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Short Communication

# Advanced HIV disease at diagnosis among newly diagnosed people with HIV in rural eastern Uganda: a retrospective cohort study

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ABSTRACT

*Objectives:* Advanced HIV disease (AHD) at diagnosis substantially contributes to HIV-related morbidity and mortality but has been understudied. We determined the prevalence and factors associated with AHD at diagnosis among newly diagnosed people with HIV (PWH) in rural eastern Uganda.

*Methods:* We conducted a retrospective cohort study of newly diagnosed PWH between May 2020 and July 2023 across 23 public health facilities in 14 districts in rural eastern Uganda. AHD at diagnosis was defined by a cluster of differentiation 4 count <200 cells/μL or World Health Organization clinical stage 3-4 disease. A generalized linear mixed model was used to identify factors associated with AHD at diagnosis.

*Results:* Among 1233 participants, we found that 24/1233 (1.9%) had AHD at diagnosis. In adjusted analysis, AHD at diagnosis was independently associated with being male rather than female (adjusted odds ratio, 3.84; 95% confidence interval, 1.53-9.61).

*Conclusions:* The low prevalence of AHD at diagnosis among newly diagnosed PWH suggests progress toward earlier diagnosis in rural eastern Uganda. Men tended to present with AHD at diagnosis more than women, although the finding is imprecise. Our findings highlight the need for targeted, gender-sensitive interventions to promote early diagnosis and care linkage.

## Introduction

Advanced HIV disease (AHD), characterized by a cluster of differentiation (CD4) count below 200 cells/μL or World Health Organization (WHO) clinical stage 3-4 [1], remains a major contributor to HIV-related morbidity and mortality globally, despite the widespread scale-up of antiretroviral therapy (ART). Early diagnosis and timely initiation of ART are critical to reducing severe immunosuppression and improving health outcomes [2]. However, many people with HIV (PWH) continue to present late to care with AHD at diagnosis. A 2025 rapid review of 117 cohorts including 1,814,362 individuals across 52 countries showed that 33.7% of PWH present with AHD, with the prevalence particularly higher among hospitalized individuals at 44.3% compared with 33.5% among outpatients [3].

Uganda has a high HIV burden, with an estimated 1.4 million PWH [4]. By December 2024, the HIV prevalence was 4.9%, and Uganda was nearly on track to achieve all the 95-95-95 targets: 94% knew their status, 90% received ART, and 97% achieved viral suppression [5]. In recent years, efforts to expand HIV testing services (HTS) and linkage to care have intensified, particularly in rural areas where access to health services remains limited. AHD at diagnosis exacerbates the risk of morbidity and mortality. However, data on the prevalence of AHD at diagnosis and the associated factors among newly diagnosed PWH in rural settings are limited. Therefore, this study determined the prevalence of AHD at diagnosis and the associated factors among newly diagnosed PWH attending public health facilities in rural eastern Uganda. Findings contribute to designing targeted and context-relevant interventions to promote early HIV diagnosis and prompt linkage to care.

## Methods and materials

### *Data source and study population*

This retrospective cohort study was conducted in rural eastern Uganda using routinely collected data from newly diagnosed PWH between May 2020 and July 2023. Data were retrieved between March and April 2025 using a standardized tool with built-in quality controls across 23 accredited facilities located in 14 districts. Health facilities were purposively selected based on their capacity to provide HTS. Eligible individuals were aged ≥15 years with a confirmed HIV diagnosis and

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available clinical data on CD4 counts and WHO clinical staging. Electronic medical records were abstracted, supplemented by data in HTS registers, ensuring data completeness and accuracy.

We obtained ethical approval from the Mbale Regional Referral Hospital Research Ethics Committee (Ref: MRRH-2025-558). Administrative permission was granted by participating health facilities. All data were anonymized to protect participant confidentiality.

### *Study variables and measurements*

The primary outcome was AHD at diagnosis, defined as a CD4 count below 200 cells/μL or WHO clinical stage 3-4. Independent variables included demographic factors such as age, sex, and marital status; clinical variables, including tuberculosis presumptive status, history of HIV testing, and multiple sexual partnerships; and HTS-related factors such as testing model (community vs health facility) and approach (healthcare provider-initiated counseling and testing vs client-initiated counseling and testing).

### *Statistical analysis*

We summarized participant characteristics by AHD at diagnosis status using means, standard deviations, and proportions. We assessed differences between PWH with and without AHD at diagnosis using a *t*-test for continuous variables and chi-square or Fisher's exact tests for categorical variables. Factors independently associated with AHD at diagnosis were identified using generalized linear mixed models with a logit link function and binomial distribution. We included the district as a random effect to account for clustering. Adjusted odds ratios (aORs) and 95% confidence intervals (CIs) were reported. Model fit was assessed with the Akaike information criterion (AIC) and discrimination with the C-statistic. Analyses were conducted using R version 4.2.1.

## Results

### *Distribution of characteristics of newly diagnosed people with HIV at public health facilities in rural eastern Uganda, by AHD status at diagnosis*

Of 1233 newly diagnosed PWH (Table 1), 24/12333 (1.9%) presented with AHD at diagnosis. Nearly half of the participants (49.6%, 611/1233) sought HTS for other reasons, while assisted partner notification/index testing accounted for 20.4% (251/1233) and self-initiated testing for 15.5% (191/1233). Smaller proportions were for prevention of mother-to-child transmission of HIV (97/1233, 7.9%) and sexual network strategy (83/1233, 6.7%).

Individuals with AHD at diagnosis were significantly older on average (mean age 41.4 vs 36.3 years, $P = 0.035$), more likely to be male (70.8% [17/24] vs 38.1% [461/1209], $P = 0.002$), and more often separated (29.2% [7/24] vs 10.0% [121/1209], $P = 0.010$). There were no statistically significant differences in TB presumption, history of HIV testing, HIV testing model or approach, or most clinical and sociodemographic characteristics between the two groups.

### *Factors associated with AHD at diagnosis among newly diagnosed PWH at public health facilities in rural eastern Uganda*

In unadjusted analyses (Table 2), increasing age, male sex, and separated marital status were significantly associated with higher odds of AHD at diagnosis. After adjusting for covariates, only sex remained significantly associated with AHD at diagnosis, with males having higher odds compared to females, although the findings are imprecise (aOR, 3.84; 95% CI, 1.53–9.61). Age, marital status, and HTS approach were not significantly associated with AHD at diagnosis. The final model showed acceptable discrimination (C-statistic = 76.1%), and the AIC was 231.6.

## Discussion

In this study, among newly diagnosed PWH in rural eastern Uganda, the prevalence of AHD at diagnosis was low (1.9%), suggesting progress toward earlier HIV diagnosis in this setting. This finding aligns with expanding HIV testing and linkage-to-care efforts, which are critical for improving clinical outcomes and reducing HIV transmission. Our findings are consistent with the African Cohort Study conducted across 12 clinics in Uganda, Kenya, Tanzania, and Nigeria, which reported a decline in AHD (CD4 <200 cells/μL) from 10.5% to 3.1%, alongside an increase in ART coverage from 76.6% to 100% [2]. Consistent with our findings, a recent systematic review and meta-analysis from Ethiopia comparing 2005-2015 (before test-and-treat era) with 2016-2024 (after the test-and-treat era) found a decline in the prevalence of PWH presenting with WHO stage 3 disease from 47% to 21%

**Table 1**
Characteristics of newly diagnosed people with HIV at public health facilities in rural eastern Uganda, by AHD status at diagnosis.

| Variable | Level | All (n = 1233) | AHD at diagnosis | | *P*-value |
|---|---|---|---|---|---|
| | | | No (n = 1209) | Yes (n = 24) | |
| Age group | 15-24 | 210 (17.0) | 209 (17.3) | 1 (4.2) | 0.186 |
| | 25-59 | 966 (78.3) | 945 (78.2) | 21 (87.5) | |
| | ≥60 | 57 (4.6) | 55 (4.5) | 2 (8.3) | |
| | mean (SD) | 36.4 (11.8) | 36.3 (11.8) | 41.4 (11.8) | 0.035 |
| Sex | Female | 755 (61.2) | 748 (61.9) | 7 (29.2) | 0.002 |
| | Male | 478 (38.8) | 461 (38.1) | 17 (70.8) | |
| Marital status | Never/single | 389 (31.5) | 383 (31.7) | 6 (25.0) | 0.010 |
| | Married | 716 (58.1) | 705 (58.3) | 11 (45.8) | |
| | Separated | 128 (10.4) | 121 (10.0) | 7 (29.2) | |
| Tuberculosis presumption at HIV diagnosis | No | 1085 (88.0) | 1064 (88.0) | 21 (87.5) | 1.000 |
| | Yes | 148 (12.0) | 145 (12.0) | 3 (12.5) | |
| Clusters of differentiation 4 test done | No | 110 (8.9) | 106 (8.8) | 4 (16.7) | 0.326 |
| | Yes | 1123 (91.1) | 1103 (91.2) | 20 (83.3) | |
| Multiple sexual partnerships | No | 355 (28.8) | 352 (29.1) | 3 (12.5) | 0.121 |
| | Yes | 878 (71.2) | 857 (70.9) | 21 (87.5) | |
| Ever tested for HIV | No | 883 (71.6) | 865 (71.5) | 18 (75.0) | 0.886 |
| | Yes | 350 (28.4) | 344 (28.5) | 6 (25.0) | |
| HTS model | Community | 553 (44.8) | 544 (45.0) | 9 (37.5) | 0.600 |
| | Health facility | 680 (55.2) | 665 (55.0) | 15 (62.5) | |
| HTS approach | Client-initiated counseling and testing | 137 (11.1) | 132 (10.9) | 5 (20.8) | 0.229 |
| | Healthcare provider-initiated counseling and testing | 1096 (88.9) | 1077 (89.1) | 19 (79.2) | |

AHD, advance HIV disease; HTS, HIV testing services.

**Table 2**
Factors associated with AHD at diagnosis among newly diagnosed PWH at public health facilities in rural eastern Uganda.

| Variable | Level | Unadjusted analysis OR (95% CI) | Adjusted analysis Adjusted OR (95% CI) |
|---|---|---|---|
| Age (years) | One-year increase | **1.03[a] (1.00-1.06)** | 1.01 (0.98-1.05) |
| Sex | Female | 1 | 1 |
| | Male | **3.94[b] (1.69-10.26)** | **3.84[b] (1.53-9.61)** |
| Marital status | Never/single | 1 | 1 |
| | Married | 1.00 (0.38-2.91) | 0.88 (0.31-2.45) |
| | Separated | **3.69[a] (1.20-11.67)** | 3.16 (0.95-10.57) |
| HIV testing service approach | Client-initiated counseling and testing | 1 | 1 |
| | Healthcare provider-initiated counseling and testing | 0.47 (0.18-1.42) | 0.63 (0.22-1.82) |

CI, confidence interval; OR, odds ratio.
Statistical significance codes at 5% level: [a]$P$ <0.05
[b] $P$ <0.01.Bolded figures are statistically significant.

during the period—a 55% decline [6]. Similarly, presentation with WHO stage 4 disease dropped from 14% to 8% during the same period, corresponding with a nearly 43% decrease [6].

Although imprecise, men tended to present with AHD at diagnosis more than women, consistent with existing literature indicating that men, whether ART naïve or experienced, present late for HIV testing and care and often with AHD [7–10]. This may be explained by gender norms, health-seeking behaviors, and structural barriers, among others.

The findings suggest a need for targeted interventions to increase early HIV diagnosis among men to close the gap in HTS.

Study limitations include the small number of PWH with AHD at diagnosis, which may have reduced the statistical power to detect associations. Incomplete clinical records and unmeasured confounders are additional probable limitations. Despite these limitations, our findings emphasize the need for gender-sensitive strategies in HTS and suggest that continued efforts to enhance early HIV diagnosis are yielding positive results in rural eastern Uganda.

## Conclusion and recommendations

We found a low prevalence of AHD at diagnosis among newly diagnosed PWH, suggesting progress toward earlier HIV diagnosis in rural eastern Uganda. Men tended to present with AHD at diagnosis more than women, although the finding is imprecise. Our findings highlight the need for targeted, gender-sensitive interventions to promote early diagnosis and care linkage.

## Declaration of competing interest

The authors have no competing interests to declare.

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## Ethical approval statement

We obtained ethical approval from the Mbale Regional Referral Hospital Research Ethics Committee (Ref: MRRH-2025-558). Administrative permission was granted by participating health facilities. All data were anonymized to protect participant confidentiality.

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## Author contributions

SMS, SA, and JI: Study conception and design. SMS: Acquisition of data. SA and JI: Analysis and interpretation of data. SMS, SA, and JI: Drafting of manuscript. SA and JI. Critical revision of the manuscript: SMS, SA, and JI: Final approval of the manuscript.

## References

[1] Justman JE, Syowai M. Advanced HIV disease and epidemic control in sub-Saharan Africa. *Lancet Glob Health* 2025;**13**:e375–6. doi:10.1016/S2214-109X(25)00020-8.
[2] Oboho IK, Esber AL, Dear N, Paulin HN, Iroezindu M, Bahemana E, et al. Advanced HIV disease in East Africa and Nigeria, in The African Cohort Study. *J Acquir Immune Defic Syndr* 2024;**96**:51–60. doi:10.1097/QAI.0000000000003392.
[3] Ford N, Kassanjee R, Stelzle D, Jarvis JN, Sued O, Perrin G, et al. Global prevalence of advanced HIV disease in healthcare settings: a rapid review. *J Int AIDS Soc* 2025;**28**:e26415. doi:10.1002/jia2.26415.
[4] Sadiq A, Kwizera R, Kiiza TK, Ayebare P, Ahimbisibwe C, Ndyetukira JF, et al. Experiences, challenges, gaps, and strategies for counselling persons presenting with advanced HIV-associated meningitis in Uganda. *AIDS Res Ther* 2025;**22**:21. doi:10.1186/s12981-025-00705-z.
[5] Republic of Uganda *Fact sheets on HIV & aids epidemic in Uganda.* Kampala: Uagnda AIDS Commission; 2025.
[6] Moges S, Lajore BA, Debesay BA, Belato DT. Advanced stage disease progression and mortality rate before and after the implementation of the universal test and treat strategy (UTT) for HIV patients in Ethiopia: a systematic review and meta-analysis. *J Epidemiol Glob Health* 2025;**15**:101. doi:10.1007/s44197-025-00422-w.
[7] Bendera A, Baryomuntebe DM, Kevin NU, Nanyingi M, Kinengyere PB, Mujeeb S, et al. Determinants of late HIV diagnosis and advanced HIV disease among people living with HIV in Tanzania. *HIV/AIDS* 2024;**16**:313–23. doi:10.2147/HIV.S473291.
[8] Ainembabazi B, Katana E, Bongomin F, Wanduru P, Mayega RW, Mukose AD. Prevalence of advanced HIV disease and associated factors among antiretroviral therapy naïve adults enrolling in care at public health facilities in Kampala. *Uganda. Ther Adv Infect Dis* 2024;**11**:20499361241251936. doi:10.1177/20499361241251936.
[9] Kitenge MK, Fatti G, Eshun-Wilson I, Nyasulu PS. Persistent advanced HIV disease in rural KwaZulu-Natal, South Africa: trends, characteristics, and the urgent need for targeted interventions. *PLoS One* 2025;**20**:e0317674. doi:10.1371/journal.pone.0317674.
[10] Tukamuhebwa PM, Gemmell I. A cross-sectional study evaluating the screening, diagnosis and management of advanced HIV disease at the AIDS support organization service centre in Mbarara City, Southwestern Uganda. *BMC Infect Dis* 2025;**25**:254. doi:10.1186/s12879-025-10682-3.