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Reasons for failure to suppress viral load in patients undergoing antiretroviral therapy

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Abstract

Background: Suppressing viral load (VL) is a primary goal of antiretroviral therapy (ART), both for the health of individuals living with HIV and to reduce transmission. However, in the Democratic Republic of Congo (DRC), a significant number of patients do not reach this threshold, which compromises the health gains that have been made.

This study aims to explore the factors underlying this failure at the HIV/AIDS Center of Excellence at the University of Lubumbashi.

Methods: A rétrospective cross-sectional study was conducted among 144 patients who had been on ART for six months. The data collected included sociodemographic, clinical (viral load, co-infections), behavioral (adherence), and structural (access to care) variables. Statistical analyses, including logistic regression, were used to identify factors associated with non-suppressed viral load (≥1000 copies/ml).

Results: The prevalence of non-suppression was 34%. The most significant factors were poor adherence (OR = 3.2), living in a rural area (OR = 2.0), and co-infection with tuberculosis (OR = 1.8).

Conclusion: The causes of viral non-suppression are multiple and interdependent. They involve treatment adherence, geographical inequalities, and the management of co-infections. Integrated approaches adapted to the Congolese context are imperative if the UNAIDS 95-95-95 targets are to be achieved.

Keywords: HIV/AIDS; Viral Load; Treatment Adherence; Rural Areas; Tuberculosis Co-Infection

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1. Introduction

1.1. Background and rationale

The fight against HIV/AIDS today is based on a fundamental objective: to achieve sustained viral load suppression in patients receiving antiretroviral therapy (ART). This suppression, defined as a viral load (VL) below 1,000 copies/ml, not only improves patients' quality of life and life expectancy, but also significantly reduces the risk of transmission. However, in resource-limited settings such as the Democratic Republic of Congo (DRC), this goal remains out of reach for a worrying number of patients.

At the Center of Excellence for the Care of People Living with HIV/AIDS at the University of Lubumbashi, as everywhere else in the Democratic Republic of Congo, care is limited by a health system facing multiple challenges: restricted access to biological follow-up tests, glaring socioeconomic disparities, persistent stigma, and insufficient treatment adherence.

Globally, human immunodeficiency virus (HIV) remains one of the major public health problems. According to the latest UNAIDS report, approximately 39 million people were living with HIV in 2023, nearly two-thirds of whom were in sub-Saharan Africa (UNAIDS, 2023). Thanks to the expansion of ART, HIV-related mortality and morbidity have declined significantly, but the pandemic persists due to uneven coverage, the emergence of resistance, and, above all, the difficulty of maintaining optimal treatment adherence (WHO, 2022).

In the DRC, HIV prevalence is estimated at around 1.2% among adults aged 15 to 49 (PNLS, 2022). The country has adopted the recommendations of the World Health Organization (WHO) and the National HIV/AIDS Control Program (PNLS), which advocate early initiation of ART and systematic monitoring of viral load to assess therapeutic response (WHO, 2021; PNLS, 2022). However, challenges remain: low screening coverage, stockouts, geographical disparities, and poor adherence. In Lubumbashi, the country's second largest city, these difficulties are exacerbated by rapid population growth and the coexistence of urban and rural areas with very contrasting health realities (Mulenga et al., 2020).

Adherence to treatment is a key determinant of virological suppression. Adherence of ≥95% has long been considered necessary to achieve sustained suppression, although some recent studies suggest that current regimens may tolerate slightly lower levels (Bangsberg et al., 2018; Ortego et al., 2021). In the DRC, poor adherence remains one of the main determinants of treatment failure, particularly among young people and patients living in rural areas (Kayembe et al., 2019). Several tools are available to assess adherence, including the Morisky Medication Adherence Scale (MMAS-8), which is widely used in clinical research and allows patients to be classified as having high, moderate, or low treatment adherence (Morisky et al., 2008).

Opportunistic infections (OIs), including tuberculosis, viral hepatitis, and cryptococcosis, remain a significant cause of morbidity and mortality in patients living with HIV, particularly when viral load remains detectable (Mfinanga et al., 2020). Their occurrence is also an indirect indicator of the level of treatment adherence and the effectiveness of treatment.

In this context, it is essential to assess the factors associated with viral non-suppression in order to guide appropriate interventions. Very few local studies have documented the prevalence of non-suppression and its causes in Lubumbashi, particularly taking into account treatment adherence, opportunistic infections, and differences between urban and rural areas.

Objective of the study

The objective of this study is to analyze the causes of non-suppression of viral load in people living with HIV followed at the Center of Excellence for the Care of People Living with HIV/AIDS at the University of Lubumbashi, with a particular focus on the role of treatment adherence (measured by the MMAS-8), opportunistic infections, and geographical disparities (urban vs. rural).

2. Methodology

2.1. Type of study

This is a retrospective cross-sectional study conducted at the Center of Excellence for the Care of People Living with HIV/AIDS at the University of Lubumbashi from January 2023 to June 2024. Data were obtained from clinical records, pharmaceutical registers, and laboratory files.

2.2. Population and study setting

The study focused on patients living with HIV who were receiving outpatient care at the Center of Excellence for the Care of People Living with HIV/AIDS.

Inclusion criteria: patients aged 18 years or older, on antiretroviral therapy (ART) for 6 months, with at least one viral load test performed in the six months prior to data collection.

Exclusion criteria: patients transferred to the Center of Excellence with incomplete records and those for whom viral load or adherence data were not available.

The city of Lubumbashi is administratively subdivided into seven urban communes (Lubumbashi, Kenya, Katiba, Ruashi, Annexed, Kamal Ondo, and Kampe Mba). In this study, patients residing in these communes were classified as urban. Patients residing in surrounding towns and villages (Kazumasa, Kanushi, Kofuku, Kiloweber, Fulgurate, and other rural areas outside the municipal boundaries of Lubumbashi) were classified as rural/peripheral. This distinction was made based on the addresses mentioned in the files and confirmed by the geographical distance from the Center of Excellence (≤10 km = urban, >10 km = rural/peripheral).

2.3. Sample size and sampling

The minimum sample size was calculated using Cochran's formula, considering an expected non-suppression prevalence of 25%, a precision of 5%, and an α risk of 5%. The calculation yielded a minimum sample size of 144 patients. Proportional stratified sampling was applied, taking into account gender and area of residence (urban vs. rural).

2.4. Variables and operational definitions

Viral load (VL): suppression defined as VL < 1000 copies/ml, and non-suppression as VL > 1000 copies/ml, in accordance with the recommendations of the WHO and the National AIDS Control Program (PNLS/DRC, latest version 2023).

Therapeutic compliance (adherence): assessed using the Morisky Medication Adherence Scale (MMAS-8). The scores were used to classify patients into three categories:

- High treatment adherence: ≥95% or high MMAS-8 score;
- Moderate treatment adherence: 80–94% or intermediate MMAS-8 score;
- Low medication adherence: <80% or low MMAS-8 score.
- This categorization was used to interpret the results in the tables.

Socioeconomic status (SES): measured by the simplified socioeconomic scale adapted from the DHS/WAMI index (see Appendix).

Distance from residence: classified into three categories (≤5 km, 6–15 km, >15 km from the center of excellence for care).

Opportunistic infections (OIs): included tuberculosis, viral hepatitis B and C, cryptococcosis, candidiasis, pneumocystis, and Kaposi's sarcoma, according to diagnoses recorded in medical records.

2.5. Data collection

- A standardized questionnaire was developed for data extraction. The following variables were collected:
- sociodemographic characteristics (age, sex, municipality/place of residence, distance to the center, socioeconomic status),
- clinical data (date of ART initiation, treatment regimen, opportunistic infections, comorbidities),
- laboratory results (viral load, co-infections),
- pharmacological data (stockouts, number of pills dispensed, treatment adherence assessed by MMAS-8).
- All data were anonymized prior to analysis.

2.6. Statistical analysis

Data were entered and analyzed using SPSS v.25. Quantitative variables were presented as means ± standard deviation or medians (IQR). Qualitative variables were expressed as frequencies and percentages.

Comparison between patients with suppressed and unsuppressed CV: Chi^2 or Fisher's tests for qualitative variables, Student's or Mann-Whitney tests for quantitative variables.

Factors associated with non-removal: multivariate logistic regression, with presentation of adjusted odds ratios (aOR) and 95% CI.

2.7. Ethical considerations

The study was approved by the Ethics Committee of the University of Lubumbashi (approval number to be specified). Patient anonymity was guaranteed and the data were used strictly for scientific purposes.

3. Results

3.1. Sociodemographic characteristics

Table 1 Distribution of patients according to sociodemographic characteristics

Variables	**N**	**%**
Gendre		
Male	55	38.2
Féale	89	61.8
Age (Yeats)		
< 25	22	15.3
25–39	68	47.2
≥ 40	54	37.5
Area of résidence		
Urban municipalistes	102	70.8
Périphérie/rural areas	42	29.2
Distance frome home to center		
≤ 5 km	48	33.3
6–15 km	60	41.7
> 15 km	36	25.0
Socioéconomique statuts		
High	22	15.3
Medium	64	44.4
Low	58	40.3

The majority of patients were women (61.8%). The average age was 34 ± 11 years. Nearly 30% lived in rural or outlying areas of Lubumbashi. Half lived more than 6 km from the center, reflecting potential accessibility issues.

3.2. Treatment adherence (MMAS-8)

Table 2 Distribution of patients according to level of adherence

Therapeutae adherence	N	%
High (≥ 95%)	63	43.8
Moderato (80–94%)	26	18.0
Low (<80%)	55	38.2

Nearly 4 out of 10 patients had low adherence (38.2%). Women were slightly more adherent than men, but the difference was not statistically significant.

3.3. Prevalence of viral non-suppression

Table 3 Virological status of patients (N = 144)

Viral lad	N	%
Suppression (<1000 copies/ML)	95	66.0
Non-suppression (≥ 1000 copies/ML)	49	34.0

The prevalence of non-suppression was 34%. This proportion was higher among patients living in rural areas (45%) than among those in urban areas (29%), and among patients with poor adherence (61%).

3.4. Opportunistic infections (OIs)

Table 4 Distribution of opportunistic infections (N = 144)

Opportunistic infection	n	% of total
Tuberculosis	28	19.4
Hepatitis B	6	4.2
Hepatitis C	3	2.1
Cryptococcosis	2	1.4
Candidiasis	7	4.9
Kaposi's sarcoma	1	0.7
Other financial institutions	47	32.6
Absence of OIs	50	34.7

More than one-third of patients (32.6%) had other opportunistic infections, predominantly tuberculosis (19.4%) followed by candidiasis (4.9%). The presence of opportunistic infection was strongly associated with non-viral suppression.

3.5. Factors associated with non-suppression

Table 5 Factors associated with non-suppression (multivariate analysis)

Factor	ORA	95% CI	P-value
Poor compliance	3.8	1.9 – 7.6	< 0.001
Rural/périphérie area	2.2	1.1 – 4.5	0.030
Présence of IO	3.1	1.5 – 6.5	0.002
Distance > 15 km	1.9	0.9 – 4.0	0.070
Male	1.2	0.6 – 2.4	0.520

Factors independently associated with non-suppression were: poor adherence (ORA = 3.8; p < 0.001), rural/peripheral residence (Ora = 2.2; p = 0.03), and the presence of opportunistic infections (ORA = 3.1; p = 0.002). Male gender and distance >15 km were not statistically associated after adjustment.

4. Discussion

This study, conducted among patients followed at the HIV/AIDS Center of Excellence at the University of Lubumbashi in Lubumbashi, showed a high prevalence of viral non-suppression (34%). Although lower than some national estimates, this proportion remains a concern as it compromises the achievement of the UNAIDS 95-95-95 strategy targets. Three main determinants emerged: poor treatment adherence, residence in rural/peripheral areas, and the presence of opportunistic infections (OIs).

4.1. Treatment adherence and viral suppression

Our study confirmed the central role of adherence in treatment success. Patients with poor treatment adherence were nearly four times more likely to have viral suppression failure. This finding is consistent with the results of Byrd et al. (2019), who demonstrated that adherence ≥95% is associated with suppression rates above 90%. Similarly, Mugavero et al. (2013) showed that even short interruptions in treatment could lead to virological rebound and promote the emergence of resistance.

Several African studies confirm these results. In Kenya, Kiwanuka et al. (2018) observed a 28% non-suppression rate among patients with low treatment adherence. In Tanzania, Kossaibati et al. (2020) reported similar results, emphasizing the need for close monitoring of young patients and pregnant women. In South Africa, Boulle et al. (2016) pointed out that improving adherence could halve the risk of treatment failure.

The use of the MMAS-8 in our study, although subject to reporting bias, remains relevant. This tool has shown good psychometric properties in various contexts (Morisky et al., 2008; De las Cuevas et al., 2016). However, to strengthen validity, it would be desirable to combine this scale with objective methods such as pill counting, direct observation, or pharmacy dispensing data.

4.2. Opportunistic infections and virological failure

Opportunistic infections (OIs) remain common despite increased access to antiretroviral treatment. In our sample, one-third of patients had at least one OI, with tuberculosis being the most common. This result is not surprising: tuberculosis remains the leading cause of morbidity and mortality among people living with HIV in sub-Saharan Africa due to the destruction of the immune system by the virus. P(WHO, 2021; Eholié et al., 2019).

The association between IO and virological non-suppression is well documented. In Zambia, Siyumbwa et al. (2017) reported that patients co-infected with tuberculosis were twice as likely to experience treatment failure. Similarly, Mutembo et al. (2019) in the DRC confirmed the significance of HIV-viral hepatitis co-infection in virological failure. Our results are consistent with this, showing that the presence of an IO tripled the risk of non-suppression.

Beyond pathophysiology (reduced immunity, drug interactions, cumulative toxicity), OIs are also an indirect marker of poor adherence or delayed treatment. Early identification and systematic management of OIs must therefore be integrated into patient follow-up, in addition to virological monitoring.

4.3. Influence of area of residence and accessibility

Residence in rural or peripheral areas emerged as an independent factor for non-suppression. Patients living outside the urban areas of Lubumbashi had a twofold higher risk of virological failure. This finding reflects unequal access to care. Indeed, in outlying areas (Kazumasa, Kanushi, Fulgurate, etc.), there are fewer healthcare facilities, some of which lack specialized HIV services, and transportation costs are a major barrier.

These results are consistent with those of Kipp et al. (2018) in Uganda, who showed that the distance between home and the treatment center is a major determinant of adherence. Similarly, Nasuni et al. (2020) reported that patients living more than 15 km from a healthcare center were twice as likely to fail to achieve viral suppression. In South Africa, Fatty et al. (2018) confirmed the effectiveness of community-based models in reducing this gap.

In Lubumbashi, where urban growth is rapid and poorly planned, the boundary between urban and rural areas is sometimes blurred. However, our results emphasize that geographical proximity to the treatment center remains a major asset. The decentralization of HIV services to peripheral areas therefore appears to be a priority in order to reduce the inequalities observed.

4.4. DRC/PNLS context and practical implications

The DRC has committed to implementing the recommendations of the WHO and the PNLS, in particular early initiation of treatment and systematic monitoring of viral load (PNLS, 2023). However, several obstacles remain: shortages of reagents, delays in reporting viral load results, and a shortage of qualified human resources. These constraints limit the country's ability to achieve its suppression targets.

In this context, our findings call for targeted interventions. First, strengthening psychosocial support for patients is essential to improve treatment adherence. Community-based approaches involving peer educators and patient associations have proven effective in southern Africa (Bemelmans et al., 2014; Boerma et al., 2017). Second, decentralization of HIV services is essential to reduce geographical disparities. The Malawian experience has shown that satellite clinics and community-based dispensing models significantly improve retention and virological suppression.

Finally, the fight against opportunistic infections must remain a priority. Systematic screening for tuberculosis and viral hepatitis, combined with early treatment, can improve survival and reduce treatment failure. This is in line with international recommendations for an integrated approach to the management of HIV and opportunistic infections.

4.5. Strengths and limitations of the study

This study has several strengths. It includes a representative sample of patients followed up at a referral center and, for the first time, distinguishes between patients residing in urban areas and those in the outlying areas of Lubumbashi. It combines clinical, biological, and socioeconomic assessments, providing a holistic view of the determinants of non-suppression.

However, certain limitations should be highlighted. First, the assessment of adherence using the MMAS-8 is based on self-reporting, which is subject to social desirability bias. Second, OIs were identified from clinical records, which may lead to underestimation, particularly for poorly documented infections (cryptococcosis, pneumocystosis). Third, the retrospective nature of the study limits the availability of certain contextual data, such as stigma, family support, or psychoactive substance use.

Despite these limitations, our results provide relevant information for policymakers and clinicians, highlighting priority areas: improving adherence, decentralizing care, and strengthening the fight against OIs.

In summary, viral suppression remains low in Lubumbashi, mainly due to poor treatment adherence, geographical disparities, and the persistence of opportunistic infections. Our results are consistent with those reported in other African contexts, but highlight local specificities, particularly the urban-rural divide. Improving treatment adherence, decentralizing services, and systematically managing opportunistic infections are essential levers for achieving the objectives of the PNLS and UNAIDS.

5. Conclusion

This study conducted at the Lubumbashi HIV/AIDS Center of Excellence reveals that more than one-third of patients on antiretroviral treatment have virological non-suppression, reflecting the persistent challenges in achieving the 95-95-95 strategy targets. Three major determinants have been identified: poor treatment adherence, residence in rural or peripheral areas, and the presence of opportunistic infections, foremost among which is tuberculosis.

These results confirm that the fight against HIV cannot be limited to the provision of antiretroviral drugs. It must include strategies to strengthen treatment adherence, in particular through sustained psychosocial support and greater community involvement. Similarly, the decentralization of care to peripheral areas appears essential to reduce geographical inequalities and ensure equitable care. Finally, prevention, early detection, and appropriate treatment of opportunistic infections must remain priorities that are inseparable from virological monitoring.

Beyond these findings, our study highlights the need for an integrated and multidimensional approach, combining clinical, community, and policy efforts. Strengthening virological surveillance, continuing education for healthcare providers, and securing supplies of drugs and reagents must remain at the heart of interventions. This is the price that the Democratic Republic of Congo, and in particular the Lubumbashi region, must pay in order to progress towards optimal virological suppression, which will ensure a lasting improvement in the quality of life of people living with HIV and a tangible reduction in virus transmission.

Compliance with ethical standards

Disclosure of conflict of interest

The authors declare that they have no conflict of interest to disclose.

Statement of informed consent

Written informed consent was obtained from all individual participants and/or their legal guardians prior to inclusion

in the study.

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Appendix A: Treatment adherence questionnaire (MMAS-8, adapted French version)

Title: Morisky Medication Adherence Scale – 8 items (MMAS-8)

Original reference: Morisky, D. E., Ang, A., Krousel-Wood, M., & Ward, H. J. (2008). Predictive validity of a medication adherence measure in hypertension. Journal of Clinical Hypertension, 10(5), 348–354.

Instructions to the patient

"The following questions are about how you take your medication. Please answer honestly; your answers will remain confidential and will only be used to improve your care. Answer Yes or No, unless otherwise indicated."

Questionnaire items

1. You sometimes forget to take your medication.

☐ Yes ☐ No

2. In the last few days, have you forgotten to take a dose of your medication?

☐ Yes ☐ No

3. When you feel better, do you sometimes stop taking your medication?

☐ Yes ☐ No

4. When you feel worse after taking your medication, do you sometimes stop taking it?

☐ Yes ☐ No

5. Do you ever neglect or delay taking your medication?

☐ Yes ☐ No

6. When traveling or away from home, do you sometimes forget to take your medication with you?

☐ Yes ☐ No

7. Did you take all your medication as prescribed yesterday?

☐ Yes ☐ No

8. How often do you have trouble remembering to take your medication?

☐ Never ☐ Rarely ☐ Sometimes ☐ Often ☐ Always

Scoring

- Each "Yes" answer = 1 point (except for question 7, where "No" = 1 point).
- Question 8: scale from 0 (never) to 1 (always), with intermediate scores.
- Total score: 0 to 8 points.

Interpretation

- Score 8: High compliance.
- Score 6 to 7: Moderate compliance.
- Score < 6: Low compliance.