

# A STUDY ON THE OUTCOME OF ENHANCED ADHERENCE COUNSELING AMONG UNSUPPRESSED HIV CLIENTS IN BENUE STATE.

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## ABSTRACT

**Background:** According to the WHO estimation, up to 70% of patients with an initial high viral load will be virally suppressed following an adherence intervention. In Benue State, very limited studies have been done that show the viral load suppression following enhanced adherence counselling (EAC). This study assesses viral suppression after enhanced adherence counselling and its predictors among unsuppressed HIV seropositive people in the State.

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**Method:** This was a cross-sectional descriptive study of all HIV-infected people with a viral load greater than 1000 copies/ml after 6 months on HAART as of December 2022, in Benue State. Patients with VL  $\geq$  1000 copies/ml were expected to receive EAC and have a repeat VL after three months of good adherence. Six months following the documented unsuppressed result, we determined: the viral load suppression rate after EAC, the time to commencement of EAC, the time to repeat the viral load test after EAC, and the predictors of viral load suppression among high viral load HIV seropositive people on ART.

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**Result:** Of the 234,185 PLHIV on ART between December 2022 and July 2023, up to 210,514 (89.9%) did viral load testing and 9194 (3.9%) had VL >1000 copies/ml. Of these 9,194 unsuppressed PLHIV, EAC uptake was 90.3% (n=8,307), EAC completion rate was 62.5% (n=5,220), and viral suppression rate following EAC was 93.8% (4897/5220). The probability of viral load suppression was higher among PLHIV who have been on treatment for less than 5 years were more likely to achieve viral suppression.

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**Conclusion:** This study showed that the full potential of EAC to achieve viral load suppression has not been fully utilized. There were major gaps in EAC enrolment and

**Comment [U12]:** what did the study show about achieving viral suppression with EAC?

completion of EAC. The reasons for his gaps need to be identified and addressed to optimize the benefits of EAC.

**Keywords:** People living with HIV, Enhanced adherence counselling, unsuppressed viral load

## 1.0 INTRODUCTION

Nigeria currently ranks fourth in the world regarding the HIV burden.[1] Nigeria has a generalized HIV epidemic with the highest HIV burden in the West and Central African sub-region.[1] The country has an estimated 1.8 million people living with HIV (PLHIV).[1] However, only 81% of PLHIV on treatment were virally suppressed.[2] Benue State has the second highest prevalence and burden of HIV in Nigeria with an HIV prevalence of 4.8% giving an estimated burden of 184,745 people living with HIV.[2]

**Comment [U13]:** Include the date

The Joint United Nations Program on HIV/AIDS (UNAIDS) targets for 2025 aim for 95% of those living with HIV to know their status, 95% of those who know their status to be on treatment, and 95% of those on treatment to be virally suppressed- popularly referred to as the 95-95-95 target.[3] Monitoring people on ART is essential to ensure successful treatment, identify adherence challenges, and diagnose treatment failure.[4,5] The World Health Organization (WHO) recommended as the gold standard, the use of viral load testing to evaluate patient's responses to ART. [4]

The Federal Ministry of Health of Nigeria (FMOH) recommended that all HIV/AIDS clients initiating ART should have viral load determined 6 months following initiation of therapy and every 12 months after that.[5] If the VL is  $\geq 1000$  copies/ml, the patient should receive enhanced adherence counselling (EAC) and have a repeat VL only after three months of good adherence.[5] Unsuppressed viral load is inimical to the epidemiologic control of HIV/AIDS as it aids transmission, and has been associated with increased morbidity due to opportunistic

**Comment [U14]:** Include the timing for children

**Comment [U15]:** Can also occur due to organ damage/failure

infections (OIs) thus resulting in a rise in mortality. [6,7] Poor adherence is a common reason for treatment failure [8–10] and as such, the WHO recommends enhanced adherence counselling sessions for 3–6 months for people with high viral load.

Enhanced adherence counseling (EAC) involves a structured assessment of the current level of adherence, exploration of specific barriers contributing to poor adherence, identification of potential solutions to address barriers, and joint development of an individualized adherence interventional plan. [5] According to the WHO estimation, up to 70 % of patients with an initial high viral load (greater than 1000 copies/ml) will be virally suppressed following an adherence intervention.[4] Enhanced adherence counselling is effective in achieving viral load resuppression in virally unsuppressed clients and thus prevents antiretroviral drug switch.[11,12]

**Comment [U16]:** Treatment failure and the need for antiretroviral switch

A retrospective cross-sectional study to evaluate the virologic suppression rate among patients on ART for  $\geq 6$  months in five hospitals in Haiti, obtained a viral load suppression rate of 25.1% following intensified adherence counseling.[13] The study identified that patients with poor adherence, males, and those having been on ART for 24- 35 months were all significantly less likely to achieve virologic suppression. Compared with a descriptive study of patients on antiretroviral therapy in Swaziland, it obtained a viral load suppression rate after EAC of 54%.[14] The study identified that children, adolescents, and those with advanced disease were most likely to have high viral loads and least likely to achieve viral suppression at retesting. However, an institutional-based retrospective study among people living with HIV in Zimbabwe obtained a viral load suppression rate of 31.2% among 489 enrolled in EAC which is similar to the study in Haiti.[15] The viral load suppression rate was low despite 83% of the patients attending three EAC sessions. The study ascribed the low rate to several gaps in routine viral load testing, enrolment into EAC, and repeat viral load testing. A retrospective follow-up study among 346 HIV-positive adults enrolled in EAC

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**Comment [U19]:** What about enrolment and retesting affected viral suppression?

in a high caseload facility in the West Gojjam zone, Ethiopia, obtained a viral load suppression rate of 51.73%.[16] The study identified that the average time to commence EAC and to complete EAC following a high viral load result is 8 weeks and 13 weeks respectively. Gender, educational status, residence, baseline CD4 count, first viral load count, and baseline adherence level were significantly associated with viral load suppression.

A similar study among 235 randomly selected HIV seropositive people in public hospitals in the North Wollo Zone of Ethiopia obtained a viral load suppression rate of 66.4%.[17] The study found that being female; CD4 count  $\geq 350$  cells/mm<sup>3</sup> and absence of recurrent opportunistic infections were independent predictors of viral load suppression after enhanced adherence counseling.

In Nigeria, very limited studies have been done that show viral load suppression following EAC.[12,18] A retrospective review of the electronic medical record of people living with HIV across 22 comprehensive health facilities in Akwa Ibom, Nigeria, obtained a viral load suppression rate after EAC of 73.8% from 3088 patients enrolled in EAC.[19] In this study, 94.8% (3088/3257) of the unsuppressed clients were enrolled in EAC of whom 53.1% (1728/3257) started EAC within one month of the documented unsuppressed results and 81.5% (2517/3088) completed their EAC sessions. Overall, 75.9% (2344/3088) of the patients enrolled in EAC received post-EAC VL tests within 6 months from the documented results.[12]

The study identified that a major gap in the EAC cascade was the low completion of EAC. Furthermore, individuals who had been on antiretroviral therapy for less than 12 months and those who completed EAC within 3 months demonstrated a reduced likelihood of persistent viremia.

A descriptive cross-sectional study of patient records carried out among patients on highly active antiretroviral therapy (HAART), at the Infectious Disease Institute, College of Medicine, University of Ibadan, revealed a viral load suppression rate of 51.0% following EAC among 400 unsuppressed patients.[18] The study identified that adolescents and young adults have a greater risk of virologic failure as they face multiple social, psychological, and adherence challenges that increase their susceptibility to failure to suppress.

**Comment [U20]:** Replace with...achieve viral suppression

No research has been done in Benue state that assessed viral load suppression following EAC and its predictors among unsuppressed HIV seropositive people. The findings of this research will help the Federal Ministry of Health of Nigeria and other stakeholders assess the progress in the implementation of the national guidelines on EAC and improve the patient's health outcomes. This study aims to determine the viral load suppression rate after enhanced adherence counseling and its predictors among unsuppressed HIV seropositive people in Benue state, the time to commence EAC after the unsuppressed VL result, and to estimate the time to repeat the viral load test after EAC.

## 2.0 METHODOLOGY

### 2.1. STUDY SETTING

Benue State lies within the lower river Benue Trough in Nigeria's North-central region. The state has 23 local government areas (LGAs).[20]It shares boundaries with five other States: Nassarawa to the north, Taraba to the east, Cross-River to the south, Enugu to the southwest, and Kogi to the west. The State shares a common boundary with the Republic of Cameroon on the southeast. Benue State has a population of 4,253,641 people [21] and occupies a landmass of 33,955 square kilometers.[20]

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AIDS Public Health Initiative, supported by the US President's Emergency Plan for AIDS Relief (PEPFAR) through the Centers for Disease Control and Prevention (CDC) supports the government of Nigeria to address HIV/AIDS and other diseases of public health importance. In Benue State, APIN supports the provision of HIV/AIDS services to over 264 health facilities across 23 local government areas (LGAs).

## 2.2. STUDY POPULATION

All HIV-infected people who have a viral load greater than 1000 copies/ml after 6 months of antiretroviral therapy in December 2022 in Benue state, Nigeria.

## 2.3. ELIGIBILITY CRITERIA

### 2.3.1 INCLUSION CRITERIA

All HIV-infected people with a viral load greater than 1000 copies/ml with repeat viral load results after complete enhanced adherence counselling sessions in Benue state, Nigeria.

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### 2.3.2. EXCLUSION CRITERIA

All HIV-infected people who were on antiretroviral therapy for less than 6 months and those who did not start EAC sessions.

**Comment [U23]:** Were clients who did not complete EAC included in the study?

Patients with missing ART information.

Patients with erroneous viral load data or conflicting information.

## 2.4 STUDY DESIGN

Cross-sectional descriptive study.

## 2.5 DATA COLLECTION

A total sampling of medical records of all those with VL  $\geq$  1000cp/ml who were active and receiving ART from the Laboratory Information Management System (LIMS). Relevant

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individual patient sociodemographic and clinic data were abstracted from the patient ART care card/ folder and EAC registers. Sociodemographic characteristics consist of sex and age. The clinical characteristics analyzed include the duration of ART (calculated as the difference between the ART start date and the date of the last clinic visit), EAC enrolment, and time to EAC completion as “within 3 months” and “after 3 months” based on the national ART treatment guidelines.[5]

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## 2.6 DATA MANAGEMENT

Data were cleaned and consistency checks were done severally to ensure accuracy and completeness. The data were analyzed using Statistical Package for Social Science version 20.0 for Windows (SPSS Inc., Chicago, Illinois). Descriptive statistics and frequencies were used to describe the characteristics of the study participants. Multivariable logistic regression analysis was employed to determine factors associated with EAC enrolment, EAC completion, and persistent VL unsuppression (post-EAC VL >1000 copies/mL). Adjusted odds ratios and 95% CIs were reported. The statistically significant differences for quantitative data will be evaluated by chi-squared statistics with significant association ( $P > .05$ ).

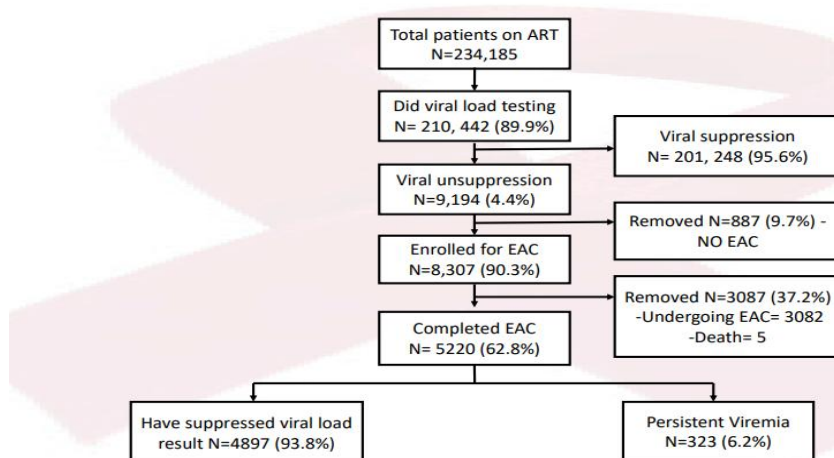
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## 2.7 ETHICAL CONSIDERATION

The Research Ethics Committee (REC) of the Benue State Ministry of Health approved this study. (Approval Ref #: MOH/STA/204/1/279). As the study would require no direct contact with the human participants and would utilize de-identified program data, the ethics gave a waiver from obtaining informed consent from the study participants. All data collected in this study were kept confidential and only the study investigators had access to the individual patient data.

### 3.0 RESULTS



**Figure 1.**

**Baseline characteristics of study participants:** A total of 234,185 PLHIV were receiving ART care in Benue State as of December 2022. Of these, 210,442 (89.9%) had undergone viral load testing and of those tested, 9,194 (3.9%) had unsuppressed viral load at the start of the study. 6,203 (67.5%) are females. The mean age of the study participants was 34.6 ( $\pm 34.55$ SD). The majority 4,861 (52.9%) of the participants receive treatment in health facilities with less than 1000 people on ART, and 5753 (62.6%) have been treated for less than 5 years. 5,223 (56.8%) commence EAC within 1 month. At baseline, most, 8168 (77.1%) participants were staged in WHO clinical stage 1, and 2472 (26.9%) had a CD4 count above 200 cells/ $\mu$ l. (Table 1).

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## Outcomes for patients with unsuppressed viral load

### EAC enrolment

Of the 9,194 (3.9%) with unsuppressed viral load, 8,307 (90.3%) were enrolled for EAC “Figure 1”. EAC enrolment was 90.7% among males and 96.3% among the age group 0- 9 years. EAC enrolment across the facilities was 91.6% in facilities with more than 1000 people on ART and 91.5% among clients that have been on ART for over 5 years. EAC enrolment was 90.4% among participants who were WHO clinical stage 1. In multivariable analysis to determine factors associated with EAC enrolment, those above 20 years were more likely to be enrolled in EAC (20-29years, aOR= 4.46; 95%CI, 1.05-18.85; *P*= following the documented unsuppressed result, we determined: the viral load suppression rate after EAC, the time to commencement of EAC, the time to repeat the viral load test after EAC, and the predictors of viral load suppression among high viral load HIV seropositive people on ART.

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**Result:** Of the 234,185 PLHIV on ART between December 2022 and July 2023, up to 210, 514 (89.9%) did viral load testing and 9194 (3.9%) had VL >1000 copies/ml. Of these 9,194 unsuppressed PLHIV, EAC uptake was 90.3% (n=8,307), EAC completion rate was 62.5% (n=5,220), and viral suppression rate following EAC was 93.8% (4897/5220). The probability of viral load suppression was higher among PLHIV who have been on treatment for less than 5 years were more likely to achieve viral suppression.

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Comment [U40]: what did the study show about achieving viral suppression with EAC?

**Conclusion:** This study showed that the full potential of EAC to achieve viral load suppression has not been fully utilized. There were major gaps in EAC enrolment and completion of EAC. The reasons for his gaps need to be identified and addressed to optimize the benefits of EAC.

**Keywords:** People living with HIV, Enhanced adherence counselling, unsuppressed viral load

## 1.0 INTRODUCTION

Nigeria currently ranks fourth in the world regarding the HIV burden.[1] Nigeria has a generalized HIV epidemic with the highest HIV burden in the West and Central African sub-region.[1] The country has an estimated 1.8 million people living with HIV (PLHIV).[1] However, only 81% of PLHIV on treatment were virally suppressed.[2] Benue State has the second highest prevalence and burden of HIV in Nigeria with an HIV prevalence of 4.8% giving an estimated burden of 184,745 people living with HIV.[2]

**Comment [U41]:** Include the date

The Joint United Nations Program on HIV/AIDS (UNAIDS) targets for 2025 aim for 95% of those living with HIV to know their status, 95% of those who know their status to be on treatment, and 95% of those on treatment to be virally suppressed- popularly referred to as the 95-95-95 target.[3] Monitoring people on ART is essential to ensure successful treatment, identify adherence challenges, and diagnose treatment failure.[4,5] The World Health Organization (WHO) recommended as the gold standard, the use of viral load testing to evaluate patient's responses to ART. [4]

The Federal Ministry of Health of Nigeria (FMOH) recommended that all HIV/AIDS clients initiating ART should have viral load determined 6 months following initiation of therapy and every 12 months after that.[5] If the VL is  $\geq 1000$  copies/ml, the patient should receive enhanced adherence counselling (EAC) and have a repeat VL only after three months of good adherence.[5] Unsuppressed viral load is inimical to the epidemiologic control of HIV/AIDS as it aids transmission, and has been associated with increased morbidity due to opportunistic infections (OIs) thus resulting in a rise in mortality. [6,7] Poor adherence is a common reason for treatment failure [8–10] and as such, the WHO recommends enhanced adherence counselling sessions for 3–6 months for people with high viral load.

**Comment [U42]:** Include the timing for children

**Comment [U43]:** Can also occur due to organ damage/failure

Enhanced adherence counseling (EAC) involves a structured assessment of the current level of adherence, exploration of specific barriers contributing to poor adherence, identification of potential solutions to address barriers, and joint development of an individualized adherence interventional plan. [5] According to the WHO estimation, up to 70 % of patients with an initial high viral load (greater than 1000 copies/ml) will be virally suppressed following an adherence intervention.[4] Enhanced adherence counselling is effective in achieving viral load resuppression in virally unsuppressed clients and thus prevents antiretroviral drug switch.[11,12]

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Gender, educational status, residence, baseline CD4 count, first viral load count, and baseline adherence level were significantly associated with viral load suppression.

A similar study among 235 randomly selected HIV seropositive people in public hospitals in the North Wollo Zone of Ethiopia obtained a viral load suppression rate of 66.4%. [17] The study found that being female; CD4 count  $\geq 350$  cells/mm<sup>3</sup> and absence of recurrent opportunistic infections were independent predictors of viral load suppression after enhanced adherence counseling.

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The study identified that a major gap in the EAC cascade was the low completion of EAC. Furthermore, individuals who had been on antiretroviral therapy for less than 12 months and those who completed EAC within 3 months demonstrated a reduced likelihood of persistent viremia.

A descriptive cross-sectional study of patient records carried out among patients on highly active antiretroviral therapy (HAART), at the Infectious Disease Institute, College of Medicine, University of Ibadan, revealed a viral load suppression rate of 51.0% following

EAC among 400 unsuppressed patients.[18] The study identified that adolescents and young adults have a greater risk of virologic failure as they face multiple social, psychological, and adherence challenges that increase their susceptibility to failure to suppress.

**Comment [U48]:** Replace with...achieve viral suppression

No research has been done in Benue state that assessed viral load suppression following EAC and its predictors among unsuppressed HIV seropositive people. The findings of this research will help the Federal Ministry of Health of Nigeria and other stakeholders assess the progress in the implementation of the national guidelines on EAC and improve the patient's health outcomes. This study aims to determine the viral load suppression rate after enhanced adherence counseling and its predictors among unsuppressed HIV seropositive people in Benue state, the time to commence EAC after the unsuppressed VL result, and to estimate the time to repeat the viral load test after EAC.

## 2.0 METHODOLOGY

### 2.1. STUDY SETTING

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All HIV-infected people who have a viral load greater than 1000 copies/ml after 6 months of antiretroviral therapy in December 2022 in Benue state, Nigeria.

## 2.3. ELIGIBILITY CRITERIA

### 2.3.1 INCLUSION CRITERIA

All HIV-infected people with a viral load greater than 1000 copies/ml with repeat viral load results after complete enhanced adherence counselling sessions in Benue state, Nigeria.

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### 2.3.2. EXCLUSION CRITERIA

**Comment [U51]:** Were clients who did not complete EAC included in the study?

All HIV-infected people who were on antiretroviral therapy for less than 6 months and those who did not start EAC sessions.

Patients with missing ART information.

Patients with erroneous viral load data or conflicting information.

## 2.4 STUDY DESIGN

Cross-sectional descriptive study.

## 2.5 DATA COLLECTION

A total sampling of medical records of all those with VL  $\geq$  1000cp/ml who were active and receiving ART from the Laboratory Information Management System (LIMS). Relevant

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individual patient sociodemographic and clinic data were abstracted from the patient ART care card/ folder and EAC registers. Sociodemographic characteristics consist of sex and age.

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The clinical characteristics analyzed include the duration of ART (calculated as the difference

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between the ART start date and the date of the last clinic visit), EAC enrolment, and time to EAC completion as “within 3 months” and “after 3 months” based on the national ART treatment guidelines.[5]

## 2.6 DATA MANAGEMENT

Data were cleaned and consistency checks were done severally to ensure accuracy and completeness. The data were analyzed using Statistical Package for Social Science version 20.0 for Windows (SPSS Inc., Chicago, Illinois). Descriptive statistics and frequencies were used to describe the characteristics of the study participants. Multivariable logistic regression analysis was employed to determine factors associated with EAC enrolment, EAC completion, and persistent VL unsuppression (post-EAC VL >1000 copies/mL). Adjusted odds ratios and 95% CIs were reported. The statistically significant differences for quantitative data will be evaluated by chi-squared statistics with significant association ( $P > 0.05$ ).

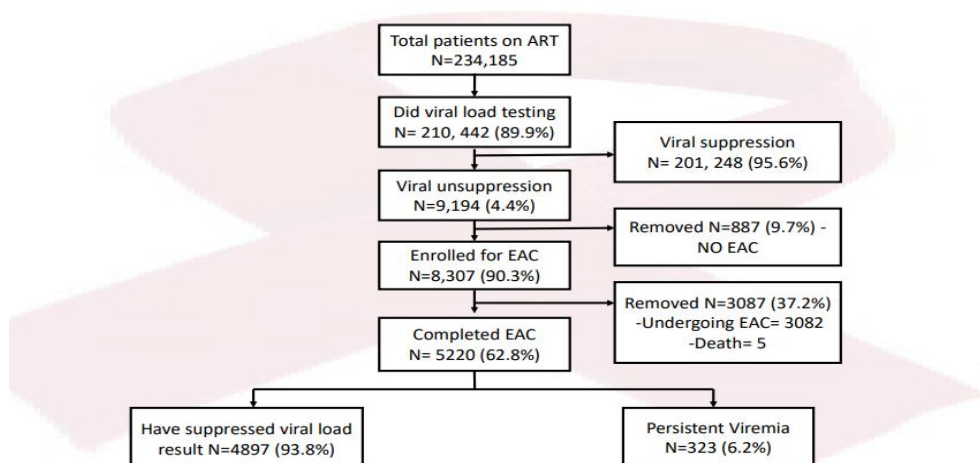
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## 2.7 ETHICAL CONSIDERATION

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### 3.0 RESULTS



**Figure 1. Baseline characteristics of study participants:**

A total of 234,185 PLHIV were receiving ART care in Benue State as of December 2022. Of these, 210,442 (89.9%) had undergone viral load testing and of those tested, 9,194 (3.9%) had unsuppressed viral load at the start of the study. 6,203 (67.5%) are females. The mean age of the study participants was 34.6 ( $\pm 34.55$ SD). The majority 4,861 (52.9%) of the participants receive treatment in health facilities with less than 1000 people on ART, and 5753 (62.6%) have been treated for less than 5 years. 5,223 (56.8%) commence EAC within 1 month. At baseline, most, 8168 (77.1%) participants were staged in WHO clinical stage 1, and 2472 (26.9%) had a CD4 count above 200 cells/ $\mu$ l. (Table 1).

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#### Outcomes for patients with unsuppressed viral load

##### EAC enrolment



Of the 9,194 (3.9%) with unsuppressed viral load, 8,307 (90.3%) were enrolled for EAC “Figure 1”. EAC enrolment was 90.7% among males and 96.3% among the age group 30-39 years, aOR=5.22; 95% CI, 1.26-21.65;  $P=.02$ ; 40-50 years, aOR=5.27; 95%CI, 1.27-21.85;  $P=.02$ ; >50 years, aOR=4.37, 95% CI,1.03-18.53;  $P=0.04$ ). EAC enrolment was also more likely in those from the low-volume facilities (aOR=1.36; 95%CL, 1.05-1.76;  $P=.02$ ) than those from the high-volume facilities. (Table 2)

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### EAC Completion

Of those enrolled for EAC, 5220 (62.8%) completed their EAC sessions during the review period, 3082 (37.1%) were still undergoing EAC and 5 (0.1%) died. EAC completion differs across age, facility status, WHO status, and sex categories. In multivariable analysis to determine factors associated with completion of EAC, those above 20 years were less likely to complete EAC (20-29years, aOR= 0.19; 95%CI, 0.11-0.32;  $P\leq 0.001$ ; 30-39 years, aOR=0.28; 95% CI, 0.14-0.38;  $P\leq 0.001$ ; 40-50 years, aOR=0.26; 95%CI, 0.15-0.42;  $P\leq 0.001$ ; >50 years, aOR=0.17, 95% CI,0.10-0.29;  $P\leq 0.001$ ). EAC completion was also more likely in those who have been on ART for more than 5 years. (Table 3)

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### Post EAC VL Characteristics

A repeat viral load test was done for all those who completed EAC. 4897 (93.8%) had suppressed viral load (60% in those who were enrolled in EAC and 0% in those who were not enrolled in EAC, Chi-square test  $P$ -value <0.001).

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In the multivariate analysis to determine factors associated with VL suppression following EAC (Table 4), those who have been on ART for 5 years or more are less likely to be virally suppressed following EAC (aOR=0.84; 95% CI, 0.53-1.35;  $P=0.03$ ) than those who have been on ART for less than 5 years.

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**Table 1. SOCIO-DEMOGRAPHIC CHARACTERISTICS OF THE PATIENTS**

Variables	Frequency N= 9,194	Percentage (%)
<b>Sex</b>		
Male	2991	32.5
Female	6203	67.5
<b>Age (years)</b>		
0-9	401	4.4
10-19	1016	11.1
20-29	1624	17.7
30-39	2890	31.4
40-50	2196	23.9
>50	1067	11.6
<b>Facility Status</b>		
High volume	4333	47.1
Low volume	4861	52.9
<b>Duration on ART (years)</b>		
<5	4790	52.1
≥5	4404	47.9
<b>WHO Stage</b>		
1	8168	88.8
2	675	7.3
3	326	3.5
4	25	0.3
<b>Baseline CD4 count (cells/mm<sup>3</sup>)</b>		
<200	527	5.7
>200	2506	27.3
Missing	6161	67.0
<b>Commencement of EAC (months)</b>		
<1	5225	56.8
≥1	3082	33.5
No EAC	888	9.7

**Comment [U71]:** total is 100.1%

**Comment [U72]:** total is 99.9

**Table 2. Results show the relationship between baseline characteristics and enrolment into EAC among study participants.**

**Comment [U73]:** Relationship

Variables	EAC		Total N= 9,194 ( % )	Test statistics	P- value	OR (95%CI)	P value	AOR (95%CI)	P value
	Enrolled for EAC N=8307 (90.3%)	Not Enrolled for EAC N=887 (9.7%)							
<b>Sex</b>									
Male	2715 (90.7%)	276 (9.3%)	2991 (32.5%)	0.90	0.344	Reference			
Female	5592 (90.1%)	611 (9.9%)	6203 (67.5%)			0.93 (0.80-1.08)	0.34	1.03(0.81-1.33)	0.78
<b>Age (years)</b>									
0-9	386 (96.3%)	15 (3.7%)	401 (4.4%)	40.45	≤0.001	Reference			
10-19	955 (94.0%)	61 (6.0%)	1016 (11.1%)			1.64(0.92-2.93)	0.10	2.65(0.61-11.50)	0.19
20-29	1436 (88.4%)	188 (11.6%)	1624(17.7%)			3.37(1.97-5.77)	≤0.001	4.46(1.05-18.85)	0.04*
30	2592 (89.7%)	298 (10.3%)	2890 (31.4%)			2.96(1.74-5.02)	≤0.001	5.22(1.26-21.65)	0.02*
40-50	1974 (89.9%)	222 (10.1%)	2196 (23.9%)			2.89(1.70-4.94)	≤0.001	5.27(1.27-21.85)	0.02*
>50	964 (90.4%)	103 (9.6%)	1067 (11.6%)			2.75(1.58-4.79)	≤0.001	4.37(1.03-18.53)	0.04*
<b>Facility Status</b>									
High volume	3968 (91.6%)	365 (8.4%)	4333 (47.1%)	14.08	≤0.001	Reference			
Low volume	4339 (89.2%)	522 (10.8%)	4861 (52.9%)			1.31(1.14-1.51)	≤0.001	1.36(1.05-1.76)	0.02*
<b>Duration on ART (years)</b>									
<5	4294 (89.7%)	496 (10.3%)	4790 (52.1%)	5.74	0.017	Reference			
≥5	4013 (91.1%)	391 (8.9%)	4404 (47.9%)			1.19 (1.03-1.36)	0.017	0.85(0.64-1.12)	0.26
<b>WHO Stage</b>									
1	7387 (90.4%)	781 (9.6%)	8168 (88.8%)	1.83	0.61	Reference			
2	605 (89.6%)	70 (10.4%)	675 (7.3%)			1.09 (0.85-1.42)	0.49	0.87(0.59-1.29)	0.50
3	291 (89.3%)	35 (10.7%)	326 (3.5%)			1.14(0.80-1.63)	0.48	1.02(0.562-1.67)	0.95
4	24 (96.0%)	1 (4.0%)	25(0.3%)			0.40(0.05-2.92)	0.36	0.62(0.08-4.80)	0.65
<b>Baseline CD4 count (cells/mm<sup>3</sup>)</b>									
<200	461 (87.5%)	66 (12.5%)	527 (17.4%)	9.53	0.009	Reference			
≥200	2243 (89.5%)	263 (10.5%)	2506 (82.6%)			0.82(0.62-1.09)	0.17	0.87(0.65-1.17)	0.38
Missing	5603 (90.9%)	558 (9.1%)	6161 (67.0%)						
<b>Commencement of EAC (months)</b>									
<1	5225 (100.0%)	0 (0.0%)	5223 (56.8%)	**					
≥1	3082 (100.0%)	0 (0.0%)	3082 (33.5%)						
No EAC	0 (0.0%)	0 (0.0%)	887 (9.7%)						

\*\*Test statistics not done

**Table 3: Results show the relationship between baseline characteristics and completion of EAC among study participants**

**Comment [U74]:** The relationship...

Variables	Completion of EAC		Total N= 8,307 ( % )	Test Statistics	P- value	OR (95%CI)	P value	AOR (95%CI)	P value
	EAC Completed N=5,220 (62.8%)	EAC Not completed N= 3087 (37.2%)							
<b>Sex</b>									
Male	1673 (61.6%)	1042 (38.4%)	2715 (32.7%)	2.56	0.109	Reference			
Female	3547 (63.4%)	2045 (36.6%)	5592 (67.3%)			1.08(0.98-1.18)	0.11	0.91(0.76-1.08)	0.28
<b>Age (years)</b>									
0-9	167 (43.3%)	219 (56.7%)	386 (4.6%)	231.54	≤0.001	Reference			
10-19	430 (45.0%)	525 (55.0%)	955 (11.5%)			1.07(0.85-1.36)	0.56	0.65(0.38-1.10)	0.11
20-29	959 (66.8%)	477 (33.2%)	1436(17.3%)			2.64(2.10-3.32)	≤0.001	0.19(0.11-0.32)	≤0.001*
30-39	1730 (66.7%)	862 (33.3%)	2592 (31.2%)			2.63(2.11-3.27)	≤0.001	0.28(0.14-0.38)	≤0.001*
40-50	1289 (65.3%)	685 (34.7%)	1974 (23.8%)			2.47(1.98-3.08)	≤0.001	0.26(0.15-0.42)	≤0.001*
>50	645 (66.9%)	319 (33.1%)	964 (11.6%)			2.65(2.08-3.38)	≤0.001	0.17(0.10-0.29)	≤0.001*
<b>Facility Status</b>									
High volume	2479 (62.5%)	1489 (37.5%)	3968 (47.8%)	0.43	0.512	Reference			
Low volume	2741 (63.2%)	1598 (36.8%)	4339 (52.2%)			1.03(0.94-1.13)	0.51	0.88(0.73-1.07)	0.21
<b>Duration on ART (years)</b>									
<5	2793 (65.0%)	1501 (35.0%)	4294 (51.7%)	18.52	≤0.001	Reference			
≥5	2427 (60.5%)	1586 (39.5%)	4013 (48.7%)			1.22(1.11-1.33)	≤0.001	1.26(1.02-1.57)	0.04*
<b>WHO Stage</b>									
1	4638 (62.8%)	2749 (37.2%)	7387 (88.9%)	4.17	0.244	Reference			
2	395 (65.3%)	210 (34.7%)	605 (7.3%)			1.11(0.94-1.33)	0.22	0.87(0.67-1.14)	0.32
3	175 (60.1%)	116 (39.1%)	291 (3.5%)			0.89(0.70-1.14)	0.36	1.28(0.91-1.81)	0.15
4	12 (50.0%)	12 (50.0%)	24 (0.3%)			0.59(0.27-1.30)	0.20	1.93(0.61-6.05)	0.26
<b>Baseline CD4 count (cells/mm<sup>3</sup>)</b>									
<200	298 (64.6%)	163 (35.4%)	461 (5.6%)	3.75	0.153	Reference			
≥200	1441 (64.2%)	802 (35.8%)	2243 (27.0%)			1.029(0.83-1.26)	0.87	0.89(0.72-1.11)	0.31
Missing	3481 (62.1%)	2122 (37.9%)	5603 (67.5%)						
<b>Commencement of EAC (months)</b>									
<1	5219 (99.9%)	5 (0.1%)	5224 (62.9%)						
≥1	1 (0.03%)	3082 (99.97%)	3083 (37.1%)						
No EAC									

**Table 4. Results show the relationship between baseline characteristics and viral load**

**Comment [U75]:**

**re-suppression among study participants.**

Variables	Viral Load Suppression		Total N=5220	Test Statistics	P value	OR (95%CI)	P value	AOR (95%CI)	P value
	Suppressed N=4897(93.8%)	Unsuppressed N=323(3.9%)							
<b>Sex</b>									
Male	1550 (92.7%)	123 (7.3%)	1673 (32.0%)	5.75	0.016	Reference			
Female	3347 (94.4%)	200 (5.6%)	3547 (68.0%)			1.33(1.05-1.68)	0.02	1.22(0.83-1.80)	0.31
<b>Age (years)</b>									
0-9	153 (91.6%)	14 (8.4%)	167 (3.2%)	72.20	≤0.001	Reference			
10-19	364 (84.7%)	66 (15.3%)	430 (8.2%)			1.98(1.08-3.64)	0.03	3.76(0.48-29.60)	0.21
20-29	912 (95.1%)	47 (4.9%)	959 (18.4%)			0.56(0.30-1.05)	0.07	1.49(0.19-11.93)	0.71
30-39	1632 (94.3%)	98 (5.7%)	1730 (33.1%)			0.66(0.37-1.18)	0.16	1.96(0.25-15.02)	0.52
40-50	1218 (94.5%)	71 (5.5%)	1289 (24.5%)			0.64(0.35-1.16)	0.14	1.81(0.24-13.98)	0.57
>50	618 (95.8%)	27 (4.2%)	645 (12.4%)			0.48(0.24-0.93)	0.03	1.69(0.21-13.34)	0.62
<b>Facility Status</b>									
High volume	2295(92.6%)	184 (7.4%)	2479 (47.5%)	12.40	≤0.001	Reference			
Low volume	2602 (94.9%)	139 (5.1%)	2741 (52.5%)			0.67(0.53-0.84)	≤0.001	0.72(0.46-1.14)	0.16
<b>Duration on ART (years)</b>									
<5	2645 (94.7%)	148 (5.3%)	2793 (53.5%)	8.16	0.004	Reference			
≥5	2252 (92.8%)	175 (7.2%)	2427 (46.5%)			1.40(1.11-1.74)	0.004	0.84(0.53-0.79)	0.03*
<b>WHO Stage</b>									
1	4358(94.0%)	280 (6.0%)	4638 (88.9%)	15.97	0.001	Reference			
2	367(92.9%)	28 (7.1%)	395 (7.7%)			1.19(0.79-1.78)	0.40	1.31(0.77-2.23)	0.33
3	164(93.7%)	11 (6.3%)	175 (3.4%)			1.04(0.56-1.95)	0.89	1.38(0.64-2.95)	0.41
4	8(66.7%)	4 (33.3%)	12 (0.23%)			7.78(2.33-26.00)	≤0.001	6.58(1.16-37.21)	0.45
<b>Baseline CD4 count (cells/mm<sup>3</sup>)</b>									
<200	273(91.6%)	25 (8.4%)	298 (5.7%)	56.84	0.033	Reference			
>200	1338(92.9%)	103 (7.1%)	1441 (27.6%)			0.84(0.53-1.33)	0.46	0.83(0.53-1.35)	0.48
Missing	3286(94.4%)	195 (5.6%)	3481 (66.7%)						
<b>Commencement of EAC (months)</b>									
<1	4897 (93.8%)	323 (6.2%)	5220 (100%)						
≥1	0 (0.0%)	0 (0.0%)	(0.0%)						
No EAC									

#### 4.0. DISCUSSION

In this study, 89.9% of PLHIV on ART in Benue State had undergone viral load tests, and 4.4% of those who underwent viral load tests had high viral loads, this is lower than values in other similar studies.[15] Of those with high viral load, 90.3% of these had enrolled in EAC and 62.8% completed EAC per the national guidelines.[5] 93.8% of those who completed EAC achieved viral load < 1000 copies/ml. This is higher than both the WHO target (70%) [4] and values found in other studies.[13,15,17–19] It is however slightly lower than the 95% target for viral load suppression captured under the UNAIDS 95-95-95 targets.[3] The high post-EAC viral load suppression rate in this study compared to other studies reflects the huge investment by APIN in the continuous training of adherence counsellors to educate PLHIV on the importance of adherence to ART. In addition, APIN encourages in-person EAC in addition to phone EAC, this is particularly significant given that many clients have to travel long distances to reach the health facilities. Studies have shown that long travel distances and lack of money for traveling to health institutions affect ART adherence and follow-up visits within the recommended time.[22,23] The result from this study further highlights the role of enhanced adherence counselling in achieving viral load resuppression in virally unsuppressed clients and thus prevents antiretroviral drug switch.[11,12]

In this study, the analysis showed a delay in commencing clients on EAC and a delay in completing EAC within the recommended time. 33.5% of PLHIV with VL >1000 copies/ml did not initiate EAC until after one month and only 62.8% of PLHIV who were enrolled in EAC completed EAC within the recommended time. This delay may lead to delayed identification of ART resistance and delayed switch to the alternative line of ART regimen. Failure to switch to the appropriate regimen for PLHIV with resistance due to the delay

**Comment [U76]:** Any reason(s) for the result should also be discussed

**Comment [U77]:** Any discussion of the enrolment and completion rates of EAC?

**Comment [U78]:** Over 33 per cent

increases the risk of sexual transmission of ART-resistant strains as well as the potential failure of other lines of ART. [24–28] In Benue state, fear of stigma and discrimination has a significant influence on the health-seeking behavior of PLHIV and this is consistent with findings from previous studies.[29–32] Due to this fear, many PLHIV travel long distances far from where they reside to receive ART, in addition, a lack of means of reaching them such as via telephone and ill-defined physical address, results in delay in enrolment in EAC. Within many health facilities delay also results from the failure of adherence counsellors to receive VL results >1000 copies/ml as soon as they are available from the laboratory. To achieve optimal treatment outcomes it is important to address the factors associated with timely EAC enrolment and completion.

Duration on ART was significantly associated with viral load suppression following EAC. Patients who have taken ART for 5 years or more were less likely to have viral suppression compared to those who have taken ART drugs for less than 5 years. This is similar to findings reported in other studies.[15,29] This could be associated with the build-up of multiple drug-resistant mutations and treatment fatigue.

**Comment [U79]:** five

**Comment [U80]:** a shorter duration

**Comment [U81]:** fatigue

The major strength of this study was the usage of routine program data over one year, with information collected on all PLHIV who were on ART and had viral load >1000 copies/ml in Benue State.

The major limitation of our study is that our study methodology involved review of records, and hence our analysis and interpretation of the data are limited to only those variables that are routinely collected from patients/caregivers and captured in the patient records. Some of the important variables like the education status of the patient, distance of the patient's residence to the ART centers, patient's clinical condition, and so on, could have played a major role in initial viral load testing, enrolment for EAC, repeat viral load testing and viral

suppression, were not available. Thus, we were unable to account for the influence of these factors in our analysis.

## **5.0 CONCLUSION**

In this study, 93.8% of the patients achieved a viral load result of < 1000 copies/ml following EAC. Duration on ART is statistically associated with viral load suppression following EAC. The study showed a major gap in the EAC cascade, that is enrollment in EAC and completion of EAC. These gaps impair the role of EAC in achieving optimal viral load suppression. The reasons for this gap need to be assessed and addressed by HIV program managers and healthcare providers. This study therefore recommends further studies to identify possible reasons for gaps in the EAC cascade in Benue State.

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## **Author Contributions**

**O. Orsar:** Conceptualization; Writing – original draft; Writing – review & editing.

**E. Ukpabi:** Methodology; Writing – original draft; Writing – review & editing.

**G. Aloba:** Formal analysis; Writing – review & editing



**G. Anefu:** Supervision

**D. Ayatse:** Writing – review & editing.

**E. Ejimkaraonye:** Data review; Resources

**V. Orih;** Writing – review & editing.

**J. Zugu;** Writing – review & editing.

**S. Haanongon:** Writing – review & editing.

**T. Tule:** Writing – review & editing.

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