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Original Article

Prevalence and factors contributing to first-line drug Resistance among patients attending the ART clinic at Mbarara Regional Referral Hospital. A cross-sectional study.

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Abstract

Background:

The study aims to assess the prevalence and factors contributing to first-line drug Resistance among patients attending the ART clinic at Mbarara Regional Referral Hospital.

Methodology:

The study employed a descriptive cross-sectional design to assess the prevalence and contributing factors of HIV drug resistance among patients attending the ART clinic of Mbarara Regional Referral Hospital (MRRH). The target population consisted of adult patients (aged 18 years and above) living with HIV who are attending the ART clinic at MRRH and are on first-line ART regimens. systematic random sampling technique was used to ensure Representativeness and minimize selection bias.

Results:

Of the 87 participants whose records were reviewed, 11(12.6%) individuals were found to be resistant to first-line antiretroviral therapy, while the vast majority of the sample, 76(87.4%), were identified as non-resistant, indicating that their current first-line regimens remained effective at the time of the study. In terms of gender, 51(58.6%) were females while 36(41.4%) males. 44(50.6%) were married, 25(28.7%) divorced and 18(20.7%) single. 58(66.7%) resided in rural areas while 29(33.3%) in Urban or peri urban settings. Regarding ART adherence, 62(71.3%) of participants maintained good adherence (≥95%), but 9(10.3%) were classified as having poor adherence (<85%), while 16(18.4%) had a fair adherence status. 78(89.7%) of participants reported that they had received formal HIV education at the clinic, while 9(10.3%) did not. 24(27.6%) of the participants reported experiencing side effects from their medication, which is a factor that often leads to treatment interruptions

Conclusion:

The study concludes that HIV first-line drug resistance is a significant clinical challenge at Mbarara Regional Referral Hospital.

Recommendations:

MRRH should strengthen Community Drug Distribution Points (CDDPs) to reduce the transport burden for rural patients.

Keywords: *HIV drug resistance, First-line antiretroviral therapy, Adherence, Mbarara Regional Referral Hospital.*
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Background

HIV drug resistance (HIVDR) occurs when genetic mutations make the virus less sensitive to medication, leading to treatment failure, higher viral loads, and the potential transmission of resistant strains (WHO, 2025). Usually, when the virus mutates, it reduces the ability of ART drugs to block replication. HIVDR is often driven by inconsistent, improper, or interrupted taking of medication, which allows the virus to replicate in the presence of drugs. HIVDR can develop in individuals receiving ART or be present in treatment-naive individuals or those re-initiating ART, often transmitted from someone with resistant virus.

If unaddressed, HIVDR can lead to increased HIV-associated illness, mortality, and the spread of more resistant strains. It also necessitates more expensive, toxic, and complex treatment regimens. WHO monitors HIVDR globally, reporting increasing resistance to common drugs like Dolutegravir. Prevention strategies include

strengthening treatment adherence, optimizing treatment regimens, and monitoring viral load. Also, WHO recommends that HIV resistance testing is carried out for individuals upon diagnosis, before starting ART, and when treatment fails

Globally, about 39.9 million people live with HIV, of whom 30.7 million people had access to ART by the end of 2023, and sub-Saharan Africa accounts for 67% of all people living with HIV

worldwide. (WHO, 2024). However, in sub-Saharan Africa, access to antiretroviral therapy (ART) has expanded dramatically over the past decade. This scale-up of ART has led to significant reductions in morbidity and mortality, but it has also been accompanied by the emergence of HIV drug resistance, which occurs due to genetic mutations in the virus that reduce the efficacy of antiretroviral drugs, often resulting from suboptimal adherence, incomplete viral suppression, or transmission of resistant strains (World Health Organization, 2025).

In sub-Saharan Africa, where over 70% of global HIV infections are concentrated, the prevalence of HIV drug resistance among adults living with HIV has been estimated at around 35%, with key contributors including prior exposure to antiretrovirals, failure to achieve viral load suppression, older age, rural residence, and variations in national treatment programs (Nsonga et al., 2025). These factors create a complex interplay that exacerbates resistance, particularly to non-nucleoside reverse transcriptase inhibitors (NNRTIs) and nucleoside reverse transcriptase inhibitors (NRTIs), threatening the long-term success of ART regimens (Nsonga et al., 2025).

In Uganda, a country with an adult HIV prevalence of about 6% and high ART coverage reaching over 80%, population-based studies have documented fluctuating trends in drug resistance over time (Uganda Virus Research Institute, 2018). Longitudinal data from rural and urban communities indicate that while overall viraemic pretreatment resistance to NNRTIs decreased from 0.56% in 2012 to 0.25% in 2017 due to improved viral suppression rates, resistance among viraemic pretreatment individuals rose from 4.86% to 9.61% during the same period, highlighting the ongoing challenge of acquired and transmitted mutations such as K103N and M184V (Martin et al., 2025). Among adults initiating ART, pretreatment drug resistance has been reported at 18.2%, predominantly to NNRTIs at 14.1%, underscoring the need for vigilant monitoring in treatment-naïve populations (Watera et al., 2021). Furthermore, in treatment-experienced individuals with virological failure, resistance levels are markedly higher, with NNRI resistance exceeding 50% and NRTI resistance around 36%, contributing disproportionately to the population-level burden (Martin et al., 2025).

Southwestern Uganda, including the Mbarara region, hosts a significant HIV burden with regional referral hospitals serving as key ART delivery points. Local studies have shown relatively low transmitted drug resistance rates, such as 3% in Mbarara compared to 7% in urban Kampala, with no major shifts over time, though the presence of mutations like K103N in pretreatment cases has been linked to suboptimal treatment outcomes in some instances (Lee et al., 2014). At facilities like Mbarara Regional Referral Hospital (MRRH), where patients on dolutegravir-based regimens are managed, emerging resistance to integrase strand transfer inhibitors has been observed in up to 10.6% of cases, particularly among children and those with prior treatment exposure, emphasizing the regional variations in resistance patterns (Ssentongo et al., 2025). The study aims to assess the prevalence and factors contributing to first-line drug Resistance among patients attending the ART clinic at Mbarara Regional Referral Hospital.

Methodology

Study Design

This study employed a descriptive cross-sectional design to assess the prevalence and contributing factors of HIV drug resistance among patients attending the ART clinic of Mbarara Regional Referral Hospital (MRRH).

Study Area

The study was conducted at the ART clinic of MRRH, located in Mbarara City, southwestern Uganda. MRRH serves as a tertiary referral facility for the Ankole sub-region, catering to a diverse population from urban, peri-urban, and rural areas, with an estimated catchment of over 4 million people (Uganda Ministry of Health, 2022). The clinic manages approximately 10,000 HIV-positive patients annually, providing first- and second-line ART regimens in line with national guidelines, including dolutegravir-based therapies. This setting is ideal for the study due to its high patient volume.

Study Population

The target population consisted of adult patients (aged 18 years and above) living with HIV who are attending the ART clinic at MRRH and were on first-line ART regimens. This included both treatment-naïve individuals recently initiated on therapy and those with prior exposure, encompassing a mix of virologically suppressed and failing cases. The population was estimated at around 5,000 active clinic attendees based on hospital records, providing a feasible base for sampling (Mbarara Regional Referral Hospital, 2024).

Sample Size Determination

The sample size for this study was calculated using the formula for estimating prevalence in a finite population: $n = [Z^2 * p * (1-p)] / d^2$, where Z is the Z-score for a 95% confidence interval

(1.96), p is the estimated prevalence of HIV drug resistance (adult HIV prevalence of about 6% by the Uganda Virus Research Institute, 2018), and d is the margin of error (0.05). Z=1.96, P=0.06, Q=0.94, D=0.05 n= 1.96x1.96x0.06x0.94 / 0.05x0.05 n=86.666=87

Therefore, 87 participants were included in the study

Sampling Procedure

Participants were selected using a systematic random sampling technique to ensure

Representativeness and minimize selection bias. The clinic's daily attendance register serves as the sampling frame, with an average of 100 patients per day. A sampling interval (k) will be determined by dividing the daily attendance by the required daily sample (e.g., k = 100 / 10 = 10 if aiming for 10 participants per day over 8.7 clinic days).

Inclusion and Exclusion Criteria

Inclusion Criteria

All files for individuals aged 18 years and older diagnosed with HIV and enrolled in the ART clinic at MRRH and on first-line ART for at least six months.

Exclusion Criteria

Files with Incomplete information

Data Collection Method

Data were collected through document review of files for patients with HIV drug resistance at Mbarara Regional Referral Hospital.

Study Variables

Dependent Variables

HIV first-line drug resistance

Independent Variables

Prevalence, Sociodemographic and Socioeconomic factors, as well as Treatment-related factors.

Data Management and Analysis

Descriptive statistics (frequencies, means) summarized prevalence and variables.

Ethical Considerations

Ethical approval was obtained from the Mbarara University of Science and Technology Research Ethics Committee and the Uganda National Council for Science and Technology. Written informed consent was secured, emphasizing voluntariness, confidentiality (via coded identifiers), and the right to withdraw. Participants with detected resistance were referred for clinical management.

Results

The prevalence of HIV first-line drug resistance among patients attending the ART clinic at Mbarara Regional Referral Hospital, southwestern Uganda

Table 1: Prevalence of HIV First-Line Drug Resistance, n=87

Variable	Category	Frequency (n)	Percentage (%)
HIV Drug Resistance	Resistant	11	12.6%
	Non-Resistant	76	87.4%
Total		**87**	**100%**

Table 1 shows that out of the total 87 participants whose records were reviewed, 11(12.6%) individuals were found to be resistant to first-line antiretroviral therapy, while the vast majority of the sample, 76(87.4%), were identified as non-resistant, indicating that their current first-line regimens remained effective at the time of the study.

The sociodemographic factors contributing to HIV first-line drug resistance among patients attending the ART clinic at Mbarara Regional Referral Hospital

Table 2: Sociodemographic Characteristics of Participants n=87

Variable	Category	Frequency (n)	Percentage (%)
Age Group	18 – 24 years	15	17.2%
	25 – 34 years	32	36.8%
	35 – 45 years	22	25.3%
	Above 45 years	18	20.7%
Gender	Female	51	58.6%
	Male	36	41.4%
Marital Status	Single	18	20.7%
	Married	44	50.6%
	Divorced/Widowed	25	28.7%
Education Level	None / Primary	38	43.7%
	Secondary	34	39.1%
	Tertiary	15	17.2%
Residence	Rural	58	66.7%
	Urban/Peri-urban	29	33.3%

Table 2 revealed that the largest proportion of participants belonged to the 25–34 age group, representing 32(36.8%) of the sample, followed by the 35–45 age category at 22 (25.3%); 18(20.7%) were aged above 45 years, while the 18–24 age group was the least represented at 15(17.2%). In terms of gender, 51(58.6%) were females while 36(41.4%) males. 44(50.6%) were married, 25(28.7%) divorced and 18(20.7%) single. 58(66.7%) resided in rural areas while 29(33.3%) in Urban or peri urban settings.

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Figure 1: Educational levels of participants, n=87

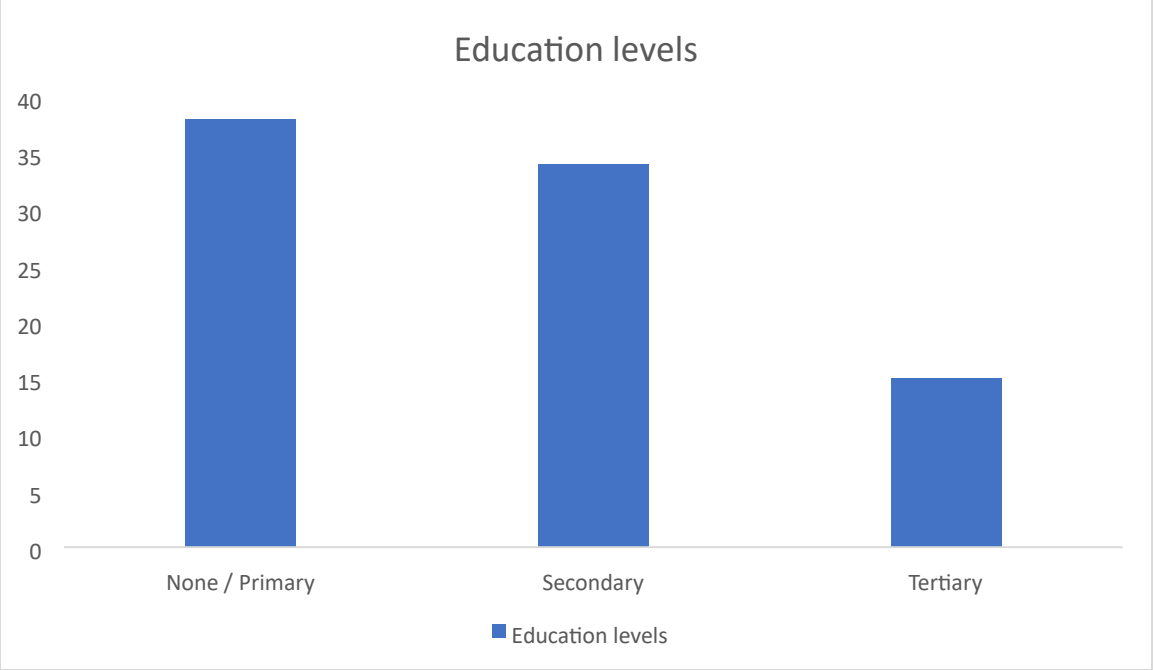


Fig 1: The education level of the participants showed that a significant portion had either no formal education or had only reached the primary level, 38(43.7%), 34(39.1%), while only 15(17.2%) had attained tertiary education.

Treatment-related factors contributing to first-line drug resistance among patients attending the ART clinic at Mbarara Regional Referral Hospital.

Table 3: Treatment-Related Factors, n=87

Variable	Category	Frequency (n)	Percentage (%)
Duration on ART	6 – 12 months	12	13.8%
	13 – 60 months	45	51.7%
	Above 60 months	30	34.5%
ART Adherence Status	Good (≥95%)	62	71.3%
	Fair (85-94%)	16	18.4%
	Poor (<85%)	9	10.3%
Viral Load Status	Suppressed (<1000 copies)	74	85.1%
	Unsuppressed (≥1000 copies)	13	14.9%

History of Regimen Switch	Yes	19	21.8%
	No	68	78.2%

Table 3 shows that 45(51.7%) had been on antiretroviral therapy for a duration of 13 to 60 months, 30(34.5%) were on treatment for above 60 months, while 12(13.8%) had been on ART for only 6 to 12 months. Regarding ART adherence, 62(71.3%) of participants maintained good adherence (≥95%), but 9(10.3%) were classified as having poor adherence (<85%) while 16(18.4%) had a fair adherence status. Viral load status indicated that while most participants, 74(85.1%), were virologically suppressed, 13(14.9%) were virologically unsuppressed (1000 copies). Additionally, a minority of participants, 19(21.8%), had a history of switching their ART regimens, while the majority, 68(78.2%), had remained on their initial first-line therapy.

Table 3: Psychosocial and Knowledge Factors (N=87)

Variable	Category	Frequency (n)	Percentage (%)
Received HIV Education	Yes	78	89.7%
	No	9	10.3%
Experienced Side Effects	Yes	24	27.6%
	No	63	72.4%
Disclosed Status to Partner	Yes	69	79.3%
	No	18	20.7%

Table 4 reveals that 78(89.7%) of participants reported that they had received formal HIV education at the clinic, while 9(10.3%) did not. 24(27.6%) of the participants reported experiencing side effects from their medication, which is a factor that often leads to treatment interruptions, while 63(72.4%) did not. 69(79.3%) had disclosed their HIV status to their partners, while a significant 18(20.7%) had not, a factor frequently linked to hidden non-adherence and social isolation, which can further complicate the management of long-term antiretroviral therapy.

Discussion

The prevalence of HIV first-line drug resistance among patients attending the ART clinic at MRRH, southwestern Uganda

Regarding the study findings about the prevalence of HIV first-line drug resistance at MRRH, the study established that out of 87 participants, the majority (76; 87.4%) were not resistant to HIV first-line drugs, while the minority (11; 12.6%) were resistant. The primary purpose of the study was to establish the prevalence and the contributing factors to HIV first-line drug resistance, which was established at 12.6%, slightly higher than the national prevalence of 12.1% reported by the Ministry of Health in 2018. This finding indicates that a significant portion of the patient population is harboring viral strains that are no longer fully susceptible to standard first-line antiretroviral therapy (ART). However, it remains lower than the 18.2% pre-treatment drug resistance reported among adults initiating ART in broader Ugandan cohorts. The results also align with longitudinal data from communities in Uganda, which showed that resistance among viraemic individuals rose from 4.86% to 9.61% between 2012 and 2017. The findings at MRRH are consistent with the regional dynamics described by Lee et al. (2014), who noted that transmitted drug resistance (TDR) in Mbarara was generally lower than in urban centers like Kampala. The current 12.6% figure suggests that while regional rates historically started lower, there is an upward trend in resistance at major referral points that necessitates vigilant monitoring.

The sociodemographic factors contributing to HIV first-line drug resistance among patients attending the ART clinic at MRRH

Regarding the sociodemographic factors contributing to HIV first-line drug resistance among patients attending the ART clinic of MRRH, the study findings revealed that the majority, 32(36.8%) participants, were aged 25-34 years, the most prominent age group among participants, while a minority, 15(17.2%), were aged 18-24 years. The majority finding is because young adults and youths are highly sexually active and indulge in risky lifestyles coupled with peer influence. These findings align with findings by Akullian et al. (2020), who noted that younger age groups

often are at risk of HIV exposure though may demonstrate lower viral suppression rates due to socioeconomic vulnerabilities (Akullian et al., 2020). Furthermore, findings showed that the majority (58; 66.7%) of the participants were living in rural areas, while minority 29(33.3%) lived in urban or peri-urban settings. Rural patients at MRRH face significant geographic and financial barriers, such as high transport costs to Mbarara City, which often result in treatment interruptions. This study finding in Mbarara is in agreement with research observations by Nsonga et al. (2025), who identified rural residence as a key contributor to drug resistance in sub-Saharan Africa due to the challenges associated with rural health-seeking behaviors (Nsonga et al. 2025).

Additionally, the study noted that gender was a key factor in HIV drug resistance, whereby the majority (51; 58.6%) of the participants were females, while minority 36(41.4%) were males. While some literature suggests women may have better adherence in certain contexts, others highlight that caregiving responsibilities and stigma can act as disproportionate barriers in Ugandan settings, leading to suboptimal adherence and resistance. The prevalence of non-disclosure (20.7%) also mirrors patterns seen in other regional studies where fear of stigma promotes isolation and hidden medication interruptions (Machava et al., 2024).

From the study findings, other important sociodemographic factors were marital status and education level. Majority 44(50.6%) participants were married while minority 18(20.7%) were single. Also, the majority, 38(43.7%), had no formal education or had stopped at the primary level, while the minority, 15(17.2%), had reached the tertiary level. Socioeconomic status, including education and wealth, indirectly fosters HIVDR by influencing health literacy, affordability of care, and stigma tolerance. Low education levels correlate with poorer understanding of ART regimens, leading to suboptimal adherence and resistance emergence. A systematic review of ART adherence in SSA identified education as a determinant, with lower literacy associated with higher non-adherence rates (Heestermans et al., 2016).

Treatment-related factors contributing to HIV first-line drug resistance among patients attending the ART clinic at MRRH.

Regarding the treatment factors contributing to HIV first-line drug resistance, the study revealed that the majority, 45(51.7%), participants had been on ART for about 13-60 months, while minority 12(13.8%) respondents had been on ART for a period of about 6-12 months. Scientific literature suggests that prolonged exposure to first-line regimens, particularly those with low genetic barriers like NNRTI-based therapies, increases the likelihood of single-point mutations leading to the development of resistance. These findings are in agreement with a study by Miruka et al. (2024) about Behavioral aspects in line with ART duration, such as forgetting doses or non-disclosure leading to hidden interruptions, which further perpetuate this cycle, indirectly fostering resistance persistence. The type of ART regimen and timeliness of switches significantly affect HIVDR emergence, particularly in regimens with low genetic barriers to resistance (Miruka et al., 2024).

Furthermore, the study found that the majority (62; 71.3%) had good drug compliance, while minority 9(10.3%) of patients had poor adherence (compliance <85%). Suboptimal adherence is a well-documented driver of HIVDR because it creates "drug pressure" that allows the virus to replicate and select for resistant variants. Kyaw et al. (2016) demonstrated that even minority drug-resistant mutations are common in patients with intermittent adherence and persistent high viral loads.

Additionally, the majority (74; 85.1%) of the participants had suppressed viral loads, while minority 13(14.9%) of the participants were virologically unsuppressed. The majority finding is probably because of good drug adherence and a good lifestyle. However, the minority finding is a key driver of drug resistance, and it's probably because of poor drug compliance and poor lifestyles. According to Kiros et al. (2025), failure to achieve viral suppression is the strongest predictor of acquired drug resistance in sub-Saharan Africa; hence, the findings are in agreement with most research studies.

Also, from the study findings, the majority (63; 72.4%) experienced no major side effects while on ART, while minority 24(27.6%) participants reported side effects. Side effects are very significant; if they become unbearable, they lead to "pill-shyness" and self-directed drug holidays, which undermine treatment efficacy and foster resistance persistence. This finding is in agreement with studies that indicate that acquired resistance, driven by these elements, predominates over transmitted resistance, with machine learning models highlighting programmatic treatment issues as stronger predictors than individual behaviors. Key contributors include poor adherence, inappropriate regimen selection or delays in switching, inadequate viral load monitoring, and behavioral barriers such as stigma or substance use (Kiros et al., 2025)

Conclusion

The study concludes that HIV first-line drug resistance is a significant clinical challenge at Mbarara Regional Referral Hospital. The primary drivers include: 32 individuals aged 25-34 years, 51females, 18 single individuals, 38 individuals with no formal education or only primary level, and 58 rural residents. Additionally, 45 individuals are on ART for a period of 13-60 months, 9 have poor drug

compliance, 13un suppressed viral loads, 24 individuals are experiencing side effects, 19 individuals have kept switching their ART regimen, and 9respondents who didn't receive HIV education.

Recommendations.

MRRH should strengthen Community Drug Distribution Points (CDDPs) to reduce the transport burden for rural patients.

Accelerate the transition of all patients from NNRTI-based regimens to Dolutegravir (DTG)-based therapies as per WHO guidelines.

Implement intensive adherence counseling (IAC) for the 14.9% of patients with unsuppressed viral loads to prevent the selection of further resistant mutations.

Conduct longitudinal genotypic studies at MRRH to identify specific common mutations like K103N or M184V in the local population.

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Finally, I extend my appreciation to all the participants and individuals who assisted in data collection and field research. Your contributions were vital to the success of this project.

List of abbreviations

ART: Antiretroviral Therapy
CDDPs: Community Drug Distribution Points
DTG: Dolutegravir
HIV: Human Immunodeficiency Virus
HIVDR: HIV Drug Resistance
IAC: Intensive Adherence Counseling
MRRH: Mbarara Regional Referral Hospital
NNRTIs: Non-Nucleoside Reverse Transcriptase Inhibitors
NRTIs: Nucleoside Reverse Transcriptase Inhibitors
SSA: Sub-Saharan Africa
TDR: Transmitted Drug Resistance
WHO: World Health Organization

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Conflict of interest

No conflict of interest declared.

Author contributions

IN: Conceptualization, Methodology, Data collection, Investigation, Writing-original draft.
HN: Validation, Project administration
FS: Supervision, Validation.
RM: Writing-review and editing.
JFN: Data curation, Visualization, Supervision.
All authors: Approved the final version of the manuscript and agreed to be accountable for the work.

Data availability

Data are available upon request.

Informed consent

Written informed consent was obtained from all participants prior to their inclusion in the study. Participants were informed about the purpose of the study, procedures involved, potential risks and benefits, and their right to withdraw at any time without penalty.

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References

1. AkulliSan, A., Morrison, M., Garnett, G. P., Mnisi, Z., Lukhele, N., Bridenbecker, D., ... & Bershteyn, A. (2020). The effect of 90-90-90 on HIV-1 incidence and mortality in eSwatini: A mathematical modelling study. *The Lancet HIV, 7*(5), e348-e358. https://pmc.ncbi.nlm.nih.gov/articles/PMC7062634
2. Heestermans, T., Browne, J. L., Aitken, S. C., Vervoort, S. C., & Klipstein-Grobusch, K. (2016). Determinants of adherence to antiretroviral therapy among HIV-positive adults in sub-Saharan Africa: A systematic review. *BMJ Global Health, 1*(4), e000125. https://gh.bmj.com/content/1/4/e000125
3. Kiros, M., Mirin, T., Biset, S., Getu, B. D., Getachew, M., & Alemu, A. (2025). Prevalence and factors associated with HIV drug resistance among adult persons living with HIV/AIDS in nine countries of Sub-Saharan Africa using population-based HIV impact assessments. *BMC Public Health, 25*(1), 1-12. https://link.springer.com/article/10.1186/s12889-025- 24633-9

4. Kyaw, N. T., Harries, A. D., Kumar, A. M., O, M. M., Kyaw, K. W., Win, T., ... & Oo, H. N. (2016). High rate of virological failure and low rate of switching to second-line treatment among adolescents and adults living with HIV on first-line ART in Myanmar, 2005-2015. *PLoS One, 11*(2), e0151789. https://pmc.ncbi.nlm.nih.gov/articles/PMC4879357
5. Lee, G. Q., Bangsberg, D. R., Muzoora, C., Boum, Y., Oyugi, J. H., Emenyonu, N., ... & Hunt, P. W. (2014). Prevalence and virologic consequences of transmitted HIV-1 drug resistance in Uganda. *AIDS Research and Human Retroviruses, 30*(9), 896-906. https://www.liebertpub.com/doi/10.1089/aid.2014.0034
6. Machava, M. A., Sacoor, C., Fernandes, Q., Macuamule, C., de Schacht, C., Nhangave, A., ... & Chongo, P. (2024). Sociodemographic factors associated with non-disclosure of HIV serostatus to sexual partners in Maputo, Mozambique. *Scientific Reports, 14*(1), 72430. https://www.nature.com/articles/s41598-024-72430-y
7. Mbarara Regional Referral Hospital. (2024). *Annual HIV clinic report*. Mbarara, Uganda: MRRH.
8. Miruka, F. O., Nyanga, N., Otieno, G., Onyango, R., Ngugi, C., & Masaba, R. (2024). Factors associated with drug resistance mutations among antiretroviral therapy-experienced adolescents living with HIV in South Rift Valley, Kenya. *Journal of Public Health in Africa, 15*(1), 1488. https://publichealthinafrica.org/index.php/jphia/article/view/1488/2542
9. Ssentongo, P., Ba, D. M., Fronterre, C., Xing, J., Chinchilli, V., & Ssentongo, A. E. (2025). Global, regional, and national prevalence of HIV-1 drug resistance in treatment-naive and treatment-experienced children and adolescents: a systematic review and meta-analysis. *eClinicalMedicine, 68*, 102438. https://www.thelancet.com/journals/eclinm/article/PIIS2589-5370(24)00438-3/fulltext
10. Uganda Ministry of Health. (2022). *National HIV/AIDS strategic plan 2020/21-2024/25*. Kampala: MOH.
11. Uganda Virus Research Institute. (2018). *National HIV drug resistance prevention, monitoring and surveillance activities: National status report*. https://www.uvri.go.ug/sites/default/files/files/HIVDR%20REPORT%20%20_Draft%20 9.pdf
12. Watera, C., Mukiza, N., Isabwe, M., Owora, J., Nangendo, F., Kiwanuka, G., ... & Kaleebu, P. (2021). HIV drug resistance among adults initiating antiretroviral therapy in Uganda. *Journal of Antimicrobial Chemotherapy, 76*(9),2407-2414. https://academic.oup.com/jac/article/76/9/2407/6276545
13. World Health Organization. (2024). *HIV drug resistance – brief report 2024*. https://www.who.int/publications/i/item/9789240086319
14. World Health Organization. (2025). *Fact sheet: HIV drug resistance*. https://www.who.int/news-room/fact-sheets/detail/hiv-drug-resistance