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The Extent of Scale-Up of HIV Viral Load Testing Services and Linkages to Intensive Adherence Counselling Support Among HIV-Infected Patients On Anti-Retroviral Therapy in Gomba District Uganda: Secondary Data Analysis.

Student Name:

Student Number: Dissertation

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Date

Declaration

No portion of this work has been submitted in support of an application for degree or qualification, to this or any other University or institution of learning.

Name:
Signature:

Abstract

Background

The third 90 global target of the Joint United Nations Program on HIV/AIDS requires 90% of all people on antiretroviral therapy (ART) to have suppressed viral load (VL). This requires that those unsuppressed should be provided with intensified adherence counselling (IAC). However, monitoring and uptake of these services are suspected to be poor in many communities in Uganda.

Study Aim

To determine the extent to which VL testing and IAC services were provided to HIV-infected patients on ART in Gomba district, Uganda in 2017.

Methods

A cross-sectional descriptive design that employed methods of secondary data analysis of routinely available program data on HIV-infected patients in Gomba district. Medical records of patients who had been on ART for at least six months from all the facilities in the district that provide ART were analysed. Descriptive statistics were applied to the sample to determine sample characteristics and the study outcome estimates. Multivariable logistic regression analysis was used to estimate the predictors of uptake of VL testing and IAC services.

Results

Uptake of VL testing and IAC linkage was 67.4% (279/414) and 80.5% (331/411) respectively. Duration on ART above five years ($p<0.001$), and 1-5 years ($p<0.01$) plus receiving ART from health center level III ($p<0.005$) were significantly associated with increased VL testing uptake. Ages 16- 30 years ($p<0.01$) and 31-45 years ($p<0.05$)

reduced the odds of VL testing uptake. Health facility level III was significantly associated with increased linkage to IAC ($p<0.05$).

Conclusion

VL testing uptake in Gomba district was higher than the national average, and there were commendable linkages to IAC. HIV-infected patients new on ART should be supported to take up VL testing and capacities of lower level health facilities should be improved to provide IAC.

Keywords

VL testing, intensified adherence counselling, ART, HIV-infected, Uganda

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List of Abbreviations

AIDS	Acquired Immune Deficiency Syndrome
ART	Anti-Retroviral Treatment
CDC	Center for Disease Control
DHO	District Health Officer
HC	Health Center
HIV	Human Immunodeficiency Virus
IAC	Intensive Adherence Counselling
MoH	Ministry of Health
SSA	Sub-Saharan Africa
UAC	Uganda AIDS Commission
UBOS	Uganda Bureau of Statistics
UNAIDS	Joint United Nations Programme on HIV/AIDS
USAID	United States Agency for International Development
VL	Viral Load
WHO	World Health Organization

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Chapter 1- Introduction and Background

1.1. Burden of HIV

The HIV epidemic remains a significant human health scourge that has challenged the world for the past 30 years with over 70 million people reported to have been infected with HIV and 35 million deaths since the beginning of the epidemic (World Health Organization [WHO], 2018). According to the Joint United Nations Programme on HIV/AIDS (UNAIDS), globally, there were 36.9 million People Living with HIV [PLHIV], and 940,000 people died of HIV-related illness in 2017(UNAIDS, 2018a). While the epidemic shows prospects towards a decline worldwide, the magnitude of the situation in East and Southern Africa remains perturbing, contributing to over half of the global HIV burden (19.6 million PLHIV) at the end of 2017(UNAIDS, 2018b). Over 44% (1.8 million) of new HIV infections and 40% (940,000) of AIDS-related deaths in 2017 occurred in the Eastern and Southern Africa regions (UNAIDS, 2018a). Uganda still has a high burden of disease with an estimated 1.3 million PLHIV in Uganda at the end of 2017(UNAIDS, 2018b). The prevalence of HIV among individuals aged 15 to 64 years from a national survey report in Uganda is at 6.2% (Ministry of Health Uganda,[MoH] 2017).

UNAIDS set ambitious targets in 2014, that aim to see the end of the HIV epidemic by 2030. The targets state that by 2020, 90% of PLHIV need to be know their HIV-infection status, 90% of those who are aware of their diagnosis should receive ART, and 90% of those on ART should have sustained Viral Load (VL) suppression (UNAIDS, 2014).

Reaching the third target is reliant on access and scale-up of laboratory testing services

to measure the HIV VL (Carmona, Peter and Berrie, 2017). There has been an increase in the number of PLHIV accessing ART, with 89% of them being able to access ART in Uganda in 2017 and this calls for a need to maintain treatment success and reduce cases of ART failure(UNAIDS, 2018b)

1.2. Viral Load Monitoring

WHO recommends the use of VL testing – the measure of HIV plasma concentration – as the gold standard method for monitoring the clinical response to ART among HIV-infected patients (WHO, 2016). VL testing should be conducted at six and 12 months after initiation of ART and every 12 months subsequently for patients stable on ART. Viral suppression is defined as a VL below the detectable threshold using viral assays. The recommended thresholds by WHO are a VL measurement below 1000 copies per ml when using plasma and 5000 copies per ml for dry blood spots and these are the same threshold levels used in Uganda (MoH, Uganda, 2016; WHO, 2016). Having unsuppresed VL, therefore, implies having a VL test result above the recommended threshold.

1.3. Intensive Adherence Counselling

The Intensive Adherence Counselling (IAC) process involves helping the HIV-infected patients identify and gain insight into their barriers to ART adherence, and explore ways of overcoming obstacles and making a plan to adhere to ART (WHO, 2016). The IAC package includes the provision of individual needs assessment, education sessions and adherence counselling to patients(MoH, Uganda, 2016). According to the MoH in Uganda, individuals with unsuppressed VL should undergo three IAC sessions that are provided each a month apart, after which a VL test is repeated. IAC provision requires a

multidisciplinary team that comprises of counsellors, clinicians, family members, nurses and peers among others (MoH, Uganda, 2016; WHO, 2016).

1.4. Problem statement on VL monitoring and IAC in Uganda

Enormous efforts have been directed towards the scale-up of VL testing services in many low-income countries including Uganda (Roberts et al., 2016), however, the levels of VL monitoring are still low in most parts of the country with only 10% of patients on ART reported to have a VL test done in 2015 (Lecher et al., 2015).In the absence of routine VL monitoring, CD4 cell count and clinical monitoring are utilised resulting in poor tracking of adherence and efficacy of ART regimens (Keiser *et* al., 2011). There is also lack of routine monitoring of the VL testing scale-up activities in many parts of the country, and this is worse in rural communities like Gomba district (District Health Officer [DHO] Gomba, 2018)

The IAC program has been implemented in Uganda since 2015, though, there has not been any training of health workers staff and recruitment of personnel to support the activity in many of the health centres in Uganda including Gomba district (DHO Gomba, 2018). The lack of adequate motivational counselling support for ART adherence results in ART failure and need for expensive second-line ART regimens that are unavailable in most resource-limited settings like Uganda(Billioux *et al.*, 2015). PLHIV with unsuppressed VLs resultantly experience increased morbidity and mortality that could be avoided by adherence support (Townsend et al., 2009). Also, suboptimal adherence to ART, which is a challenge for patients who have been on ART for a long duration like in Uganda, results in the emergence of drug-resistant HIV strains and transmission of

these strains in the population (Blower *et al.*, 2003; Mbonye *et al.*, 2013) and this further highlights the need for IAC for those with unsuppressed VL.

1.5. Public Health Significance of the study

It is imperative that VL monitoring is done for all HIV-infected patients on ART and IAC conducted for those with unsuppressed VL to achieve the UNAIDS goals related to viral suppression(WHO, 2016).VL testing gives PLHIV a measure of understanding of HIV infection status, and motivation to adhere to ART treatment. VL testing also prolongs the use of first-line regimens, prevents the development of drug resistance and ensures the longevity of HIV treatment programs where drug options are limited to mostly first and second line treatments (Rowley, 2013).

Poor adherence to ART that can be supported through IAC is one of the major causes of VL non-suppression, and most patients attain VL suppression after IAC sessions except in cases of a failing ART regimen (Joseph Davey *et al.*, 2018). Outcomes of ART are dependent on the utilisation of VL measurement, but there are documented challenges in scale-up of routine VL testing (Lecher *et al.*, 2016). Additionally, there is inadequate data on the extent to which IAC is provided for individuals with unsuppressed VL in Uganda. The study, therefore, evaluated the extent of scale-up of VL testing for HIV-infected patients on ART and linkages to IAC in Gomba district, Uganda in 2017. The research is expected to provide new knowledge to health workers and policymakers regarding referrals and linkages for PLHIV on ART with unsuppressed VLs to IAC that can be used to improve service performance of health facilities in Uganda.

Chapter 2 - Literature Review

2.1. Objectives of the literature review

Existing literature on HIV VL monitoring and IAC for PLHIV on ART in the Sub-Saharan African (SSA) region was reviewed with the aim of reporting

- The HIV-treatment monitoring practices and trends in SSA countries
- Existing knowledge and gaps in the literature on VL monitoring in Uganda and other SSA countries
- Existing knowledge and gaps in the literature on adherence counselling interventions for PLHIV on ART with unsuppressed VL in Uganda and SSA countries

2.2. Literature Search Strategy

A literature search was conducted from September to October 2018 for publications and reports related to this research study through the University of Liverpool search engine called Discover. The academic health database search engines used and the search terms utilised are highlighted in Table 2.1. The keywords were used in combination with each other and the Boolean terms OR plus AND were used as conjunctions to combine or exclude keywords in the search, to achieve more refined and focused results. Additionally, the local and international websites including the MoH in Uganda, WHO, UNAIDS, and USAID were searched for relevant data. Also, pertinent references to the original research reports or publications were reviewed for more relevant information.

Table 2. 1. Databases and terms used in the literature search

Database	Keywords/phrase	Retrievals	Retained	Reasons for Rejection
EBSCO MEDLINE	HIV OR "Human Immunodeficiency Virus" OR AIDS OR "Acquired Immune Deficiency Syndrome" AND ART OR "Antiretroviral Medication" OR Treatment AND Monitoring AND Africa OR "Sub Saharan Africa"	69	7	Some focused on laboratory technologies and other monitoring strategies like CD4 and symptomatic approach
PUBMED	"HIV" OR" Human Immunodeficiency Virus" OR AIDS OR "Acquired Immune Deficiency Syndrome"	59	5	Some inappropriate topics and repetitions from previous searches
SCOPUS	AND "Viral load" OR "Viral load testing" OR "viral load monitoring" OR "viral load scale-up" OR "virological monitoring" AND Africa or "Sub-Saharan Africa"	77	6	Most repetitions from other searches
EBSCO Discovery science	Virological failure" OR "unsuppressed viral load" OR "ART treatment failure" AND "adherence" or "adherence counselling" OR "intensive adherence counselling" OR "enhanced adherence counselling." AND "Africa" OR "Sub-Saharan Africa"	68	3	Most focused on general adherence without treatment failure, and others focused on reasons for non-adherence
Science Direct.	HIV" AND "ART" OR "Anti-Retroviral Treatment" OR "HIV treatment" AND "monitoring" or "follow-up" AND Africa" OR "Sub-Saharan Africa"	43	3	Most repetitions from other searches
Google scholar	"viral load monitoring" scale up	30	3	

The criteria for inclusion were articles in English from 2011 to 2018, though, updated data was considered for the past five years, and more relevant information was obtained for articles published earlier. Also included were articles within the SSA region; articles related to HIV VL monitoring; and articles on adherence counselling. Peer-reviewed systematic reviews, interventional, analytical, and cross-sectional studies were included. Literature from other regions and qualitative studies were excluded.

A total of 22 articles were selected and are summarised in the next subsection. The literature review process is illustrated in figure 2.1 below.

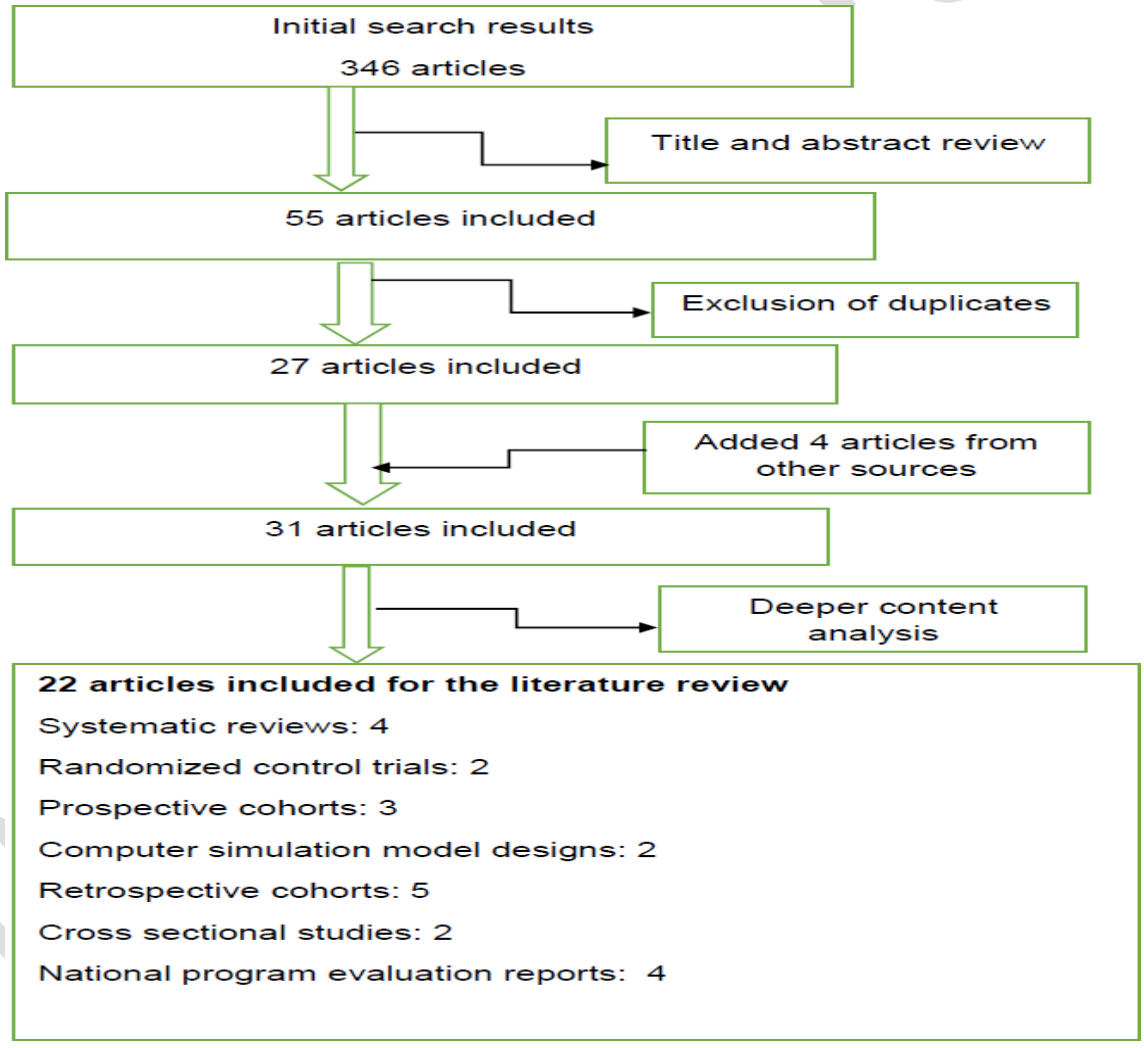

Figure 2. 1 Literature review process overview

2.3. Summary of Literature Review

2.3.1. HIV Treatment Monitoring Approaches

Until recently HIV programs in Uganda have previously used the CD4 cell count to monitor the response of HIV-infected patients on ART(MoH, Uganda, 2016). A systematic review and meta-analysis by Vojnov *et al. (*2016), of 30 studies conducted from 2005 to 2015 in eight countries from SSA illustrated that Point-of-Care CD4 testing devices increased linkage of PLHIV into HIV care and accelerated initiation of ART. The authors derived significant strength in the review from the multiple numbers of studies and geographical coverage of the articles, however, the majority of the studies were cross-sectional study designs that is not robust enough to demonstrate elements of causality and temporality strength (Solem, 2015).

A systematic review that included 18 studies on adults and paediatrics conducted from 2006 to 2012 by Rutherford *et al.*, (2014) however, illustrated that 2010 WHO clinical and immunological criteria for assessing virological failure were insensitive and had low positive predictive value. The study had broad geographical coverage including Africa, Asia and South America; nonetheless, the studies used pooled estimates of sensitivities that may sometimes be misleading(Gatsonis and Paliwal, 2006). Also, another systematic review by Ford *et al.*, (2015) of 13 studies conducted mostly in high-income, and three African countries provided more evidence that CD4 count monitoring offers little information for patients who are clinically stable on ART and have viral suppression. The systematic review was a robust study design whose results informed WHO's the current recommendation to stop the use of CD4 cell count testing once patients are stable on ART and adopt VL monitoring for PLHIV on ART (Ford *et al.*,

2015). The review was limited by few studies from low-income countries like Uganda and minimal studies in the review evaluated the non-HIV causes of the decline in CD4.

2.3.2. Benefits of VL monitoring

A prospective cohort study that followed up 2,539 HIV- infected ART naïve in Malawi, Mozambique and Guinea provided evidence that VL monitoring six months after initiation of ART is a useful prognostic marker for prognosis of HIV disease and patient retention into care(De Luca *et al.*, 2012). The authors obtained study strength from a multiple site cohort design that increases the validity of results (Pope and Stanistreet, 2017), howbeit, the use of VL monitoring for patients on second-line ART was not illustrated in the study (De Luca *et al.*, 2012). Another prospective cohort analysis that compared outcomes of over 18,000 HIV-infected patients followed up using VL monitoring in South Africa with over 80,000 patients followed up using CD4 monitoring in Malawi and Zambia illustrated early switch to second-line regimens, improved patient survival, and improved retention in care for the patients followed using VL monitoring (Keiser *et al.*, 2011). The large sample size of over 100,000 participants with a robust prospective cohort design increased study strength; nonetheless, the outcomes in the study could be explained by other factors such as limited access to treatment to manage HIV complications in low-income countries of Zambia and Malawi.

A systematic review that included one observational study and five Randomized Controlled Trails (RCT) by Tucker *et al.* (2014), provides more evidence that VL monitoring is useful for assessing early response and adherence to ART plus creating opportunities for adherence interventions that can achieve viral suppression. The systematic review included RCTs, study designs that eliminate study bias and thus

provided strong scientific evidence (Burns, Rohrich and Chung, 2011). The limitation of the review was a short follow-up period of participants in the reviewed studies and the inclusion of only adults (Tucker *et al.*, 2014). A retrospective cohort analysis of over 5,500 patients undergoing VL monitoring in Swaziland by Jobanputra *et al.* (2014), also revealed that VL monitoring had a significant impact on reinforcing adherence among patients with unsuppressed VL (73% of 210 unsuppressed patients were linked to IAC). The authors derive study strength from a suitable location that is highly HIV-endemic and following up of patients through the entire VL monitoring course but was limited by its inability to analyse the content of counselling sessions and had few patients on second-line therapy (Jobanputra *et al.*, 2014).

2.3.3. Cost-effectiveness of VL monitoring

The cost-effectiveness of the use of VL monitoring to monitor PLHIV on ART in limited resource settings has been an issue of debate. An RCT conducted in Uganda by Kahn et al.(2011), showed that adding VL to CD4 and clinical monitoring increased costs by $5181 per Disability-Adjusted Life Years (DALYs) and while another conducted in Cameroon by Boyer et al. (2013) revealed that VL increased expense by $4768 per DALYS compared to clinical monitoring for patients on ART. The two studies being RCTs (a robust study design) provided strong arguments that VL monitoring was costly and had low clinical benefit. Notwithstanding, the studies had short follow-up periods of two years thus did not account for the full benefits of VL monitoring (Kahn *et al.*, 2011; Boyer *et al.*, 2013).

Conversely, a cost-effectiveness study in Cote d'Ivoire that used the Cost-Effectiveness of Preventing AIDS Complications-International model to compare the cost-

effectiveness of VL and CD4 monitoring illustrated that VL confirmation of immunological failure was less costly and more effective as it reduced the time of failing on ART in comparison to immunological monitoring (Ouattara *et al.*, 2016). Another model-based analysis study done in South Africa by Hamers et al. (2012) that used the Markov model illustrates that VL monitoring saves costs by accurately diagnosing the people to switch to second-line ART regimens and switches are done promptly before clinical progression of disease and death. The strength in the model analyses lies in their transparency and simulation of RCT designs though in both models not all data was available as they are simulations of complex clinical systems(Hamers, Schuurman, *et al.*, 2012; Ouattara *et al.*, 2016).

2.3.4. Scale up of VL Monitoring services

A national program evaluation report analysing seven countries, Kenya, Namibia, South Africa, Côte d'Ivoire, Tanzania, Malawi, and Uganda that had scaled up routine VL monitoring in 2014 indicated that in Uganda, only 10% of patients on ART had a VL test done between 2014 and 2015. Namibia had the highest scale up reaching up-to 95% of people on ART; South Africa had 75%, Kenya 38%, Malawi 11 %, Tanzania and Côte d'Ivoire still had low rates at 3% in 2015 (Lecher et al., 2015).

There was an improvement in VL testing services to 23% by June 2016 in Uganda and also documented improvement for other six countries though only Namibia and South Africa had over 85% according to a follow-on program progress report by Lecher et al. (2016). A program report evaluating VL interventions in northern Uganda revealed an improvement in scale-up of VL testing services to 37% after quality improvement support was offered to 50 high volume centres (Ochola, Aloyo and Rahimzai, 2016).

The national VL testing rate had improved to 42.6 % by June 2016, according to the country's national AIDS report(Uganda AIDS Commission [UAC], 2016).

2.3.5. Factors associated with Viral non- suppression

A cross-sectional analysis of medical records for 244,370 HIV patients on ART from 271 public health facilities in South Africa evaluated factors associated with unsuppressed VL (Davey *et al.*, 2018). Results showed that 25% of the patients had viral non-suppression and the risk factors for viral non-suppression were, male gender, being on ART for less than a year or more than ten years, children and adolescents, TB treatment, and having a CD4 cell count of <100 at the start of ART. Results from a retrospective analysis of program data from Kenya's national VL database also revealed that the unsuppressed VL was more common in children, adolescents and males gender (Mwau et al., 2018).

In a retrospective cohort analysis in Mozambique, un-suppressed VL rates were documented at 27%, and similarly, children and adolescent had more elevated VL compared to adults (Swannet *et al.*, 2017). Another descriptive cross-sectional study in Uganda by (Bulage *et al.*, 2017) on routinely collected program data on VL revealed unsuppressed VL rate at 11%. The children, adolescents, individuals with poor adherence to ART, and those on TB medication had increased odds of having unsuppressed VL. The strength of all four studies from South Africa, Kenya, Mozambique and Uganda is that they used large samples that were representative of vast geographical regions and they were conducted in SSA. The studies, however, used routinely available program data records and therefore had missing records while the retrospective cross-sectional reviews could not allow for determination of causality of

viral non-suppression (Bulage *et al.*, 2017; Swannet *et al.*, 2017; Davey *et al.*, 2018; Mwau *et al.*, 2018)

2.3.6. Adherence counselling

Results from a retrospective cohort analysis of conducted in rural Uganda by Billioux *et al.(* 2015), revealed that 60% of 142 HIV-infected patients that had viral non-suppressed achieved viral suppression after additional counselling interventions. The cohort analysis was, however, limited to a program setting that had additional funding and adherence provided by a multidisciplinary team which is not very representative of the context in Gomba (Billioux *et al.*, 2015). In a single-arm prospective study done in South Africa, 65% of the 388 HIV-infected patients on second-line therapy achieved viral suppression after IAC, but, the study lacked a control arm to determine the effectiveness of the intervention (Fox *et al.*, 2016).

A retrospective cohort analysis of 449 records of children and adolescents in Uganda that had viral non-suppression indicated that only 77% of them completed the recommended IAC sessions with IAC being provided up to 200 days after VL test and only 23% received viral suppression after the intervention(Nasuuna *et al.*, 2018). The study did not evaluate the content plus provider of the IAC sessions and didn't provide data on adults. There are no other documented studies indicating whether attention is being given to the individuals with unsuppressed VL despite guidelines that recommend IAC in Uganda.

2.4. Practical Significance of this Research

The critical review of the literature revealed sufficient information on the viral load suppression among PLHIV who received ART and clinical evaluation in Uganda and

other SSA countries. Nonetheless, the extent of scale-up of VL testing services has not yet been thoroughly evaluated in the entire country especially in remote settings in Uganda (UAC, 2016). Additionally, there is little known about linkages to IAC in the Ugandan health system.

Therefore, the Student Investigator identified the need to establish the status of VL testing uptake, linkage of unsuppressed patients to IAC, and potential predictors of these outcomes in the rural district of Gomba, in Uganda. This knowledge will determine the performance status of the HIV programs in the district and improve HIV program service quality (maximise the chances of viral re-suppression and minimise the switches to second-line ART regimens as stipulated in the national ART treatment guidelines).

Chapter 3- Methodology

3.1. Research questions

The study addresses the following questions: To what extent were HIV VL testing services provided to HIV positive patients on ART in Gomba district, Uganda in 2017? To what extent were HIV positive patients on ART with unsuppressed VLs linked to IAC support services in Gomba district, Uganda in 2017?

3.2. Study aim

To determine the extent to which VL testing and IAC services were provided to HIV positive patients on ART in Gomba district in 2017 to improve HIV service quality in Uganda.

3.3. Objectives

1. To review the available literature on the VL testing and IAC in SSA countries including Uganda.
2. To estimate the proportion of PLHIV on ART who had VL tests done from January 2017 to December 2017 in Gomba district in Uganda, using descriptive secondary data analysis from a cross-sectional study.
3. To estimate the proportion of PLHIV on ART with unsuppressed VLs from January 2017- December 2017 that were linked to IAC support within three months from receipt of VL results in Gomba district in Uganda, using descriptive secondary data analysis from a cross-sectional study.

4. To identify factors associated with the uptake of VL testing and IAC services among PLHIV on ART and with unsuppressed VL, respectively, in Gomba district in Uganda, using logistic regression analysis from a cross-sectional study.
5. To disseminate new knowledge and provide recommendations to inform policies on service quality improvement among the district health workers, district leaders, and other stakeholders.

3.4. Positionality and Epistemological approach

The Student Investigator has been working in HIV research and treatment programs for over six years. She has observed several delays in the implementation of various WHO and MoH guidelines regarding care for HIV-infected people. The researcher was aware that her personal views and experiences of HIV program in Uganda could impact adversely on the study findings and interpretations; thus, adopted a positivist approach and minimised any potential impact of her position or biases to the study (Carson *et al.*, 2001). Positivists assume that there is one single truth that does not change, and can be observed and measured by the researcher while interpretivists claim that there are multiple realities and information about them is socially constructed (Gilson, 2012). The Student Investigator as a positivist in this study used secondary data analysis and thus was independent of the research as she did not influence primary data collection(Gilson, 2012). She had no undisclosed interest in the study and remained detached from the participants to make a clear distinction between feeling and objectivity (Carson et al., 2001). Positivists take on an empirical, generalised and deterministic approach to research and the Student Investigator made quantifiable observations on VL testing and IAC uptake which led to statistical analysis of the

collected data and did not rely on her own preconceptions (Carson *et al.*, 2001). An interpretivist would explore more on attitudes and experiences in accessing VL testing and IAC However; this study aims to measure the extent of VL monitoring and IAC linkages, hence a positivist approach(Pope and Stanistreet, 2017).

3.5. Study Design

A cross-sectional descriptive epidemiology design that employed methods of secondary data analysis of routinely available program data on HIV-infected patients receiving ART in Gomba district was used for the study. A cross-sectional design was the most appropriate for this study because of its cost-effectiveness and ability to determine the prevalence of certain outcomes in study samples plus evaluating the odds ratio for association of factors; information that can be useful for public health planning(Pope and Stanistreet, 2017). Additionally, the design is a common applicability to other similar studies in SSA that estimated interval prevalence and associations of VL outcomes and exposures or risk for viral suppression (Bulage et al., 2017; Joseph Davey et al., 2018; Mwau et al., 2018). The proportions of PLHIV on ART who received VL tests and those linked to IAC support from January 2017 to December 2017 were evaluated.

3.6. Setting

The study was conducted in Gomba district, one of the 111 administrative districts in Uganda(Uganda Bureau of Statistics [UBOS], 2016). Uganda is classified as a low-income country in the SSA region (figure 3.1), and the economy is mainly supported by agriculture, forestry, fishing and industry (World Bank, 2018). Poverty characterises the Ugandan society with 24.5% of its inhabitants living below the poverty line [less than

$1.25 a day] (World Bank, 2018); thus the health and development indicators need much improvement.

Gomba district has a population of 160,075, and 49% are females; the district has five sub-counties, 37 parishes and 287 villages(UBOS, 2016). Gomba district is located in the central region of Uganda as illustrated in figure 3.1 below and 92% of its population is rural (UBOS, 2016).

Figure 3. 1: Map showing Uganda in Africa and Gomba district in Uganda.

The prevalence of HIV in Gomba is about 6.4%, and the district has eight health facilities that are supported by non-governmental organisations to provide ART to over 4,200 HIV-infected patients (DHO Gomba, 2018). One of the eight health facilities is at Health Center (HC) level IV, this is the highest level of the health facility in the district that serves the entire district, and it provides general curative and preventive services to the population in addition to HIV treatment services. The other seven are lower level

health facilities are at level III HCs, and these provide maternity care, ambulatory and laboratory services (Orem and Zikusooka, 2010). All the health facilities that provide ART in the district were included in the study to have a more representative sample. In addition to being rural, Gomba district was selected for the study because, the staffing level in the district was at 58.5% at the time of study conduct, and there were are no qualified and trained counsellors to provide adherence counselling support to HIV-infected patients on ART. IAC in Gomba district is provided mostly by support staff like peer workers and linkage facilitators who do not have any documented and recognised training (DHO Gomba, 2018).

3.7. Sample frame, Sample size and Study population.

The study population was HIV-infected patients on ART in Gomba district Uganda. All the eight health facilities that provide ART were included in the study, and the sampling frame was narrowed to all HIV-infected patients on ART for at least six months at these facilities using the WHO recommended guidelines for VL testing(WHO, 2017). The two study samples were HIV-infected patients who have been on ART for at least six months and HIV positive patients on ART with non-suppressed VLs. The study samples were randomly selected from all the eight facilities that provide ART in Gomba district.

3.1.1. Sample size calculation for participants

Based on Charan and Biswas,(2013) the sample size equation for cross-section studies is $\frac{(Z1-\alpha/2)^2\, p(1-p)}{d^2}$

Z1- α/2, the standard normal variate at alpha level of 5% (P < 0.05) is 1.96; P was the proportion of PLHIV on ART and received VL testing [estimated at 42.6% based on

(UAC, 2016)]; and the proportion of identified HIV unsuppressed population on ART who were linked to IAC services [estimated at 50% as the usual standard as conservative estimates for outcomes or effects sizes with no literature backup(Pope and Stanistreet, 2017)]. d is the required level of precision (margin of error) decided for this study at a 95% confidence interval.

Sample size for VL Testing = 1.962 x 0.426 x (1 – 0.426) / 0.052 = 375.58, approximately 376. Considering 10% of the participants missing data based on literature (Elahi, 2008), the sample size for the estimation of the VL testing uptake was 37.6 + 376 = 414.

Sample size for IAC = 1.962 x 0.50 x (1 – 0.50) / 0.052 = 384.2. With 10% missing data level, the total sample size was 384.2 + 38.4= 423.

Overall 837 records were reviewed for the analysis.

To determine the number of participants to be selected from each health facility, the proportionate allocation method was used for each health facility. The ratio that was used to determine the sample size for each health facility was the patients on ART for at least six months at the facility compared to the total number of the patient on ART for at least six months in the entire district. The sample size for each facility was determined, and participants whose records were to be included in the analysis were randomly selected from the list of “all patients on ART for at least six months at each facility (sampling frame)”. Table 3.1 below illustrates how the sample size for each health facility was determined.

Table 3. 1: Sample size determination for each health facility

	Total Clients on ART for at least six months	**The proportion of clients per health centre**	**The sample size for VL Testing per health centre**	**The sample size for IAC linkage per health centre**
Health facility				
Maddu HC IV	1391	0.334	138	141
GombaKanoni HC III	1132	0.272	113	115
Kifampa HC III	527	0.126	52	53
Mpenja HC III	261	0.063	26	27
Kyai HC III	254	0.061	25	26
Kisozi HC III	249	0.06	25	25
Bukalagi HC III	185	0.044	18	19
Rapha Medical HC III	162	0.04	17	17
TOTALS	**4161**		**414**	**423**

3.8. Participant recruitment

As the study used methods of secondary data analysis, there was no direct recruitment of study participants. Primary data from health facility patient records were used. Patient medical records for all clients on ART are routinely documented on paper-based treatment cards that are kept in files and are later updated on to paper-based ART and

IAC registers for each health facility. At some facilities, data on the paper-based treatment cards was also entered into an electronic database.

Health facility staff were used as gateways to access confidential data as the Student Investigator was not permitted direct access to participant information due to stringent guidelines in the country on HIV care records in Uganda. Initially, a list of all patients on ART for at least six months at each facility was generated from the electronic database or entered into an MS Excel sheet 2007 version for health facilities that lacked electronic records. Each patient was given a unique study code by the facility staff, and the list of codes from each health facility was sent to Student Investigator who then randomly selected the number of specified participants for each facility. The list of codes of selected participants was then posted back to health facility staff who linked the codes to participants whose records were to be chosen for the abstractions.

3.8.1. Inclusion criteria.

All HIV-infected patients attending health centres in the Gomba district, in Uganda who had been on ART for at least six months from January 2017 to December 2017 were included in the study, including transfer-in clients.

3.8.2. Exclusion criteria.

HIV-infected patients on ART whose duration on ART is not specified or documented, including transfer-in HIV-infected patients on ART who have not been on ART for six months, from January 2017 to December 2017 were excluded from the analysis.

3.9. Instrument

An MS Excel sheet 2007 version was used as the instrument for the random selection of participants for each facility and to collect data on the selected participants (Appendix

II). The excel sheet was piloted on three participants at each health facility and was found to be appropriate to capture the data required for the secondary data analysis. No modifications were made to the tool, and it was used to collect data for the rest of the participant records. The excel sheet was password protected.

3.10. Data collection.

Data collection occurred over six weeks from mid-October to the end of November 2018 after all approvals had been obtained.

Data were abstracted from the sources below;

1. Paper registers: The ART registers and Intensified Adherence Counselling Registers.
2. Electronic ART registers for health facilities that had them.
3. Patient treatment card at all the health facilities, where data was found incomplete in the registers.

Data from the paper registers and the patient treatment cards was entered into the MS Excel sheet 2007 version by selected health facility staff. The Student Investigator trained the health facility staff on the specific indicators to be entered into the excel sheet, and also visited the health facilities during the data collection process to ensure the quality of the process. The Student Investigator reviewed all the records of the participants that were abstracted.

Data on key demographic variables including age, sex, and marital status, was abstracted from the registers and patient treatment cards into the excel sheet. Data on the start date of ART was used to calculate duration on ART at the time of VL test, date of VL test date, VL test result, date VL test results received at facility, date VL test

results provided to the patient. Also, the date of the first IAC session was updated in the excel sheet for the sample of the participants that had unsuppressed VL.

3.11. Operational Definition of study variable

The two dependent variables were VL testing uptake and IAC linkage, VL testing uptake was defined as having at least one VL test done once during the one year period of the study, and IAC linkage was defined as the provision of IAC to a participant with unsuppressed VL within three months of receipt of results at the health facility. IAC uptake within three months of viral failure detection was considered for the analysis to align with possible maximum patient appointment period though IAC was supposed to be immediate, perhaps, in the next clinical appointment, as soon as viral non-suppression was determined (MoH, Uganda, 2016). The time to first IAC session was defined as the time difference between the date receipt of VL test results at the health facility and date of first IAC.

The independent variables in this study included demographic characteristics such as age at the time of VL testing, gender and marital status. Other variables included were duration on ART at the time of the VL test and health facility level.

3.12. Data management

3.12.1. Data quality

To ensure data quality, the health facility staff that abstracted data were trained on the tool. The data was checked for uniformity, consistency, completeness and validity. The Student Investigator reviewed data, and some of the data cleaning activities included logical interpretation of entries, further analysis for missing entries, duplicate entries,

and converted numbers stored as texts into numbers. The health facility staff were asked to verify the data that was queried. After data cleaning, the data was coded and the codes assigned to the variables (See Appendix III for a data codes)

3.12.2. Data analysis

Data was exported to Statistical Package for the Social Sciences (SPSS) version 20.0 computer software package for analysis. The prevalence for VL test done for patients on ART for at least six months was determined. The proportion of patients with non-suppressed VLs who are linked with IAC within three months of receipt of VL test results at each health facility were computed. Descriptive analysis was done for continuous variables using means or medians depending on the normality of the distribution of the variables, and frequencies to describe the characteristics of the study sample and determine the prevalence (proportions) of the outcome variables. Bivariate analysis was used to analyse the relationship between each variable and each outcome (VL testing uptake plus IAC linkage). To determine the strength of association between the variables and the outcomes, the Chi-Square test was applied, and p-values of less than 0.05 were considered as statistically significant (Pope and Stanistreet, 2017). All variables in the bivariate analysis that showed a p-value <0.05 for association with VL uptake or linkage to IAC were considered for the multivariable logistic regression analysis to assess independent relationships further while adjusting for potential confounders (Katz, 2003) [See Appendix III for a data analysis matrix].

3.13. Ethical approval

The University Of Liverpool Board Of Ethics and the local ethical body called Mildmay Uganda Research Ethics Committee gave ethical approval to carry out the study and a

support letter was also obtained from the DHO of Gomba district (See Appendix IV for approval letters). Additionally, the Uganda National Council of Science and Technology provided registration for the study.

Confidentiality of the information obtained from the registers was maintained as the data was de-identified before being accessed by the Student Investigator. The data was sent to a secure email address, and the excel sheets containing all the data were stored on a password-protected computer and will be kept for five years, after which it will be destroyed.

Chapter 4- Results

The study aimed at evaluating the extent of uptake of VL testing and IAC services among HIV- infected patients in Gomba district. The results regarding the uptake of VL testing are first described in section 4.1, and those related to IAC linkage are later described in section 4.2 of this chapter. The results in each sub-section are presented as first descriptive to define the baseline characteristics and outcome prevalence, then followed by the inferential characteristics to determine the associations of the outcome variables with the independent variables.

4.1. Uptake of VL Testing

A total of 414 PLHIV who had been on ART for at least a six months on ART were included in the descriptive cross-section analysis to assess the extent of scale-up of VL testing and the factors associated with VL testing uptake.

4.1.1. Baseline characteristics of the sample for uptake of VL Testing

The socio-demographic and clinical characteristics of the study participants are summarised in table 4.1. The majority of study participants (44.4%) were aged between 31 and 45 years, children below 15 years were only 5.8%, and the mean age of the participants was 39.5 years. Majority of the study participants were women (60.4%), and more than half of the study participants were married (66.5%). Two-thirds of study participants (66.7%) received ART services from an HC level III while one-third (33.3%) received similar services from an HC level IV (Table 4.1). The mean duration of ART therapy of participants was 40.3 months with the most significant proportion of study participants (61.6%) having been on ART therapy for 1-5 years.

Table 4. 1: Socio-demographics and clinical characteristics of participants

Characteristic	Frequency(n)	Per cent (%)	Mean ± SD
Age categories			
1-15 years	24	5.8	
16-30 years	76	18.4	
31-45 years	182	44.4	
46 years or more	132	21.0	
Age, years			39.5±14.1
Gender			
Male	164	39.6	
Female	250	60.4	
Marital Status			
Married	246	66.5	
Divorced/Separated	46	12.4	
Widowed	24	14.6	
Single	54	13	
Child	27	6.5	
Health Facility Level			
Health Center IV	138	33.3	
Health Center III	276	66.7	
Duration on ART			
6-11.9 months	79	19.1	
1-5 years	255	61.6	
>5 years	80	19.3	
Duration on ART, months			40.3±31.6

4.1.2. Missing data

Overall, the documentation in the patient files was proper, though some patient files lacked socio-demographic variables like contact details, age, marital status, and sex. The health facility staff had to search in other documents such as ART registers to collect this information. Even after a thorough search, the team was unable to determine the marital status of 17 participants that were part of the analysis.

4.1.3. Proportions of patients with Viral load testing uptake

The proportion of HIV patients on ART therapy for at least six months with VL uptake. The proportions of patients with a VL test done from January to December 2017 were 67.4% (279/414).

Table 4.2 shows that VL testing uptake was higher among participants above 46 years (77.3%) and children up to 15 years (75%) than the other age categories. A higher proportion of women (70%) had VL testing than men (64%). VL testing was also higher among the widowed (79%) compared to the separated/divorced (74 %), the married (67%) and the single (59%). Also, a higher proportion (74%) of the participants from HC level III had their VL testing compared to HC level IV (55%). Additionally, VL testing uptake was higher among participants who had been on ART for more than five years (80%) than participants on ART between 1-5 years (70%) and 6-11.9 months (46%).

Table 4. 2: Characteristic of participants with viral load testing uptake.

Characteristics	**Numbers and proportions of participants with VL uptake group Mean ± SD N (%)**
Age categories	
1-15 years	18(75.0)
16-30 years	41(53.9)
31-45 years	118(64.8)
46 years or more	102(77.3)
Age	40.9±14.5
Gender	
Male	105(64.0)
Female	174(69.6)
Marital Status	
Married	165(67.1)
Divorced/Separated	34(73.9)
Single	32(59.3)
Widowed/Widower	19(79.2)
Health Facility Level	
Health Center IV	76(55.1)
Health Center III	203(73.6)
Duration on ART	
6-11.9 months	36(45.6)
1-5 years	179(70.2)
>5 years	64(80.0)
Duration on ART, months	44.3±32.8

4.1.4. Factors associated with VL testing uptake

Bivariate analysis shows that the duration on ART was significantly associated with VL testing uptake; participants who had been on ART more than 5 years and for 1- 5 years

were five times more likely (OR_{crude}4.78, CI, 2.4, 9.7) and three times more likely (OR_{crude}2.8, CI 1.7, 4.7) respectively to have a VL test than those who had been on ART for less a six months. Health centre level was also revealed a significant associated with VL testing uptake; participants receiving ART treatment from HC level III were twice more likely (OR_{crude}2.3, CI 1.5, 3.5) to have a VL test compared to those who receive ART treatment from HC level IV. Additionally, age was significantly associated with reduced uptake of VL testing at bivariate analysis at 16- 30 years (OR_{crude}0.3, CI 0.2,0.6) and at 31- 45 years (OR_{crude}0.5, CI 0.3, 0.9). Gender and marital status did not achieve any statistical significance in relation to VL testing uptake at the bivariate analysis level, and the 95% confidence interval that spaces the null interval confirms this observation (Table 4.3).

At multivariable analysis level, being on ART for more than 5 years (OR_{adj}4.6, CI 2.1, 9.8) and 1-5 years (OR_{adj}2.4 CI 1.4, 4.1), receiving ART treatment from a HC level III (OR_{adj}2.7, CI 1.7, 4.3), were significantly associated having increased VL test done while being an individual aged 16-30 years (OR_{adj}0.4 CI 0.2, 0.8) and 31-45 years (OR_{adj}0.6, CI 0.3, 0.97) was significantly associated with reduced VL testing uptake. Factors that were not significantly associated with VL testing uptake include gender, marital status and being below 15 years (Table 4.3).

Table 4. 3: Odds ratios for VL testing in patients using bivariate and multivariable logistic regression modelling.

	Bivariate analysis		**Multivariable analysis**	
Characteristics	**OR (95% CI)**	**p-value**	**OR (95% CI)**	**p-value**
Age group				
1-15 years	0.88(0.32,2.42)	0.808	0.85(0.29,2.47)	0.768
16-30 years	0.34(0.19,0.63)	P<0.001	0.40(0.21,0.77)	P<0.01
31-45 years	0.54(0.33,0.90)	P<0.05	0.56(0.33,0.97)	P<0.05
46+ years	1		1	
Duration on ART				
6-11.9 months	1		1	
1-5 years	2.81(1.68,4.72)	P<0.001	2.37(1.38,4.09)	P<0.01
>5 years	4.78(2.36,9.66)	P<0.001	4.60(2.16,9.77)	P<0.001
Health facility Level				
Health IV	1		1	
Health III	2.27(1.48,3.48)	P<0.001	2.70(1.68,4.33)	P<0.001
Gender				
Male	1			
Female	1.29(0.85,1.95)	.237		
Marital Status				
Married	1			
Divorced/Separated	1.39(0.68,2.83)	0.362		
Single	0.71(0.39,1.31)	0.275		
Widowed/Widower	1.87(0.67,5.18)	0.231		

4.2. Linkage to IAC

All the 411 PLHIV on ART who had unsuppressed VL from January 2017- December 2017 in Gomba district were included in the descriptive cross-section analysis to assess linkage for IAC support within three months from receipt of VL results. The VL non-suppression rate at the time of the study was 9.9% (411/ 4100) of all the HIV- infected patients on ART for at least six months in the district. Factors associated with IAC uptake were also evaluated

4.2.1. Baseline characteristics of the sample of PHLIV on ART with unsuppressed VL in Gomba district

The mean age of the participants was 30.7 years; the majority of the participants were aged 31-45 years (32%) and children 15 years and below constituted 28% of the total sample. The proportion of women was higher than men (52.1% versus 47.9%). The majority (70%) of study participants had been on ART therapy for 1-5 years, and the mean duration of ART therapy of patients was 43.5 months. More than half of the study participants (62.5%) received ART services from an HC level III while (37.5%) received similar services from an HC level IV.

Table 4. 4: Socio-demographics and clinical characteristics of participants with unsuppressed VL

Characteristic	Frequency(n)	Per cent (%)	Mean ± SD
Age categories			
1-15 years	115	28.0	
16-30 years	78	19.0	
31-45 years	133	32.4	
46+ years	85	20.7	
Age, years			30.7±17.6
Gender			
Male	197	47.9	
Female	214	52.1	
Marital Status			
Divorced/Separated	41	10.0	
Married	163	39.7	
Single	70	17.0	
Widow/Widowed	22	5.4	
Health Facility Level			
Health Center IV	154	37.5	
Health Center III	257	62.5	
Duration on ART			
6-11.9 months	42	10.2	
1 -5 years	287	69.8	
>5 years	82	20.0	
Duration on ART, months			43.5±29.0

4.2.2. Proportions of PLHIV on ART with unsuppressed VLs that were linked for IAC support

A total of 8 in 10 (80.5%) of the non-suppressed study participants (331/411) were linked to IAC support within three months from receipt of VL test results, 3.6%(15/411) were linked to IAC in more than three months while 15.8% (65/411) were linked to IAC during the period of data analysis.

As shown in Table 4.5 below a higher proportion of women (82%) compared to men (79%) were linked to IAC. Also, higher proportions of the linkages to IAC were more at HC level IV (87%) in comparison to HC level III (76.7%). Linkage to IAC was highest among participants aged 46 and above years (83.5 %) in comparison to those aged 31-45 (81.2 %), 16- 30 years (79.5%) and children up to 15 years (78.3%). There were minimal differences in the frequency of linkage to IAC in respect to marital status expect for 95.5% linkage rate among the widowed who also represented a small portion of the study population (5.8%). IAC linkage proportions were also higher among participants who had been on ART for more than five years (89%) than participants who had been on ART for 1 –5 years (79%) and 6-11.9 months (76%). The mean duration of ART for participants linked to IAC was 35.4 months, and the mean age was 28.7 years.

Table 4. 5: Characteristics of participants linked to IAC

Characteristic	Numbers and Proportion of the participants linked to IAC within three months Mean ± SD N (%)
Age categories	
1-15 years	90 (78.3)
16—30 years	62 (79.5)
31-45 years	108 (81.2)
46+ years	71 (83.5)
Age, years	28.7 ± 17.0
Gender	
Male	169(79.0)
Female	162 (82.2)
Marital Status	
Divorced/Separated	33 (80.5)
Single	57 (81.4)
Married	130 (79.8)
Widow/Widowed	21 (95.5)
Health Facility Level	
Health Center IV	134 (87)
Health Center III	197 (76.7)
Duration on ART	
6-11.9months	32 (76.2)
1 -5 years	226 (78.7)
>5 years	73 (89.0)
Duration on ART, months	35.4±22.0.

4.2.3. Factors associated with linkage to IAC services

Table 4.6 shows the crude odds ratios associated with linkage to IAC and other background characteristics. Unadjusted bivariate analysis shows that duration on ART was significantly associated with linkage to IAC services at 1-5 years (OR_{crude}0.5, CI 0.2, 0.97). Health centre level was also significantly associated with linkage to IAC. Participants receiving ART treatment from HC level III (OR_{crude}2.0, CI 1.2, 3.5) were twice more likely to be linked to IAC compared to those who receive ART treatment from HC level IV. No significant association was found between age, gender plus marital status and linkage to IAC within three months of receipt of results at the health facility at the bivariate level of analysis

At multivariable analysis level, HC level III was still significantly associated with increased linkage to IAC, OR_{adj} 1.78 CI (1.00, 3.16). The association of linkage of IAC and duration on ART was not statistically significant at multivariable level. The multivariable analysis provides enough evidence to accept the null hypothesis that background characteristics including age, gender, marital status, and duration of ART are not associated with linkage to IAC as shown in Table 4.6 below.

Table 4. 6: Odds ratios for linkage to IAC among patients using bivariate and multivariable logistic regression modelling

	Bivariate analysis		**Multivariable analysis**	
Characteristics	**OR (95% CI)**	**p-value**	**OR (95% CI)**	**p-value**
Age group				
1-15 years	1			
16-30 years	0.84(0.53,2.18)	0.838		
31-45 years	0.57(0.65,2.23)	0.565		
46+ years	0.35(0.68,2.91)	0.354		
Duration on ART				
6-11.9 months	0.40(0.15,1.06)	0.066	0.50(0.18,1.40)	0.188
1-5 years	0.46(0.22,0.97)	P<0.05	0.56(0.26,1.22)	0.146
>5 years	1		1	
Health facility Level				
Health IV	1		1	
Health III	2.041(1.18,3.54)	P<0.05	1.78(1.00,3.16)	P<0.05
Gender				
Male	1			
Female	1.23(0.75,2.02)	0.405		
Marital Status				
Married	1			
Divorced/Separated	1.05(0.44,2.48)	0.917		
Single	1.11(0.55,2.27)	0.769		
Widowed/Widower	5.33(0.69,41.88)	0.108		

4.3. Results Summary

Uptake of VL testing among PLHIV who had been on ART for at least six months in Gomba district was 67.4%, and 80.5% of the PLHIV with unsuppressed VL in Gomba district were linked to IAC for the analysed period of January to December 2017.

Bivariate analysis revealed an association between VL testing uptake and duration of ART, age plus health facility level. Multivariable logistic regression analysis findings show significant associations between VL testing uptake and duration on ART, health facility level plus age. Only health centre level was significantly associated with linkage to IAC at multivariable logistic analysis.

Neither gender nor marital were significantly associated with uptake of VL testing and linkage to IAC.

Chapter 5-Discussion, Conclusions, and Recommendations

Since the start of the scale-up of routine VL monitoring in Uganda, this is the first study that has evaluated the extent to which VL testing and IAC services are provided to HIV-infected patients on ART in a rural setting. In this chapter, the implications of the findings from the research in relation to the study objectives, context of the study, and previous literature, are described. Additionally, a discussion on the strengths and weaknesses of the research plus the main lessons learnt is included. The chapter ends with the public health relevance of the research findings and recommendations.

5.1. Implications of the findings

5.1.1. Uptake of VL testing

Descriptive analysis of the sample of patients who had been on ART for at least six months revealed a rate of 67.4% VL testing uptake from January 2017 to Dec 2017 in Gomba district. This estimate is 24.8% higher than the national uptake of VL testing that was reported at 42.6% from July 2015 to June 2016 (UAC, 2016). The higher value can be attributed to continued government programs and activities aimed at increasing uptake of VL testing throughout the country such as training of health workers on VL monitoring including sample collection, logistic supply management and interpretation of results(DHO Gomba, 2018). The government is also supported by several organisations including PEPFAR, USAID and CDC to support capacity building of the health workers and this increase is therefore expected to continue as the country strives towards reaching the third 90.

The uptake of VL testing is, however, still much lower than that of other countries in SSA including Kenya, Namibia and South Africa where the uptake of VL testing is over

75%(Lecher *et al.*, 2016). Much as the government has diverted efforts to scale–up VL testing, there remains a lack of knowledge of the importance of VL testing among patients, thus contributing to the lower value. Also, the DHO further reported that for the period of study analysis, there were still challenges in the district regarding record keeping of results, documentation of VL tests done and transportation of samples to the national central laboratory (DHO Gomba, 2018).

5.1.2. Factors associated with uptake of VL testing

Age: In this study, the relationship between the age of the HIV-infected participants and uptake of VL testing was significant at both the bivariate and multivariable logistic regression analysis levels. People aged 16- 30 and those aged 31 to 45 years were less likely to have VL testing uptake in comparison to those aged above 46 years. Being a child did not affect the odds of taking up VL testing. This result is contrary to that of a retrospective cohort study set in Maputo, Mozambique that showed a strong association between age and uptake of VL testing where children below 15 years were more likely to have a VL test done(Swannet *et al.*, 2017). In the study in Gomba, however, there were very few children in the study possibly due to the enormous success of Prevention of Mother-to-Child Transmission of HIV (PMTCT) program in Uganda, and therefore significant associations could not be determined (UAC, 2016). Nevertheless, a considerable portion of the children (75%) had a VL test for the period of data analysis reflecting high priority being given to children to have VL testing in Gomba district.

Duration on ART: Findings demonstrate that the longer HIV-infected patients were on ART, the higher the odds of uptake of VL testing; participants who had been on ART for more than five years were five times more likely to have a VL test done than those who

had been of ART for 6-11.9 months. In a retrospective cohort study set in Maputo, Mozambique, duration of ART was also found to be significantly associated with uptake of VL testing (Swannet *et al.*, 2017). According to a systematic review by Stadeli and Richman (2013), people who had been ART for a longer duration had higher rates of acquired ART resistance. It is, therefore, a good observation in this study that HIV-infected patient on longer ART duration of ART are taking up VL testing as cases of suspected ART failure can be detected early.

Health facility level: Accessing services from lower level health centre increased the odds of having a VL test done. At multivariable analysis level, individuals who received ART services from HC III were three times more likely to have a VL test done than those who got ART services from HC IV. There are seven HCs at level III, and one HC at level IV in the district and more HIV-infected patients (66.7%) received ART from HC level III, and thus higher odds of service uptake at HC III observed. This is a new finding as there are no other studies that have evaluated uptake of VL testing and health centre level.

Gender: Gender was not associated with VL uptake in this study and findings were similar to those in a retrospective cohort study set in Maputo, Mozambique that revealed minimal differences in the chances of uptake VL test uptake per gender comparison (Swannet *et al.*, 2017).

Marital status: Findings demonstrate that there was no association of marital status and uptake of VL testing. Given that most of the adults in the study sample were married, this could be the reason why the statistical analysis did not reveal any

association. A cross-sectional and a cohort study conducted in Tanzania that evaluated factors associated with uptake of HIV related services revealed, however, an association that being married is strongly associated with increased uptake of other HIV related services such as HIV counselling and testing and ART for PMTCT especially among women (Gourlay *et al.*, 2015; Mahande, Phimemon and Ramadhani, 2016).

5.1.3. Linkage to IAC

A total of 8 in 10 of the study participants that had viral non-suppression (80.5%) were linked to IAC support within three months from receipt of VL test results at the health facility. The result is higher than that reported in a retrospective study in Uganda by Nasuuna *et al.*, (2018) where about 50% of the 449 children had the first session of IAC within 100 days (3.3 months) of availability of results at the national central laboratory. The results could imply that measures that are being used to track individuals with non-suppressed VLs in the district such as telephone calls and active follow up by VHT members are effective (DHO Gomba, 2018).

5.1.4. Factors associated with linkage to IAC

Age: The cross tabulation results show that linkages to IAC were highest among those above 46 years and lowest in children below 15 years much as no association was found between age and linkage to IAC at the bivariate logistic regression analysis.

According to the DHO Gomba, (2018), parents often collect drugs for children and do not bring them for some of the visits, and therefore this could be the explanation for the low proportion of children linked to IAC.

Duration on ART: PLHIV who had been on ART for more than five years had higher odds of being linked to IAC at bivariate analysis. However, the association of IAC linkage and duration on ART was not statistically significant at multivariable analysis. From cross tabulation result, participants who had been on ART more than five years had higher linkage rates to IAC. The result could be attributed to a further understanding of the need to adhere to clinic appointments as an individual stays longer on the ART program according to the DHO Gomba, (2018). Participants who had been on ART for 6-11.9 months had lower linkage rates to IAC compared to those who had been on ART for a longer duration, and the postulated reason for this is limited knowledge on the need to adhere to ART and clinic visits according to the DHO Gomba, (2018).

Health facility level: The relation between HC level and linkage to IAC was statistically significant. HIV-infected people with unsuppressed VL that received services from HC level III were 1.7 times more likely to be linked to IAC in comparison with those that received services from HC level IV. This is a new finding as no other study has evaluated IAC linkages and associated factors. The result is of interest because the IAC service at lower level health facilities is provided by unskilled staff while more trained personnel provide IAC at HC level IV (DHO Gomba, 2018). The result can be attributed to the higher proportion of people that had VL suppression from lower level HC III (62.5%) that could imply more expected linkages to IAC.

Gender: Gender was not associated with the linkage of IAC at bivariate logistic regression analysis level, though uptake of IAC was higher among women compared to men (82% versus 79%) in this study. Results can be compared to a retrospective cohort

study done in South Africa where gender was not associated with uptake of HIV treatment nor TB treatment services (Meehan *et al.*, 2018).

5.2. Discussion of research Process and Lessons Learned

5.2.1. Literature search and review process

The literature search process was rigorous, and several databases were searched. Data on VL testing scale up and uptake in SSA countries was readily available with several reports and journal articles identified on the subject. However, only one study conducted in Maputo, Mozambique evaluated factors associated with VL testing uptake, other articles provided data on the extent of scale up and challenges found during the implementation of VL testing plus recommendations.

Regarding IAC, there was limited literature on the topic. Most studies were cross-sectional designs that evaluated factors associated with viral non-suppression and provided recommendations of the need for IAC. One of the identified studies was conducted in Uganda, and it evaluated the outcomes of IAC provision among adolescents. Another study conducted in Swaziland evaluated VL re-suppression among patients who had detectable VL after receiving IAC, and the last one in South Africa evaluated the outcomes of IAC among individuals failing on second-line therapy. There was neither literature about the extent of provision of IAC to PLHIV in a rural setting in Uganda nor data on factors associated with linkage to IAC. The process highlighted a gap in the literature that the study fills.

5.2.2. Methodology and data collection process

The study used a cross-sectional study design to determine the frequency of uptake of VL and IAC services plus associated factors. The study involved all the eight health centres in the district, and PPS allocation was used to obtain a random sample size for each health facility; thus the sample is considered to be representative of the entire district, and selection bias was avoided. Data collection was difficult as a couple of registers needed to be checked due to lack of an electronic database where all data is collected at most facilities. There were some queries identified as the data was reviewed and verified which could be attributed to the fact that the Student Investigator had no direct access to records but used health facility staff to support the process. The Student Investigator, howbeit, continued to guide the health facility staff and resultantly data required to answer the research questions was collected.

5.2.3. Analysis and result writing process

The data were coded and analysed using SPSS. The results were reviewed by the university DA thus increasing internal validity. The results were discussed, and comparisons were made to other studies within the SSA region. The results also provided some more information related to VL non-suppression and associated factors, albeit, this was not discussed broadly as it was not related to the study objectives.

5.2.4. Study Strengths

This study is unique in evaluating the extent of scale-up of VL testing and IAC linkages in a rural setting in Uganda. The study also contributes to the body of literature in Uganda on VL testing services, IAC provision and associated factors such that the implementation of health promotion policies related to achieving the UNAIDS third 90 is improved.

The study used random sampling technique and proportionate allocation method to select participants from all the eight health facilities that provide ART services in Gomba district and this increased the validity of the study(Pope and Stanistreet, 2017). The data collection tool was used at all the health facilities to capture the relevant information and this tool can be used to collect data in other health facilities around the country thus the study ensured reliability of measurement. Additionally, all PLHIV with viral non-suppression were included in the analysis for IAC, and participants were selected from all facilities that provide ART in the district, therefore, the results are considered to be representative of the entire district and the results can be generalised to other rural districts in the country.

5.2.5. Study Limitations

The study employed secondary data analysis of the health facility records, and this proved arduous and time-consuming. There were incorrect or missing records in some of the registers or paper files, and various other related documents had to be searched for the information. The Student Investigator did not have control over the data collected and could only use the available data. The use of other cross-sectional methods like structured questionnaires could have provided data on possible associated factors such as level of education, occupation, level of household income and distance to a health facility that could have added value to research findings. This could have improved the robustness of the study by controlling for the potential demographic confounders. The study was solely quantitative study and thus its inability to explore perceptions and experiences of both VL testing and IAC which could have been investigated using

qualitative methods. The cross-sectional study design is also limited to identifying association instead of causality (Pope and Stanistreet, 2017).

5.2.6. Lessons learned

The process of getting approval from the local regulatory process was simplified for the Investigator, and this can be attributed to initial permission from the district to have the study conducted. The investigator sought the input of the DHO during the process of proposal writing, and this engagement provided more meaningful discussions and development of study objectives. It was, therefore, faster to get approval from the local ethical bodies as approval from the area of study implementation had already been obtained. Stakeholder involvement at proposal development is thus a key component to having a successful approval process.

Abstraction of records was more effortless at facilities that had electronic systems and the process of abstraction required less staff and time in comparison to those that lacked the systems. Facilities that have more electronic records will be considered for future similar research by Student Investigator. Additionally, due to time constraints that are related to completion of the dissertation in time, the Student Investigator was limited to secondary data analysis as approvals for other methods would take a longer time.

Early planning of research process could have been useful to carry out a cross-sectional study with questionnaires that would have yielded more independent variables for analysis.

5.3. Public Health Relevance, Recommendations, and Conclusion

5.3.1. Public Health Relevance

There has been an acceptance of the WHO policy to utilise VL testing to monitor ART treatment in Uganda. Results from the study illustrate an improvement in the VL testing services uptake which was reported at 67.4% for the district. To meet the UNAIDS targets, the current efforts to scale up VL testing need to be further strengthened to increase VL testing coverage. The study also provides useful information on the provision of IAC to PLHIV with viral non-suppression. There were observed linkages of up to 80.5% of individuals with unsuppressed VL to IAC which is a vital component to achieving viral suppression among these individuals (WHO, 2016).

Additionally, the study provides more useful information regarding determinants for uptake of VL testing and IAC services. Decision makers in the district can, therefore, draft strategies to support individuals new on ART regimes to support their uptake of VL testing and linkage to IAC as results illustrated low uptake of the services among those who were on ART for 6-11.9 months. The study also showed that an increased proportion of individuals testing from health centre level III and that receiving services from there increased the odds of service uptake. This result is useful for the government to provide more support in terms of capacity building including staff training and infrastructure development to lower health facilities that have fewer and less qualified staff such that standardised IAC services are provided to all PLHIV in the district.

5.3.2. Recommendations

5.3.2.1. Recommendations for practice

- Strategies should be implemented that encourage uptake of VL testing and linkages to IAC among those on ART for 6-11.9 months as they have increased the risk of viral non-suppression and ART failure.
- The district health facility management should further sensitise the larger health stakeholders of their shortfalls in providing VL testing services and source other avenues, including funding, to improve VL testing for all the HIV- infected patients on ART for at least six months.
- The district should aim at training staff at the HC level III to standardise the processes of the provision of IAC to individuals receiving the service from that level of health facility.

5.3.2.2. Recommendations for policy

- The scale-up VL testing needs to be continued throughout the country and monitoring should also be instituted at district levels and reflected in the national program evaluation report.
- IAC provision should be monitored closely, and the training of staff should be conducted throughout the country.

5.3.2.3. Recommendations for future research

Further research is required to:

- To evaluate outcomes of IAC with a specific focus on VL test results after IAC and also evaluate the factors associated with improved outcomes such as viral suppression using a prospective cohort study design. This research is

particularly important in the implementation of ART programs for limited resource settings such as Uganda.

- This study was limited to one geographical area; the national HIV program would benefit from evaluation of linkages to IAC in other parts of the country to improve service delivery in areas where linkages are low.
- More in-depth qualitative studies are also required to understand the perceptions and experiences of HIV-infected patients as they access IAC services which could be useful in assessing the quality of services provided to the clients.

5.3.3. Conclusion

The study was a cross-sectional descriptive design that employed methods of secondary data analysis to evaluate the extent of uptake of VL testing services and linkage to IAC for HIV-infected patients receiving ART in Gomba district. The uptake of VL testing in Gomba district at the time of the study was higher than the national average rate and efforts towards scale-up of VL testing to reach all PLHIV on ART for six months should be continued to achieve the UNAIDS targets. Longer duration on ART and receiving ART services from health centre level III increased the odds of having a VL test done. It is vital that managers and clinicians be informed about the factors associated with VL testing. Individuals new on ART should be followed up closely and strategies implemented to support their uptake of VL testing.

There are evident linkages of PLHIV with viral non-suppression to IAC services within Gomba district with over 80% linkage rate. Receiving services from health centre level III was associated with increased odds of linkage to IAC. Government support is recommeded to improve the capacity of staff at health center level III to provide IAC.

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