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ANALYSIS OF VIROLOGICAL MONITORING AND VIRAL LOAD RETENTION AMONG PEOPLE LIVING WITH HIV AT THE LABORATOIRE D'ANALYSES MÉDICALES MALAGASY FROM 2022 TO 2024

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ABSTRACT

Introduction: HIV infection remains a major global public health issue. Although Madagascar has a low HIV prevalence (0.3%), biological monitoring remains challenging. Viral load is the key indicator of antiretroviral treatment effectiveness. **Objective:** To evaluate baseline viral load and virological retention among people living with HIV in order to assess treatment performance. **Methods:** A retrospective descriptive study was conducted at the Laboratoire d' Analyses Médicales Malagasy (LA2M) using records of patients who underwent HIV viral load testing between February 2022 and February 2024. Exhaustive sampling was used. **Results:** A total of 4,964 records were included, predominantly men (59.83%) and individuals aged 25–49 years (67.6%). Routine follow-up was the main reason for testing (62.8%), and the TDF/3TC/DTG treatment was the most prescribed (82.30%). Viral suppression rates (<1000 copies/ml) were high: 88.1% after 6 months of ART, 89.4% after 12 months, and 90.6% during routine follow-up. **Conclusion:** Most people living with HIV achieved and maintained an undetectable viral load, reflecting satisfactory effectiveness of antiretroviral therapy and the relevance of biological monitoring at the national level. Strengthening regular viral load monitoring and improving result transmission are recommended for sustainable epidemic control.

Keywords: HIV, viral load, virological suppression, antiretroviral therapy.

INTRODUCTION

HIV infection remains a major global public health concern. According to UNAIDS, approximately 39 million people were living with HIV in 2023, nearly two-thirds of whom were in sub-Saharan Africa. In Madagascar, HIV prevalence remains low at approximately 0.3%, but biological monitoring of infected patients remains a challenge. Viral load corresponds to the quantification of HIV RNA in plasma. An undetectable viral load reflects good adherence to treatment. The World Health Organization (WHO) recommends viral load testing six months after initiation of antiretroviral therapy (ART), followed by annual routine monitoring. In Madagascar, this activity is carried out by the Laboratoire d'Analyses Médicales Malagasy (LA2M). The main objective of this study was to evaluate baseline viral load and virological retention among PLHIV in order to assess treatment performance.

The specifics objectives were to:

- Describe the sociodemographic characteristics of people living with HIV (PLHIV).
- Identify the base line HIV viral load among PLHIV.
- Assess HIV viral load retention among PLHIV during follow-up

METHODS

This retrospective descriptive study was conducted at the Service de Surveillance Bactériologie Surveillance–Virologie et Parasitologie (SSBSVP) of the Laboratoire d'Analyses Médicales Malagasy (LA2M), Antananarivo, Madagascar, which operates under the central Directorate of the Ministry of Public Health. The study covered the period from February 2022 to February 2024.

Complete records of patients of all ages who underwent HIV viral load testing at LA2M were included. Incomplete records and duplicate files were excluded, using exhaustive sampling. Data were collected from HIV viral load request forms, entered into the HORUS database software, and subsequently exported to Excel. The dataset was cleaned by removing duplicates and reviewing missing information.

The variables analyzed included HIV viral load, sociodemographic characteristics (age, sex, origin, pregnancy status), reason for testing, treatment regimen, and viral load retention. Data entry and statistical analysis were performed using Epi Info software version 7.2. Quantitative variables were expressed as mean ± standard deviation, while qualitative variables were presented as percentages.

This study was conducted after obtaining favorable approval and authorization from the relevant hierarchical authorities, with strict adherence to confidentiality and anonymity of patient data.

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RESULTS

Sociodemographic Characteristics

Gender

During this study, 4,964 records were included. Men accounted for 2,970 cases (59.83%), while women represented 1,994 cases (40.17%). The sex ratio was 1.4.

Age group

The most represented age group was 25–49 years, accounting for 67.6% of participants (n = 3,457), followed by the 15–24 years age group, representing 14.4% of cases. The meanage of participants was 34.4 years.

Place of origin

Region	Percentage (%)	Number of Cases
Analamanga	49.9	2,482
Atsinanana	23.1	—
Diana	5.4	—
Boeny	5.1	—
Haute Matsiatra	3.2	—
Atsimo-Andrefana	3.8	—
Menabe	2.7	—
Sava	2.7	—
Anosy	1.9	—
Vakinankaratra	1.6	—
Vatovavy-Fitovinany	0.2	—
Other regions	0.39	—

Pregnancy status

In this population, 0.74% of people living with HIV (PLHIV) were pregnant women, corresponding to 37 cases.

Reason for requesting the test

Most viral load measurements were performed as part of routine follow-up, involving 2,780 patients, which represented 62.8% of the study population. Other reasons for viral load testing included pre-treatment assessment (25.37%), testing at 6 months after initiation of antiretroviral therapy (ART) (8.4%), testing at 12 months after ART initiation (3.34%), and suspected treatment failure (0.09%).

Type of ART regimen received

The TDF/3TC/DTG regimen was the most commonly prescribed, involving 3,186 patients, corresponding to 82.30% of the sample, followed by 3TC/TDF/EFV in 10.98% of cases, while other regimens accounted for 6.72%.

Initial HIV Viral Load of PLHIV

Regarding HIV viral load measurement prior to the initiation of antiretroviral therapy (ART), 31.4% of patients had an initial viral load of less than 1,000 copies/mL (n = 370), while the remaining patients presented with a viral load greater than 1,000 copies/mL (Figure 1).

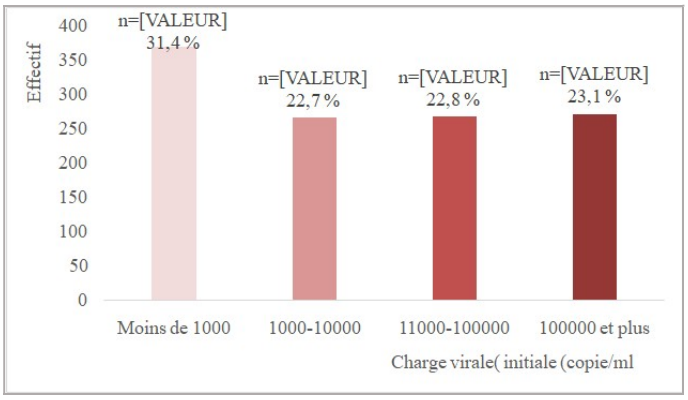

Figure 1: Distribution of PLHIV according to Initial Viral Load Between 2022 and 2024

Retention of HIV Viral Load Monitoring Among PLHIV

- **HIV viral load of PLHIV after 6 months of ART initiation**

After six months of treatment, 88.1% of patients (n = 357) had a viral load below 1,000 copies/mL, representing the most frequent category.

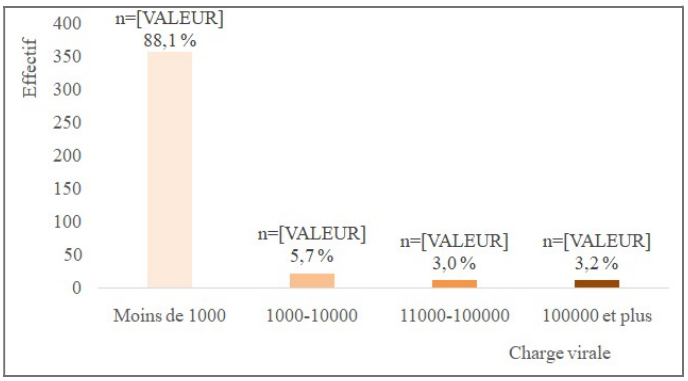

Figure 2: Distribution of PLHIV according to viral load after 6 months of treatment

- **HIV Viral Load Among PLHIV After 12 Months of ARV Treatment Initiation**

One year after the initiation of antiretroviral (ARV) treatment, 89.4% of PLHIV maintained a viral load below 1000 copies/mL (n = 143).

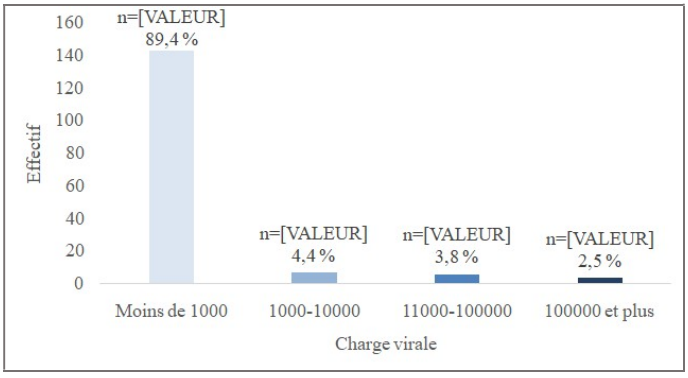

Figure 3: Distribution of PLHIV according to viral load after 12 months of treatment

- **Routine HIV Viral Load Monitoring**

During routine follow-up, 2,535 (90.6%) PLHIV had a viral load below 1000 copies/mL

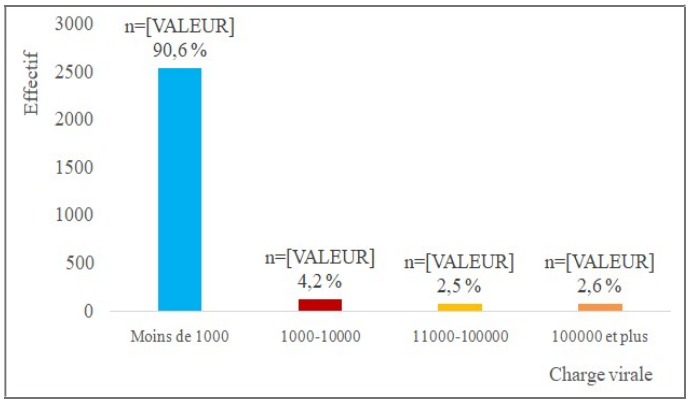

Figure 4: Distribution of PLHIV According to Routine Viral Load

DISCUSSION

Sociodemographic Data

In this study, a sex ratio of 1.4 was observed. This result is consistent with a previous study conducted in Antananarivo [5], but differs from findings reported in several Sub-Saharan African countries [6].

The most affected age group was 25–49 years, which aligns with multiple reports in the literature [7–11]. This age range corresponds to the period of greatest socioeconomic and sexual activity, which may explain the higher prevalence observed.

Most patients originated from the Analamanga region, followed by the Atsinanana region. This distribution may be explained by the location of the testing laboratory in Analamanga, which facilitates sample transportation compared with more remote regions. It may also reflect the high population density and increased mobility within the region [12].

In this series, 0.74% of people living with HIV (PLHIV) were pregnant women. This figure is slightly higher than official estimates for Madagascar reported by UNAIDS/RFI, which place the prevalence at approximately 0.4% [1,14].

Routine follow-up was the main reason for requesting viral load testing, consistent with international recommendations that emphasize regular virological monitoring as the primary indication [15].

The TDF/3TC/DTG regimen (Tenofovir, Lamivudine, Dolutegravir) was the most commonly used. This reflects the adoption of this protocol as the first-line treatment in Madagascar following WHO recommendations. Similar findings were reported by Raberahona *et al.,* (2024) [5]. This regimen is preferred due to its good tolerability, strong virological efficacy, and favorable resistance profile [15]. Furthermore, a study by Zuma *et al.,* (2023) in Southern Africa demonstrated that the introduction of Dolutegravir significantly improved viral suppression across several countries [13].

Initial HIV Viral Load Among PLHIV

In this study, 31.4% of cases presented with an initial viral load below 1000 copies/mL. This findingis consistent with several international studies, namely 35% according to Zhou *et al.,* (2022) and 30% according to Robb *et al.,* (2016) **[17].**

Ali *et al.,* (2019) indicated that the lower the initial viral load, the faster viral suppression is achieved **[18].** This highlights the importance of performing an initial viral load test before the initiation of antiretroviral (ARV) treatment.

HIV viral load retention among PLHIV

- **HIV viral load among PLHIV after 6 months of ARV treatmentinitiation**

After six months of antiretroviral (ARV) treatment initiation, 88.1% of patients achieved a viral load below 1000 copies/mL, indicating a favorable virological response to therapy. This finding is consistent with studies conducted in Ethiopia, which reported 86% viral suppression [18], and in Uganda, where 84.2% suppression at six months was observed [19]. Such outcomes may be explained by effective patient follow-up and adherence to ARV treatment.

However, this result differs from a study conducted in Nigeria, which reported a lower suppression rate of 76.4% at six months [20]. This discrepancy may be attributed to treatment interruptions or poor adherence to therapy.

These findings underscore the importance of close monitoring and therapeutic support in achieving treatment success, defined by the World Health Organization (WHO) as an HIV viral load below 1000 copies/mL. Overall, the results of this study demonstrate satisfactory effectiveness of ARV treatment among patients followed at LA2M.

- **HIV viral loadamong PLHIV after 12 months of ARV treatmentinitiation**

After twelve months of antiretroviral treatment initiation, 89.4% of patients achieved a viral load below 1000 copies/mL, reflecting sustained improvement in treatment effectiveness. This finding is comparable to studies conducted in Uganda and Ethiopia, which reported viral suppression rates at 12 months of 90.2% and 88.6%, respectively.

These similarities suggest that the treatment effectiveness observed in our study is consistent with outcomes reported in other African settings where regular virological monitoring is implemented. The results demonstrate sustained virological suppression at 12 months in Madagascar, aligning with regional trends.

In contrast, a study conducted in South Africa reported a slightly lower suppression rate of 82.5%, attributed to treatment interruptions and loss to follow-up. This underscores the critical importance of maintaining treatment adherence and ensuring systematic biological monitoring to achieve optimal outcomes.

- **HIV viral loadamong PLHIV duringroutine follow-up**

In this study, 90.6% of people living with HIV (PLHIV) achieved a viral load below 1000 copies/mL during routine follow-up, indicating satisfactory virological suppression in the vast majority of patients tested at LA2M.

Comparable findings have been reported in several studies, including 95% in the study by Hurisa et al. (2024) [22], 89.9% in the study by Koné et al. (2024) [23], and 90% in the study by Marty et al. (2022) [11]. These comparisons confirm the consistency of our results with international standards, despite contextual differences in healthcare infrastructure.

Limitations and Recommendations

This study highlights the overall satisfactory performance of virological monitoring at LA2M, while also underscoring certain short comings related to accessibility and continuity of follow-up. The main limitations include the retrospective design, the monocentric nature of the study, and the absence of specific assessment of risk factors associated with non-suppression of viral load (>1000 copies/mL).

Based on these findings, it is recommended to streng then the regularity of viral load monitoring among people living with HIV, intensify awareness and adherence-support interventions for antiretroviral therapy, and promote prospective multicenter studies to optimize patient management and contribute to the long-term control of HIV infection in Madagascar. Further more, conducting a case-control study is advised to identify the risk factors associated with virological failure (>1000 copies/mL).

CONCLUSION

This study assessed HIV viral load among people living with HIV to enhance patient management and care. A total of 4,964 patients were included, with males accounting for 59.83% and the majority (67.6%) belonging to the 25–49-year age group. Routine follow-up was the primary reason for viral load testing (62.8%), and the most frequently prescribed treatment regimen was TDF/3TC/DTG (82.30%).

The findings demonstrated high rates of viral suppression (<1000 copies/mL), with 88.1% at 6 months, 89.4% at 12 months, and 90.6% during routine follow-up. These results highlight the strong effectiveness of antiretroviral therapy and indicate satisfactory treatment adherence among most patients.

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