed attainment of VL suppression in the presence of respectful care, financial/material support, participation in peer networks, utilisation of differentiated services with high extrinsic motivation and agency.

Pathways to viral non-suppression

We also identified three pathways that led to viral nonsuppression among YPLHIV: Pathway 1 shows VL nonsuppression without differentiated service utilisation and peer networks participation. Pathway 2 shows VL non-suppression in the absence of stigma and utilisation of differentiated care services. Pathway 3 shows VL

Table 4 fsQCA ar	alysis showing pathways to viral suppr	ession and viral nor	n-supp	ression					
			Viral	suppre	ession		Viral supp	non- ressio	n
Conditions		Necessity score	1	2	3	4	1	2	3
Context condition	Stigma	0.78	•					\oplus	•
	Confidentiality and privacy	0.90	•	•	•				
	Respectful care	0.67	\oplus	•	•	•			•
Intervention	Material support integrated into care	0.69	•	•	•	•			
	Differentiated care	0.46	•		•	•	\oplus	\oplus	
	Peer-support network	0.55	•	•		•	\oplus		
Mechanism	Extrinsic motivation	0.82		•	•	•			\oplus
	Agency	0.86	•	\oplus	•	•			
Unique coverage			0.03	0.06	0.04	0	0.17	0.02	0.15
Raw coverage			0.13	0.10	0.28	0.23	0.45	0.22	0.33
Overall solution co	nsistency		0.81				0.46		
Overall solution co	verage		0.36				0.62		

•, Condition is present; \oplus , Condition is absent; empty cells=condition is not relevant to pathway.

Table 5 Analytical process of IPT consolidation using QCA

Theory consolidation using QCA

Programme theory

YPLHIV are more likely to adhere to treatment and achieve viral load suppression if they are motivated by intrinsic or extrinsic factors. Extrinsic motivation can be provided by linking financial and material support to clinical care for socioeconomically disadvantaged YPLHIV, reinforcing positive treatment behaviour. Intrinsic motivation can be achieved by offering care services that address individual needs, are tailored to YPLHIV preferences or are provided by peers. This will lead to increased self-efficacy, sense of control, agency and trust, which can help YPLHIV overcome barriers to adherence and viral load suppression.

Pathways (CMOs) generated after QCA analysis

Pathways (GMOS) generated after QC	JA analysis		
Pathway 1	Pathway 2	Pathway 3	Pathway 4
YPLHIV achieved viral suppression in the context of high stigma and disrespectful care, were also materially supported, belonged to a peer network, and used differentiated services. They were satisfied with care privacy- confidentiality and had high levels of agency	YPLHIV achieved viral suppression in the context of respectful care, confidentiality and privacy, were also materially supported and part of a peer network. Extrinsically motivated with low levels of agency.	YPLHIV achieved viral suppression in the context of respectful care, confidentiality and privacy, materially supported and used differentiated services. Extrinsically motivated and had high levels of agency.	YPLHIV achieved viral suppression in the context of respectful care, were materially supported, belonged to peer networks, and used differentiated services. Extrinsically motivated and had high levels of agency.
Ļ		-	Ļ
Refined programme theories			
YPLHIV face challenges staying in care due to stigma in their community and poor treatment at healthcare facilities. But, being part of peer networks and having access to confidential and differentiated services empowers YPLHIV and helps them overcome obstacles to treatment adherence, leading to successful viral suppression	When YPLHIV receive respect privacy confidentiality at heal more likely to stick to their tre- viral suppression. This can be extrinsic motivators, such as motivators, such as being para access to confidential healtho	tful treatment and have thcare facilities, they are eatment plan and achieve e achieved through both material support and intrinsic rt of a peer network or having care services.	When YPLHIV receive respectful care and material support at healthcare facilities, their chances of achieving viral suppression are increased by both intrinsic and extrinsic motivation. This can be achieved by using confidential healthcare services and being part of a peer network.

Programme theory

Health services/facilities that provide respectful care are more likely to improve viral suppression in YPLHIV; because when YPLHIV feel respected, they may be (more) motivated intrinsically (through agency-enhancing interventions) or extrinsically (through material incentives) to address and overcome adherence barriers to achieve viral suppression. Health facilities that provide agency-enhancing interventions can intrinsically motivate YPLHIVs in high-stigma and disrespectful care settings to address adherence barriers and achieve viral load suppression.

CMO, context-mechanism-outcome; IPT, initial program theory; QCA, qualitative comparative analysis; YPLHIV, young people living with HIV.

non-suppression in the presence of stigma, and respectful care, with the absence of extrinsic motivation. This is illustrated in table 4.

Table 5 illustrates the analytical process used to consolidate the initial programme theory (IPT) based on the four pathways to viral suppression. The refined IPT states that:

Health services/facilities that provide respectful care are more likely to improve viral suppression in YPLHIV; when YPLHIV feel respected, they may be (more) motivated intrinsically (through agency-enhancing interventions) or extrinsically (through material incentives) to address and overcome adherence barriers to achieve viral suppression. Health facilities providing agencyenhancing interventions can intrinsically motivate YPLHIVs in high-stigma and disrespectful care settings to address adherence barriers and suppress VL.

DISCUSSION

Our study combined RE and QCA to identify and test conditions configurations that explain how and why YPLHIV achieve viral suppression within a youth-friendly programme delivering HIV services. We found that services granting the condition of privacy-confidentiality, while necessary, are not sufficient to achieve viral suppression in YPLHIV. To achieve viral suppression, privacyconfidentiality must be present with seven other conditions: differentiated care services, material support, peer network support, respectful care, agency and extrinsic motivation. These conditions, when combined, can lead to viral suppression through four different pathways, which reflect variations in context conditions, utilisation patterns and motivation processes in YPLHIV.

The first pathway (pathway 1) found that YPLHIV in non-conducive settings (high stigma and disrespectful care) who achieved VL suppression used all available intrinsic and extrinsic motivation-based interventions. However, only interventions based on intrinsic motivation (peer support and differentiated services) could trigger the corresponding mechanism (agency), which led to viral suppression. This implies that while YPLHIV in non-supportive settings might still use interventions based on extrinsic motivation, these interventions are not likely to be adequate to achieve viral suppression. On the other hand, intrinsic motivation-based interventions were effective on their own in achieving viral suppression. This finding supports previous research that shows improved viral suppression in YPLHIV through peer-support and DSD.^{48 49} By allowing YPLHIV to set their own treatment goals and make their plans, the programme's peer-support network empowers YPLHIV by building a sense of agency to motivate them towards better adherence behaviour. By offering flexible care and drug delivery options, differentiated HIV services build agency by putting YPLHIV in charge of their care. The combination of peer support and differentiated services means that intrinsic motivation can diffuse within YPLHIV groups from mentor YPLHIV to others. This may explain why peer-supported DSD models in low-income and middle-income settings have produced superior⁴⁸ HIV viral suppression outcomes compared with standard clinic care.

Pathways 2 and 3 also demonstrate that YPLHIV in conducive environments who achieved VL suppression used intrinsic and some extrinsic motivation-based interventions. In pathway 2, both intervention types activated their corresponding mechanisms (agency and external motivation) when the intrinsic motivation-based intervention was differentiated care. However, in pathway 3, only extrinsic motivation-based intervention (material support) activated the corresponding mechanism (extrinsic motivation) when the used intrinsic motivationbased intervention was a peer-support network. Both pathways suggest that YPLHIV in conducive settings use a combination of extrinsic and intrinsic motivation-based interventions. While not all intrinsic motivation-based interventions are effective, the effective ones (such as differentiated services) must be complemented with extrinsic motivation-based interventions to achieve VL suppression, whereas extrinsic motivation-based interventions can be effective independently.

Pathway 4 shows that YPLHIV achieved viral suppression in a setting of respectful care, were materially supported, belonged to peer networks and used differentiated services. They were also extrinsically motivated and had high levels of agency. This suggests that in conducive environments, some YPLHIV will use intrinsic and extrinsic motivation-based interventions, and both types can be jointly effective in achieving VL suppression.

Taken together, our findings suggest that while YPLHIV who achieved VL suppression, used both intrinsic and extrinsic motivation-based interventions, the effectiveness of interventions varied with context conditions. The more non-conducive the environment, the more important individual agency becomes in achieving VL suppression, suggesting that agency is a key factor determining the health outcomes of young people in unconducive environments. Importantly, it suggests that while unfavourable settings can present challenges, HIV services that build agency can support young people to develop an adequate level of agency to withstand an unsupportive environment to achieve better outcomes. Similar results have been found in many other studies from 60 countries that focus on sexual and reproductive health and HIV/ AIDS programmes.^{50–53} These studies emphasise the importance of incorporating agency building into health programmes to enhance health outcomes, especially in environments where harmful norms and gender restrictions limit agency, particularly among women and young people.54

However, while promoting agency in health services is important, it should not be a substitute for broader efforts to improve the overall environment for young people, such as stigma reduction and improving privacy and confidentiality. Our findings prove that viral suppression can occur even when agency is not important (pathway 2) or less essential (pathways 3 and 4). Thus, providing support in a conducive environment can still lead to good health outcomes for young people lacking agency. Another implication of our findings is that, despite their high likelihood of being used, extrinsic motivation factors such as material support may not be effective in non-conducive settings with entrenched structural barriers, like stigma, discrimination or non-respectful care. This unsustainable approach can create perverse incentives or undermine intrinsic motivation.^{34 55} Extrinsic incentives can be a helpful component of a comprehensive programme that considers the various individual, social and structural factors that influence behaviour.⁵⁵

Implications and reflections for youth-friendly service practice and research

Our findings on the necessary and sufficient conditions can form the basis for developing or revising minimum care packages for better reach and effectiveness. However, we have shown that these conditions may differ based on the context conditions. YFHS researchers and practitioners should use available guidance⁵⁶ to assess their intervention contexts to determine the appropriate

minimum conditions for a high-impact, sustainable minimum care package. Such context-specific packages can appeal to policymakers, making them easier to adopt, as in Zimbabwe and other African countries.⁴⁸ Additionally, context-specific packages will help build a more context-appropriate evidence base for YFHS, making it more relevant and valuable.⁵⁶

Our study makes a methodological contribution as an example of how QCA can be used within a RE as a theorybased method to gain a deeper understanding of how YFHS programmes work, which differs from the more common evaluation approaches that rely on positivist or probabilistic methods. When dealing with large-N studies like ours, analysing and synthesising numerous CMOs in developing or refining a programme theory can become unwieldy. QCA provides additional value by allowing RE to focus on the key or most plausible causal conditions and explanations while maintaining RE's complex notions of causality and a holistic, generative perspective. Using QCA this way enabled us to extend the empirical support of realist theory in a controlled manner by transfer of ideas from a few cases to several cases.²³ In addition, our approach allowed the triangulation of quantitative and qualitative findings to strengthen the robustness of our evaluation further.^{20 21}

Our study has limitations. One challenge was determining whether documented missed clinic appointments were due to patient behaviour or service delivery issues, particularly during the peak period of the COVID-19 epidemic included in our analysis. Although we triangulated multiple data sources to address this, we cannot completely rule out errors in our estimates and interpretations. Second, it was not possible to assess adherence directly. We used viral outcomes as a proxy for adherence, but this may not accurately reflect adherence and may overlook resistance mutations among otherwise adherent YPLHIV. This may have introduced measurement error and case misclassification. Third, while we tried to confirm the theoretical assumptions about our objectives, some conceptual or methodological issues may have been missed. We may have overlooked significant data or information that could have influenced our analysis and interpretations differently because we had to reduce our list of conditions to the optimal number recommended for QCA analysis.²³ This could also explain the low coverage of 0.36 we obtained, which may limit the generalisability and make it difficult to draw broader conclusions about the relationship between the causal factors and viral suppression. Although listing and calibrating characteristics in QCA do not constitute realist causal analysis, it is crucial to recognise that realist theories and empirical insights guided our condition selection for QCA. This approach enables a systematic analysis that maintains the generative/relational perspective of context from a realist standpoint. It also highlights the compatibility between RE and QCA approaches.²³

CONCLUSIONS

Our findings demonstrate that the attainment of VL suppression among YPLHIV depends on their capacity to adjust to various context conditions, which can influence their patterns of HIV service utilisation and trigger various motivation processes. Therefore, to improve the effectiveness of YFHS at scale, health services must consider how the existing context conditions in which they deliver interventions shape YPLHIV motivation processes and the service utilisation patterns that unfold from such preferences.

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Acknowledgements The authors are grateful for the support they received from APIN management during their study. They also thank the patients (adolescents and young people living with HIV), their caregivers and healthcare providers who consented to their information being used for research purposes. Mr Jacob Inalegwu, the peer-support group lead in one of the study facilities, made valuable input during the pilot of data collection instruments, for which the authors are grateful. Finally, the authors thank Dr Honey Okpe and Dr Kelechi Ngwoke for coordinating the youth-friendly initiative within the APIN Program.

Contributors OB conceived the study, conducted the analysis and wrote all manuscript drafts. All authors provided critical reviews of the draft. All authors read and approved the final draft. OB is responsible for the overall content as guarantor and accepts full responsibility for the finished work and the conduct of the study, had access to the data, and controlled the decision to publish

Funding Some of the program data used is based on a project funded by the US Presidents Emergency Plan for AIDS (PEPFAR), awarded through the Centers for Disease Control and Prevention, and managed by APIN Public Health Initiatives Ltd/ Gte. OB received doctoral research funding from the Belgium Directorate-General for Development Cooperation (DGD) awarded through the Institute of Tropical Medicine Antwerp, Belgium. SVB received funding from the Flanders Research Foundation (FWO) grant number 1221821N.

Disclaimer The funder had no role in the conduct and writing of this study.

Competing interests None declared.

Patient and public involvement Patients and/or the public were involved in the design, or conduct, or reporting, or dissemination plans of this research. Refer to the Methods section for further details.

Patient consent for publication Not applicable.

Ethics approval This study involves human participants and this study was approved by the Health Research Ethics Committee of the Benue State Ministry of Health, and the Institutional Review Boards of APIN, the Federal Medical Center, Makurdi, and the Institute of Tropical Medicine, Antwerp, Belgium. The management of the 10 study health facilities also approved the study. Participants gave informed consent to participate in the study before taking part.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement Data may be obtained from a third party and are not publicly available.

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Supplementary Material

Table 1. Description of APIN YFHS interventions mapped to National Minimum Standards guidelines

National Standards	YFHS Program	Work package
Standard 1: An enabling environment exists in the	Enabling community environment	Within selected facilities/communities
community to support the provision and	YFHS community engagement strategy that includes awareness building and	 Conducting needs (met and unmet) assessment of
appropriate utilisation of adolescent and vouth	fostering collaboration with relevant community stakeholders	adolescents or youth SRH across all supported
health services		facilities
		 Site selection based on the program set criteria
		Identify and engage a multisectoral group of
		adolescent/youth influencers/advocates and
		champions
		 Identify YPLHIV who were also virally suppressed,
		train and engage them as 'champions.'
		 Establish a working group that includes a cross-
		section of stakeholders such as community leaders,
		youth workers, health providers, representatives of
		local ministries of Health and Education, academics,
		young people, parents, teachers, raith leaders,
		Constitute district VEHS implementation team
		Establishing community-facility linkages and referral
		service systems in anticipation of the demand likely to
		be raised by community engagement
		Establish facility linkage with community services: economic,
		legal, and paralegal and social services, youth community
		groups, targeting youth both in and out of school, gender-
		based violence recovery centres, educational institutions,
		bursary/scholarship programs, income generating
		activities, constituency development funds, vocational
		training centres for skills development
standard 2: Young people in the catchment area	Improved awareness, setting and organisation, and procedures in health facilities	Keorienting facility structure and processes to improve the pace convenience appeal and eccessibility of
of the health facility are aware of its services,	racinties	the ease, convenience, appeal, and accessibility of
services from it		services
		 Dedicated clinic days to adolescents and young
		people
		— Dedicated space for adolescents and young
		people
		Operating hours adjusted for more convenience
		(e.g. opening after-school hours and on
		weekends as adapted to young people
		— Increased branding as a youth-friendly centre
		— Renovation of consultation rooms and
		reception area for better privacy-confidentiality
Standard 3: Young people find the environment,	Improving facility characteristics and processes to attract and provide	Implementation of differentiated drug delivery systems,
setting, organisation and procedures of health	services in a manner convenient and appealing to adolescents and young	including out-of-facility drug delivery systems
facilities appealing and acceptable.	people	 Fast-track facility delivery
		 Multi-month dispensing
		 Community ART groups (C-ARG)
		Community refill groups
Standard 4: All young people who visit health	Enabling facility environment	No user fee for all HIV services for adolescents and young
service delivery facilities are treated with	Creating an enabling environment within facilities to provide services to all	people
respect, dignity and in an equitable manner	adolescents irrespective of their ability to pay, age, sex, marital status,	 Establish community-facility linkages with referral links to
irrespective of their health, socio-demographic	education level, ethnic origin, sexual orientation, or other characteristics.	NGOs / CBOs/ youth associations for subsidised fees
or political status		regarding non-HIV services
		 Implementing the gender non-discrimination policy within health facilities
Standard 5: The services provided by health	Supportive supervision by health authorities at all levels	
facilities to young people are evidence-	Conduct supportive supervision in collaboration with government health	 Fund and conduct regular supportive supervision
informed and effective, and in line with the	authorities at all levels to ensure the quality of services according to	activities in collaboration with bealth authorities of the
nationally defined package	nationally defined standards	activities in collaboration with health authorities at the
		federal, state and local government levels
		•
		Develop and integrate Comprehensive Sexuality
	Provide effective and relevant services to YPLHIV	service and integrate comprehensive sexuality
	fulfile all adolescents' needs	Education with HIV and SRH service delivery
		Clinical package of care
		Comprehensive HIV services including HIV
		testing services, linkage to HIV care and
		treatment
		 — STI testing and counselling
		 Maternal and reproductive health services,
		including contraception counselling and
		provision, abortion, and post-abortion care (in
		line with national guidelines)

Standard 6: Service providers are sensitive to the needs of young people and maintain their privacy-confidentiality in service provision Standard 7: Service providers are skilled and motivated to provide health services to young people in an adolescent/youth-friendly manner Standard 8: Managerial systems are in place to improve/sustain the quality of health services provided to young people by the health service delivery facilities.	Improve provider competence to deliver YFHS To improve the technical competence of care providers for effective delivery of effective health services to adolescents, and to respect, protect and fulfil adolescents' rights to information, privacy, confidentiality, non-discrimination, non-judgmental attitude, and respect. Improve accountability systems and data for decision-making for YFHS Improving data use for decision-making among health facility managers. Supporting facility-level accountability mechanisms	 Referral for mental health services and management of substance abuse Enrolment in psychosocial support groups Operation Triple Zero (OTZ) Orientation & voluntary recruitment of adolescents into OTZ is completed by taking the OTZ pledge & registered in the OTZ register Orientation on 7 OTZ modules (adolescent transition from OTZ into the adult clinic, adolescent participation in their health, leadership, treatment literacy, OTZ logos, pledge, anthem, peer-to-peer mentorship, PHDP and positive living) E-communication through WhatsApp, text messaging, and phone calls for daily motivational messaging and updates Regular monthly OTZ meetings Activities during OTZ meeting include health therapy sessions, review of personal adherence strategy and goals, life skills support and career counselling, topical discussions, watching educative videos and edutainments, drug dispensing for stable pairs, play therapy, art therapy Monthly tracking and appropriate interventions instituted as necessary Adolescent & youth open days during school holidays Ongoing transition plan to adult & differentiated care models Cross-site exchange visits by OTZ clubs and site teams Feedback to site teams on progress and sharing best practices Staff capacity training needs assessment Identify the adolescent focal person and constitute a facility OTZ implementation team Ensure availability of routine service delivery tools in facility and community delivery outlets, including OTZ tools (registers, Rx literacy material, phones) at the facility Establish and maintain data monitoring systems for data collection and analysis disaggregated by age, sex, and service type. Fund regular data review meetings and rain providers
		 Establish and maintain data monitoring systems for data collection and analysis disaggregated by age, sex, and service type. Fund regular data review meetings and rain providers on data use for decision making Establish Data quality assurance and mentorship of site providers on data use and action Support accountability mechanisms like facility monthly and quarterly performance reviews
Standard 9: Young people are actively involved in the design, provision and monitoring of adolescent- and youth-friendly health services	Adolescent/vouth involvement Involving YPLHIV or their representatives in service planning or decision- making apparatus of the health facilities Establish feedback systems	Adolescents/youths exit interviews and feedback system via regular facility-based OTZ focal group meetings. Example questions include How they found out about your facility If they would refer your facility to their peers If they felt respected

If their privacy was protected
If they received the services they came for or were denied based on age, marital status, or other markers
The inclusion of adolescents and youth representatives in
the facility advisory committee that includes youth will enable regular quality improvement and ensure that young people can hold the facility accountable.

Table 2 Synthesised CMOCs

CMOc Improved tru	ust and cooperation				
Context	Program resources	Immediate outcomes	Mechanisms	Outcomes	Resulting CMOC
High stigma environment Low privacy and confidentiality	Differentiated services or channels, including digital engagement.	Increased convenience Less stigmatising channels of engagement with providers and services Improved privacy and confidentiality	YPLHIV trusts services better YPLHIV willing to cooperate with providers to address adherence concerns	Improved engagement with providers/services Increased retention and utilisation of services YPLHIV learn/practice new adherence- enhancing skills Improved adherence Improved viral load suppression	YPLHIV (young people living with HIV) are more likely to seek and continue medical treatment in high-stigma environments if care services are tailored to their specific needs. Tailored care reduces stigma by providing YPLHIV with private and confidential access to medical services. With this type of care, YPLHIV will have more trust and cooperation with their healthcare providers, which can improve their adherence to medical treatments.
Supporting quote	"Ok, I must confess that w lot of them [] now wait [] adolescents only com unless you have been ide and stigma are very very	e have really softene ing time has been se le pick drugs twice a entified as non-adhe down the ladder in t	ed care provision fo eriously reduced by year because we h rent or your viral k his facility, but we a	r them in this facility, we the fact that you do not ave case managers who c bad has not been suppres are still a work in progress	have really made it easy for quite a have to queue to see the doctors; an deliver their drugs at home, [] ssed. Now confidentiality breaches s"
Source	IDI healthcare provider (H	CP003)	<i>p</i>		
CMOC2 Extrinsic m	otivation				
Context	Program resources	Immediate outcomes	Mechanisms	Outcomes	Resulting CMOC
Resource limitation	Community-facility linkage Linking or integrating material support into care	Reduced socioeconomi c barriers to access	Increased extrinsic motivation	Increased engagement with services Retention in care Improved adherence through positive reinforcement of adherence behaviour Better viral load suppression	In areas with limited resources, linking financial and material support to medical care can encourage socioeconomically disadvantaged YPLHIV (young people living with HIV) to seek and continue treatment. This approach uses positive reinforcement to motivate YPLHIV to engage in care."
Supporting quote	"For adherence support? I us with money [] to tak this support started, they (have sex) This support of	Like now this suppor e care of ourselves s used to encourage of group has belond my	t group that they a so that we will not g us to stay away from life: now I have sto	re doing for us is helping go to boys to beg money m sex or be conscious abo upped all those behaviour	us, especially we girls [] they help or go around following boys. Since but the type of people we stay with s that I used to do to harm myself "
Source	IDI Adolescent (C003)			pped an those benaviours	

CMOC3 Empowerr	nent				
Context	Program resources	Immediate	Mechanisms	Outcomes	Resulting CMOC
		outcome			
Adult-focused	Mental health services	Individual	YPLHIV feel	Improved self-	Young people living with HIV
health services	Psychosocial services	needs of	empowered	management	(YPLHIV) with specific individual
	Transitional care	YPLHIV	YPLHIV self-	Improved adherence	needs can be encouraged to
Non-transitional		addressed	efficacy	and viral load	seek and continue medical
care for			increases	suppression	treatment if healthcare services
adolescents					help them take control of their
					health and improve their self-
					management skills. By
					empowering YPLHIV in this way,
					they will feel more confident in
					managing their health, which
					can lead to better adherence to
					the viral load
Supporting	"We do contact tracing lik	e for example thi	s how in school wh	om I talk to on the nhon	a I told him to get a diary and "tick
auotes	everything as you take you	ur drugs and send t	be diary to me on t	he phone" []" After a w	bile he was able to monitor himself
quotes	without even my supervisi	ion "			The, he was able to monitor minisen
	IDI health-care provider (H	CP005)			
CMOC4 Enhanced	self-efficacy and agency				
CMOC4 Enhanced Context	self-efficacy and agency Program	Immediate	Mechanisms	Outcomes	Resulting CMOC
CMOC4 Enhanced Context	self-efficacy and agency Program resources/intervention	Immediate outcomes	Mechanisms	Outcomes	Resulting CMOC
CMOC4 Enhanced Context Multiple support	self-efficacy and agency Program resources/intervention Treatment support by	Immediate outcomes Improved	Mechanisms Improved self-	Outcomes Improved	Resulting CMOC This theory posits that when
CMOC4 Enhanced Context Multiple support needs of YPLHIV	self-efficacy and agency Program resources/intervention Treatment support by peer educators, peer-	Immediate outcomes Improved participation	Mechanisms Improved self- efficacy	Outcomes Improved engagement and	Resulting CMOC This theory posits that when YPLHIV are supported by health
CMOC4 Enhanced Context Multiple support needs of YPLHIV	self-efficacy and agency Program resources/intervention Treatment support by peer educators, peer- networks, or peer	Immediate outcomes Improved participation in care	Mechanisms Improved self- efficacy Increased	Outcomes Improved engagement and retention in care	Resulting CMOC This theory posits that when YPLHIV are supported by health workers to provide treatment
CMOC4 Enhanced Context Multiple support needs of YPLHIV	self-efficacy and agency Program resources/intervention Treatment support by peer educators, peer- networks, or peer support groups	Immediate outcomes Improved participation in care	Mechanisms Improved self- efficacy Increased agency/sense	Outcomes Improved engagement and retention in care Better adherence	Resulting CMOC This theory posits that when YPLHIV are supported by health workers to provide treatment support to each other using
CMOC4 Enhanced Context Multiple support needs of YPLHIV	self-efficacy and agency Program resources/intervention Treatment support by peer educators, peer- networks, or peer support groups	Immediate outcomes Improved participation in care	Mechanisms Improved self- efficacy Increased agency/sense of control	Outcomes Improved engagement and retention in care Better adherence Improved viral load	Resulting CMOC This theory posits that when YPLHIV are supported by health workers to provide treatment support to each other using problem solving techniques and
CMOC4 Enhanced Context Multiple support needs of YPLHIV	self-efficacy and agency Program resources/intervention Treatment support by peer educators, peer- networks, or peer support groups	Immediate outcomes Improved participation in care	Mechanisms Improved self- efficacy Increased agency/sense of control	Outcomes Improved engagement and retention in care Better adherence Improved viral load suppression	Resulting CMOC This theory posits that when YPLHIV are supported by health workers to provide treatment support to each other using problem solving techniques and role-modelling (I), more YPLHIV
CMOC4 Enhanced Context Multiple support needs of YPLHIV	self-efficacy and agency Program resources/intervention Treatment support by peer educators, peer- networks, or peer support groups	Immediate outcomes Improved participation in care	Mechanisms Improved self- efficacy Increased agency/sense of control	Outcomes Improved engagement and retention in care Better adherence Improved viral load suppression	Resulting CMOC This theory posits that when YPLHIV are supported by health workers to provide treatment support to each other using problem solving techniques and role-modelling (I), more YPLHIV with multiple support needs (C)
CMOC4 Enhanced Context Multiple support needs of YPLHIV	self-efficacy and agency Program resources/intervention Treatment support by peer educators, peer- networks, or peer support groups	Immediate outcomes Improved participation in care	Mechanisms Improved self- efficacy Increased agency/sense of control	Outcomes Improved engagement and retention in care Better adherence Improved viral load suppression	Resulting CMOC This theory posits that when YPLHIV are supported by health workers to provide treatment support to each other using problem solving techniques and role-modelling (I), more YPLHIV with multiple support needs (C) will enhance their treatment
CMOC4 Enhanced Context Multiple support needs of YPLHIV	self-efficacy and agency Program resources/intervention Treatment support by peer educators, peer- networks, or peer support groups	Immediate outcomes Improved participation in care	Mechanisms Improved self- efficacy Increased agency/sense of control	Outcomes Improved engagement and retention in care Better adherence Improved viral load suppression	Resulting CMOC This theory posits that when YPLHIV are supported by health workers to provide treatment support to each other using problem solving techniques and role-modelling (I), more YPLHIV with multiple support needs (C) will enhance their treatment self-efficacy (M) and learn positive adherers behavior
CMOC4 Enhanced Context Multiple support needs of YPLHIV	self-efficacy and agency Program resources/intervention Treatment support by peer educators, peer- networks, or peer support groups	Immediate outcomes Improved participation in care	Mechanisms Improved self- efficacy Increased agency/sense of control	Outcomes Improved engagement and retention in care Better adherence Improved viral load suppression	Resulting CMOC This theory posits that when YPLHIV are supported by health workers to provide treatment support to each other using problem solving techniques and role-modelling (I), more YPLHIV with multiple support needs (C) will enhance their treatment self-efficacy (M) and learn positive adherence behavior that leads to improved viral
CMOC4 Enhanced Context Multiple support needs of YPLHIV	self-efficacy and agency Program resources/intervention Treatment support by peer educators, peer- networks, or peer support groups	Immediate outcomes Improved participation in care	Mechanisms Improved self- efficacy Increased agency/sense of control	Outcomes Improved engagement and retention in care Better adherence Improved viral load suppression	Resulting CMOC This theory posits that when YPLHIV are supported by health workers to provide treatment support to each other using problem solving techniques and role-modelling (I), more YPLHIV with multiple support needs (C) will enhance their treatment self-efficacy (M) and learn positive adherence behavior that leads to improved viral load suppression (O)
CMOC4 Enhanced Context Multiple support needs of YPLHIV	self-efficacy and agency Program resources/intervention Treatment support by peer educators, peer- networks, or peer support groups	Immediate outcomes Improved participation in care	Mechanisms Improved self- efficacy Increased agency/sense of control	Outcomes Improved engagement and retention in care Better adherence Improved viral load suppression	Resulting CMOC This theory posits that when YPLHIV are supported by health workers to provide treatment support to each other using problem solving techniques and role-modelling (I), more YPLHIV with multiple support needs (C) will enhance their treatment self-efficacy (M) and learn positive adherence behavior that leads to improved viral load suppression (O)
CMOC4 Enhanced Context Multiple support needs of YPLHIV Supporting quote	self-efficacy and agency Program resources/intervention Treatment support by peer educators, peer- networks, or peer support groups " and also, in the OTZ gro those things posted [] so	Immediate outcomes Improved participation in care up [] though, I an	Mechanisms Improved self- efficacy Increased agency/sense of control n not too good abo	Outcomes Improved engagement and retention in care Better adherence Improved viral load suppression	Resulting CMOC This theory posits that when YPLHIV are supported by health workers to provide treatment support to each other using problem solving techniques and role-modelling (I), more YPLHIV with multiple support needs (C) will enhance their treatment self-efficacy (M) and learn positive adherence behavior that leads to improved viral load suppression (O) e social media, but then, I do see all redication, concerning sex
CMOC4 Enhanced Context Multiple support needs of YPLHIV Supporting quote	self-efficacy and agency Program resources/intervention Treatment support by peer educators, peer- networks, or peer support groups " and also, in the OTZ gro those things posted [] so education, or maybe HIV i	Immediate outcomes Improved participation in care up [] though, I an metimes they advi nformation, so like	Mechanisms Improved self- efficacy Increased agency/sense of control n not too good abo ise little adolescent that I got educated	Outcomes Improved engagement and retention in care Better adherence Improved viral load suppression ut Facebook and all these s on how to take their me d. And now I know how I	Resulting CMOC This theory posits that when YPLHIV are supported by health workers to provide treatment support to each other using problem solving techniques and role-modelling (I), more YPLHIV with multiple support needs (C) will enhance their treatment self-efficacy (M) and learn positive adherence behavior that leads to improved viral load suppression (O) e social media, but then, I do see all edication, concerning sex can manage myself, to deal with
CMOC4 Enhanced Context Multiple support needs of YPLHIV Supporting quote	self-efficacy and agency Program resources/intervention Treatment support by peer educators, peer- networks, or peer support groups " and also, in the OTZ gro those things posted [] sc education, or maybe HIV i stigma and HIV disclosure.	Immediate outcomes Improved participation in care up [] though, I an metimes they advi nformation, so like	Mechanisms Improved self- efficacy Increased agency/sense of control n not too good abo ise little adolescent that I got educated	Outcomes Improved engagement and retention in care Better adherence Improved viral load suppression	Resulting CMOC This theory posits that when YPLHIV are supported by health workers to provide treatment support to each other using problem solving techniques and role-modelling (I), more YPLHIV with multiple support needs (C) will enhance their treatment self-efficacy (M) and learn positive adherence behavior that leads to improved viral load suppression (O) e social media, but then, I do see all edication, concerning sex can manage myself, to deal with