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# Role of Supply Chain in the Implementation of Multi-Month Dispensing of Antiretroviral among People Living with Human Immunodeficiency Virus in Tanzania

George M. Ruhago[1]*, Godbless G. Mariki[2], Frida N. Ngalesoni[1, 3], Beatrice Christian[2], Irene Makundi[5], Marina Njelekela[4]

[1]Department of Development Studies, School of Public Health and Social Sciences, Muhimbili University of Health and Allied Sciences, Dar es Salaam, Tanzania
[2]Management and Development for Health, Dar es Salaam, Tanzania
[3]Amref Health Africa-Tanzania, Dar es Salaam, Tanzania
[4]Deloitte Consulting LTD, Dar es Salaam, Tanzania
[5]Muhimbili National Hospital, Dar es Salaam, Tanzania

***Corresponding author:**

Dr. George Ruhago

Muhimbili University of Health and Allied Sciences

P. O. Box 65001

Dar es Salaam, Tanzania

Email: ruhagogm@gmail.com

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**Abstract**

***Background***

Globally, it is estimated that by 2020 28.2 million of all people living with HIV were accessing antiretroviral (ARV) therapy. Providing Multi-Month Dispensing (MMD) of ARV for stable clients has been reported to increase adherence and improve health outcomes in terms of death, retention, adherence, immunosuppression, and viral suppression. The objective of this study was to investigate the role of the health commodities supply chain in the implementation of MMD among people living with Human Immuno Deficiency Virus (HIV) in Tanzania.

***Methods***

This was a mixed-method cross-sectional study, to investigate the role of the supply chain in the roll-out of the MMD strategy. The study was carried out in 44 Care and Treatment Clinics (CTC) in Mtwara, Lindi, Morogoro, Iringa, Njombe and Ruvuma regions. A structured electronic questionnaire was administered to CTC in-charges and key informant interviews were conducted with 14 District Pharmacists. STATA software version 15 was used for quantitative data analysis and NVIVO 11 was used for qualitative data analysis.

***Results***

Majority of the health facilities 95.4% had enough first-line ARV medications; 59.1% had enough stock of second-line medications 70.4% had enough stock of paediatrics regimens to support MMD implementation. ARV related factors contributed to 36% of the most common challenges attributed to poor implementation of MMD (ARV stock (23%) and ARV shortage (13%)).. This study established that, the solution of running out of ARV stock is to ensure that ordering is timely done, using quality data and whenever need be, redistribution from nearby facilities to ensure uninterrupted supply of ARVs.

***Conclusion***

ARV supply chain is at the core of the successful implementation of MMD. The supply chain of ARV drugs should be thoroughly reviewed to ensure ARV resupply is processed timely for all health facilities to maintain appropriate stock levels. To realise and sustain MMD goals.

***Keywords:*** *Antiretroviral, Multi-Month Dispensing, HIV, HIV/AIDS, Supply Chain.*

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**Background**

Globally, by June 2020, 84% of the people living with HIV (PLHIV) knew their HIV status and among then 87% were accessing treatment. Of these 90% were virally suppressed (1). In Tanzania as of December 2019, 78% of PLHIV knew their status, 78% of those who knew their status were accessing treatment and 88% of those accessing treatment were virally suppressed (2). Significant progress has been made in expanding access to ARV in low- and middle-income countries (LMICs). With this rapid increase of availability of HIV/AIDS care and treatment services, a critical concern is the capacity of the health system to effectively meet the needs of treatment. Providing HIV/AIDS stable patients with multi-month dispensing (MMD) of antiretrovirals (ARVs) is one differentiated service delivery model (DSDM) that has been recommended to alleviate health system challenges that may affect the efficient provision of ARV(3). Stable clients are those with 'viral suppression' defined as "two consecutive viral load measurements below 1000 copies/ml or in the absence of viral load monitoring, rising CD4 cell counts or CD4 counts above 200 cells/cubic millimetre. These clients are being given MMD of ARV medications for, either three or six months to increase adherence and hence maintain favourable health outcomes in terms of death, retention, adherence and viral suppression. Implementation of these innovative approaches for care and treatment interventions requires a stable supply chain for ARVs and health system adjustment to accommodate these changes to realize the expected outcomes (4).

One such health system adjustment is a stable supply chain that delivers a reliable, continuous supply of health commodities to its customers (5). Stock-out of ARV drugs which ultimately results in rationing of available stocks hampers both service delivery models for the distribution of ARV and achievement of the treat-all strategy (4). In Rwanda, to implement the three-monthly MMD policy necessitated a one-time procurement of additional ARVs for all health facilities so ensure availability of adequate stock to administer to stable clients. Based on procurement and supply chain systems, which considered lead-time and other uncertainties, it was estimated that six months of stock will be required to adequately meet the additional need for ARV's (6). A comprehensive review of both inventory management and distribution systems is recommended prior to the introduction of MMD to ensure adequate planning for the anticipated increase in the volume of needed ARV's (5, 7).

Little is known on the response of the ARVs supply chain following the implementation of MMD in Tanzania. Therefore, this study intended to determine the ARV supply chain in the implementation of MMD among PLHIV in Tanzania.

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## Methods

### *Study design*

The study was a mixed-method cross-sectional study employing to investigate the role of the health supply chain in the implementation of MMD.

### *Study Area*

The study was carried out at 44 randomly selected care and treatment centres (CTC) in the southern regions of Tanzania namely Mtwara, Lindi, Morogoro, Iringa, Njombe and Ruvuma. The study area was chosen based on the convenience of access to data, due to existing monitoring and evaluation collaboration between Muhimbili University of Health and Allied Sciences (MUHAS) and Deloitte Consulting Limited.

**Table 1: Study facilities characteristics**

| SN | Region | District | Facility Name | Type of Facility | Facility Ownership |
|---|---|---|---|---|---|
| 1 | Iringa | Mafinga TC | Ihongole | Health Center | Government |
| 2 | | Mufindi DC | Usokami | Health Center | Faith Based Organization |
| 3 | | Mufindi DC | Ifwagi | Health Center | Government |
| 4 | | Mufindi DC | Kasanga | Health Center | Government |
| 5 | | Iringa MC | Frelimo | Hospital | Government |
| 6 | | Mafinga TC | Mafinga | Hospital | Government |
| 7 | | Iringa MC | Iringa RRH | Hospital | Government |
| 8 | | Iringa MC | Alamano | Dispensary | Faith Based Organization |
| 9 | | Iringa MC | St Edigio | Dispensary | Faith Based Organization |
| 10 | | Mufindi DC | Nyololo | Health Center | Non-Government Organization |
| 11 | | Iringa DC | Nzihi | Hospital | Government |
| 12 | Lindi | Nachingwea DC | Nachingwea | Hospital | Government |
| 13 | | Nachingwea DC | Mnero | Hospital | Faith Based Organization |
| 14 | | Liwale DC | Liwale | Hospital | Government |
| 15 | Morogoro | Mvomero DC | Turiani | Hospital | Faith Based Organization |
| 16 | | Kilombero DC | Mang'ula | Health Center | Government |
| 17 | | Kilosa DC | Kidodi | Health Center | Government |
| 18 | | Gairo DC | Gairo | Health Center | Government |
| 19 | | Ulanga DC | Lupiro | Health Center | Government |
| 20 | | Kilosa DC | St. Kizito | Hospital | Faith Based Organization |
| 21 | | Ifakara TC | St. Francis | Hospital | Faith Based Organization |
| 22 | | Morogoro MC | Morogoro RRH | Hospital | Government |
| 23 | | Morogoro MC | Sabasaba | Health Center | Government |
| 24 | Mtwara | Mtwara MC | Ufukoni | Dispensary | Government |

| | | | | | |
|---|---|---|---|---|---|
| 25 | | Newala TC | Newala | Hospital | Government |
| 26 | | Masasi DC | Ndanda | Hospital | Faith Based Organization |
| 27 | | Nanyumbu TC | Mangaka | Hospital | Government |
| 28 | | Masasi DC | Nagaga | Health Center | Government |
| 29 | Njombe | Ludewa DC | Madope | Dispensary | Government |
| 30 | | Njombe TC | Idundilanga | Dispensary | Government |
| 31 | | Njombe TC | Njombe | Hospital | Government |
| 32 | | Makete DC | Ikonda | Hospital | Faith Based Organization |
| 33 | | Ludewa DC | Mlangali | Health Center | Government |
| 34 | | Ludewa DC | Lugarawa | Hospital | Faith Based Organization |
| 35 | | Njombe TC | Njombe | Health Center | Government |
| 36 | | Makambako TC | St. Joseph Ikelu | Hospital | Faith Based Organization |
| 37 | | Makambako TC | Makambako | Health Center | Government |
| 38 | | Makete DC | Makete Hospital | Hospital | Government |
| 39 | | Makete DC | Mfumbi | Dispensary | Government |
| 40 | Ruvuma | Mbinga TC | Mpepai | Health Center | Faith Based Organization |
| 41 | | Madaba DC | Madaba | Health Center | Government |
| 42 | | Madaba DC | Lilondo | Dispensary | Government |
| 43 | | Nyasa DC | Liuli | Hospital | Non-Government Organization |
| 44 | | Tunduru DC | Tunduru | Hospital | Government |

***Study Population***

*Quantitative data*

The study population for quantitate data was all active (100%) patient files from 44 facilities. Active client files are those with at least one visit recorded in the last six months. A total of 83,142 active electronic clients' files were retrieved from CTC2 database.

*Qualitative data*

For qualitative data, Key informant interviews were conducted with 14 District Pharmacists from Ruvuma, Njombe, Iringa, Morogoro, Lindi and Mtwara regions. The final sample size for Key informants was determined based on theoretical saturation, which refers to the point at which no new concepts emerge from the review of data drawn from a sample that is diverse in pertinent characteristics and experiences (8, 9). In this study saturation was achieved based on daily reviews of notes and transcripts from interviews.

*Sampling procedures and sample size*

The study involved 146 high-volume health facilities providing care and treatment services to about eighty percent (80%) of all clients in six southern zone regions of Tanzania. To ensure

representation of different facility levels i.e., hospitals, health centres and dispensaries depending on the proportion of PLHIV served by the strata; within each stratum, simple random sampling was employed to obtain a final sample of 44 facilities that were involved in this study. At each facility active files were retrieved for data extraction (Table 3).

**Table 2: Stratified random sampling of Health facilities by level**

| Facility Level | % Proportion of clients served | Number of HF's per category |
|---|---|---|
| Hospitals | 47.5% | 21 |
| Health Centres | 36.5% | 16 |
| Dispensaries | 17% | 7 |
| **Total** | **100%** | **44** |

***Data collection***

*Quantitative data*

To collect data on the role of the supply chain in the implementation of MMD, a structured electronic questionnaire was administered to 44 CTC in-charges of sampled facilities. Information collected included general health facility information, laboratory services, staffing, workload and commodity availability. Data on MMD client were extracted from patient electronic files.

*Qualitative data*

Key informant interviews were conducted with pharmacists from districts with sampled facilities. Interview guides were used to probe respondents to acquire rich information. The question asked included How do CTCs in you council get their resupply of ARV's? With regard to MMD, how is it being implemented at facilities in your council? How MMD implementation has affected Supply chain system in your council?; Do you have any final comments or recommendations on MMD implementation? The interview was recorded using a tape recorder. Additionally, the researcher took notes during the interview.

***Confidentiality***

Confidentiality was maintained by de-identifying all electronic patient records, key informant interviews and supply chain information. All data was kept with utmost confidentiality in password protected electronic equipment the password was known only to the research team.

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***Data management and analysis***

*Quantitative data*

STATA software version 15 was used for quantitative data analysis. Descriptive statistics were done to determine the characteristics of PLHIV electronic files and MMD status.

*Qualitative data*

A thematic analytical approach was employed in the analysis of this data, this method explores for emerging themes that can describe the subject under investigation (10). All interviews were audio-recorded, transcribed verbatim into a computer Microsoft word. Transcripts were then imported to NVIVO 11 to be coded and sorted. Transcripts were initially examined to identify primary coding categories as well as the range of themes present within each category. Codes and sub-codes that were derived directly from the transcripts were used as a guideline when coding. Developed codebook contained identified coding categories and themes, new emerged themes were attached in the appropriate code as coding proceeding. The purpose of this process was to systematically group text data into fewer content-related themes that share the same meaning.

## Results

***Characteristics of HIV Clients***

A total of 83,142 electronic clients' files were retrieved from CTC2 database of all 44 sampled health facilities. Majority of client, 54,404 (64.4%) were of females, while 28,738 (34.6%) were male clients. About 99.2% of clients were above five years of age. Clients' duration on ARV was assessed, and about 51.6% had over five years on ARV while 48.4% had less than five years on medication

**Table 3: Characteristics of HIV clients**

| | Characteristic | N = 83,142 | % |
|---|---|---|---|
| Age (Years) | < 5 | 633 | 0.8 |
| | ≥5 | 82,509 | 99.2 |
| Sex | Female | 54,404 | 65.4 |
| | Male | 28,738 | 34.6 |
| Days on ARV | < 180 | 6,838 | 8.2 |
| | 180+ | 76,304 | 91.8 |

***Characteristics of Key Informants***

Key informant interviews were conducted to a total of 14 district pharmacist, all of them were degree holders with working experience ranging from three to seventeen years in their current roles. All participants had vast knowledge on how PLHIV are being managed at their supervised facilities including MMD intervention.

***Facility capacity to provide ARV***

Facility capacity to provide ARV was assessed based on the facility stock adequacy to serve the current pool of eligible clients at the study period. The majority (95.4) of the facilities confirmed to have enough first-line ARV medications; 59.1% had enough stock of second-line medications 70.4% had adequate stock of paediatrics regimens to support MMD implementation. (Table 4).

**Table 4: Facility's capacity to provide ARV for MMD clients**

| | Characteristic | N= 44 | Percentage (%) |
|---|---|---|---|
| Enough ARV stock for 1st line | Yes | 42 | 95.4 |
| | No | 2 | 4.6 |
| Enough ARV stock for ARV stock 2nd line | Yes | 26 | 59.1 |
| | No | 18 | 40.9 |
| Enough ARV stock for Paediatrics (Above 5years) | Yes | 31 | 70.4 |
| | No | 13 | 29.6 |

***Compliance on MMD Service Delivery Model***

This section presents the results of the compliance of MMD across the studied facilities. The study findings show that, 51,478 out of 83,142 (61.9%) clients who were analyzed by the study were eligible for receiving MMD, and 31,664 (38.1%) clients were not eligible. The key informant interviews revealed similar information on the HCW knowledge to determine clients who are eligible for MMD and those that are not, one respondent had this to say.

> *"…For us stable clients are those that after starting using ARV continue to demonstrate higher level of ARV treatment adherence, the correct way of using ARV's lead to lower viral load and high CD4 count …" (Key Informant IR2 from Iringa).*

Therefore, in order to gain more insights on facilities compliance to MMD, a cross tabulation analysis was performed to establish whether facilities provided MMD to stable clients. Out of

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51,478 stable clients, 82.1% were put on MMD while 17.9% did not received MMD. This is summarized in (Table 5).

**Table 5: Clients provided with MMD per eligibility categorizations**

| MMD Eligibility | On MMD | | |
|---|---|---|---|
| | Yes | No | Total |
| Eligible | 42,259 (82.1) | 9,219 (17.9**) | **51,478 (100)** |
| Not eligible | 10,685(33.7) ** | 20,979 (66.3) | **31,664(100)** |
| **Total** | **52,944** | **30,198** | **83,142** |

***Poor compliance of MMD*

Some clients eligible for MMD were reluctant to be given 90 days ARVs pills as they did not want to be seen carrying those pills, as narrated by one respondent.

> *"…we were also receiving packages with 30 pills; therefore, we were supposed to give each client three packages to make the total of 90 pills that also bring challenges because some of the clients did not want to be seen carrying a large number of pills…" (Key Informant IR1 from Iringa).*

***Standard Set-Up to Provide ARVs***

The findings of the study show that health facilities were in line with standards set up to provide ARVs. This is justified in the below quotation;

> *"…Most of the facilities now provide pills for three months, and the important thing is improvement in the packaging, mostly the ARV is tenofovir, lamivudine and dolutegravir (TLD) with a package that contains 90 pills. Clients are given after conducting thorough assessment to ensure client's stability. Also, we started to provide after receiving the guideline from the government that require us to start providing pills to the client who qualifies in the stable client criteria..." (Key Informant IR1 from Iringa).*

***ARV Stock Status and Ordering***

To ensure smooth implementation of MMD, facilities were supposed to keep enough stock of ARVs to supply for the needy stable clients. This was done through proper forecasting and ordering of ARV's from Medical Stores Department (MSD) as it was noted from an interview from Key informant from Iringa.

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*"…The first thing that we did was to identify clients who are classified as stable. This helped us to forecast our needs to be able to get the supplies because we knew demand will increase, therefore we tried to identify and get the number of the stable client then the pharmacist make some projections that will help us to meet our requirements, thereafter we would order for the pills that we think could be enough to serve the demand" (Key Informant IR2 from Iringa).*

***ARV availability and MMD implementation***

The study further measured the influence of ARV stock in relation to adherence to MMD implementation. The most common mentioned challenges attributed to poor implementation of MMD were ARV stock-outs (23%), followed by a 19% delay of HVL results and 13% ARV shortage. Overall, the ARV-related factors contributed to 36% of all challenges (Figure 1).

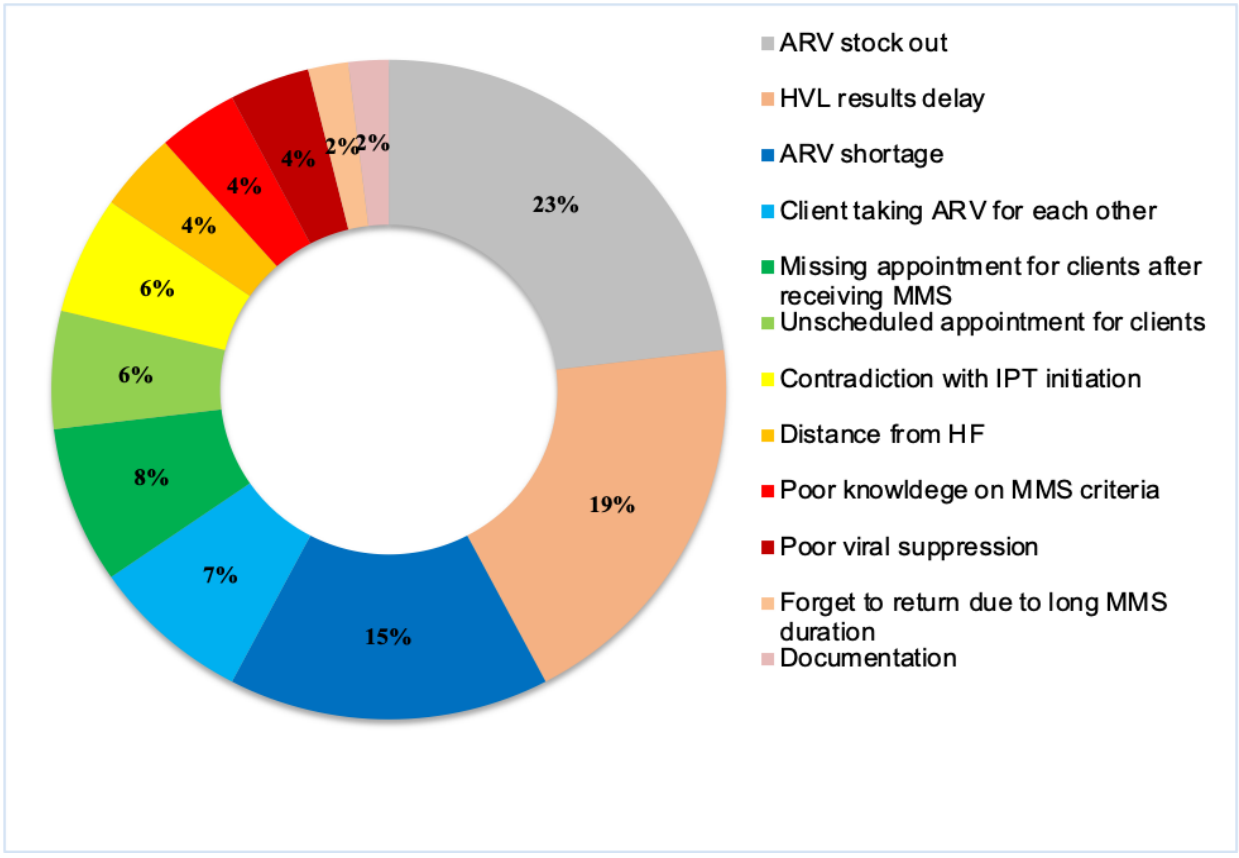


**Figure 1. Facility Challenges Affecting Implementation of MMD**

This was corroborated by the qualitative findings whereas one of the key informants had the following excerpt to comment.

*"…Some of the clients do not prefer seen carrying the pills. This brings some challenges. The major challenge was however a shortage of supply after a while supply increased and things become better…" (Key Informant NJ1 from Njombe).*

Following ARV's stock out, the quantity of drugs dispensed to clients is reduced to ensure continuity of services so that all clients get ARV medication during their visits. This was evidently captured during an interview with key informant from Njombe and Mtwara who had the following to say.

*"Anything good must have challenges, one of the challenges that we have met is sometimes we are out of stock for some of the regimes, therefore we were supposed to take the client back to the one-month medication system because the stock does not allow…… Some paediatric regimes like ABC/3TC also second-line pills like Lopinavir/ritonavir together with Atazanavir were out of stock. (Key Informant NJ3 from Njombe).*

*"…We look at the available stock and decide to go back to one-month dispensing system so that all the clients will be able to get the pills…. When the supply is full, stable the client would receive the three-month pills…" (Key Informant MT2 from Mtwara).*

Thus, ARVs supply capacity depended on the capacity of the health facility to make an order to MSD. Health facilities to be able to have a stock to serve their client they should make an order based on the site category i.e., ordering site/non-ordering site.

*"…CTC receives ARVs in two different ways, first there are those centres that they order directly from MSD (mother sites). We currently have four health facilities that order direct from MSD therefore MSD sends to them directly. But we also have other health facilities that are non-ordering sites, which receive their ARVs through ordering facilities that order directly to MSD." (Key Informant NJ1 from Njombe.*

The absence of persistent supply to the facilities makes it hard to serve all the targeted community as per the government guideline; hence the client cannot have a clear understanding regarding their clinic appointments. This was likely to interfere with their daily schedules as they must do more clinic visits. Especially when they are given pills for one month instead of three months or more.

> *"…we have met with low supply of the ARVs., Although we order the amount of the medicines required, but we receive less the amount ordered, this forces us to make more emergency order and sometimes we are told MSD is out of stock and we are forced to wait until they arrive. (Key Informant IR2 from Iringa).*

The problem of ARV ordering and stock-outs is attributed to several bottlenecks. This can be viewed from the comment made by one of the key informants.

> *"…The challenge that we have is the geographical location of our district and the infrastructure, it hinders the distribution of ARVs that is why you may find ordering site mother sites cannot help non-ordering site…" (Key Informant IR1 from Iringa).*

Nevertheless, due to poor geographical location and not meeting criteria for the site to place ARV's orders directly from MSD some of the non-ordering sites find different means to solve challenges they encounter. This includes the use of motorcycles to carry some of the pills from the mother sites. The below quotation justifies this.

> *"…what we are doing to rescue the situation, the non-ordering sites come with motorcycle to pick the pills for their sites…Because of the motorcycle capacity, they just take a little and when they are out of stock again motorcycle is sent again to collect from the mother site or if there is any car that it pass-by will collect for them…" (Key Informant NJ1 from Njombe).*

***Shelf Life of Existing Stock***

Visual inspection for the shelf life of ARV medicines is normally done prior to dispensing them to the needy clients so that medicines do not expire before being consumed by the client. The study found that with the current package of default first-line ARV, healthcare providers are supposed to open the package and repackage pills to clients to reach the number of required days which can be consumed before expiry, as the packages are fixed with 90 pills each. The below excerpt describes this more clearly.

> *"…the challenge led us to open the packs using First Expiry First Out (FEFO) approach, then we start counting the pills enough to be consumed by clients before expiry. However, quality of pills can be compromised since they are not stored in their original containers…" (Interview with Key Informant IR2 from Iringa).*

To countercheck, the setback raised by ARV's shelf life was done by facility by ensuring management of medication with short expiration dates. This was done by providing ARV

medication with a short shelf life to clients who are not under MMD service and those with long expiration duration to MMD clients. This was narrated by one of the key informants who offered the following excerpt.

> *…You may find you have batches of pills some of them last for a long period of time when some are for a short period of time therefore for the short life span pills, we give them to the patient who fall under the short period of time like those who are new clients. A patient who falls under three months period and stable patient we give them pills that have longer life span…"(Interview with Key Informant IR2 from Iringa).*

**Discussion**

The finding of the study established that supply chain factors are very important in promoting the effective implementation of MMD. The supply chain ensures the availability of ARV at all-time based on the requirement of the facility. This is the first step to ensure that the facility does not have ARV stock out. The study found that it is paramount for the facilities first to understand the standard setup to provide ARVs with a main focus on stable clients. To do so, healthcare providers have to assess the clients' criteria for MMD and make the projection of required ARV medications. A study in Ethiopia, on the supply chain management performance of HIV/ AIDS commodities and factors affecting it, corroborate these findings, narrating that a health commodity inventory control system has been important to maintain appropriate stock levels (11). In another study, it was reported that lack of proper supply chain pre-planning and stock-outs could interfere with the implementation of DSDM such as MMD (12).

The findings of this study pointed out that stock out affected the implementation of MMD at health facilities. Consequently, the lack of sufficient stock to support MMD at health facilities led to healthcare providers' failure to comply with the implementation of MMD. The available drugs will not suffice for all active clients who are on ARV, to be provided with 90 or 180 days pills. However, stock out of ARV's at health facilities is contributed by several other factors, some of which are beyond the capacity of the health facilities. These includes shortages in the national pipeline, long order fulfilment rate such as delays in ordering and or distribution. The study findings showed that some facilities order ARVs directly from MSD; these facilities are termed as mother sites, while other facilities order the ARV drugs from the mother sites. Shortage of ARVs at mother sites will also be reflected at non-ordering sites. In addition, some of the non-ordering sited can experience shortage as a result of failure of

ordering site to deliver ARV's to these sites due to lack of required resources. Therefore, the study established that the solution of running out of ARV stock is to ensure that timely ordering using quality data and whenever need be, redistribution from nearby facilities. Similarly approach has been proposed in Uganda as a means to reduce ARV stockout(13). Supporting ordering sites with resources for distribution of ARV's to non-ordering sites remains of paramount importance, alternatively, non-ordering sites need to be equipped and order directly from MSD. A study in Uganda highlighted ARV stock out as a bottleneck in the implementation of MMD (14). Similarly, findings have been reported regarding HIV service delivery in Liberia, highlighting that, commodity supply chain disruptions are likely to hamper the achievement of the 95 95 95 targets since eligible clients will not receive MMD (15).

Another supply chain factor assessed by the study was the shelf life of ARV drugs. It was noted that the ordering process, storage and package of ARV drugs largely affect the quality of drugs over time. At first, the quality of drug is being affected by the long ordering process ranging from MSD, which order the drugs abroad from the time they reach the country, their life cycle is reduced(16, 17). With ordering of drugs taking a long time, it somehow affects the life cycle of the drug, however, the study found out that providers use First Expiry First Out (FEFO) approach to dispensing ARV drugs to manage the shelf life of the drugs. This finding was consistent with a previous study in Ethiopia which indicated that, due to storage challenges, health facilities manage their ARV stock through adaptation of the FEFO approach(13). Therefore, it is worthwhile for this study to argue that the shelf life of ARV drugs if not managed properly will result in running out of stock of required ARV medication due to expiries.

Poor ordering processes could affect the shelf life of ARV drugs because it takes a period for the drug to reach the facility. This is complemented by a recent study in Ethiopia, which showed that only 30% of health facilities received their ARV drugs orders on time. (11). Again, a review of ARV's procurement and supply chain management ascertained that the average ARV shelf life is usually 24–36 months, a product must arrive in the country within a few months of manufacture; hence manufacturers do not take the risk of keeping goods ready for stock themselves, and most ARVs are 'made to order though this can result in longer lead times and an inability to meet emergency orders (18). Additionally, it was also noted that, shelf life of ARV drugs is being attributed to poor distribution process which take long time for the drugs to reach health facilities (11). A similar finding has been documented elsewhere, such as in Uganda and Malawi (19, 20). Therefore, it is crucial that healthcare providers are provided with appropriate training on the supply chain and distribution of ARV

drugs to clients. This will ensure consistent availability and distribution of ARVs to MMD eligible clients.

In interpreting the results of this study, should be noted that the study was conducted during the COVID-19 outbreak, this might have led to increased number of ineligible clients being put on MMD to reduce congestion at care and treatment clinics. The study was conducted in only six regions of Tanzania, and the sampling frame was based on patient volume and health facility levels. Moreover, trustworthiness of the results of this study was assured through triangulation with respondents from different settings, interviews were conducted by experienced researchers and to the saturation point, we further triangulated qualitative and quantitative results.

## Conclusion

A robust supply chain system is of paramount importance to ensure uninterrupted availability of ARV's for successful implementation of MMD. The current design of the ARV ordering system with ordering and a non-ordering site causes ARV shortages at non-ordering sites due to distribution challenges. Therefore, the supply chain of ARV medications should be thoroughly reviewed to ensure ARV resupply is processed timely for all health facilities to maintain appropriate stock levels. Wherever possible, non-ordering sites should be capacitated to order ARVs directly from MSD. Adhering to criteria for assigning only stable clients to MMD is key in ensuring the forecasted ARV drugs are sufficient. The supply chain of ARV drugs should be prioritized if the achievement of the MMD intervention is to be realized and sustained.

## Abbreviations

| | |
|---|---|
| ADR | Adverse Drug Reaction |
| AIDS | Acquired Immunodeficiency Syndrome |
| ART | Antiretroviral Therapy |
| ARV | Antiretroviral |
| CTC | Care and Treatment Centre |
| HVL | HIV Viral Load |
| MMD | Multi-Month Dispensing |
| OI | Opportunistic Infections |
| PLHIV | People Living with HIV |

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## Declarations

### Competing interests

All authors declare that they have no competing interests.

### Ethical approval and consent to participate

Ethical approval to conduct this study was obtained from MUHAS Senate Research and Publications Committee. A formal written informed consent, in Kiswahili, was used. The informed consent described the purpose of the study, the procedures to be followed, and the benefits of participation. Participants were advised that their participation in this evaluation is voluntary, and they have the right to withdraw from the study at any point in time. For secondary data, confidentiality was maintained by de-identifying all the study data at the end of data collection.

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No funding was received for this study.

### Authors' contributions

GMR and GGM collected all the primary data, conducted the analyses and wrote the first draft. FNN contributed to the research design, interpretation of the results, and writing the manuscript. BCU,IRM MAN contributed interpretation of the results, and writing the manuscript.

**References**

1. **Global HIV & AIDS statistics** — Fact sheet [Internet]. 2021 [cited 08/12/2021]. Available from: https://www.unaids.org/en/resources/fact-sheet.
2. **Global AIDS Monitoring - Country progress report - United Republic of Tanzania** [Internet]. 2020 [cited 08/11/2021]. Available from: https://www.unaids.org/sites/default/files/country/documents/TZA_2020_countryreport.pdf
3. Hagey JM, Li X, Barr-Walker J, Penner J, Kadima J, Oyaro P, et al. **Differentiated HIV care in sub-Saharan Africa: a scoping review to inform antiretroviral therapy provision for stable HIV-infected individuals in Kenya.** AIDS care. 2018;30(12):1477-87.
4. **HIV Service Delivery Models Mapping HIV Service Delivery Strategies in Tanzania** [Internet]. Ministry of Health, Community Development, Gender, Elderly and Children 2017. Available from: https://differentiatedservicedelivery.org/Portals/0/adam/Content/nKMF99s69UqVMa9DJQp96A/File/SDM_Tanzania_Mapping%20Report_04pril2017_FINAL.pdf.
5. Jamieson D, Kellerman SE. **The 90 90 90 strategy to end the HIV Pandemic by 2030: Can the supply chain handle it?** Journal of the international AIDS society. 2016;19(1):20917.
6. Nsanzimana S, Remera E, Ribakare M, Burns T, Dludlu S, Mills EJ, et al. **Phased implementation of spaced clinic visits for stable HIV-positive patients in Rwanda to support Treat All.** Journal of the International AIDS Society. 2017;20:21635.
7. **National Accelerated Action Plan on HIV Testing Services** [Internet]. 2019 [cited 07/12/2021]. Available from: http://www.nacp.go.tz/download/national-accelerated-action-plan-on-hiv-testing-services/.
8. Morse JM. **The significance of saturation.** Sage publications Sage CA: Thousand Oaks, CA; 1995. p. 147-9.
9. Nápoles-Springer AM, Stewart AL. **Overview of qualitative methods in research with diverse populations: Making research reflect the population.** Medical Care. 2006;44(11):S5-S9.
10. Braun V, Clarke V. **Using thematic analysis in psychology.** Qualitative research in psychology. 2006;3(2):77-101.
11. Damtie TA, Ibrahim AJ, Yikna BB. S**upply chain management performance of HIV/AIDS commodities and factors affecting it at health facilities of SNNPRS of**

**Ethiopia; from the perspective of achieving 90-90-90 strategies.** Integrated pharmacy research & practice. 2020;9:11.

12. Roy M, Moore CB, Sikazwe I, Holmes CB. **A review of differentiated service delivery for HIV treatment: effectiveness, mechanisms, targeting, and scale.** Current HIV/AIDS Reports. 2019;16(4):324-34.
13. Gabriel T, Tafesse TB. **Supply Chain Management of Antiretroviral Drugs in Public Health Facilities in Eastern Ethiopia.** Journal of Young Pharmacists. 2017;9(4).
14. Zakumumpa H, Rujumba J, Kwiringira J, Katureebe C, Spicer N. **Understanding implementation barriers in the national scale-up of differentiated ART delivery in Uganda.** BMC Health Services Research. 2020;20(1):222.
15. Adeiza MA, Wachekwa I, Nuta C, Donato S, Koomson F, Whitney J, et al. **Gaps and Opportunities in HIV Service Delivery in High Volume HIV Care Centers in Liberia: Lessons From the Field.** Annals of Global Health. 2021;87(1).
16. Bott RF, Oliveira WP. **Storage conditions for stability testing of pharmaceuticals in hot and humid regions.** Drug development and industrial pharmacy. 2007;33(4):393-401.
17. Foster S, Laing R, Melgaard B, Zaffran M. **Ensuring supplies of appropriate drugs and vaccines.** 2011.
18. Iqbal MJ, Geer MI, Dar PA. M**edicines Management in Hospitals: A Supply Chain Perspective.** Systematic Reviews in Pharmacy. 2017;8(1).
19. Prust ML, Banda CK, Nyirenda R, Chimbwandira F, Kalua T, Jahn A, et al. **Multi-month prescriptions, fast-track refills, and community ART groups: results from a process evaluation in Malawi on using differentiated models of care to achieve national HIV treatment goals.** Journal of the International AIDS Society. 2017;20:21650.
20. Zakumumpa H, Rujumba J, Kwiringira J, Katureebe C, Spicer N. **Understanding implementation barriers in the national scale-up of differentiated ART delivery in Uganda.** BMC health services research. 2020;20(1):1-16.