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# Factors Associated with Viral Load Suppression amongst People Living with HIV on Highly Active Anti-retroviral Therapy [Haart] at Kaloko, Chipulukusu and Kantolomba Art Health Facilities of Ndola District

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***Abstract***

*It is important to monitor HIV clients in ART treatment using viral load testing in an effort to meet the third 95 strategy of UNAIDS 95-95-95, which is viral load suppression. The target "95-95-95" strategy is expected to be achieved by 2030. Unfortunately, there is insufficient regional data, especially in the third "95". Screening for viral load in low- and middle-income countries allows VLS monitoring of individual categories and demographics, necessary to achieve global epidemic control. The aim of this study was to find progress in the three [3] rural health centers in Ndola District on the achievement of VLS among HIV-positive patients on ART and related factors affecting the program. Sociodemography data, including age, gender, drug type and duration of treatment and laboratory variability [current viral load results], were extracted from client records using the SmartCare system. VL suppression and failure are determined using WHO definitions [viral pressure such as viral load <1000 copies/ml and virologic failure ≥1000 copies/ml]. Regular clinic [used as a proxy for adherence to medication and medication] will be defined as monthly clinical access to HAART treatment and other clinical management over the past 12 months.*

***Keywords:*** *ART, HIV, Suppression, SmartCare, Viral load.*

## Introduction

The HIV epidemic has been a major public health concern not only in Africa but also across the world. The World Health Organization [WHO] report has estimated that 37.7 million people were living with HIV by the end of 2020 and that more than 25.4 million of people living with the virus live in the WHO Region [1]. ART therapy has been among the responses to HIV infection epidemic control for people living with HIV, and anti-retroviral drugs (ARVs) remain the only known treatment for HIV in people living with HIV. The combination of ART drugs should be taken daily in a consistent manner in order to achieve viral load suppression [2]. The term "Undetectable viral load" is where HIV copies are less than 50 copies of HIV per milliliter of blood [<50 copies / mL] [3].

The suppressed VL helps ensure that HIV-positive people living with HIV will not transmit HIV sexually even when they fail to take precautionary measures such as wearing condoms, sharing needles, abstinence, or mother-to-child transmission during pregnancy, birth or breastfeeding. [2, 4]. Part of the goal of the Joint United Nations Program on HIV / AIDS [UNAIDS] is to eradicate the HIV / AIDS epidemic by 2030, and that 95.0% of all people receiving anti-retroviral treatment [ART] are virally suppressed [5].

The aim of policymakers in the fight against the HIV epidemic is for everyone living with HIV to have a suppressed viral load, but this is not always possible. Of the people living with HIV in the African Region in 2018, just over half [52.0%] have had a suppressed viral load [6].

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The ZAMPHIA 2016 report revealed that VL suppression in HIV-positive people in Zambia was highest in adults: 73.5% in HIV-positive women and 73.0% in HIV-positive men aged 45 to 59 years. In addition, ZAMPHIA of 2016 revealed that VL suppression is much lower in young adults: 34.0% for HIV-positive women and 35.7% for HIV-positive men aged 15 to 24 years. In addition, ZAMPHIA data for 2016 showed a difference in VL suppression across all administrative provinces, from 50.0% in the Northern Province to 67.0% in the Eastern Province, at 15 to 59 years of age.

Although these statistics show that we are achieving the goal of achieving VL suppression in people living with HIV, the rates are surprisingly low. It is important to investigate the factors that affect the achievement of the goal of finding VL suppression among all people living with the virus and on ART.

Among the things that are believed to be associated with VL pressure are ignorance of HIV status, gender, duration on ART, initial CD4 T cell count, WHO class, type of ART, adherence to treatment, and simultaneous TB infection [8]. In addition, a history of loss of follow-up and educational status, as well as treatment regimens, may have related characteristics [8, 9].

There has been an increase in ART activities in Zambia over the years and VL monitoring is required to evaluate the effectiveness of this program. This study aims to determine the prevalence of VL suppression in some ART centers in Ndola Zambia, namely Chipulukusu, Kaloko and Kantolomba, and testing whether age and gender are associated with VL suppression in these selected ART facilities.

The findings may provide a basis for informing policy and strategies to improve care in Ndola Zambia.

## Problem Statement

Despite gain made towards achieving VL suppression in PLHIV by increasing access to ART, VL suppression remains alarmingly low. Among the PLHIV in the African Region in 2018, only slightly over half [52.0%] had a suppressed viral load [6]. The picture among PLHIV currently on ART is better; for ages 15 to 59 years, PLHIV who self-reported current use of ART, 89.2% are virally suppressed: 89.7% of HIV-positive females and 88.2% of HIV-positive males [7].

With the aim of achieving VL suppression in every patient on ART, the 10.8% overall, 10.3% among HIV-positive females and 11.8% among HIV-negative males represent the population of major concern as they have the potential to trigger an upsurge in transmissions.

The potential for future growth in HIV transmission remains strong if control measures are not put in place. Without appropriate control measures, the affected people will continue to be a source of transmission.

There is need to put in place control measures that would improve outcomes of ART in this population, but the measures need to be based on statistical evidence. Such evidence remains scanty.

This study addressed the problem of scanty information, specifically for the populations served through Chipulukusu, Kaloko and Kantolomba ART clinics.

## Study Justification

The study aims to add to the literature and contribute to public health knowledge by studying factors associated with viral load suppression in a group of ART clients that have been on treatment for more than 6 months at 3 selected rural health facilities in the Ndola District.

It is my hope that the findings of this study will be used to influence policy and, therefore, direct focus on the development of programs and interventions that will encourage people living with HIV / AIDS to achieve and live with undetectable levels of HIV and successful, productive life.

This study also intends to compare factors that contribute to Viral load Suppression

between people living with HIV in Africa and other parts of the world.

## Literature Review

According to a review of the 2019 WHO report, monitoring the HIV response program is important to ensure high-quality care and high clinical outcomes for people living with HIV. Increased monitoring of viral load in the blood plays an important role in monitoring both individual response to anti-retroviral therapy and efficacy in achieving program goals [10]. The main goal for all program owners is for everyone with HIV in their ART program to attain VL suppression.

## Viral Load Testing

In order to have efficient Viral load testing systems; it is important to have quality control systems within the laboratory that requires well-functioning sample referral networks, consistent processes driven by healthcare providers; Quality Data systems, Quality assurance and control as well as improved courier systems and mechanisms to handle specimen collection, a robust Data management and analysis team that can report accurately and allow for a timely interpretation of results by clinical staff.

We have observed that a number of countries are now scaling up viral load testing and tracking of suppressed viral loads among people living with HIV receiving anti-retroviral therapy is cardinal to appreciate whether progress is being made. This requires monitoring and evaluation plans set up that will help to measure the success of the Viral load programme in terms of implementation and clinical outcomes.

Coordination, collaboration and communication is cardinal in routine viral load monitoring and evaluation data and systems. This requires:

1. A well set up laboratory, clinical, and monitoring and evaluation team,
2. Data systems at the facility level, well functioning laboratories and,
3. Efficient data capture as well as monitoring and evaluation tools.

The relevance of robust monitoring and evaluation plans cannot be re-emphasized; these M & E systems require clear data flow that is easy to understand, data elements used in the program, and indicators (and their definitions) for viral load monitoring.

Using viral load data is important for client-level and programme-level decision-making and should be emphasized in monitoring and evaluation plans [10].

UNAIDS has indicated that the global ART expansion has increased the demand for viral load monitoring. In 2018, 23.3 million people were receiving ART, an increase of nearly 200%, compared with 8 million in 2010.

Scale-up of HIV viral load testing during the period of 2013–2018 in eight sub-Saharan African countries reports successful efforts to increase access to viral load monitoring for ART Clients.

Initially, many sub-Saharan African countries were only initiating viral load testing to monitor treatment success. The development to move from using CD4 counts to molecular-based viral load testing as a national strategy required educating health care providers and clients in order to increase the demand for viral load testing, training laboratory personnel in order to improve the quality and efficiency of molecular testing, optimizing the laboratory network, and strengthening clinical services for the effective patient or client management [11].

## Global Perspective

It is reported that 36.9 million people were living with HIV, and only 21.7 million were reported to have received anti-retroviral treatment in 2017. 1.8 million people were diagnosed with HIV, and 1 million died from AIDS-related illnesses. (Acquired Immune Deficiency Syndrome) in 2017 [11].

In July 2021, the WHO Fact Sheet reported that about two-thirds of people living with HIV live in Africa, and despite the benefits of

Antiretroviral Therapy [ART], there is a growing concern for clients experiencing treatment failure.

People living with HIV need continuous HIV care and access to anti-retroviral treatment to stay under constant viral load suppression in order to improve their immune system; reduce the risk of drug resistance and HIV-related disease as well.

## Regional Perspective

In 2019 [12] conducted, a study to evaluate the progress of HIV testing, the researchers examined expansion and activities in eight countries in sub-Saharan Africa [Côte d'Ivoire, Kenya, Lesotho, Malawi, Namibia, South Africa, Tanzania, and Uganda.] during 2013–2018. Data from a preliminary annual progress report for viral load testing in all countries except Lesotho were published in 2015 and 2016. The selection of countries in this report was based on data availability and agreement with the respective ministries of health. Data was collected for each calendar year.

Testing for viral load 6 months after initiation of ART, followed by testing at 12 months and every year thereafter, was prescribed by national guidelines.

Health department officials and CDC program officials collected data from an electronic laboratory system on accumulated clients in ART treatment and also noted the number of ART clients with at least one viral load test result, viral load suppression [defined as less than 1,000 copies of HIV RNA in a sample], and the median transition time from sample collection to the time the sample results are released and received.

Avert figures for 2019 reported that as of early 2019, South Africa showed the largest number of clients receiving ART treatment at 4.57 million among all the countries surveyed; representing about 59% of South Africans living with HIV based on UNAIDS data.

From 2013 to 2018, the number of people receiving anti-retroviral drugs increased by 78% in all eight countries, from 5,190,275 before rising to 9,240,111 in 2018, thus increasing the need for viral load testing.

During this period, the average time it took from sample collection to release of test results was reduced in Kenya to 55.6%, Lesotho to 50%, and Uganda to 22.2%.

In contrast, the transition period increased in Côte d'Ivoire, Namibia, South Africa, and Tanzania, and the transition period in Malawi has not changed [12].

In 2013–2018, the proportion of ART patients with at least one result of a viral load test increased in Côte d'Ivoire [from 3.8% to 74.1%], Kenya [from 8.4% to 85.8% %], Lesotho [from 4.9% to 51.9%], and Malawi [from 6% to 51.3%], Namibia [from 60.5% to 99.9%], and Uganda [ from 4.9% to 89%. South Africa and Tanzania were excluded from the analysis because the 2018 data were only available from January to June.

The viral load rate was ≥80% before the scale-up strategy in only three of the eight countries: Uganda [90%], Malawi [86%], and Tanzania [80%].

At the end of 2018, all countries except Côte d'Ivoire reported viral load suppression of less than or equal to 85%. The highest viral suppression of 94.4% has been reported by Namibia. The largest increase in viral load from 2013 to 2018 occurred in Kenya [40%], followed by Namibia [28%] and Lesotho [24%]; Vl suppression rates rose by <20% in Côte d'Ivoire, South Africa, and Tanzania. The viral load has not changed in Malawi, and in Uganda, the rate has dropped by 2.4%, while the number of viral load tests is increasing [12].

Between 1 October and 15 November 2019, a cross-sectional survey was conducted among 15-49-year-old pregnant women attending antenatal care in 1 589 nationally representative public health facilities in South Africa [13].

Data on anti-retroviral therapy [ART] status, viral load testing, viral load result documentation, and viral suppression were extracted from medical records. Survey-based

logistic regression examined factors associated with coverage of viral load testing. All analyses took into account the survey design.

Of the 8 112 pregnant women who were eligible for a viral load test,905 women were started on antiretroviral drugs during pregnancy and received antiretroviral therapy for at least 3 months, and 7,207 women who started antiretroviral therapy, 81.7% received a viral load test, which is 94.1% of them. The results of the viral load test were recorded in medical records. Among those with the results of a viral load test, 74.1% were infected with the virus. A lower proportion [73.0%] of women who started ART during pregnancy received a viral load test compared to women who started ART before pregnancy [82.8%]. Viral load was low [56.8%] among women who started ART during pregnancy. Viral load was 76.1% in women starting ART before pregnancy. The introduction of ART during pregnancy than before pregnancy was associated with a lower chance of getting a viral load test during pregnancy [altered rate of complications: adjusted odds ratio: 1.6, 95% confidence interval: 1.4-1.8].

Most [81.7%] women received viral load testing, and the results documentation was high [94.1%]. The low viral suppression among pregnant women initiating ART during pregnancy highlights the importance of enhanced adherence counselling and the need to fast-track the roll-out of Dolutegravir to enable the achievement of more rapid viral suppression. The coverage of viral load testing could be improved further by implementing quality improvement initiatives [13].

## Local Perspective

In as much as the success of HIV treatment programs is dependent on retention and viral suppression, routine program monitoring of these outcomes may not be complete.

In July 2015 a study was conducted in Zambia [14] that extracted data from the SmartCare electronic system to collect a large representative cohort of patients on treatment in the region. This study traced a sample of clients with unknown status or lost to follow-up to document true care status and Viral load status.

The study selected health facilities from 4 provinces that were defined by facility type and province with probability proportional to size. In each facility, data was collected on adults with at least 1 clinical visit after treatment initiation in the past 24 months.

Lost-to-follow-up clients, i.e. clients late for 90 or more days late for their last appointment, were identified from a selected random sample, and records were reviewed and traced. Clients were contacted through phone calls and personal home visits in the community.

In 1 of 4 provinces, they also collected dried blood spots [DBSs] for plasma HIV RNA testing. They used inverse probability weights to incorporate sampling outcomes into Aalen-Johansen and Cox proportional hazards regression to estimate retention and viremia. They used a bias analysis approach to correct for the known inaccuracy of plasma HIV RNA levels obtained from DBSs. From a total of 64 facilities with 165,464 adults on ART, they selected 32 facilities with 104,966 patients, of whom 17,602 [17%] were lost to follow-up: Those lost to follow-up had median age 36 years, 60% were female [N = 11,241], they had a median enrollment CD4 count of 220 cells/μl, and 38% had WHO stage 1 clinical disease [N = 10,690].

The researchers traced 2,892 [16%] and found updated outcomes for 2,163 [75%]: 412 [19%] had died, 836 [39%] were alive and in care at their original clinic, 457 [21%] had transferred to a new clinic, 255 [12%] were alive and out of care, and 203 [9%] were alive, but we were unable to determine care status. Estimates using data from the EMR only suggested that 42.7% [95% CI 38.0%-47.1%] of new ART starters and 72.3% [95% CI 71.8%-73.0%] of all ART users were retained at 2 years [14].

After incorporating updated data through tracing, it was found that 77.3% [95% CI 70.5%-

84.0%] of new initiates and 91.2% [95% CI 90.5%-91.8%] of all ART users were retained [at the original clinic or transferred], indicating that routine program data underestimated retention in care markedly.

In Lusaka Province, HIV RNA levels greater than or equal to 1,000 copies/ml were present in 18.1% [95% CI 14.0%-22.3%] of patients in care, 71.3% [95% CI 58.2%-84.4%] of lost patients, and 24.7% [95% CI 21.0%-29.3%]. The main study limitations were imperfect response rates and the use of self-reported care status.

It was concluded that in this region of Zambia, routine program data underestimated retention, and the point prevalence of unsuppressed HIV RNA was high when lost patients were accounted for. Viremia was prevalent among patients who unofficially transferred: Sustained engagement remains a challenge among HIV patients in Zambia, and targeted sampling is an effective strategy to identify such gaps in the care cascade and monitor programmatic progress [14].

## Conceptual Framework

The conceptual framework for this study is based on a study conducted in rural south-western Uganda 2018 by a group of researchers [15]; that assessed associated factors that may lead to virologic failure.

This analysis was based on a conceptual framework which assumed; that ART adherence was independently associated with virological failure. Other confounders included socio-demographic [age, gender, marital status, occupation and level of education], behavioural [alcohol consumption and a number of sexual partners] and biological [body mass index, baseline CD4 counts and baseline VL] risk factors.

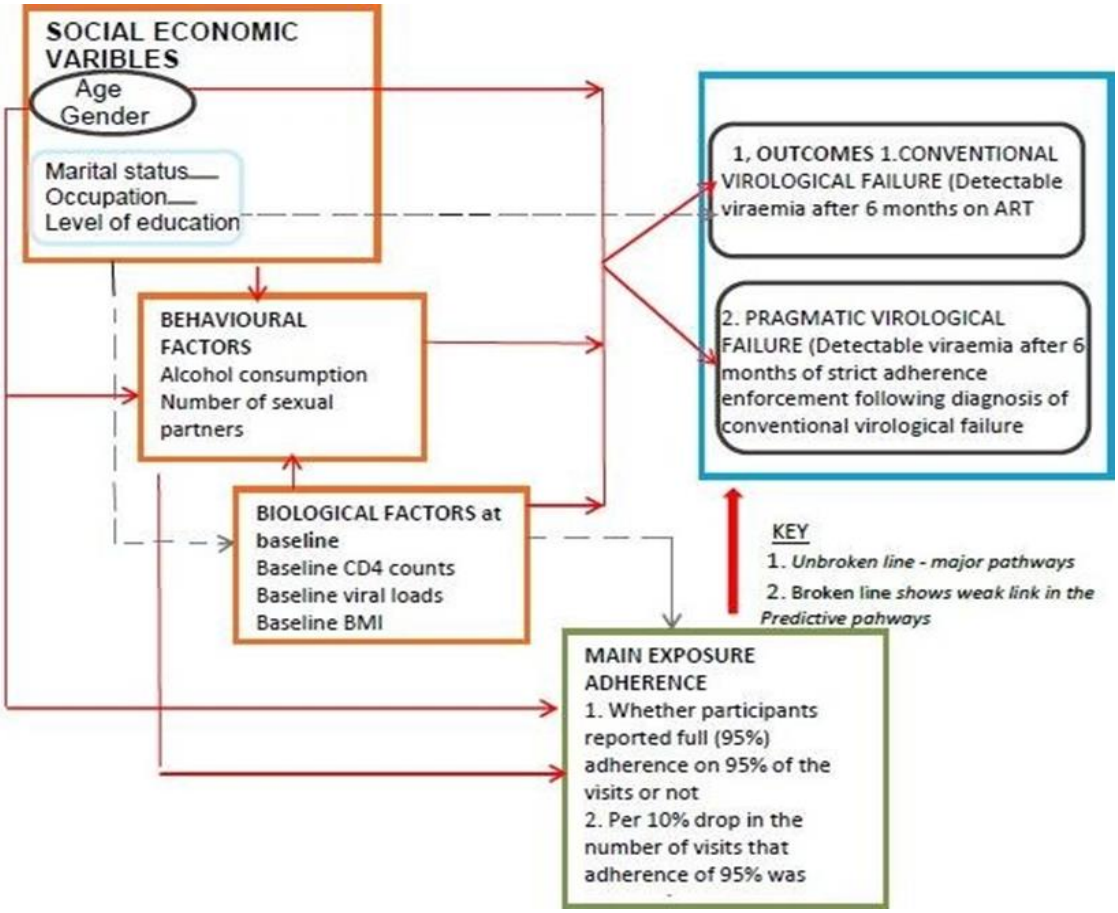


**Figure 1.** Conceptual Framework for Factors associated with Viral Load Failure [15].

To achieve the 95-955-95 treatment target by 2030, the strategy of rolling out viral load testing should be supplemented with innovative adherence enforcement to achieve sustained viral suppression among patients on ART.

This study suggested that more studies are needed to assess the factors responsible for virological failure, as this will help design strategies to address adherence issues and virological failure in different age groups.

This framework was selected for this study because it touches on most aspects that can enhance understanding of factors associated with viral load suppression and guided myself as a researcher in determining the methodology that informing my programmatic considerations in this study.

### Study Objective

To determine viral load suppression amongst people living with HIV on Highly active Anti-retroviral therapy [HAART] at Kaloko ART health facility of Ndola District.

### Specific Objectives

1. Determine the prevalence of VL suppression among clients at Chipulukusu, Kaloko and Kantolomba ART clinics in Ndola, Zambia.
2. Assess the association between viral load suppression and gender amongst clients at Chipulukusu, Kaloko and Kantolomba ART clinics in Ndola, Zambia.
3. Assess the relationship between viral load suppression and age amongst clients at Chipulukusu, Kaloko and Kantolomba ART clinics in Ndola, Zambia.

### Research Questions

1. What is the level of VL suppression among clients at Chipulukusu, Kaloko and Kantolomba ART clinics in Ndola, Zambia?
2. Is there an association between viral load suppression and gender amongst clients at Chipulukusu, Kaloko and Kantolomba ART clinics in Ndola Zambia?
3. Is there an association between viral load suppression and age amongst clients at Chipulukusu, Kaloko and Kantolomba ART clinics in Ndola Zambia.

## Methodology

### Study Design and Setting

This study was a retrospective analysis of SmartCare data from 3 anti-retroviral therapy [ART] clinics in the Ndola district; Chipulukusu, Kaloko and Kantolomba. SmartCare is the national electronic health record system used for data capturing, and information on continued care and treatment for clients on ART can be extracted using this system.

In 2004, SmartCare was developed and deployed by the Ministry of Health in 2004 in partnership with the Centers for Disease Control and Prevention [CDC] and many other implementing partners.

### Study Population

The targeted population for this study were all PLWHIV on ART for at-least 6 months or more at Chipulukusu, Kaloko and Kantolomba clinics.

### Sample Size

The sample size for this study was the total number of PLWHIV registered in the SmartCare system at Chipulukusu, Kaloko and Kantolomba clinics from December 2018 to October 2022.

### Data Collection

The data were abstracted from the SmartCare system using a structured tool capturing values on age, gender, duration on treatment, viral load, and adherence to treatment, appointment keeping and ART regimen of each client.

### Data Management and Cleaning

The data were abstracted from the SmartCare system into Microsoft Excel 2013®, and exported to SAS® version 9.4 for cleaning and statistical analysis. The data were checked for missing values, out of expected range values, period on ART of less than 6 months, and one viral load test in the past 12 months. Records with missing values or out of expected range values were verified against values in clients'

files. Records with a period on ART of less than 6 months or no viral load test in the past 12 months were excluded from the final dataset for statistical analyses.

## Statistical Analyses

The data comprised both continuous and categorical variables. The variables considered as continuous were age, duration on treatment and viral load. The variables considered as categorical were sex and facility.

Age was recorded into programmatically important categories which included the groups 5 to 14, 20 to 34 for Males and 15 to 24 for females. A new variable, suppression status, was defined and recorded. Suppression status 'successful' was defined and recorded as 'Viral load equal to 50 viral copies or less per microliter [ml] after 6 months or more on ART.

Continuous variables were described using means and standard deviations, and medians and range values. Normality of distribution of continuous variables, a prerequisite for use of parametric methods for testing statistical significance of differences in the distributions of continuous variables between groups, was verified using the Shapiro-Wilk's test for normality. Categorical variables were described using frequency and percentage distributions.

Statistical significance of the association between continuous factors and viral load suppression was tested using the parametric two-sample test for difference in the distribution of a continuous variable between being suppressed and non-suppressed with the factor non-normally distributed. The non-parametric Wilcoxon rank-sum test was used to test statistical significance of association between continuous factors and viral load suppression for difference in the distribution of a continuous variable between being suppressed and non-suppressed with the factor non-normally distributed.

Statistical association between categorical factors and viral load suppression was tested using the chi-square, with Yate's correction, test for association between two categorical variables.

## Ethical Considerations [Consent, Confidentiality]

The study adhered to ethics as provided for by Texila American University Research and the National Health Research Authority of Zambia. The author sought approval to carry out the study from Texila American University. A letter of authorization was obtained from Texila American University to carry out the study in the selected district and health facilities.

The approval was then presented to Texila University Ethics Committee and the National Health Research Authority for ethical clearance, which was presented to the selected province and district.

Additionally, all information gathered was handled carefully and stored securely to maintain confidentiality. Client data was de-identified with no use of personal data such as names or ART numbers. All information collected will be treated with confidentiality.

# Results

The study recruited 795 ART clients registered in the SmartCare database for Chipulukusu, Kaloko and Kantolomba clinics for the period 2018 to October 2022. Descriptive statistics for age, duration of treatment and viral load of the recruited clients are shown in Table 1.

**Table 1.** Descriptive Statistics for Age, Duration on Treatment and Viral Load

| Variable | N | Mean | Standard Deviation | Median | Minimum | Maximum |
|---|---|---|---|---|---|---|
| Age | 795 | 37.56 | 10.50 | 37.00 | 5.00 | 72.00 |
| Duration in months | 795 | 6.00 | 0 | 6.00 | 6.00 | 6.00 |
| Last viral load record | 795 | 963.08 | 10,077.98 | 0 | 0 | 223,300.00 |

The age of the recruited clients ranged from 5 to 72 years, with a mean of 37.56 years and standard deviation 10.5 years, and median 37 years. Most of the recruited clients had been on ART for a minimum and maximum period of 6 months. Recorded viral load of the recruited clients ranged from 0 to 223,300 copies per ml, with a mean 963.08 and standard deviation 10,077.98, and a median 0.

Descriptive statistics for sex, dispensation, facility and duration on treatment and viral load are shown in Table 2.

**Table 2.** Descriptive Statistics for Sex, Dispensation, Facility and Viral on Treatment and Viral Load

| Variable | Frequency | Percent | Cumulative Frequency | Cumulative Percent |
|---|---|---|---|---|
| Sex | | | | |
| Female | 513 | 64.53 | 513 | 64.53 |
| Male | 282 | 35.47 | 795 | 100.00 |
| Dispensation | | | | |
| AZT 300 mg BD + 3TC 150 mg BD + LPV/r iii po BD | 2 | 0.25 | 2 | 0.25 |
| TDF 300 mg OD + 3TC 150 mg BD + EFV 600 mg OD | 4 | 0.51 | 6 | 0.76 |
| TDF 300 mg OD + 3TC 300 mg OD + DTG 50 mg OD | 779 | 99.24 | 785 | 100.00 |
| Facility | | | | |
| Kaloko Urban Health Center | 396 | 49.81 | 396 | 49.81 |
| Kantolomba Health Post | 299 | 37.61 | 695 | 87.42 |
| Lubuto Urban Health Center | 100 | 12.58 | 795 | 100.00 |
| Viral suppression | | | | |
| Failed | 74 | 9.31 | 74 | 9.31 |
| Success | 721 | 90.69 | 795 | 90.69 |

Over two-thirds [64.53%] of the recruited clients were female. Almost all [99.25%] ART dispensations were of TDF 300 mg OD + 3TC 300 mg OD + DTG 50 mg OD. At 49.81% and 12.58%, the majority of the recruited clients were from Kaloko Urban Health Center, and the minority were from Chipulukusu Health Center, respectively. Successful viral load suppression had been achieved in over ninety percent [90.69%] of the recruited clients.

Viral load suppression according to age group, sex, dispensed drug and facility is shown in Figure 2, Figure 3, Figure 4, Figure 5 and Table 3. All the recruited clients in age groups 5 to 14 years and 65 and above years [100.00%, 10/10 and 100.00%, 11/11 respectively] had achieved viral load suppression 6 months after initiation on ART. At 86.31%, the lowest level of viral load suppression was achieved among the recruited clients aged 55 to 59 years old. Viral load suppression in the programmatically important age groups of 15 to 24 years and 20 to 34 was 89.83% [53/59] and 90.43% [274/303], respectively.

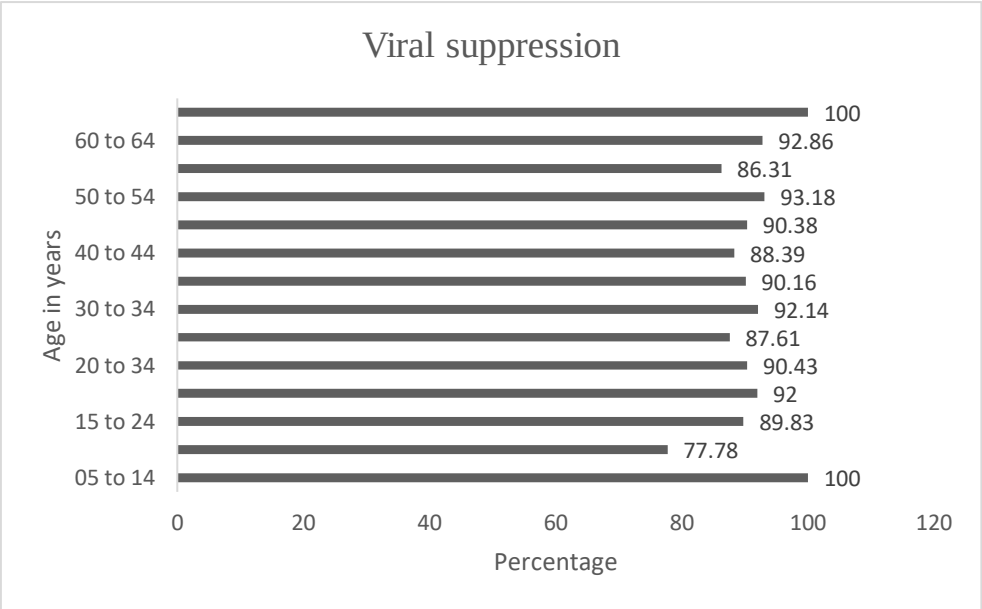


**Figure 2.** Age-Specific Viral Load Suppression

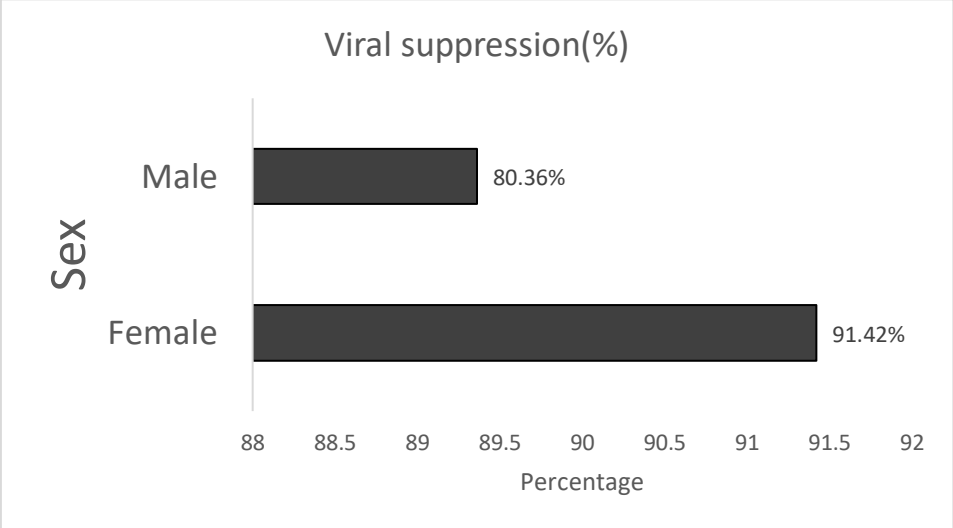


**Figure 3.** Sex-Specific Viral Load Suppression

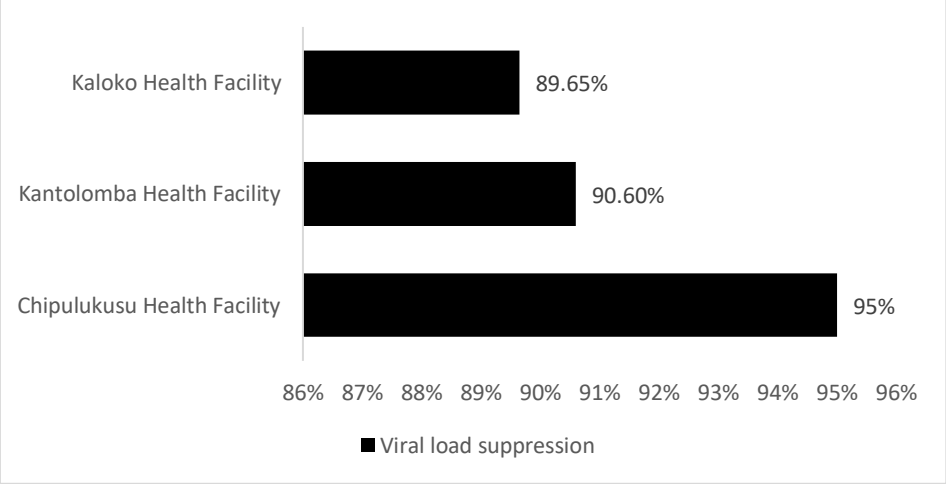


**Figure 4:** Facility Specific Viral Load Suppression

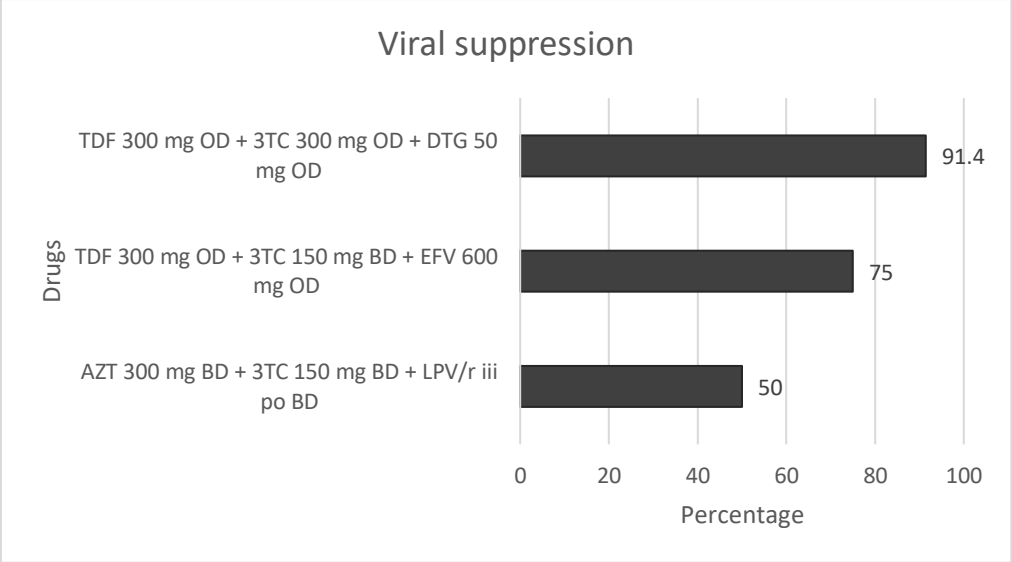


**Figure 5.** Drugs Specific Viral Load Suppression

**Table 3.** Viral Load Suppression according to Age Group, Sex Dispensed Drug and Facility

| **Age group** | **Frequency** | **Percent** | **Percent Viral suppression** |
|---|---|---|---|
| 05 to 14 | 10 | 1.26 | 100.00 |
| 15 to 19 | 9 | 1.13 | 77.78 |
| 15 to 24 | 59 | 7.42 | 89.83 |
| 20 to 24 | 50 | 6.29 | 92.00 |
| 20 to 34 | 303 | 38.11 | 90.43 |
| 25 to 29 | 113 | 14.21 | 87.61 |
| 30 to 34 | 140 | 17.61 | 92.14 |
| 35 to 39 | 166 | 20.88 | 90.16 |
| 40 to 44 | 112 | 14.09 | 88.39 |
| 45 to 49 | 97 | 12.20 | 90.38 |
| 50 to 54 | 44 | 5.53 | 93.18 |
| 55 to 59 | 29 | 3.65 | 86.31 |
| 60 to 64 | 14 | 1.76 | 92.86 |
| 65 and above | 11 | 1.38 | 100.00 |
| Sex | | | |
| Female | 513 | 64.53 | 91.42 |
| Male | 282 | 35.47 | 89.36 |
| Facility | | | |
| Kaloko Urban Health Center | 396 | 49.81 | 89.65 |
| Kantolomba Health Post | 299 | 37.61 | 90.64 |
| Chipulukusu Health Center | 100 | 12.58 | 95.00 |
| Drug dispensed | | | |
| AZT 300 mg BD + 3TC 150 mg BD + LPV/r iii po BD | 2 | 0.25 | 50.00 |
| TDF 300 mg OD + 3TC 150 mg BD + EFV 600 mg OD | 4 | 0.51 | 75.00 |
| TDF 300 mg OD + 3TC 300 mg OD + DTG 50 mg OD | 779 | 99.24 | 91.4 |

Viral load suppression seemed slightly higher among females [91.42%, 469/513] compared to that of males [86.36%, 252/282]. Among the facilities, viral load suppression seemed highest at Chipulukusu Urban Health Center [95.00%, 95/100] and lowest at Kaloko Urban Health Center [89.65%, 365/396]. Comparing viral load suppression among the dispensed drugs, it seemed highest under TDF 300 mg OD + 3TC 300 mg OD + DTG 50 mg OD drug group [99.24%, 712/779].

The distribution of age in the viral load was not normally distributed in both the non-suppressed group [W = 0.37, p-value <0.0001] and the viral load suppressed group. The non-parametric Wilcoxon-sum test for the difference in the distribution of age between viral load non-suppressed group and the viral load suppressed group was not significant [Z = 28208.50, p-value = 0.5084]. Therefore, Age was not among the statistically significant factors associated with viral load suppression.

Association of sex and facility with viral suppression were also non-statistically significant [chi-square = 0.9003, p-value = 0.3427 and chi-square = 5.5139, p-value = 0.1390 respectively]. The association of dispensation with viral suppression was statistically significant chi-square = 2.1885, p-value = 0.0189]. As such, drug dispensed was the statistically significant factor found to be associated with viral load suppression among the recruited clients and the collected factors from the SmartCare database.

## Discussion

The majority [64.53%] of the recruited clients in this study were female. This may mean, on one hand, that females constitute a bigger proportion of PLHIV in populations served by Chipulukusu, Kaloko and Kantolomba ART clinics of Ndola Zambia than males. Such a conclusion would be in line with the national sex-specific prevalences and the region prevalences that pit prevalences in females to be higher than those in males [7, 16, 17]. This, on the other hand, may mean that more HIV-positive females access ART clinics more than their male counterparts. Such a conclusion would be consistent with findings by Ankomah et al [2016] that female clients are more willing and do access ART clinics than males [18]. Either way, measures have to be taken that reduce infections in both females and males, but more in females, and that increase males to be tested and access ART services.

The average and median age in this study were 37.7 and 37.0 years, respectively, suggesting that a relatively young age group of the population is accessing ART. All the ART clients included in this study had been on treatment for a minimum and maximum period of 6 months. As such, ART initiation has been done at a relatively young age which is good because older age at ART initiation has been shown in other studies, such as one by Ssebetride et al 2018 to be associated with a higher risk of mortality compared to younger age [19].

VL suppression was found to be 90.69% overall. The observed viral suppression in this study is comparable to the national level of 89.2% reported in the Zambia Population-based HIV Impact Assessment [ZAMPHIA] [7]. Observed VL suppression seemed higher in females than in males [91.4% vs 89.4%]. This is consistence with the reported sex-specific national levels of 89.7% in HIV-positive females and 88.2% in HIV-positive males. However, these figures fall short of the target 95.00% to 100.00%.

Looking at age specific VL suppression, all the youngest age groups [5 to 14 years] and the old age group of 65 years and above had attained a suppressed VL. This is particularly important and encouraging as these two age groups are assumed to have the weakest immunity and are more vulnerable to anti retral viral resistance [20], morbidities and hence moratlity especially if VL is not suppressed among them. VL suppression levels were found relatively high but still short of the 95% to 100% programmatic target. This is concerning as the age group

constitutes the active population who are very likely to transmit the virus if the VL is not suppressed.

Many challenges comprise the factors that hinder the achievement of a 95% to 100% VL suppression. As shown in other studies, among the factors that are associated with VL suppression are not knowing HIV status, gender, time on ART, baseline CD4 T cell count, WHO stage, ART regimen, adherence, and TB co-infection [8]. Others are young age, low hemoglobin, history of lost to follow-up and educational status, and treatment regimen [8,9]. This study only considered age, sex, facility, and treatment reagimen. Only treatment reagimen was found significantly associated with VL suppression. The analysis had been restricted to ART clients who had been on HAART for not less and not more than 6 months. This may have controlled the effects of the other factors as their variations may not have been so much due to the short time period of exposure to HAART.

## Conclusion and Recommendations

## Conclusions

In Chipulukusu, Kaloko and Kantolomba ART clinics in Ndola Zambia:

1. VL suppression is high but still below target.
2. HIV-positive females access ART clinics more than their male counterparts.
3. Age and sex are not associated with VL suppression.

### Recommendations

1. Efforts to increase VL suppression should be expanded.
2. Efforts targeted at increasing access to ART by males should be expanded.
3. Efforts to increase suppression among the highly active age groups should be expanded, and those addressing the vulnerable young and old age groups sustained.

## Limitations

This is a retrospective study of secondary data. As such, the data was not designed to specifically address the objectives of the current study, and this may be the reason that age and sex, factors found to be significantly associated with VL suppression in other studies, may not have been found significant in this study. However, the descriptive part was consistent with findings from the other studies. This suggests clinical significance, implying that the seen differences between age groups or gender in VL suppression levels is clinically important, and it is possible that clinical practice can change because of the seen differences despite statistical significance.

## Conflict of Interest Statement

I certify that I have no affiliations with or involved in any organization or entity with any financial interest or non- financial interest [such as personal or professional relationships or affiliations] in the materials discussed in this manuscript.


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