

# Evaluating Antiretroviral Therapy Service Delivery Models Through Lot Quality Assurance Sampling in Central Uganda

Semei Christopher Mukama<sup>1</sup>, Jane Senyondo Nakawesi<sup>1</sup>, Dedrix Stephenson Bindeeba<sup>1</sup>, Simon Ezajobo<sup>1</sup>, Andrew Mugisa<sup>1</sup>, Catherine Senyimba<sup>1</sup>, Eve Namitala<sup>1</sup>, Robert Onzima DDM Anguyo<sup>2</sup>, Simon Peter Katongole<sup>3</sup>, Barbara Mukasa<sup>1</sup>

<sup>1</sup>Mildmay Uganda, Kampala, Uganda; <sup>2</sup>Department of International Public Health, Liverpool School of Tropical Medicine (LSTM), Kampala, Uganda; <sup>3</sup>Department of Public Health, Gudia University Project, Kampala, Uganda

Correspondence: Simon Peter Katongole, Email [spkatongole@gmail.com](mailto:spkatongole@gmail.com)

**Background:** This study evaluated the effectiveness and responsiveness of differentiated Human Immunodeficiency Virus (HIV)/Acquired Immuno-Deficiency Syndrome (AIDS) service delivery models (DSDMs) implemented to enhance antiretroviral therapy (ART) access and outcomes for patients while addressing Tuberculosis (TB)-HIV integration, focusing on four of the five DSDMs currently implemented in Uganda.

**Methodology:** A descriptive cross-sectional survey was conducted in eight districts of central Uganda using Lot Quality Assurance Sampling approach from 7th to 23rd March 2023. We randomly sampled 2668 patients who have been on ART for at least 1 year in a Facility-Based Individual Management (FBIM) model or in a non-FBIM DSDM for at least one year. Data were collected through patient interviews and review of records in ART and DSDM registers as well as ART cards. We analyzed the data in proportions, comparing the selected ART outcome and responsiveness indicators between Community Client Led ART Distribution (CCLAD), Community Drugs Distribution Point (CDDP) and Fast-Track Drug Refill (FTDR) DSDMs with the standard care (FBIM) model. The ART outcome variables include patients retained in the 1st line of the ART regimen, patients in World Health Organization clinical stage 1 during the last facility visit, patients who had no CD4 request during the past 12 months, viral load suppression, ART adherence, and patients who reported that they did not experience HIV/AIDS-related symptoms in the past 6 months. The variables on TB care include screening for TB using the intensified case finding form and patients tested positive for TB. Responsiveness variables include the perceived; travel time for ART refill, travel distance for ART refill, convenience and flexibility during ART refill, cost of travel for ART refill, fear of being seen at ART refill point, waiting time before service, adequacy of service time, crowding and risk of infections, social support, ability to address ART treatment challenges, HIV status disclosure and barriers to access. Non-overlap in 95% confidence interval in indicator proportion between non-FBIM DSDM and FBIM means a statistically significant difference in proportion, or otherwise non-significant.

**Results:** Higher proportions of ART patients in the CCLAD and CDDP DSDMs adhered to ART, had suppressed viral load, and a lower TB prevalence than those in FBIM model. Additionally, more CCLAD and CDDP clients reported shorter travel time and distance to access ART than their counterparts in the FBIM model. Compared to FBIM model, higher proportions of those in CCLAD and CDDP also reported flexibility in ART refill scheduling, reduced transport costs, fewer privacy concerns, less HIV/AIDS-related stigma, shorter waiting times, more efficient services, decreased congestion at ART pickup sites, enhanced peer support, improved problem-solving assistance, and increased HIV status disclosure. The FTDR model outperformed FBIM in proportions with fewer requests for CD4 testing, viral load suppression, as well as proportions of clients who reported; shorter travel time, lower transportation cost, decreased privacy concerns, shorter waiting time, and efficient service provision. Compared to both CDDP and FTDR, the FBIM had a higher proportion of clients remain on the first-line ART regimen.

**Conclusion:** Community-based DSDMs show responsiveness to clients' needs without compromising the effectiveness of ART care for patients. Although FTDR also demonstrates high effectiveness and responsiveness for clients on ART, there is potential for further improvement. Planners and implementers of ART programs should consider both demand- and supply-side innovations to sustain the continuation of DSDMs.

**Keywords:** HIV/AIDS, TB-HIV, DSDM, LQAS

## Introduction

HIV service providers have recently shifted their focus from entirely health facility-based to differentiated service delivery models (DSDMs).<sup>1</sup> This aims to reduce the number of unnecessary interactions between patients receiving antiretroviral therapy (ART) and the healthcare system while ensuring that patients' needs are met. Adoption of the DSDMs is essential for providing the most effective results in the global fight against Human Immunodeficiency Virus (HIV)/Acquired Immuno-Deficiency Syndrome (AIDS). The DSDMs are cutting-edge strategies that cater to HIV/AIDS services to certain populations.<sup>2</sup> These approaches, which cover a range of interventions and tactics, are designed to improve HIV/AIDS service accessibility, cost, and quality.<sup>1</sup> They are also boosting patient involvement and retaining participants in the program.<sup>3-5</sup>

Monitoring treatment outcomes, particularly in patients who have not required a switch to second or third lines of treatment, is crucial for the success of ART in managing HIV infection.<sup>3</sup> The World Health Organization's clinical staging system serves as a vital tool to assess disease progression and monitor individuals on ART. The staging system guides healthcare providers in optimizing treatment strategies and categorizing patients based on favorable virological and immunological responses, particularly at the World Health Organization Clinical Stage 1.<sup>4</sup>

Virological monitoring has become the preferred method for evaluating ART outcomes, with CD4 count monitoring taking a secondary role.<sup>5</sup> However, certain client subgroups, such as those with poor treatment adherence or a poor WHO clinical stage, still undergo CD4 monitoring.<sup>6</sup> CD4 count assessment remains relevant due to its complementary role alongside virological monitoring. This provides valuable insights into HIV/AIDS patients' immune status and optimizes their management.<sup>7</sup> Achieving and maintaining a suppressed viral load is crucial to assessing ART effectiveness, improving clinical outcomes, and reducing HIV transmission risk. Monitoring the viral load is essential for treatment response evaluation, informed decision-making, and long-term treatment success monitoring.

Adherence to ART is vital for successful treatment outcomes for HIV/AIDS patients. In Uganda, the Ministry of Health recognizes the importance of adherence monitoring, and sets a threshold of 95% or higher as an indicator of effective adherence.<sup>6</sup> Adherence below this threshold can result in a suboptimal treatment response, virological failure, drug resistance, and increased morbidity and mortality.<sup>2</sup> Understanding factors influencing adherence and promoting strategies to improve adherence are crucial for enhancing ART outcomes and the overall well-being of HIV/AIDS patients.<sup>1</sup> Evaluating client satisfaction is also essential in assessing HIV/AIDS care delivery models' efficiency and success, leading to patient-centered care improvements.<sup>8</sup>

This study focuses on assessing the success or failures of implementing DSDMs and how responsive the models are to the needs of patients receiving ART treatment in them. Evaluating these models at the local health system level, such as within a district, provides insights into their effectiveness, strengths, weaknesses, and their capacity to address the changing healthcare needs of HIV/AIDS.<sup>9</sup> Such evaluations guide evidence-based policy decisions, resource allocation, and program adjustments, leading to improved healthcare delivery and better health outcomes for HIV/AIDS clients. The Lot quality Assurance Sampling methodology was chosen in order to provide data that supports decentralized decision-making, but the local-level analyses are beyond the scope of this study.

## Methodology

### Study Settings

The study was conducted in eight districts: Kiboga, Kyankwanzi, Mubende, Kassanda, Luwero, Nakasongola, Nakaseke, and Mityana, all implementing DSDMs. Each district was further divided into five supervision areas to apply the binomial Lot Quality Assurance Sampling approach.

### What is Lot Quality Assurance Sampling?

Lot Quality Assurance Sampling is a method that helps managers classify the performance of a section of their catchment area, referred to as supervision area, as good or poor, based on indicator coverage. This classification is achieved through a decision rule that benchmarks the identification of low-performing supervision areas. The decision rule is derived using the average coverage or target set for the indicator being monitored. The decision rule is influenced by several parameters such as sample size, upper threshold, lower threshold, type I or  $\alpha$  error and type II or  $\beta$  error. Type I or  $\alpha$  error is the

probability of misclassifying a supervision area with high coverage as low, and type II or  $\beta$  error is the probability of misclassifying a supervision area with very low coverage as high.<sup>10</sup> The upper threshold is an optimal level of performance or coverage considered optimal for an indicator, while lower threshold is a very low level of coverage of performance below which is unacceptable. The decision rule is the minimum number of respondents out of sample “n” in a supervision area who demonstrate the characteristic of interest that must be attained in order to classify acceptable performance, or otherwise unacceptable performance is classified.

The classical Lot Quality Assurance Sampling, as applied here, assumes an indicator target of 80% and a lower threshold of 50%. In theory, this means it is practically impossible to misclassify the performance of supervision areas that lie at least 30% points apart. The sample size (n) and decision rule (d) are selected such that  $\alpha$  and  $\beta$  errors are each maintained less than 10% in order to satisfy the binomial function below.<sup>9,11</sup>

$$P(x < d | n, p_U \geq 80\%) \leq \alpha \leq 0.10$$

$$P(x \geq d | n, p_L \leq 50\%) \leq \beta \leq 0.10$$

$$\alpha + \beta < 0.20$$

Whereby; x = number of successful trials. P = is the probability of success.  $p_U$  = Upper threshold.  $p_L$  = Lower threshold.

In this study, a stratified random sample of individuals was selected in each DSDM. The decision rule determines the cut-off to identify supervision areas with inadequate performance, such as those whose proportion of patients with good ART adherence have not attained a set target or the average coverage. However, this (supervision area) level of classification is beyond the scope of this paper. We chose the LQAS methodology for this study because we needed the data to support local decision-making by district authorities. Specifically, the aim was to make the study data useful for district authorities to identify low-performance supervision areas and prioritize them for improvement as earlier applied in other Lot Quality Assurance Sampling surveys.<sup>10</sup> Lot Quality Assurance Sampling is one of the best methods to provide data to guide such decision-making at decentralized settings.<sup>9,11,12</sup>

## Description and Scope of DSDM Studied

Uganda offers five ART DSDMs.<sup>6</sup> Three of the models: the Community Client-Led ART Delivery (CCLAD) model, the Community Drug Distribution Point (CDDP) model, and the Community Retail Pharmacy Drug Distribution Points (CRPDDP) model operate within the community setting for clients who are stable on ART.

In the CCLAD model, groups of six HIV clients collect ART medication refills from healthcare facilities on behalf of each other.<sup>7</sup> In the CDDP model, designated outreach sites within communities provide ART refill pick-ups where clients designated in this model find their ART. The CRPDDP involves stable clients receiving medication from a community pharmacy in partnership with a healthcare facility.<sup>13</sup> This is the latest model implemented in Uganda, albeit with a limited number of clients currently utilizing it.

The additional (two) models are health facility-based; the fast-track drug refill (FTDR) model and the facility-based individual management (FBIM) model. In the FTDR model, stable clients receive their ART refills every 3 to 6 months at their healthcare facility, often picking pre-packed medicines without undue delay, and do not require routine clinical evaluation that is characteristic of clients enrolled in FBIM. The FBIM, on the other hand, is provided as part of routine care catering for individual unstable clients or stable patients who prefer receiving their care directly through this model.

This study focused on 4 of the 5 DSDMs currently implemented in Uganda. They include CCLAD, CDDP, FBIM and the FTDR model. The CRPDDP model was excluded because it was being implemented in very few health facilities by the time of this study. Whereas we had planned to include CRPDDP as part of this study, it was later removed because of its small scope of implementation in only three districts. Moreover, only a limited number of healthcare facilities implemented CRPDDP within the districts implementing the model, resulting in a very small sample size that is unable to provide good precision of estimate.

## Study Design

This study utilized a comparative, cross-sectional design and employed the Lot Quality Assurance Sampling approach from 7th to 23rd March 2023. The study compared ART and TB outcome indicators, as well as responsiveness of ART service delivery between the non-FBIM DSDMs and FBIM. This, because all the clients enrolled in the non-FBIM DSDMs such as CCLAD, CDDP and FTDR were first in the FBIM model before transitioning to their current DSDM. Given that FBIM is the standard care for ART delivery, it was appropriate to compare outcomes of non-FBIM DSDMs with the FBIM model. To align with the Lot Quality Assurance Sampling principles, each district was stratified into five supervision areas. This stratification was based on health facilities and was conducted in consultation with the local health system staff who participated in data collection and supervision. This resulted in 40 supervision areas. [Table 1](#) displays supervision area-level strata by district.

## Sample Size Determination and Sampling Procedures

We stratified each district into five supervision areas ([Table 1](#)). As in classical Lot Quality Assurance Sampling, we targeted a minimum sample size of 19 individuals per supervision area in each DSDM. Consequently, 95 respondents per district per DSDM, 760 for the eight districts per DSDM.<sup>11</sup> This means that the 95% confidence interval per district does not exceed  $\pm 10.1$  (ie  $1.96 \times \sqrt{(0.5 \times 0.5)/95}$ ). Accordingly, we planned a minimum sample size of 3040 covering the 4

**Table 1** Supervision Areas by District

District	Supervision Area Name
Kasanda	Bukuya HCIV
	Kassanda HCIV and Kikwandwa HCIII
	Kiganda HCIV
	Musozi HCIII
	Myanzi HCIII
Kiboga	Bukomero HCIV and Katwe HCIII
	Muwanga HCIII
	Lwamata HCIII and Kyanamuyonjo HC III
	Kiboga Hospital
	Kambugu HCIII
Kyankwanzi	Mujunza HC III and Kikonda HC III
	Ntwetwe HC IV and Kiyuni HC III
	Kikolimbo HC II and Nalinya Ndagire HC III
	Kyankwanzi HC III
	Butemba HC III
Luwero	Ssekamuli HC III, Bamunanika HC III, Kalagala HC IV and Zirowe HC III
	Nyimbwa HC IV, Bombo HC III, Kasozi HC III, Makulubita HC III and Bowa HC III
	Luwero Hospital, Butuntumula HC III and Kyalugondo HC III
	Katikamu HC III, Bukalasa HC III, Kikoma HC III and Nsawo HC III
	Kamira HC III, Kibengo HC III and Wabusana HC III

(Continued)

**Table I** (Continued).

District	Supervision Area Name
Mityana	Bulera HC III, Kalangalo HC III, Kyantungo HC IV, and Kyamusisi HC III
	Busunju HC II, Ssekanyonyi HC IV, Kajjoji HC III and Kikandwa HC III
	St. Francis HOSFA HC III, Magala HC III, Naama HC III and Mityana Hospital
	Mwera HC IV, Kitongo HC III, Maanyi HC III and Mpongo HC II
	Kabule HC III, Malangala HC III, Namungo HC III and St. Jacinta Zigoti HC III
Mubende	Kitenga HC III, Kalonga HC III and Kabyuma HC II
	Kiyuni (Mubende) HC III and Kakigando HC II
	Butawata HC III and Mubende Kasambya HC III Govt
	Nabingoola HC III, and Kibalinga HC III
	Madudu HC III and Butoloogo HC III
Nakaseke	Nakaseke hospital and Bidabugya HC III
	Semuto HC IV
	Kapeeka HC III
	Wakyato HC III and Kikamulo HC III
	Nakaseke hospital and Bidabugya HC III
	Kinyogoga HC III and Ngoma HC IV
Nakasongola	Nakasongola HC IV and Wabigalo HC III
	Bamugolodde HC III, Kalungi HC III and Kazwama HC II
	Lwampanga HC III and Nakayonza HC III
	Nakitoma HC III and Nabiswera HC IV
	Kakooge HC III and Kiralamba HC III

DSDMs. The 19 clients per supervision area targeted for interview in each DSDM were allocated to the different health facilities within the supervision area using probability proportional to size approach based on the overall number of clients enrolled to ART in each healthcare facility. The 19 clients meeting the inclusion criteria were randomly chosen from the DSDM registers at the healthcare facility using their ART card numbers. Prior to the interview in the community, the ART counselor contacted the selected clients via telephone, introduced the survey and the research assistant, obtained consent, and established rapport. The data collector then followed the clients who consented to their preferred location in the community. During the interview, clients were asked for permission to review their ART records, and only those who agreed had their records examined.

## Survey Indicators

There were 21 indicators investigated under each DSDM as indicated in [Table 2](#).

## Patient Outcomes

The indicators we examined encompassed proportion of clients who are on the first line of ART from the time of enrolment to DSDM; proportion of clients in the World Health Organization clinical stage-1 during the last visit to health

**Table 2** Survey Indicators

S/ N	Indicator
<b>ART Outcomes</b>	
1	Proportion of clients who are on the first line of ART from the time of enrolment to DSDM
2	Proportion of clients in the World Health Organization clinical stage-I during the last visit to health facility
3	Proportion of clients with no CD4 request during the past 12 months
4	Proportion of clients with suppressed viral load during the last testing
5	Proportion of clients with good adherence to ART during the last health facility visit
6	Proportion of clients who reported that they did not experience any HIV-related symptom during the past 6 months
<b>TB/HIV integration</b>	
7	Proportion of clients who were evaluated for TB using the intensified case finding (ICF) form during the last health facility visit
8	Proportion of clients who tested positive for TB
<b>Satisfaction with dimensions of access</b>	
9	Proportion of clients who say it takes them a shorter time to go and refill their drugs than before
10	Proportion of clients who say they now have to travel a shorter distance to refill their drugs than before
11	Proportions of clients who reported having convenient and flexible time and day for ART drug refill than before
12	Proportion of clients who say it now costs less money to go and refill their drugs than before
13	Proportion of clients who say they can refill their medicines without fear of being seen by relatives, friends or members of the community
14	Proportion of clients who reported a shorter waiting time before being served than before
15	Proportion of clients who say the time taken to serve/treat them (service time) is short, but adequate to receive the required care and information
16	Proportion of clients who say they no longer sit in crowded queues when they want to refill their drugs and have reduced risk of acquiring other infections from other clients now than before
17	Proportion of clients who said they can more easily get solutions to the challenges related to treatment than before
18	Proportion of clients who said they have been able to disclose their HIV status to individuals they trust in the family or community as a result of the social support they receive
19	Proportion of clients who say they have not experienced any barrier when they wanted to go and refill their ART medicines
20	Proportion of clients who would recommend a friend to receive ART medicines through their current DSDM
21	Proportion of clients who say it takes them a shorter time to go and refill their drugs than before

facility; proportion of clients with no CD4 request during the past 12 months; proportion of clients with suppressed viral load during the last testing; proportion of clients with good adherence to ART during the last health facility visit; and proportion of clients who reported that they did not experience any HIV-related symptom during the past 6 months. Assessment of clients not requested a CD4 count test allowed us to identify the proportion of clients assumed to be doing well, because CD4 testing is performed for clients showing poor outcomes on other ART follow up indicators.

### Tuberculosis (TB)-HIV Integration Outcomes

This was evaluated using two indicators that include; proportion of clients who underwent TB evaluation using the intensified case-finding form and those who tested positive for TB.



## Responsiveness of the Different DSDMs

The study used specific statements to gather valuable insights into the responsiveness of services under the DSDMs. Indicators 9 to 21 present the findings of this assessment. Respondents' perspectives were assessed regarding; (i) time taken to go for drug refill, (ii) distance travelled for drug refill, (iii) cost of travel for drug refill, (iv) convenience of timing for drug refill, (v) flexibility of hours for drug refill, (vi) flexibility of days for drug refill, (vii) stigma/fear associated with being seen by relatives, friends or members of community during drug refill, (viii) waiting time during drug refill, (ix) adequacy of service time during drug refill, (x) extent of crowding and risk of infection, (xi) opportunities for other treatment such as non-communicable diseases, (xii) level of social support from peers and ability to share challenges with others, (xiii) ability to get solutions to challenges related to treatment, (xiv) ability to disclose one's HIV status, and (xv) willingness to recommend a friend to enroll on respondent's current DSDM. Respondents were presented with several statements regarding these thematic areas, and asked to express their level of agreement on a scale from strongly disagree to strongly agree. For instance, one question asked was; "would you say you strongly disagree, disagree, neither agree nor disagree, agree or strongly agree with the following statement; It takes me a shorter time to go and refill my ART drugs than ever before". Those who said they strongly agree or agree with each statement were considered to have the correct response and their proportion was calculated for each responsiveness indicator per DSDM.

## Data Collection

The survey data was collected with the Kobo Collect Application. Each supervision area had one data collector. The data collector-initiated contact with respondents through HIV/AIDS counsellors and scheduled interview appointments. Initial consent was obtained via a telephone call by the counsellor. Written informed consent was then obtained by the data collector before each interview. During the interview, the data collector sought additional consent to review the treatment records of the respondent. Some obliged, while others declined. Only those who consented to having their record reviewed had their ART records reviewed. Data collection was supervised by district supervisors.

## Data Management and Analysis

The uploaded data underwent a daily screening for duplicates and field entry errors. Corrections were made on a daily basis in real time. After data cleaning, analysis was conducted, calculating proportions with corresponding confidence intervals (CIs). Each model's data was analyzed independently. Proportions of clients in each of CCLAD, CDDP, and FTDR who had, whose records had, or reported the attribute of interest were compared to those of the FBIM model for the different indicators. Statistical significance of differences was determined by comparing the 95% CIs. Any indicator with overlap in 95% CI between a test DSDM (CCLAD, CDDP or FTDR), and the FBIM were classified to not have statistically significant difference in coverage. Non-overlap in 95% CI suggests a statistically significant difference in coverage.

## Quality Assurance

The data collection tools were pretested and identified problems corrected before data collection. We used the Kobo Collect Application for data collection. Accordingly, internal quality assurance mechanisms such in-built skip patterns, automated calculations, making all the fields "required" led to better quality and complete data. Data collectors and supervisors were selected based on strict criteria, including language skills, interview and numeracy abilities, and previous survey experience. They received comprehensive training, including a one-day field practicum before field-deployment. Supervision was conducted by experienced district officers, overseen by the investigators. Real-time monitoring and cleaning of data was performed daily to ensure completeness, consistency, and accuracy of responses. The data analysis was guided by a standard results tabulation plan to ensure reliability.

## Results

### Distribution of Respondents by DSDM and Response Rate

Table 3 provides distribution of respondents by DSDM and the response rate against the planned sample size by DSDM. The findings indicate that FTDR had the highest representation, accounting for 28.1% with 735 respondents while CDDP

(20.9%) had the least with 546 respondents. Consequently, the analysis is based on a total sample size of 2615 individuals, resulting in overall response rate of 86.0% of the expected 3040. Considering FBIM is the standard of care, it serves as the most suitable reference model for comparison.

## Socio-Demographic Characteristics of Respondents

Table 4 presents the socio-demographic characteristics of the respondents.

### Age Distribution of Respondents

Most respondents in CCLAD (37.1%) were in the 40–49 years age group, followed by those aged 50 years and above (31.3%) and 30–39 years (23.8%), with lower age groups having smaller proportions. In CDDP, the proportions of respondents decrease with age: 39.2% were 50 years and above, 29.3% were 40–49 years, 24.7% were 30–39 years, 5.7% were 20–29 years, and only 1.1% were below 20 years. For FTDR, most respondents (30.3%) were in the 30–39 years age group, followed by 29.8% in the 50 years and above group, 25.0% in the 40–49 years group, with 13.5% in the 20–

**Table 3** Distribution of Respondents and Survey Response Rate by DSDM

DSDM Type	Frequency/Attained Sample Size	Percent by DSDM	Planned Sample Size	Response Rate (%)
CCLAD	689	26.3%	760	90.7%
CDDP	546	20.9%	760	71.8%
FTDR	735	28.1%	760	96.7%
FBIM	645	24.7%	760	84.9%
Total	2615	100.0%	3040	86.0%

**Table 4** Socio-Demographic Characteristics of Respondents

Category	f/%	CCLAD	CDDP	FTDR	FBIM
<b>Age category</b>					
<20 years	f	8	6	10	30
	%	1.2%	1.1%	1.4%	4.7%
20–29 years	f	46	31	99	142
	%	6.7%	5.7%	13.5%	22.0%
30–39 years	f	164	135	223	205
	%	23.8%	24.7%	30.3%	31.8%
40–49 years	f	255	160	184	158
	%	37.1%	29.3%	25.0%	24.5%
50+ years	f	215	214	219	110
	%	31.3%	39.2%	29.8%	17.1%
Total	f	688	546	735	645
	%	100.0%	100.0%	100.0%	100.0%

(Continued)



Table 4 (Continued).

Category	f/%	CCLAD	CDDP	FTDR	FBIM
<b>Sex distribution</b>					
Male	f	405	325	445	380
	%	58.9%	59.5%	60.5%	58.9%
Female	f	283	221	290	265
	%	41.1%	40.5%	39.5%	41.1%
Total	f	688	546	735	645
	%	100.0%	100.0%	100.0%	100.0%
<b>Highest level of education ever attained</b>					
No formal education	f	196	170	192	140
	%	28.4%	31.1%	26.1%	21.7%
Pre-school	f	28	39	35	20
	%	4.1%	7.1%	4.8%	3.1%
Primary	f	271	241	321	291
	%	39.3%	44.1%	43.7%	45.1%
Intermediate	f	44	25	42	37
	%	6.4%	4.6%	5.7%	5.7%
Secondary	f	121	63	122	124
	%	17.6%	11.5%	16.6%	19.2%
Adult education	f	8	3	8	11
	%	1.2%	0.5%	1.1%	1.7%
University/higher institute	f	13	3	15	16
	%	1.9%	0.5%	2.0%	2.5%
Other	f	8	2	0	6
	%	1.2%	0.4%	0.0%	0.9%
Total	f	689	546	735	645
	%	100.0%	100.0%	100.0%	100.0%
<b>Ability to read</b>					
Cannot read at all	f	226	202	237	172
	%	32.8%	37.0%	32.2%	26.7%
Able to read only parts of the sentence	f	202	165	215	156
	%	29.3%	30.2%	29.3%	24.2%
Able to read whole sentence	f	261	179	283	317
	%	37.9%	32.8%	38.5%	49.1%

(Continued)

**Table 4** (Continued).

Category	f/%	CCLAD	CDDP	FTDR	FBIM
Total	f	689	546	735	645
	%	100.0%	100.0%	100.0%	100.0%
<b>Current marital status</b>					
Never married	f	47	25	58	112
	%	6.8%	4.6%	7.9%	17.4%
Married	f	382	277	382	340
	%	55.5%	50.7%	52.0%	52.7%
Widowed	f	69	36	60	31
	%	10.0%	6.6%	8.2%	4.8%
Divorced	f	27	25	33	24
	%	3.9%	4.6%	4.5%	3.7%
Separated	f	86	90	91	49
	%	12.5%	16.5%	12.4%	7.6%
Cohabited/living together	f	77	93	111	89
	%	11.2%	17.0%	15.1%	13.8%
Total	f	688	546	735	645
	%	100.0%	100.0%	100.0%	100.0%

29 years group and 1.4% below 20 years. Compared to the non-FBIM DSDMs, FBIM shows the lowest proportion of respondents in the oldest age group (50 years and above) at 17.1% and the highest proportion in the youngest age group (below 20 years) at 4.7%. Within the FBIM model, most respondents (31.8%) were in the 30–39 years age group, followed by 40–49 years (24.5%), and then 20–29 years (22.0%).

### Sex Distribution of Respondents

Regarding the sex of the respondents as recorded at birth, the majority across all DSDMs were male: 58.9% in CCLAD, 59.5% in CDDP, 60.5% in FTDR, and 58.9% in the FBIM model (Table 4).

### Level of Education of Respondents and Ability to Read

The majority of respondents across all DSDMs had completed primary education, followed by those with no formal education. Specifically, 39.3% of respondents in CCLAD, 44.1% in CDDP, 43.7% in FTDR, and 45.1% in the FBIM model had primary education as their highest level of attainment, while 28.4% in CCLAD, 31.1% in CDDP, 26.1% in FTDR and 21.7% in FBIM had no formal education. This was followed by secondary education, which was the highest level attained by 17.6% of respondents in CCLAD, 11.5% in CDDP, 16.6% in FTDR, and 19.2% in FBIM. The remaining education levels, such as pre-school, intermediate, adult education, and university or higher education, had very low proportions across all the DSDMs (Table 4).

The respondents' ability to read varied across the DSDMs, with those in FBIM being more likely to read compared to each of the non-FBIM models. This is evident from the fact that the highest proportion had the lowest proportion of respondents who were unable to read at all and the highest proportion of respondents who were able to read an entire sentence. Specifically, 32.8% of respondents in CCLAD, 37.0% in CDDP, 32.2% in FTDR, and 26.7% in FBIM were unable

to read at all, while 37.9% in CCLAD, 32.8% in CDDP, 38.5% in FTDR, and 49.1% in FBIM were able to read an entire sentence. Conversely, 29.3% of respondents in CCLAD, 30.2% in CDDP, 29.3% in FTDR, and 24.2% in FBIM could only read parts of a sentence.

### Current Marital Status

The highest proportion of respondents across all DSDMs were married. Specifically, 55.5% of respondents in CCLAD, 50.7% in CDDP, 52.0% in FTDR, and 52.7% in FBIM were married. Respondents in FBIM had more than twice the proportion of single (never married) individuals (17.4%) compared to those in CCLAD (6.8%), CDDP (4.6%), and FTDR (7.9%). Conversely, respondents in FBIM had nearly half the proportion of widowed individuals (4.8%) compared to those in CCLAD (10.0%), CDDP (6.6%), and FTDR (8.2%). A similar pattern was observed for the proportion of respondents who were separated: 12.5% in CCLAD, 16.5% in CDDP, 12.4% in FTDR, and 7.6% in FBIM.

### Coverage in ART Outcome Indicators by DSDM

Table 5 summarizes the coverage (%) in ART outcomes by DSDM, comparing each of CCLAD, CDDP and FTDR with FBIM using the 95% CI.

The results show that 95.5% (95% CI:  $\pm 1.6\%$ ) of CCLAD clients, 92.5% (95% CI:  $\pm 2.3\%$ ) of CDDP clients, 91.9% (95% CI:  $\pm 2.1\%$ ) of FTDR clients and 96.9% (95% CI:  $\pm 1.4\%$ ) of FBIM clients were on the first line of ART with no statistically significant difference in coverage between CCLAD, FTDR and FBIM. However, the proportion of CDDP clients on the first line of ART was significantly lower compared to FBIM, as shown by the overlap in 95% confidence intervals.

**Table 5** The Overall Coverage of Indicators of DSDMs' Responsiveness, ART Outcomes, and HIV-TB Integration

Indicator	CCLAD (95% CI)	CDDP (95%CI)	FTDR (95% CI)	FBIM (95% CI)
<b>ART outcome indicators</b>				
Proportion of clients who are on the first line of ART from the time of enrolment to DSDM	95.5% ( $\pm 1.6\%$ )	92.5%** ( $\pm 2.3\%$ )	91.9%** ( $\pm 2.1$ )	96.9% ( $\pm 1.4\%$ )
Proportion of clients in WHO clinical stage-I during the last visit to health facility	92.4% ( $\pm 2.1\%$ )	95.1% ( $\pm 1.9\%$ )	90.3% ( $\pm 2.3\%$ )	91.5% ( $\pm 2.3\%$ )
Proportion of clients with no CD4 request during the past 12 months	85.1% ( $\pm 2.8\%$ )	***	90.4%* ( $\pm 2.3\%$ )	83.6% ( $\pm 3.1\%$ )
Proportion of clients with suppressed viral load during the last testing	94.4% * ( $\pm 1.9\%$ )	96.9% * ( $\pm 1.6\%$ )	96.5% * ( $\pm 1.4\%$ )	76.3% ( $\pm 4.0\%$ )
Proportion of clients with good adherence to ART during the last health facility visit	96.1% * ( $\pm 1.6\%$ )	94.9% * ( $\pm 2.0\%$ )	95.2% * ( $\pm 1.7\%$ )	88.2% ( $\pm 2.7\%$ )
Proportion of clients who reported that they did not experience any HIV-related symptoms during the past 6 months	83.1% ( $\pm 3.0\%$ )	88.2% ( $\pm 2.9\%$ )	88.0% ( $\pm 3.0\%$ )	84.0% ( $\pm 3.1\%$ )
<b>TB assessment and positivity</b>				
Proportion of clients who were evaluated for TB using the intensified case finding (ICF) form during the last health facility visit	89.1% ( $\pm 2.5\%$ )	90.6% ( $\pm 2.6\%$ )	87.7% ** ( $\pm 2.5\%$ )	93.5% ( $\pm 2.1\%$ )
Proportion of clients who tested positive for TB	0.0% * ( $\pm 0.0\%$ )	0.0% * ( $\pm 0.0\%$ )	0.6% ( $\pm 0.6\%$ )	1.6% ( $\pm 1.1\%$ )

(Continued)

Table 5 (Continued).

Indicator	CCLAD (95% CI)	CDDP (95%CI)	FTDR (95% CI)	FBIM (95% CI)
<b>Responsiveness of the DSDMs</b>				
Proportion of clients who say it takes them a shorter time to go and refill their drugs than ever before	85.2% * (± 2.8%)	92.3% * (± 2.4%)	79.0% * (± 3.1%)	70.6% (± 3.8%)
Proportion of clients who say they now have to travel a shorter distance to refill their drugs than ever before	81.2% * (± 3.1%)	90.4% * (± 2.6%)	66.0% (± 3.6%)	59.5% (± 4.1%)
Proportions of clients who reported having convenient and flexible time and day for ART drug refill than ever before	68.5% * (± 3.7%)	55.4% (± 4.4%)	53.3% (± 3.8%)	50.6% (± 4.2%)
Proportion of clients who say it now costs less money to go and refill their drugs than ever before	87.2% * (± 2.6)	91.2% * (± 2.5)	67.2%* (± 3.6)	59.1% (± 4.1)
Proportion of clients who say they can refill their medicines without fear of being seen by relatives, friends or members of the community	91.2% * (± 2.2%)	85.9% * (± 3.1%)	74.8% (± 3.3%)	74.2% (± 3.6%)
Proportion of clients who reported a shorter waiting time before being served than ever before	95.9% * (± 1.6%)	96.1% * (± 1.7%)	90.0% * (± 2.3%)	82.5% (± 3.2%)
Proportion of clients who say the time taken to serve/treat them (service time) is short, but adequate to receive the required care and information	96.6% * (± 1.4%)	95.7% * (± 1.8%)	90.1% * (± 2.3%)	74.4% (± 3.6%)
Proportion of clients who say they no longer sit in crowded queues when they want to refill their drugs and have reduced risk of acquiring other infections from other clients now than ever before	84.3% * (± 2.9%)	89.0% * (± 2.8%)	77.4% (± 3.2%)	74.4% (± 3.6%)
Proportion of clients who said they now have a lot of social support from peers, and can share the challenges related to treatment more easily than ever before	93.2% * (± 2.0%)	93.5% * (± 2.2%)	83.9% (± 2.8%)	84.0% (± 3.1%)
Proportion of clients who said they can more easily get solutions to the challenges related to treatment than ever before	93.8% * (± 1.9%)	95.5% * (± 1.8%)	89.5% (± 5.6%)	89.0% (± 2.6%)
Proportion of clients who said they have been able to disclose their HIV status to individuals they trust in the family or community as a result of the social support they receive	87.7% * (± 2.6%)	87.0% * (± 3.0%)	73.4% (± 3.4%)	78.2% (± 3.4%)
Proportion of clients who say they have not experienced any barrier when they wanted to go and refill their ART medicines	2.4% (± 0.0%)	2.0% (± 1.3%)	2.7% (± 1.2%)	4.0% (± 1.6%)
Proportion of clients who would recommend a friend to receive ART medicines through their current DSDM	95.6% * (± 1.6%)	97.4% * (± 1.4%)	96.5% * (± 1.4%)	81.6% (± 3.2%)

**Notes:** \* Higher coverage in CCLAD, CDDP or FTDR than FBIM with statistically significant difference, \*\* Lower coverage in CCLAD, CDDP or FTDR than FBIM with statistically significant difference, \*\*\* Inadequate data to calculate coverage.

Regarding the World Health Organization clinical staging, 92.4% (95% CI: ±2.1%) of CCLAD, 95.1% (95% CI: ±1.9%) of CDDP, 90.3% (95% CI: 2.3%) of FTDR and 91.5% (95% CI ± 2.3%) of FBIM clients were in stage 1, suggesting no significant difference in proportions between each of CCLAD, CDDP, FTDR and FBIM.

There was inadequate data regarding CD4 testing among CDDP clients. Accordingly, we excluded the CDDP category's data from analysis of those who were not requested a CD4 test. At 90.4% (95% CI: ±2.3%), the FTDR clients had a significantly higher proportion who did not have a CD4 test request during the 12 months preceding the survey. However, there was no significant difference in the proportion of CCLAD (85.1% [95% CI: ±2.8%]) and FBIM (83.6% [95% CI: ±3.1%]) clients who had no CD4 request in the past 12 months.

Regarding viral load suppression, clients in each of CCLAD (94.4% [95% CI:  $\pm 1.9\%$ ]), CDDP (96.9% [95% CI  $\pm 1.6\%$ ]) and FTDR (96.5% [95% CI  $\pm 1.4\%$ ]) had significantly higher proportions with suppressed viral load during the last test compared to FBIM (76.3% [95% CI:  $\pm 4.0\%$ ]). Similarly, proportions of clients who had good (>95%) treatment adherence during the last health facility visit were significantly higher in each of CCLAD, CDDP and FTDR than FBIM DSDMs; 96.1% (95% CI  $\pm 1.6\%$ ) of CCLAD, 94.9% (95% CI  $\pm 2.0\%$ ) of CDDP, 95.2% (95% CI:  $\pm 1.7\%$ ) of FTDR, and 88.2% (95% CI:  $\pm 2.7\%$ ) of FBIM clients had good adherence during the last health facility visit.

There was no statistically significant difference between DSDMs in proportions of clients who reported that they did not experience any HIV/AIDS-related symptoms during the six months preceding the survey; 83.1% (95% CI:  $\pm 3.0\%$ ) of CCLAD, 88.2% (95% CI:  $\pm 2.9\%$ ) of CDDP, 88.0% (95% CI:  $\pm 3.0\%$ ) of FTDR and 84.0% (95% CI:  $\pm 3.1\%$ ) of FBIM clients reported that they did not experience any HIV/AIDS-related symptom during the past six months.

## Tuberculosis (TB)-HIV Integration Outcomes

Uganda expects clients on ART to be actively evaluated for TB using the intensified case finding form. Those found to be having presumptive TB are then tested using microscopy or the GeneXpert with preference given for the GeneXpert. The results in [Table 5](#) indicate that clients in the FBIM model (93.5%, 95% CI:  $\pm 2.1$ ) had a higher proportion assessed for TB using the intensified case finding form during their most recent health facility visit compared to clients in CCLAD (89.1% [95% CI:  $\pm 2.5$ ]), CDDP (90.6% [95% CI:  $\pm 2.6$ ]), and FTDR (87.7% [95% CI:  $\pm 2.5$ ]). The difference was statistically significant between FBIM and FTDR. The findings also reveal that clients in the FBIM model had a higher proportion of positive TB tests (1.6%, 95% CI:  $\pm 1.1$ ) compared to CCLAD and CDDP, each with 0.0%, and FTDR (0.6% [95% CI:  $\pm 0.6$ ]). CCLAD and CDDP models each had significantly lower proportions of those who tested positive for TB than the FBIM clients.

## Responsiveness of the Different DSDMs

A comprehensive assessment of how DSDMs satisfy the specific needs of client populations living with HIV was undertaken. [Table 5](#) also presents the responsiveness of DSDMs to clients receiving ART.

The proportions of clients who reported that it takes them a shorter time to go and refill their drugs than before were significantly higher in each of the CCLAD, CDDP, and FTDR models than in the FBIM model. Specifically, 92.3% (95% CI:  $\pm 2.4\%$ ) of CCLAD clients, 85.2% (95% CI:  $\pm 2.8\%$ ) of CDDP clients, 79% (95% CI:  $\pm 3.1\%$ ) of FTDR clients, and 70.6% (95% CI:  $\pm 3.8\%$ ) of FBIM clients indicated that it takes them a short time to go and refill their ART medicines.

In terms of distance, the proportions of clients who reported that they now have to travel a shorter distance to refill their drugs than before were significantly higher among both the CCLAD and CDDP models when compared to FBIM. However, there was no statistically significant difference between FTDR and FBIM in this regard. As shown in [Table 5](#), 81.2% (95% CI:  $\pm 3.1\%$ ) of CCLAD clients, 90.4% (95% CI:  $\pm 2.6\%$ ) of CDDP clients, 66% (95% CI:  $\pm 3.6\%$ ) of FTDR clients, and 59.5% (95% CI:  $\pm 4.1\%$ ) of FBIM clients reported that they now have to travel a shorter distance to refill their ART drugs compared to the situation before.

In terms of the convenience and flexibility in the timing and day of ART drug refills, the CCLAD group exhibited the highest proportion, which was 68.5% (95% CI:  $\pm 3.7\%$ ). Furthermore, it was the only DSDM that demonstrated significantly higher coverage compared to FBIM. On the other hand, the CDDP, FTDR, and FBIM models showed relatively lower proportions of respondents who reported having convenient and flexible timing and days for ART drug refills than ever before. The proportions for these models were 55.4% (95% CI:  $\pm 4.4\%$ ) for CDDP, 53.3% (95% CI:  $\pm 3.8\%$ ) for FTDR, and 50.6% (95% CI:  $\pm 4.2\%$ ) for FBIM, respectively.

Significantly higher proportions of clients in the CCLAD (87.2%, 95% CI:  $\pm 2.6\%$ ) and CDDP (91.2%, 95% CI:  $\pm 2.5\%$ ) models than FBIM (59.1% [95% CI:  $\pm 4.1\%$ ]) reported that it costs them less on ART drug refills than before, with the FTDR at 67.2% (95% CI:  $\pm 3.6\%$ ).

In terms of privacy, significantly higher proportions of clients in the CCLAD (91.2% [95% CI:  $\pm 2.2\%$ ]) and CDDP (85.9%, [95% CI:  $\pm 3.1\%$ ]) models than FBIM (74.2% [95% CI:  $\pm 3.6\%$ ]) reported that they can refill their medicines without fear of being seen by relatives, friends or members of the community, with the FTDR at 74.8% (95% CI:  $\pm 3.3\%$ ).

The 95.9% (95% CI:  $\pm 1.6\%$ ) of CCLAD clients, 96.1% (95% CI:  $\pm 1.7\%$ ) of CDDP clients, 90.0% (95% CI:  $\pm 2.3\%$ ) of FTDR clients and 82.5% (95% CI:  $\pm 3.2\%$ ) of FBIM clients reported that they experienced a shorter waiting time before being provided health care than before. The CCLAD, CDDP and FTDR models each have a statistically significant difference from the FBIM model.

Results for the proportion of clients who say the time taken to serve/treat them is short, but they receive the required care and information reveal that a statistically higher proportion of clients in each of CCLAD (96.6% [95% CI:  $\pm 1.4\%$ ]), CDDP (95.7% [95% CI:  $\pm 1.8\%$ ]) and FTDR (90.1% (95% CI:  $\pm 2.3\%$ )) models than the FBIM group (95% CI: 74.4% ( $\pm 3.6\%$ )).

Regarding crowding and risk of infection, significantly higher proportions of clients in the CCLAD (84.3% [95% CI:  $\pm 2.9\%$ ]) and CDDP (89.0% [95% CI:  $\pm 2.8\%$ ]) models than FBIM (74.4% [95% CI:  $\pm 3.6\%$ ]) reported that they no longer sit in crowded queues when they want to refill their drugs and have reduced risk of acquiring other infections from other clients now than before, with the FTDR at (77.4% [95% CI:  $\pm 3.2\%$ ]).

Regarding social support, significantly higher proportions of clients in the CCLAD (93.2% [95% CI:  $\pm 2.0\%$ ]) and CDDP (93.5% [95% CI:  $\pm 2.2\%$ ]) models than FBIM (84.0% [95% CI:  $\pm 3.1\%$ ]) reported that they now have a lot of social support from peers and can share the challenges related to treatment more easily than before, with the FTDR at 83.9% (95% CI:  $\pm 2.8\%$ ). Similarly, significantly higher proportions of clients in the CCLAD (93.8% [95% CI:  $\pm 1.9\%$ ]) and CDDP (95.5% [95% CI:  $\pm 1.8\%$ ]) models than FBIM (89.0% [95% CI:  $\pm 2.6\%$ ]) reported that they can more easily get solutions to the challenges related to treatment than before. There was no statistically significant difference between clients in the FTDR model (89.5% [95% CI:  $\pm 5.6\%$ ]) and FBIM regarding proportions who say they can more easily get solutions to the challenges related to treatment than before. Regarding disclosure of HIV status, significantly higher proportions of clients in the CCLAD (87.7% [95% CI:  $\pm 2.6\%$ ]) and CDDP (87.0% [95% CI:  $\pm 3.0\%$ ]) models than the FBIM (78.2% [95% CI:  $\pm 3.4\%$ ]) model said they have been able to disclose their HIV status to individuals they trust in the family or community as a result of the social support they receive. With 73.4% (95% CI:  $\pm 3.4\%$ ), there was no statistically significant difference between FTDR and FBIM models regarding proportion of clients who said they have been able to disclose their HIV status to individuals they trust in the family or community as a result of the social support they receive.

The proportion of clients facing no barriers when seeking to refill their ART medicine was consistently low across all DSDM groups. Among these, FBIM clients had the highest proportion, and there were no statistical differences observed across the groups. Specifically, the proportions were 2.4% (95% CI:  $\pm 0.0\%$ ) in the CCLAD model, 2.0% (95% CI:  $\pm 1.3\%$ ) in the CDDP model, 2.7% (95% CI:  $\pm 1.2\%$ ) in the FTDR model, and 4.0% (95% CI:  $\pm 1.6\%$ ) in the FBIM model.

The results further revealed that significantly higher proportions of clients in the CCLAD (95.6%, 95% CI:  $\pm 1.6\%$ ), CDDP (97.4%, 95% CI:  $\pm 1.4\%$ ), and FTDR (96.5%, 95% CI:  $\pm 1.4\%$ ) models, than the FBIM (81.6%, 95% CI:  $\pm 3.2\%$ ) model said they would recommend a friend who is HIV positive to enroll into their current DSDM.

## Discussion

This study provides valuable insights into the effectiveness and responsiveness of DSDMs in HIV/AIDS care and treatment. The results show that the CCLAD and CDDP models consistently outperformed the FBIM in virtually all the responsiveness indicators and most HIV/AIDS outcome and TB-related indicators.

This study's findings reveal that clients enrolled in community-based DSDMs, specifically CCLAD and CDDP, exhibited significantly better ART adherence, higher viral load suppression rates, and a lower TB positivity rate compared to those in the FBIM model. These results are consistent with previous studies conducted in Uganda and other regions, which also observed superior or comparable ART outcomes among clients enrolled in DSDMs compared to those in standard care models like FBIM.<sup>3,14,15</sup> This outcome is anticipated, as only "stable" ART clients are eligible to participate in non-FBIM DSDMs, with the exception of the facility-based group model, which also allows unstable clients to join. In the Ugandan context, a stable ART client is defined as one who has been on the same ART regimen for at least 12 months, maintains viral suppression, demonstrates over 95% adherence to medication, is on first- or second-



line treatment, is in WHO clinical stage 1 or 2, and if co-infected with HIV and TB, has completed the intensive phase of anti-TB treatment and is sputum negative.<sup>16</sup>

The design and implementation of DSDMs in Uganda further emphasize that ART clients who become unstable while on a non-FBIM DSDM are referred back to FBIM, with the exception of those in the facility-based group model.<sup>6</sup> This implies that the observed improvements in HIV/AIDS and TB outcomes are not solely attributable to the non-FBIM DSDMs themselves but rather reflect the adherence of ART program implementers to the DSDM guidelines. By promptly transferring patients experiencing clinical deterioration, increased viral loads, or poor treatment adherence back to FBIM, these models effectively enhance the overall success of ART programs.

This study found that a higher proportion of patients in the FBIM model underwent TB screening during their most recent health facility visit compared to those in other models. These results align with previous research indicating that fewer facility visits in DSDMs lead to reduced opportunities for TB symptom screening and intensive case finding (ICF), as opposed to more frequent or comprehensive care models.<sup>17</sup> The increased TB screening in the FBIM model could also be attributed to the fact that HIV/AIDS clients in this model are potentially more vulnerable to TB or other respiratory infections, likely due to a lack of viral suppression, and therefore present with TB-like symptoms that necessitate screening.

Additionally, the significantly higher prevalence of TB among FBIM clients, as confirmed in this study, suggests that the presence of TB symptoms may prompt healthcare providers to perform more frequent evaluations. The high TB screening rates among FBIM clients may also reflect effective health system monitoring, which facilitates timely initiation of treatment when TB is suspected. In contrast, clients in community-based models like CCLAD and CDDP are generally assumed to be more stable with better adherence, potentially reducing the perceived need for TB screening.<sup>18</sup> However, the primarily facility-based nature of TB screening in Uganda may contribute to lower screening rates in non-facility-based models, such as CCLAD and CDDP, which could delay timely treatment for these clients.<sup>19</sup>

These findings highlight the necessity of implementing accessible TB screening for all HIV-positive individuals, regardless of the care model, and emphasize the importance of advocating for community-based TB screening initiatives. The higher rate of positive TB test results among FBIM clients could be linked to their increased vulnerability due to the absence of viral suppression and lower immunity. Moreover, the longer exposure to other patients in crowded healthcare facilities, where FBIM clients are more likely to spend time, might further elevate their risk of TB infection.<sup>20</sup> Previous studies have also suggested that more frequent interactions with healthcare facilities in models like FBIM and FTDR could increase exposure to environments where TB is prevalent.<sup>21</sup> Additionally, heightened awareness of opportunistic infections among FBIM clients might lead to more proactive TB screening efforts.<sup>22</sup>

In other ART outcome indicators such as proportion of clients in World Health Organization clinical stage 1, with no CD4 request during the past 12 months, and clients who reported that they did not experience any HIV-related symptoms during the past 6 months, the estimates are mostly comparable between each of CCLAD, CDDP, FTDR and FBIM, although significantly more FTDR patients received a CD4 test request than FBIM. These findings suggest that if well implemented, CCLAD, CDDP and FTDR have the potential to better ART outcomes or maintain equivalence to FBIM. In Uganda, viral load testing is standard care for the routine monitoring of ART patients. CD4 testing after ART initiation is typically recommended for clients with poor clinical stages, after treatment interruptions of three or more months or those on treatment or prophylaxis for cryptococcal infection.<sup>23</sup> Accordingly, the proportion of CD4 tests indicates poor ART outcome in this study, implying that the FBIM model performed better than the FTDR model in this indicator.

The high proportion of clients remaining on the first-line of ART across all DSDMs suggests that these models maintain patients' treatment stability and response to initial ART regimens, although the FBIM clients had significantly higher proportion in first line than each of CDDM and FTDR models and a proportion comparable to CCLAD. Some clients in the non-FBIM DSDMs are on their second-line ART regimen at DSDM-enrolment because enrolment to CCLAD, CDDP or FTDR is open to any stable clients in their first- or second-line regimens in Uganda.<sup>6,16</sup>

The CCLAD and CDDP DSDMs had higher proportions of clients reporting shorter refill times, reduced queuing and reduced travel distances. This aligns with findings from an earlier qualitative study in Central Uganda.<sup>24</sup> This suggests that these models enhance efficiency in providing timely medication access, highlighting the importance of streamlining refill processes and offering convenient locations.<sup>25</sup> The higher proportion of clients reporting convenience, flexibility, and



shorter waiting times in the CCLAD model suggests that this model better accommodates individual schedules. Additionally, the higher proportion of clients reporting prompt care in these models demonstrates their effectiveness in meeting the healthcare needs in a timely manner.<sup>1</sup>

Notably, clients in the CCLAD and CDDP models reported significantly lower experiences of stigma, similar to findings in another study among men.<sup>26</sup> However, this contrasted with earlier studies that linked community-based DSDMs with increased stigma<sup>24,27</sup>. Furthermore, non-FBIM models showed a significantly higher proportion of clients reporting improved privacy and confidentiality during refills. These findings are consistent with client-centered care principles and previous literature, highlighting the importance of reducing barriers to care for better treatment outcomes.<sup>1,28,29</sup>

Consistent with previous studies, this study found that clients in CCLAD and CDDP models reported significantly higher levels of social support compared to other models.<sup>25,26</sup> These two models emphasize client-centered care, trust-building, active engagement, peer and professional support, along with strong community networking, all of which contribute to enhanced social support.<sup>1</sup> Social support plays a critical role in promoting adherence, mental health, and overall well-being given the psychological and social challenges faced by people living with HIV, which can hinder consistent medical attendance and adherence to ART.<sup>30</sup> These findings underscore the need to incorporate social support mechanisms into other DSDMs, including the FBIM, to enhance treatment outcomes and experiences.<sup>31</sup> Furthermore, identifying and sharing best practices from these successful models could help optimize the performance of other DSDMs' in overcoming treatment challenges and developing effective solutions.

In the CCLAD, CDDP and FTDR models, clients highly perceived reduced medication refill costs. This is consistent with an earlier study that reported that CDDP and CCLAD approaches are efficient because they minimize clinic visits, unlike FTDR and FBIM.<sup>32</sup> Similarly, the long appointment time as well as minimal delays associated with FTDR at health facilities come with savings in cost associated with fewer health facility visits and other opportunity costs.<sup>28</sup>

Despite the generally positive ART outcomes and the responsiveness associated with various DSDMs in this study, almost all clients on ART across all DSDMs still face some barriers when accessing services. This finding contrasts with an earlier study from Ghana, where a high proportion of ART patients reported no barriers, despite the study not focusing on specific DSDMs.<sup>33</sup> Therefore, identifying and addressing the barriers is crucial to enable the development of targeted strategies to remove these barriers, thereby improving access to ART within these models and enhancing patients' overall experience. Notably, despite these barriers, significantly higher proportions of respondents in CCLAD, CDDP, and FTDR compared to FBIM were more willing to recommend their current model to a friend living with HIV. This highlights the value clients place on these DSDMs, perceiving them as the best available options.

## Study Limitations

The survey's main constraint was a smaller sample size than initially planned, caused by insufficient clients in specific DSDMs, particularly at lower-level health facilities. Consent issues also affected participation because some clients did not consent to participate, especially in the CRPDDP because the majority of clients were reluctant to disclose their HIV-positive status to anyone. In addition, CRPDDP has been implemented in only three districts, and in only a few healthcare facilities in these districts. This, coupled with non-response, resulted in a very low aggregate sample size. Consequently, the entire data on CRPDDP was excluded from analysis because of the very small sample size attained. Additionally, some supervision areas fell short of the minimum sample size requirements, leading to the exclusion of supervision area-level performance classification. Also limiting was the fact that part of the data was collected from records, which also had some missing entries leading to non-response in some data elements. For example, the indicator on CD4 assessment was not analyzed for the CDDP model due to inadequate sample size associated with incomplete entries in some records, a lack of consent and/or fewer patients in the model at some health facilities. Despite these limitations, the aggregated sample size for all eight districts per DSDM was adequate enough for the analysis we have conducted.

## Conclusions

The findings on ART treatment outcomes depict a good adherence to implementation guidelines for rolling out DSDMs in the eight districts. Community-based DSDMs demonstrate responsiveness to clients' needs without compromising the effectiveness of ART care for clients. As a result, the ART patients do not only embrace receiving care in the non-FBIM DSDMs but also demonstrate a greater willingness to recommend these DSDMs to other HIV-positive individuals. Although FTDR has also shown potential to better patient outcomes and experiences, there is room for further improvement. Planners and implementers of ART programs should consider both demand- and supply-side innovations to sustain the continuation of DSDMs. Efforts should be made to identify and address model-specific barriers and challenges to further enhance the benefits associated with the DSDMs and beyond.

## Ethical Approval

This study complies with the Declaration of Helsinki.<sup>34</sup> It was performed according to Mildmay Uganda Research and Ethics Committee (MUREC) (REC REF 0804-2018) and the Uganda National Council of Science and Technology (SS639ES) ethical approvals. Consent was obtained from all the study participants prior to interviewing them.

## Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

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## Disclosure

The authors report no conflicts of interest in this work.

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