Prevention of mother to child transmission of HIV services: viral load testing among pregnant women living with HIV in Mutare District of Manicaland Province, Zimbabwe

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ABSTRACT

Background

The human immunodeficiency virus (HIV) is a leading cause of death among women during pregnancy and the postpartum period, especially in areas of high prevalence. In 2018 there were approximately 1.3 million pregnant women living with HIV globally. Infants born to women living with HIV are at increased risk of contracting HIV as the virus can be transmitted to the foetus/ infant during pregnancy, labour, delivery and breastfeeding, posing a serious risk to their survival and well-being. Viral load (VL) testing of pregnant women living with HIV could contribute to improved care, thereby reducing the risk of vertical transmission of HIV from the mother to her infant.

Aim

The objective of this study was to describe HIV VL testing amongst pregnant women living with HIV at entry into the prevention-of-mother-to-child-transmission (PMTCT) services at selected health facilities in Mutare district of Manicaland Province, Zimbabwe from January to December 2018.

Methods

This descriptive cross-sectional mixed methods study evaluated the uptake of HIV VL testing amongst pregnant women living with HIV at entry into the prevention-of-mother-to-child-transmission (PMTCT) services at 15 health facilities and explored factors that influence the provision of HIV VL testing services.

Results

Among 383 pregnant women living with HIV enrolled in antenatal care (ANC) and known to be on antiretroviral therapy (ART), only 121 (32%) had a VL sample collected and 106 (88%) received their results**.** Among these 106 women, 93 (88%) had a VL <1, 000 copies/mL and 77 (73%) had a VL <50 copies/mL. The overall median duration from ANC booking to VL sample collection was 87 (IQR, 7-215) days. The duration was significantly longer among pregnant women newly started on ART [207 (IQR, 99-299) days] compared to those already on ART [50 (IQR, 0-162) days], p<0.001. The median time interval for the return of VL results from date of sample collection was 14 (IQR, 7-30) days. There was no significant difference when this variable was stratified by time of ART initiation. Viral load samples were significantly less likely to be collected at local authority facilities compared to government facilities [aOR=0.28; 95% CI: 0.16-0.48]. Barriers for VL testing identified by health care providers included staff shortages, non-availability of consumables and laboratory forms and weaknesses in sample transportation. Additionally, the turnaround time (TAT) was long as VL testing was centralised at the provincial hospital, and results feedback was not done electronically. High levels of knowledge among health care providers (75%) did not translate into high HIV VL testing coverage amongst pregnant women living with HIV.

Conclusions and recommendations

The low rate of HIV VL testing among pregnant women living with HIV in Mutare district is a cause of concern and needs to be addressed urgently in the interest of contributing to the eliminating mother to child transmission of HIV. The Ministry of Health should consider disseminating ARV and PMTCT guidelines and other policy documents using electronic platforms as these are more accessible and result in quicker dissemination, which may translate into faster implementation of new policies and policy updates. There is need to conduct regular mentorship

and supervision processes and establish quality improvement initiatives for PMTCT services. Interventions like alert systems should be implemented for ease of identifying women who require HIV VL testing. Point of care technology and mHealth could reduce VL result turnaround time. All this should be aimed at ensuring that policies and guidelines are implemented, and targets are reached within agreed timeframes, to ensure that positive outcomes can be experienced by all pregnant women living with HIV.

LIST OF ACRONYMS

ACTG	AIDS Clinical Trial Group
AIDS	Acquired Immunodeficiency Syndrome
ANC	Antenatal care
ART	Antiretroviral therapy
ARV	Antiretroviral
aOR	Adjusted Odds ratio
BHIVA	British HIV Association
CD4	Cluster of differentiation 4
CI	Confidence interval
DBS	Dry blood spot
DHS	Demographic health survey
DTG	Dolutegravir
EAC	Enhanced adherence counselling
EDTA	Ethylenediamine tetra acetic acid
eLMIS	electronic laboratory management information system
eMTCT	Elimination of mother to child transmission
EPAZ	Eliminating paediatric AIDS in Zimbabwe
ePMS	electronic patient monitoring system
GHO	Global Health Observatory
HREC	Human Research Ethics Committee
IQR	Interquartile range
ICDS	Intercensal demographic survey
INSPIRE	Integrating and scaling up PMTCT through implementation research
HIV	Human immunodeficiency virus
LMIS	Laboratory management information system
MCH	Maternal and child health
M & E	Monitoring and evaluation
mHealth	mobile health
MOH	Ministry of Health

MOHCC	Ministry of Health and Child Care
MTCT	Mother to child transmission
MRCZ	Medical Research Council of Zimbabwe
MSF	Médecins Sans Frontières
OPP	Open Polyvalent Platforms
OR	Odds ratio
PAHO	Pan American Health Organization
PCN	Primary care nurse
PLHIV	People living with HIV
PMTCT	prevention-of-mother-to-child-transmission
POC	Point of care
RGN	Registered general nurse
SDGs	Sustainable development goals
SOLTHIS	Therapeutic Solidarity and Initiatives against AIDS
SRH	Sexual and reproductive health
TAT	Turnaround time
UCT	University of Cape Town
UNICEF	United Nations Children's Fund
UNAIDS	Joint United Nations Programme on HIV & AIDS
VL	Viral load
WCBA	Women of child bearing age
WHO	World Health Organisation
ZDHS	Zimbabwe demographic health survey
ZIMPHIA	Zimbabwe population-based HIV impact assessment
ZW	Zimbabwe dollar

PREFACE

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Introduction

The human immunodeficiency virus (HIV) is a leading cause of death among women during pregnancy and the postpartum period, especially in areas of high HIV prevalence (World Health Organisation [WHO] & United Nations Children's Fund [UNICEF], 2015). In 2018 there were about 1.3 [1.0 -1.6] million pregnant women living with HIV globally (Joint United Nations Programme on HIV & AIDS [UNAIDS], 2020a) and about 91% of these women were living in sub-Saharan Africa (SSA) (UNICEF, 2018b). Infants born to pregnant women living with HIV are at increased risk of contracting HIV as the virus can be transmitted to the foetus/ infant during pregnancy, labour, delivery, and breastfeeding (The Global Health Observatory, 2019). In 2018, about 86% of the estimated 160,000 children who were newly infected with HIV through mother-to-child-transmission (MTCT) were in the WHO African Region (Global Health Observatory, 2019). Scaling up interventions for preventing vertical transmission in countries in the African Region is critical for preventing MTCT of HIV if the global targets of the elimination of mother-to-child-transmission (eMTCT) are to be achieved by 2030.

Without effective interventions, MTCT of HIV remains a threat to the survival of newborn babies. However, with effective interventions during pregnancy, labour, delivery and breastfeeding transmission rates can be reduced from 15 – 45% to below 5% (UNAIDS, 2011; WHO, 2016). This can be achieved primarily through the provision of antiretroviral therapy (ART) for pregnant women living with HIV and breastfeeding women and short course antiretroviral prophylaxis for their HIV-exposed infants (WHO, 2016). However, access to this treatment remains a challenge. About 88% of pregnant women living with HIV received ART in 2018, most of whom live in twelve of the twenty-three priority focus countries (Global Health Observatory, 2017; UNAIDS, 2019). Five of the priority focus countries achieved more than 90% coverage (Ethiopia, Kenya, Uganda, United Republic of Tanzania and Zimbabwe),

while an additional seven countries in East and Southern Africa achieved more than 95% coverage (Botswana, Malawi, Mozambique, Namibia, South Africa, Swaziland, and Zambia) (UNAIDS, 2019). Other geographical regions outside East and Southern Africa have not performed well and have not reached the planned ART coverage target of 80%. These regions include West and Central Africa at 47%, South East Asia at 55%, and the Eastern Mediterranean region at 18% (UNICEF, 2018a).

To respond to the call to eliminate MTCT of HIV, UNAIDS (2016) released the "Three Frees" Framework which states that every child should be born free of HIV, remain HIV free throughout their life, and those infected should remain AIDS-free with specific targets set for 2018 and 2020 (UNAIDS, 2011, 2016). According to the Three Frees Framework, the target set was to reduce new HIV infections among children aged 0–14 years from 190,000 in 2015 to 20,000 by December 2020. Despite these efforts, approximately 160,000 children were newly infected with HIV in 2018, falling significantly short of the 2020 target of reducing new infections to 20,000. For the AIDS free target, the aim was to provide HIV treatment to 1.4 million children aged 0–14 years by 2020. The number of children on HIV treatment increased from 860,000 in 2015 to 950,000 by 2019, 450,000 short of the December 2020 target (UNAIDS, 2020b). Given the slow rate of scale-up these December 2020 targets are unlikely to be realised. Less than ten years remain to achieve the 2030 elimination targets. It is therefore of paramount importance that HIV transmission at any point in the life cycle be curbed if the HIV community is to meaningfully contribute to the achievement of the sustainable development goals (SDGs) by 2030 (WHO & UNICEF, 2015).

Upscaling of ART among pregnant and breastfeeding women infected with HIV is crucial in eMTCT. An estimated 940,000 child HIV infections were averted between 2015 and 2019 in

focus countries (UNAIDS, 2020). Additional infections can be prevented by enhancing measures to prevent HIV acquisition during pregnancy and the breastfeeding period, such as correct and consistent use of condoms and through the adoption of safe and appropriate breastfeeding practices. Despite the above measures, there are always children who slip through this safety net and acquire HIV infection. Therefore, ART scale up is of paramount importance to prevent the 25 - 30% deaths that occur among vertically infected children before they reach the age of one year, and approximately 50% deaths in children before they reach their second birthday (World Health Organization, 2006).

Elimination of MTCT of HIV is part of the 2030 triple elimination agenda and many countries are working towards eMTCT. According to the WHO, a country is said to have achieved eMTCT if the impact targets of ≤ 50 new paediatric infections per 100,000 live births per annum and a transmission rate of either < 5% in breastfeeding populations or < 2% in non-breastfeeding populations are maintained for one year; and the following process targets are achieved and maintained for two years: 95% of pregnant women receiving antenatal care (ANC), 95% of pregnant women receiving HIV and syphilis testing in pregnancy and 95% of pregnant women diagnosed with HIV or syphilis receiving treatment (World Health Organization, 2017a). The number of countries that have achieved eMTCT of HIV and/or syphilis include Cuba (2015), Thailand, Moldova, Belarus, Armenia (2016), 6 Caribbean territories (2017), Malaysia (2018) and more recently Sri Lanka and Maldives (2019). None of these countries are from the African Region (World Health Organization, 2017a). More work is needed to eliminate MTCT in the African region to contribute to the achievement or approximation of the SDG 3 targets of ending AIDS by 2030 (United Nations, 2015).

The global movement has seen an evolution in the approach to eMTCT with the adoption of Option B+ in 2013 followed by 'Treat All' and viral load monitoring in pregnancy in 2015. Based on new evidence, WHO guidelines recommended that all pregnant women living with HIV should have an HIV viral load (VL) test done at 6 weeks gestational age as this will assist in determining the risk status of infants and plan for their optimal management (WHO, 2016a). This recent intervention of VL monitoring is meant to contribute to the elimination of MTCT.

Zimbabwe is one of the high HIV burden countries in sub-Saharan Africa (SSA) (Kharsany et al., 2016). The country has made commendable progress with its HIV & AIDS response. By December 2018, more than 90% of people living with HIV (PLHIV) knew their HIV status and 95% of PLHIV who knew their HIV status were receiving ART. AIDS-related deaths declined from 54,000 in 2010 to 22,000 in 2018 and the MTCT rate was 8% (UNAIDS, 2019). The country currently has an estimated 1.4 million people living with HIV, of which 1.2 million are aged between 15 and 64 years. HIV prevalence among adults declined over the past ten years from 18.1% in 2005 to 12.8% in 2018 (Ministry of Health and Child Care (MOHCC), 2019). Regional or geographical differences in HIV prevalence exist among adults aged 15 to 64 years across Zimbabwe, ranging from as high as 21.5% for Matabeleland South province to as low as 10.5 % in Manicaland Province (National Statistics Agency (ZIMSTAT), 2017).

Manicaland province is situated in the eastern part of the country (**Appendix 1**) and is the largest province in the country. It has a population of 1,861,755 that is 878,748 males and 983,007 females of whom 835,555 are women of childbearing age 15-49 years (National Statistics Agency (ZIMSTAT), 2017). The province has nine administrative districts, three of which (Mutare, Chipinge and Makoni) have both rural and urban populations. The population of Manicaland province has specific characteristics that could influence health-seeking

behaviour. Some of the inhabitants of Manicaland province are migrants from Malawi and Mozambique, and the province hosts the largest population of the Apostolic Faith religious group with 41.7% of Christians in Manicaland province being members of this religious group (Zimbabwe ICDS 2017). Among the Apostolic Faith group, the Johane Marange sect is the largest (53%). Some of these Apostolic Faith adherents do not seek medical services due to their religious beliefs and practices. The Apostolic sector does not allow its members to access health services but relies on faith healing. Furthermore, polygamy is rife in the Apostolic Sector in the province and young girls continue to be married to older men, often becoming pregnant at a young age and not being allowed to access health services (Hallfors et al., 2016; Munyaradzi Kenneth et al., 2016; Musevenzi, 2017).

The antenatal care (ANC) coverage is above 95% in most of the country except for thirteen districts, among which are Mutare and Buhera districts in Manicaland province (Zimbabwe Demographic Health Survey 2015/2016; National Statistics Agency [ZIMSTAT], 2017). By December 2017, seven districts in Manicaland province had ANC coverage of above 95% while the remaining two districts had less than 95% coverage, namely Buhera (90-94%) and Mutare (<90%). Despite the relatively low HIV prevalence in the province compared to national prevalence, Manicaland province had an estimated final MTCT rate of 7.18% well above the national rate of 5.2% (WHO, 2016b). The province therefore has to ensure that recommended global and national guidelines and strategies are implemented and closely monitored in order to reduce this high MTCT rate.

Aim and objectives of the study

Aim

To describe HIV VL testing amongst pregnant women living with HIV at entry to the PMTCT services at selected health facilities in Mutare district of Manicaland Province, Zimbabwe from January to December 2018.

Specific Objectives

- To describe the profile of pregnant women living with HIV who attended select clinics in the Mutare district between 1 January and 31 December 2018
- To determine what proportion of pregnant women living with HIV who had HIV VL testing and were informed of their test results.
- To identify factors associated with VL testing of pregnant women living with HIV in Mutare district
- To evaluate health professional knowledge regarding HIV VL measurement during pregnancy
- To make recommendations for improving the implementation of HIV VL monitoring of pregnant women living with HIV in Mutare district.

Literature Review

The literature review was conducted to appraise information pertaining to VL testing and monitoring among pregnant women living with HIV and people living with HIV (PLHIV) in general. The literature review covers the following areas: global and regional information on VL testing guidance including the importance of implementing guidelines, the benefits of VL testing and monitoring for PLHIV on ART, timing of VL testing in pregnant women, living with HIV factors associated with transmission of HIV from mother to their baby, benefits of VL monitoring for pregnant women living with HIV and their babies, and challenges related to VL testing and monitoring services.

A search for relevant published papers was conducted through PubMed, Google Scholar and EBSCOHOST. Articles used in the literature review included publications between 2010 and 2020 with a focus on the past 5 years. However, the search was also done for publications from 1990 onwards as basic research on HIV essential for this thesis was conducted during these formative years. The following key words were utilised during the search:

Pregnant OR Pregnancy OR PMTCT OR maternal

Viral Load OR Viral Load monitoring OR Viral Load testing OR Viremia

HIV OR AIDS OR Human Immunodeficiency Virus

Global and Regional Guidance on VL testing in pregnant women living with HIV

Evidence-based guidelines are important for directing the implementation of clinical and public health-related interventions and policies (WHO, 2010). The World Health Organisation regularly releases updated HIV guidelines, and in 2013, WHO released the first edition of the consolidated guidelines on the use of antiretroviral drugs for treating and preventing HIV

infection, which introduced Option B and Option B + policies (World Health Organization, 2016a). This was followed by major revisions in 2016 with the adoption of the Treat All policy and the use of HIV VL testing as the gold standard for monitoring people living with HIV (PLHIV) on treatment (Global Fund, 2015; World Health Organization, 2016b, 2017b).

The 2016 WHO guidelines recommended that routine VL monitoring should be done at 6 months and 12 months after ART initiation, then every 12 months thereafter for PLHIV. For pregnant women living with HIV additional VL monitoring was recommended four weeks before delivery to identify infants at increased risk of HIV acquisition (WHO, 2016).

The Zimbabwean government adopted and adapted the 2016 WHO guidelines and national guidelines were launched on World AIDS Day in 2016. The Zimbabwe PMTCT guidelines state that if a pregnant woman is newly diagnosed with HIV infection and initiated on ART, a VL test should be conducted three months after ART initiation, and if the VL result is <1,000 copies/mL it should be repeated at 36 weeks gestation. (Gumede-Moyo et al., 2017; Ministry of Health and Child Care (MOHCC), 2016). If a pregnant woman was already on ART before ANC booking, a VL test should be done at the booking visit and if this VL result is <1,000 copies/mL it should be repeated after six months during pregnancy. However, if the VL result is >1,000 copies/mL at any time point, the pregnant woman should undergo enhanced adherence counselling (EAC) and the VL repeated after a further three-month interval. These additional testing points were included to ensure that women with high VL concentrations are identified early and appropriately managed.

Setting VL cut-off values is crucial for standardisation across countries. As per the 2016 WHO recommendations, when monitoring clients on ART the virological failure cut-off value of the

HIV VL is 1,000 copies/mL; below this threshold the risk of HIV transmission is low. (Chagomerana et al., 2018; Landes et al., 2019; Mukonda et al., 2020). Most treatment programmes have adopted this cut-off threshold which is used to stratify the risk of perinatal transmission of HIV to the newborn infant (WHO, 2018b). This contrasts with viral suppression, defined as a VL <50 copies/mL, using the current generation of VL tests (Ntlantsana et al., 2019).

Benefits of VL testing for PLHIV on Antiretroviral Therapy

Viral load monitoring has been shown to play an important role in the management of PMTCT interventions. In a study completed by Sigaloff (2011), virological monitoring was found to be superior to immunological monitoring. In the same study, it was shown that there was unnecessary regimen switching when failure was based on clinical criteria compared to targeted VL testing. The WHO has also recommended VL monitoring for the diagnosis and confirmation of ART failure. It has also recommended it as a guide to provide an early and more accurate indication for switching from first-line to second-line ART regimens, thereby reducing the accumulation of resistance mutations that cause HIV drug resistance (Ruperez, 2015; WHO, 2016). Therefore, VL testing has a beneficial effect in PLHIV on ART. If used routinely, it can reduce HIV transmission among PLHIV, especially vertical mother-to-child transmission (WHO, 2016).

Viral load monitoring can lead to reduced HIV transmission at individual and community levels (Estill et al., 2012). Routine VL testing complemented by enhanced adherence counselling (EAC) in PLHIV on ART results in optimal utilisation of ART services, with improved outcomes among PLHIV (Jobanputra et al., 2014; Keiser et al., 2011). Furthermore, availability of information on viral suppression has assisted clinicians to reduce the frequency of clinic

visits hence reducing visit burden of patients and the workload of healthcare workers (Phillips et al., 2015). These benefits apply to pregnant women living with HIV and their infants; hence the need to utilise VL testing to optimise ART administration and effectiveness in these populations (Phillips et al., 2015).

Timing of viral load testing, turn-around time of VL results and point of care testing in pregnant women living with HIV

Information on HIV VL, particularly the timing of VL testing is important for proper management of pregnant women and their infants. Based on a modelling study, Lesosky et al. (2017) showed that VL monitoring for predicting VL at delivery was more accurate at a later gestational age, with the best performing option being a single VL measurement at 36 weeks of gestation. In contrast, models that monitored VL in pregnancy based on the time elapsed since ART initiation, regardless of gestation age did not perform well in predicting VL at delivery. Although single VL testing at 36 weeks gestation is considered ideal and is feasible in high-income countries (British HIV Association, 2017), it may be challenging to implement in resource-limited settings. In low- and middle-income countries (LMICs), this is due mostly to the long turnaround time (TAT) for obtaining VL results and other operational issues such as unavailability of laboratory personnel to conduct the test and collection of blood samples on specific days of the week (Minchella et al., 2017; Nyakura et al., 2019). It therefore calls for expedited TAT of results using innovations like mobile Health (mHealth) where VL results are immediately transmitted to the health facility through short message mobile texts and the corresponding paper results are delivered later. Mobile technology for health is increasingly being used to overcome shortcomings experienced with information systems, laboratory equipment and human resource capacity in low-income countries (Awiti et al., 2016; Thomas et al., 2019).

The use of point of care (POC) VL testing during pregnancy and at delivery also reduces the TAT so that the results of the VL test can be utilised for effective management of the pregnant woman and her new-born baby. Myer et al. (2017) and Bonner et al. (2013) indicated that VL monitoring during pregnancy can help guide providers to institute more intensive adherence interventions if the pregnant woman is found to have a VL >1,000 copies/mL. If necessary, the VL can also guide further clinical action, such as change of the ART regimen, to achieve viral suppression during labour and delivery, and thus minimise MTCT risk. Point of care VL monitoring has been demonstrated to be beneficial for managing PLHIV on ART as attending clinicians are able to diagnose and manage treatment failure during the same clinic visit (Myer, 2017). Evaluation of POC VL tests have been completed for the Samba HIV-1 semi Q plasma test in Malawi and Uganda and the Xpert HIV-1 VL assay in South Africa. These evaluations showed good correlation with an established laboratory based VL assay, making POC VL assay a reliable tool for clinic based VL monitoring. Although POC VL assays are available, their evaluation in PMTCT settings is limited including in Zimbabwe; hence there might be need for further research in this population group (Katoba et al., 2019; Reid et al., 2013; Ritchie et al., 2014 ; Garrett et al., 2016; Dorward et al., 2018).

Factors associated with the transmission of HIV from the mother to the baby

Several factors contribute to the transmission of HIV from the mother to her unborn foetus or newborn baby. The severity of maternal immunodeficiency, high plasma HIV VL and suboptimal obstetric practices at birth may all increase the risk of HIV transmission from mother to infant (Farquhar et al., 2005; Garcia et al., 1999; Liu et al., 2017; Ngwende et al., 2013). However, maternal plasma HIV VL is the principle determinant of HIV transmission

from the mother to the child during gestation, the intrapartum period and the postpartum period (Ahmed, 2013). This was corroborated by a study among French women living with HIV, which revealed that the maternal VL is proportional to the risk of vertical transmission (Tubiana et al., 2010). Several other studies have also demonstrated higher HIV transmission rates among pregnant women living with HIV with higher VL concentrations (Chagomerana et al., 2018; Garcia et al., 1999; Myer et al., 2017). Provision of ART at the point of contact with the pregnant women is therefore essential for early and sustained control of maternal VL and is associated with lower risk of MTCT of HIV (Townsend et al., 2008; Tubiana et al., 2010; Weiser et al., 1994).

The administration of ART to control viral replication eliminates the risk of HIV transmission in some women, particularly those who achieve very low viral load concentrations (Mandelbrot et al. (2015). He provided evidence of no HIV transmission among infants born to pregnant women on ART at conception and those whose mothers were virally suppressed (VL <50 copies/mL) at delivery. The perinatal transmission rate was higher for women with VLs of 50-400 copies/mL near delivery compared to those with <50 copies/mL (adjusted odds ratio, 4.0; 95% CI, 1.9-8.2). (Hermans et al., 2020; Joya et al., 2019). Based on this body of evidence and where resources exist, countries in SSA should use viral suppression (VL <50 copies/mL) as the standard for managing all patients on ART, including pregnant women. However, in most resource constrained settings, this may not be possible and the use of the virological failure cut-off point of HIV VL <1,000 copies/mL will continue to be utilised until available resources permit the use of a lower cut-off value.

A seminal study on the effect of maternal VL on the risk of perinatal transmission of HIV showed a nearly threefold increase in the risk of perinatal HIV transmission for each additional

log_{10} increase in VL (Thea et al., 1997). The risk of perinatal transmission of HIV is reported to be proportional to the maternal VL level, i.e., when maternal VL is low, there is a correspondingly lower level of transmission, while at higher maternal VL there is higher transmission (Mandelbrot et al., 2015; Mayaux et al., 1997). However, transmission of HIV may occur in the presence of a maternal VL < 1,000 copies/mL (Faye, 2020; Kuhn et al., 2020; Puthanakit et al., 2018). Therefore, there is no VL level above or below which transmission always or never occurs (Garcia et al., 1999; Ioannidis et al., 2001). More research on this subject is required to provide more clarity.

Benefits of viral load testing for pregnant women living with HIV and their infants

Besides conducting VL monitoring in HIV pregnant women for the benefit of identifying infants at high risk of HIV acquisition, there are also benefits to mothers and their families. Antiretroviral therapy-induced viral suppression decreases morbidity and mortality among pregnant women (Maartens et al., 2014). By keeping the mother healthy and alive, she is able to care for her children and family thus sustaining the long-term health of her household and community (Myer et al., 2017). In addition, a low VL concentration in the pregnant woman reduces the risk of HIV transmission to her uninfected spouse or partner as unprotected sexual practices may occur during pregnancy (Cohen et al., 2016). Monitoring VL to ensure sustained viral suppression in pregnant and breastfeeding women is therefore crucial to keeping infants HIV free, maintaining good maternal health, and promoting the health and wellbeing of families (Houle et al., 2015). It can be inferred that health costs are reduced when you have a healthy mother to take care of her family (Houle et al., 2015).

Challenges in provision of HIV viral load testing

There are several reasons why countries, especially in resource-limited settings, are failing to provide routine VL testing. The major reasons are the financial resources needed to undertake VL testing (Barnabas et al., 2017; Dutta et al., 2015; Zhang et al., 2016). Several logistical challenges have also been highlighted which affect the successful provision of VL testing. (Roberts et al., 2012; Roberts et al., 2016). These include unsuitable laboratory infrastructure, complex sample collection procedures, unreliable power supply, water supply and air-conditioning, non-adherence to cold chain transportation of the reagents, lack of experienced laboratory personnel and the absence of maintenance contracts for the equipment (A. N. Phillips et al., 2016). In addition, the lack of awareness among both clinicians and patients of the importance and benefits of VL testing results in reduced demand for the test (Roberts et al., 2016). Therefore, these challenges should be addressed in order to improve access to VL testing, the recommended gold standard for monitoring PLHIV on ART, including pregnant or breastfeeding women living with HIV.

Methods

Study setting

Manicaland province is the largest of 10 provinces and is situated in the eastern part of Zimbabwe. It has a population of 1,861,755 with 878,748 being males and 983,007 females, of whom 835,555 are women of childbearing age, that is 15 to 49 years of age (National Statistics Agency [ZIMSTAT], 2017). The province has nine administrative districts. Three districts (Mutare, Chipinge and Makoni) have rural and urban populations. Some of the inhabitants of the province are from Malawi and Mozambique. The province also hosts the largest group of Apostolic Faith adherents in Zimbabwe. Some of these individuals do not seek medical services because of their religious beliefs. The HIV prevalence in adults aged 15-49 years in Manicaland province is 10.5% (Zimbabwe Demographic Health Survey [ZDHS], 2015/2016). The study was conducted at 15 health facilities providing ANC services in Mutare district as described in the section on facility selection.

Viral load testing in Mutare district, Manicaland Province, Zimbabwe

Mutare district started offering HIV VL testing in June 2015 and by the end of that year, seven health facilities were offering targeted testing mostly for PLHIV on ART who had low CD4 counts. Viral load testing services were then cascaded to other health facilities and by the end of 2019, 42 health facilities in the district were offering VL testing to PLHIV on ART including pregnant and breastfeeding women. Viral load measurement is centralised at the provincial laboratory. The provincial laboratory is equipped with two C48 Roche machines and two m2000 Abbott machines, and the laboratory can process plasma and dry blood spot (DBS) samples thus enhancing the VL testing capacity (Manicaland Province HIV Report 2019 unpublished).

Viral load testing was initially introduced with support from the Ministry of Health and one partner, Médecins Sans Frontières (MSF); however, with time other partners came on board. Training of health care providers included on-the-job training on how to collect dry blood specimen (DBS) specimens, followed by ongoing mentorship. Since VL testing continues to be centralised at the provincial laboratory, motorbikes were provided to transport specimens from facilities to the provincial laboratory (Nyagadza et al., 2019). Once the samples are processed a hard copy of the results is picked up by the motor bikers the next time, they come to deliver the next batch of samples which could be within a week or longer. The laboratory management information system is not yet linked to the facilities; hence results cannot be accessed electronically.

Despite Manicaland province having been one of the first provinces to offer VL monitoring, coverage in pregnant and breastfeeding women living with HIV has remained unacceptably low at 63% at end of 2017. (Nyagadza et al., 2019). This should be urgently addressed as the country is aiming for the triple elimination of HIV, syphilis and hepatitis by 2030. It is to this effect that this study was conducted to describe accessibility of HIV VL testing amongst pregnant women living with HIV at entry into the PMTCT services including facilitatory factors and barriers to HIV VL access at selected health facilities in Mutare district of Manicaland Province, Zimbabwe. Recommendations from the study could potentially contribute to improved provision of VL testing services among pregnant women living with HIV in Mutare district, the province and nationally.

Study Design

This descriptive cross-sectional mixed methods study examined HIV VL testing amongst pregnant women living with HIV at entry to the PMTCT services at selected health facilities in Mutare district of Manicaland Province, Zimbabwe. The study was conducted from January to December 2018.

Demographic and clinical data of pregnant women living with HIV who attended 15 health facilities in Mutare district between 1 January and 31 December 2018 were retrospectively extracted from ANC registers, ART registers and patient clinical booklets. The ANC information is recorded in the ANC register, so names of pregnant women living with HIV were identified from the ANC registers. This information was then utilised to identify the women in the ART register and capture their ART numbers. Once their ART numbers were identified, these were then utilised to track the patient clinical booklets where information on VL testing is recorded (Figure 1).

The retrospective data collection was complemented by key informant interviews with health care providers (at facility and laboratory level) and pregnant women living with HIV attending ANC clinics using open ended questions. These prospective interviews were conducted between October 2019 and March 2020 (Figure 1).

Site Selection and sample size estimation

The study was completed at 15 health facilities (study sites), selected from 51 health facilities providing ANC services in Mutare district. The 51 health facilities were grouped by strata based on (1) level of service provision and size i.e. clinic, rural/mission hospital, and tertiary hospital and (2) geographical location, namely rural and urban location. The 15 study sites

were then randomly selected through stratified sampling to ensure representation by level of service provision and geographical location.

For the retrospective component, the sample size was estimated using a formula for a prevalence study, assuming that 50% of pregnant women living with HIV at the 15 research sites received a VL test during their ANC visits, and given a confidence interval of 95% and study precision of 5%.

$$\text{Sample size} = \frac{Z^2 (p) (1-p)}{e^2}$$

Where:

Z = Z statistic: For a 95% confidence interval the Z statistic = 1.96

p = fraction of pregnant women living with HIV expected to receive a VL test assumed to be 0.5 (50% of pregnant women living with HIV)

e = margin of error (5%) expressed as a fraction = 0.05

Thus, the calculated sample size was 384. If 20% of the patient booklets were missing, then review of the clinical booklets of 461 patients was required to ensure that the sample size of 384 pregnant women living with HIV with adequate clinical data was attained.

Structured prospective interviews were conducted to provide more in-depth information from health care providers as well as from the beneficiaries of the services. For the interviews conducted in this study, there was no estimation of the sample size for the nurses, the laboratory personnel, and the HIV-infected women included. Instead we planned to interview at least one nursing professional per health facility. Since the laboratory services were centralised at the

Provincial hospital, it was planned to interview only one laboratory scientist. For the 15 health facilities, the aim was to interview at least one pregnant woman living with HIV per facility, on the day that the retrospective data were extracted.

Table 1 includes the 15 study sites (column 1), the number of pregnant women living with HIV seen at these clinics in 2018 and obtained from electronic records at provincial and district level (column 4) and the estimated number of records that needed to be included per facility in the retrospective analysis to achieve the estimated sample size of 384 (column 5). To ensure a representative sample, the number of patient clinical booklets extracted per health facility was proportional to the number of pregnant women living with HIV in ANC at each study site.

Table 1:Total number of pregnant women living with HIV managed at the study sites in 2018 and the estimated numbers required to complete the retrospective analysis

	Number of pregnant women newly HIV-infected	Number of pregnant women known to be HIV-infected	Total number of Pregnant women living with HIV in ANC	Number of files of Pregnant women living with HIV to be sampled per facility	Actual number of files of Pregnant women living with HIV included in the study
Burma Valley Clinic (rural)*	5	13	18	17	17
Chikanga Clinic (urban)*	11	22	33	27	27
Chipfatsura Clinic (rural)*	7	4	11	7	7
Chitakatira Clinic (rural)*	17	31	48	45	45
Dangamvura Clinic (urban)*	17	42	59	29	29
Dora Clinic (rural)*	12	22	34	31	31
Marange Rural Hospital**	14	43	57	35	35
Mount Zuma Clinic*	7	16	23	11	11
Mutare Provincial Hospital (urban)***	3	8	11	0	0
Nzvenga Clinic (rural)*	7	17	24	13	13
Rowa Clinic (rural)*	6	15	21	11	11
Sakubva Clinic (urban)*	47	47	94	32	32
St Joseph's Mission Hospital (rural)**	12	42	54	32	32
St Werburghs Clinic (rural)*	7	10	17	10	10
Zimunya Clinic (peri-urban)*	99	92	187	84	83
Total	**271 (39%)**	**424 (61%)**	**695**	**384**	**383**

Level of delivery: *clinic - level 1, **Rural or District level – level 2, ***Provincial hospital – level 3, ANC = antenatal care

Data collection

a) A documentary review was conducted to extract retrospective data of pregnant women living with HIV attending the ante natal clinic (ANC) at selected study sites.

Facility-based antenatal attendance registers at the 15 study sites were used to identify pregnant women living with HIV who accessed ANC during the study period and to determine the time of their enrolment into ANC, whether they were tested for HIV, establish the date of HIV testing and clarify HIV and ART status. Using the ART registration number recorded in the ANC register, the ART booklets of individual patient were traced and used to obtain the timing of ART initiation. The timing of ART initiation was verified using the facility ART register. Whether pregnant women received their initial VL test results and follow-up VL tests were extracted from patient ART booklets and validated using the remaining VL form stubs where VL results are usually recorded upon receipt. In some facilities, the nurses developed improvised VL registers to suit their needs. Though these improvised registers were not officially known or recognised at provincial or national level, they had the necessary information that could be used for validation. Nurses at facility level usually develop these improvised registers if their immediate needs are not being met by the official registers.

Demographic data, data on pregnant women's obstetric history, when HIV testing was conducted, when ART was initiated, when their viral load test was initially done and whether follow up VL tests were done for monitoring were also extracted.

b) Key informant Interviews

Interviews with health care providers working in the antenatal clinics were conducted at selected sites (**Appendix 2**) and at the laboratory on the day of the visit by the researcher using standardised questionnaires (**Appendix 3**).

Interviews with pregnant women living with HIV attending ANC

Interviews with pregnant women living with HIV were conducted using a structured questionnaire (**Appendix 4**).

Data Analysis

Data were entered into Epidata version 3.1 (Epidata Association, Odense, Denmark). Quantitative data was exported to Stata version 15 (StataCorp, College Station, Texas, USA) for data cleaning and analysis. Descriptive data were summarised using numbers and percentages for categorical variables, while medians and interquartile ranges were generated for non-normally distributed continuous variables. The Wilcoxon rank-sum test was used to compare medians of non-normally distributed continuous variables. The Chi-squared test and Fischer's exact test were used to compare categorical variables. Factors associated with VL collection were explored using logistic regression. The logistic regression model was built, using variables which on univariate analysis had a p-value <0.25. Parity and type of health facility were excluded from the logistic regression model because of their collinearity with gravidity and type of health facility ownership, respectively. Levels of significance were set at 95%.

The structured questionnaire included demographic data, obstetric information, health facility access and open-ended questions that explored perceptions and experiences of VL testing.

Interviews were recorded, and field notes were kept and stored. Open-ended questions were analysed to identify recurring or shared experiences and perceptions. An independent reviewer supported the researcher's interpretation.

Ethical considerations

The study was conducted in accordance with the principles of good clinical practice as enshrined in the Belmont Report (1978), (Biomedical et al., 1978). The Helsinki Declaration (2013), (Holm, 2013), and the Council for International Organization of Medical Sciences Guidelines (CIOMS – 1982)(Council for International Organizations of Medical Sciences, 2017). The Belmont Report, The Helsinki Declaration and the CIOMS emphasize the protection of dignity and integrity of voluntary participation, right to self-determination and privacy, confidentiality at all times, anonymity and the principle of no harm done to the study participants. The study involved human subjects and was approved by the Medical Research Council of Zimbabwe, reference number: MRCZ/B/1732 and Human Research Ethics Committee (HREC) Faculty of Health Sciences, University of Cape Town, reference number: HREC REF:778/2018, (**Appendix 5** -MRCZ 2019 and 2020 approvals and **Appendix 6** – HREC 2019 and 2020 approvals). Administrative approvals and consent to review medical records of patients included in the retrospective component of the study were obtained from the Manicaland Provincial Medical Director and the District Medical Officer (DMO), Mutare District (**Appendix 7**), all from the Ministry of Health and Child Care. The study was completed in accordance with the Declaration of Helsinki.

Informed written consent was obtained from health care providers (**Appendix 8)** and all pregnant women living with HIV who participated in the prospective interviews for this study (**Appendix 9**) and data was deidentified during extraction. These participants were provided

with details of the research in a detailed information sheet, and were informed that their participation was voluntary, and they could withdraw at any time without consequence. No financial incentives were provided to these participants. To ensure privacy, information session, consent process and interviews were conducted in private rooms. A record of the participant names was kept with their study identifiers. Names were removed from the database and participants were only identified by their study number to protect their privacy and confidentiality. Members of the research team took all required precautions to ensure that research information was not shared with anyone other than the authorized members of the team. Questionnaires were kept in a locked filing cabinet in a secure environment at the DMO's office. Electronic data was stored on a password protected computer with access only granted to the research team. Data will be destroyed after 5 years.

Results

Study participants

Data was obtained on 383 pregnant women living with HIV who were either on ART or ART naïve at the time of enrolment into ANC at the 15 study sites, representing 99.7% of the estimated sample size of 384, Figure 1 and 6th column of Table 1.

Prospective interviews were completed by 12 nurses at 12 of the study sites, 1 laboratory scientist at the provincial laboratory, and 19 pregnant women living with HIV at 10 study sites (Table 2).

Table 2: Number of pregnant women living with HIV and health care workers interviewed

	Facility	**No of nurses interviewed**	**No. of pregnant women interviewed**
1	Burma Valley Clinic	1	2
2	Chikanga Clinic	1	0
3	Chitakatira Clinic	1	0
4	Chipfatsura Clinic	1	2
5	Dangamvura Clinic	1	2
6	Dora Clinic	0	0
7	Marange Rural Hospital	1	3
8	Mount Zuma Clinic	1	1
9	Mutare Provincial Hospital	0	0
10	Nzvenga Clinic	0	0
11	Rowa Clinic	1	2
12	Sakubva Clinic	1	2
13	St Werburghs Clinic	1	2
14	St Joseph's Mission Hospital	1	2
15	Zimunya Clinic	1	1
	Total	**12**	**19**

Characteristics of the pregnant women living with HIV

The characteristics of the 383 women enrolled in the retrospective component of this study are summarised in Table 3.

Table 3: Characteristics of pregnant women living with HIV attending antenatal care in Mutare district in 2018

Characteristic	All pregnant women living with HIV on ART	Women who had VL performed	Women who did not have a VL performed	p value*
	N=383 n (%)	N=121 n (%)	N=262 n (%)	
Age category (in years)				
10-14	3	1 (33.3)	2 (66.7)	0.125
15-19	24	21 (87.5)	3 (12.5)	
20-24	73	51 (69.9)	22 (30.1)	
25-29	86	55 (64.0)	31 (36.1)	
30-49	179	120 (67.0)	59 (33.0)	
Not recorded	18	14 (77.8)	4 (22.2)	
Type of health facility				
Primary health care clinic	316	225 (71.2)	91 (28.8)	0.008
Rural hospital	35	16 (45.7)	19 (54.3)	
District/mission hospital	32	21 (65.6)	11 (34.4)	
Health facility ownership				
Government	91	43 (47.3)	48 (52.8)	<0.01
Local authority	261	199 (76.3)	62 (23.8)	
Faith-based (mission)	31	20 (64.5)	11 (35.5)	
Gravidity				
1	63	46 (73.0)	17 (27.0)	0.109
2-3	190	134 (70.5)	56 (29.5)	
4-5	115	69 (60.0)	46 (40.0)	
6-7	13	11 (84.6)	2 (15.4)	
Not recorded	2	2 (100)	0 (0)	

Parity				
0	71	54 (76.1)	17 (23.9)	0.204
1-2	193	130 (67.4)	63 (32.6)	
3-4	105	66 (62.9)	39 (37.1)	
5-6	12	10 (83.3)	2 (16.7)	
Not recorded	2	2 (100.0)	0 (0)	
Gestational age at ANC booking				
0-12 weeks	42	12 (28.6)	30 (71.4)	0.137
13-26 weeks	235	83 (35.3)	152 (64.7)	
27+ weeks	83	19 (22.9)	64 (77.1)	
Not recorded	23	16 (69.6)	7 (30.4)	
ART status at ANC booking				
On ART prior to ANC booking	256	171 (66.8)	85 (33.2)	0.336
Started ART after ANC booking	127	91 (71.7)	36 (28.4)	

ART = antiretroviral therapy, VL = viral load, ANC = antenatal care, *Comparison of women who had VL performed and those who did not have a VL performed

Nearly half of these women (46.7%) were aged 30-49 years while 86 (22.5%) and 73 (20.6%) were aged 25-29 years and 20-24 years respectively. Most of these women were enrolled at primary health care facilities (82.5%) and most at health facilities belonging to a local authority (68.1%). About half of these pregnant women living with HIV had a parity of 1 or 2 and gravidity of 2 or 3. Only 42 (11.0%) of the pregnant women living with HIV presented for ANC booking during the first trimester, while 235 (61.4%) booked in the second trimester. Among all pregnant women living with HIV with recorded ART status, 256 (66.8%) were already receiving ART by the time they were booked for ANC whilst 127 (33.1%) were newly tested HIV positive and started on ART.

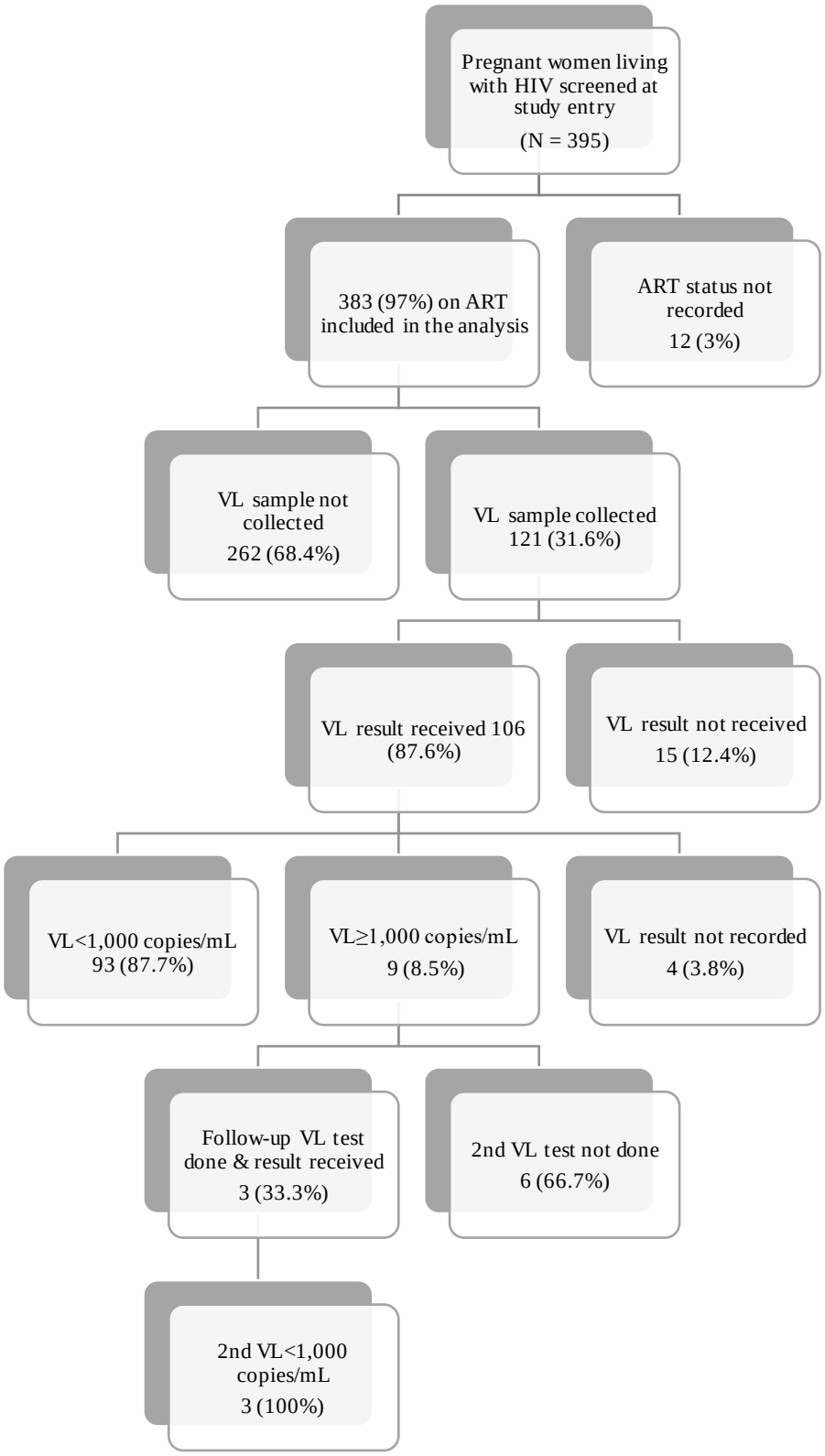


Figure 1: Study algorithm describing the participants, and the number and proportion who had viral load (VL) samples collected and who received their VL results

Viral load testing

Among the 383 pregnant women living with HIV in ANC receiving ART, only 121 (31.6%) had VL samples collected, of whom 106 (87.6%) received back their VL results, Figure 1. Among these 106 women, 93 (87.7%) had VL results of <1,000 copies/mL i.e. 77 had VL results <50 copies/mL, 4 had VL results between 50 and 199 copies/mL and 11 had VL results between 200 and 999 copies/mL. Of the 9 women (8.5%) with VL results >1,000 copies/mL, three (33%) had follow-up VL tests done after enhanced adherence counselling (EAC). The follow-up VL results of all 3 women were <1,000 copies/mL.

Time between ANC booking and VL sample collection, and time between VL sample collection and receipt of results are described in Table 4 (below) in subsets of pregnant women living with HIV with these results. Pregnant women living with HIV who were already on ART at ANC booking had been on ART for a median duration of 32 (IQR, 15-64) weeks, and those who were newly tested HIV-positive were initiated on ART on the same day of enrolment into ANC in line the HIV treat all policy. The median duration between ANC booking and VL sample collection was significantly longer among those newly started on ART. The median duration for the return of VL results was not significantly different between the two groups.

Table 4:Comparison of the time between ANC booking and VL sample collection, and the time between VL sample collection and receipt of results in pregnant women living with HIV on ART at and those not on ART at ANC enrolment

Time duration (in days)	Total		ART status at enrolment into ANC				p value*
			Already on ART		Not on ART		
	n	Median (IQR)	n	Median (IQR)	N	Median (IQR)	
Time from ANC booking to VL sample collection	101	87 (7-215)	67	50 (0-162)	33	207 (99-299)	<0.001
Time from VL sample collection to receipt of result	52	14 (7-30)	36	10 (7-30)	16	17 (11-45)	0.174

ANC = antenatal care, HIV = human immunodeficiency virus, ART = antiretroviral therapy, IQR = interquartile range, VL = viral load

Factors associated with viral load sample collection

Table 5 below describes factors associated with the collection of VL samples among the study participants. In the univariate analysis, receiving care at a rural hospital compared to a primary health care facility [odds ratio (OR)=2.94; 95% confidence interval (CI): 1.45-5.96] was significantly associated with VL collection. Furthermore, viral load samples were significantly less likely to be collected at local authority facilities compared to government facilities [aOR=0.28; 95% CI: 0.16-0.48]. On multiple logistic regression the association of viral load collection at local authority facilities compared to government facilities remained statistically significant [aOR=0.28; 95% CI: 0.16-0.48].

Table 5: Factors associated with the collection of viral load samples among pregnant women living with HIV enrolled into antenatal care in Mutare District, Zimbabwe

Characteristic	n	VL sample collected n (%)	OR (95% CI)	aOR (95% CI)
Total	**383**	121 (31.6)	-	-
Age (in years)				
10-14	3	2 (66.7)	4.07 (0.36-45.77)	2.05 (0.16-26.79)
15-19	24	3 (12.5)	0.29 (0.08-1.01)	0.27 (0.07-1.11)
20-24	73	22 (30.1)	0.88 (0.49-1.58)	0.94 (0.46-1.92)
25-29	86	31 (36.1)	1.15 (0.67-1.97)	1.10 (0.61-1.99)
30-49	179	59 (33.0)	Reference	Reference
Not recorded	18	4 (22.2)	0.58 (0.18-1.84)	0.75 (0.22-2.55)
Type of health facility				
Primary health care clinic	316	91 (28.8)	Reference	Reference
Rural hospital	35	19 (54.3)	**2.94 (1.45-5.96)**	-
District/mission hospital	32	11 (34.4)	1.30 (0.60-2.79)	-
Health facility management				
Government	91	48 (52.8)	Reference	Reference
Local authority	261	62 (23.8)	**0.28 (0.17-0.46)**	**0.28 (0.16-0.48)**
Faith-based (mission)	31	11 (35.5)	0.49 (0.21-1.14)	0.52 (0.21-1.29)
Gravidity				
1	63	17 (27.0)	Reference	Reference
2-3	190	56 (29.5)	1.13 (0.60-2.14)	0.76 (0.36-1.62)
4-5	115	46 (40.0)	1.80 (0.92-3.52)	1.07 (0.44-2.57)
6-7	13	2 (15.4)	0.49 (0.10-2.45)	0.28 (0.05-1.63)
Not recorded	2	0 (0)	-	-
Parity				
0	71	17 (23.9)	Reference	Reference
1-2	193	63 (32.6)	1.54 (0.83-2.87)	-
3-4	105	39 (37.1)	1.88 (0.96-3.68)	-
5-6	12	2 (16.7)	0.64 (0.13-3.19)	-
Not recorded	2	0 (0)	-	-
Gestational age at ANC booking				
0 -12 weeks	42	12 (28.6)	Reference	Reference
13 – 26 weeks	235	83 (35.3)	1.37 (0.66 - 2.81)	1.30 (0.59-2.86)
27 + weeks	83	19 (22.9)	0.74 (0.32 – 1.72)	0.68 (0.27-1.74)
Not recorded	23	7 (30.4)	1.09 (0.36- 3.33)	1.31 (0.40-4.26)

ART status at ANC booking				
On ART prior to ANC booking	256	85 (33.2)	Reference	Reference
started ART after ANC booking	127	36 (28.4)	0.80 (0.50-1.27)	1.12 (0.32-1.84)

VL = viral load, OR = odds ratio, aOR = adjusted odds ratio, 95% CI = 95% confidence interval, ART = antiretroviral therapy, ANC = antenatal care

Structured interviews with pregnant women living with HIV

All 19 pregnant women living with HIV reported that they had received information on VL testing during group health education talks provided before receiving ANC services or during one-on-one consultation with a nurse or both. Twelve of the 19 (63.1%) women had a VL test done. Ten of 16 (62.5%) women who were interviewed understood what VL testing meant as substantiated by the following specific comments: A 42 year old woman diagnosed with HIV infection prior to her current pregnancy and already on ART stated that "a viral load test detects the activity of the virus in one's body"- Participant 10; while a 29 year old woman with secondary education, presenting with her second pregnancy, newly diagnosed with HIV infection and started on ART stated that "a viral load test is taken to check if the ARVs I am taking are working and to check if I am responding to them" – Participant 18. However, four of the 16 (25%) women indicated that blood samples were taken but VL was not explained. The TAT for VL results for ten women who responded ranged from one to four days. Thirteen of the 19 (68.4%) women understood the meaning of a low VL result; A 29 year old woman having her second pregnancy stated that "a low VL result means that I am adhering to my treatment" – Participant 14; A 32 year old woman pregnant for the third time and was previously known to have HIV infection and on ART prior to her current pregnancy stated that "it means that the virus is being suppressed"- Participant 11; and a 35 year old woman having her first pregnancy stated that "the virus strength is low, and my health is good" – Participant 19. Twelve of the19 (63.1%) women understood the meaning of a high VL result.

Pregnant women living with HIV mentioned the following as factors that facilitated access to VL testing: (1) VL sample collection synchronised with either ANC visits or ARV resupply days, (2) free VL testing services, (3) easy accessibility to the health facility and (4) outreach services by nurses brought VL sample collection to their doorstep.

The following barriers to accessing VL testing were cited by some pregnant women living with HIV (1) few nurses at the facility compared to the number of patients they serve meant that sometimes they deferred taking samples for VL testing, (2) sometimes there were no supplies such as DBS consumables to enable the nurses to take the blood samples, (3) some facilities were too far, hence pregnant women could not access services on time and (4) some women could not access VL testing for religious reason as their religious sector did not allow its membership to access health services at all.

Interviews with health care providers

Of the 12 health care providers interviewed, 6 (50%) were primary care nurses (PCNs), 4 (33.3%) registered general nurses (RGNs) and 2 (16.7%) were midwives by training.

As shown in Figure 2, one of the twelve facilities at which the 12 interviewed nurses worked offered ANC services seven days a week, ten of the facilities offered services five days a week and one health facility offered services twice a week.

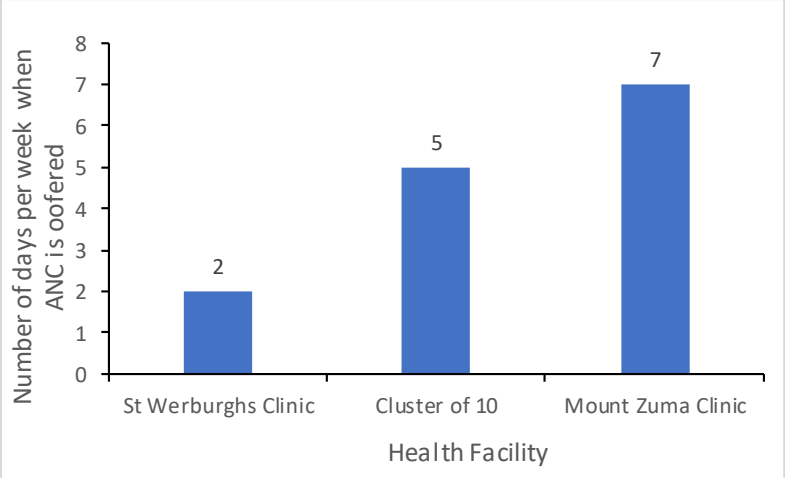


Figure 2: Number of days per week when antenatal care services are offered by health facility

NB: Cluster of 10 consisted of the following health facilities: Burma Valley Clinic, Chikanga Clinic, Chipfatsura Clinic, Chitakatira Clinic, Dangamvura Clinic, Marange Rural Hospital, Rowa Clinic, Sakubva Clinic, St Joseph's Mission Hospital and Zimunya Clinic

The number of women attending ANC per month at 10 of the 12 clinics ranged from 25 to 175 women per month, Figure 3.

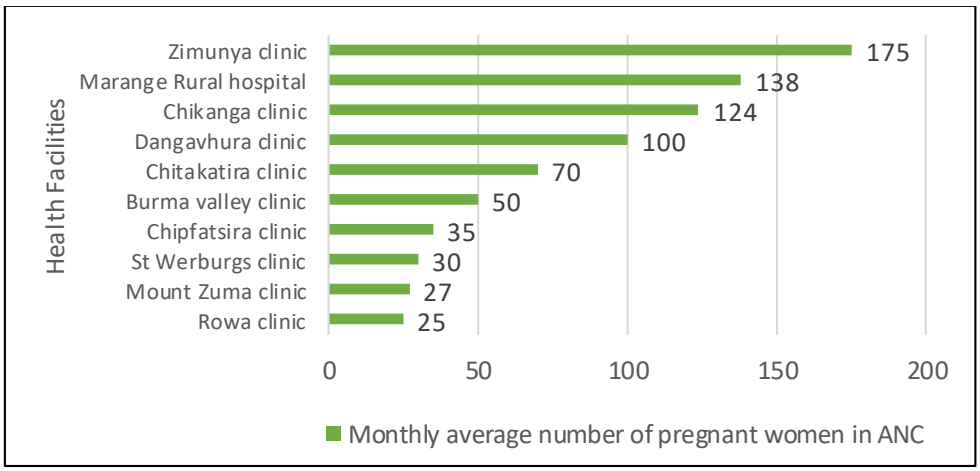


Figure 3: Average monthly number of women attending antenatal care by health facility

Ten health facilities provided data on their monthly ratio of pregnant women attending ANC per nurse. At five health facilities nurses attended to less than 20 ANC women per month, while at the remaining 5 clinics each nurse attended to 44 or more ANC women per month, Figure 4.

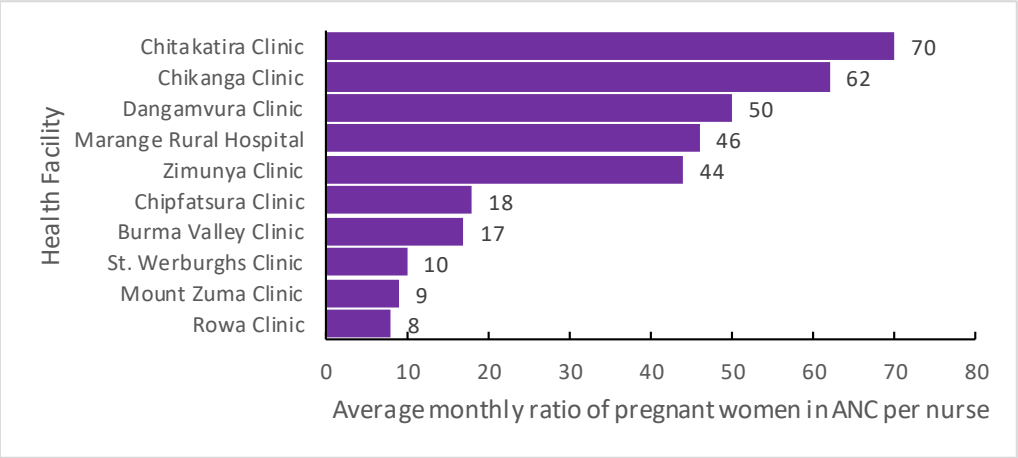


Figure 4: Monthly ratio of pregnant women attending antenatal care per nurse by health facility

Four of 12 health facilities (33.3%), all local authority health facilities, charged user fees for ANC services. The average user fee charged per each visit was one hundred Zimbabwean Dollars (ZW, 100ZW is equivalent to 5 United States Dollars) per visit. Laboratory services were free in all 12 facilities.

Antiretroviral guidelines-2016: health care provider awareness, training and understanding, and distribution

Twelve health care providers responded to questions about the 2016 antiretroviral guidelines (Table 6 below). Ten of 12 (83.3%) were aware of the existence of these guidelines. Four of the 12 health facilities had at least two nurses each trained on the new guidelines, two health facilities had three nurses trained, one facility had 6 nurses trained, while there was no data on

health provider training for the remaining five facilities. Nine nurses (75%) and one nurse (8.3%) indicated that the guidelines were easy and very easy to understand respectively.

Table 6: 2016 antiretroviral (ARV) guidelines: health care provider awareness, training and understanding

Variable	n = 12 (%)
Awareness of the 2016 ARV guidelines	
No	2 (16.7)
Yes	10 (83.3)
Number of health care providers trained on guidelines per facility	
2	4 (33.3)
3	2 (16.7)
6	1 (8.3)
Not recorded/aware	5 (41.7)
Ease of understanding the ARV guidelines	
Very easy	1 (8.3)
Easy	9 (75.0)
Not recorded	2 (16.7)

All twelve health care providers had received hard copies of the 2016 ARV guidelines and these copies were physically identified during the interviews. Eight (66.7%) had received their copies from the district teams, two (16.7%) from Natpharm, the Central Medical Stores distribution system and two (16.7%) had received their copies during training. Three health care providers (37.5%) received the guidelines in 2016, one in April and two in June 2016, 2 (25%) received the guidelines in 2017, one in June and the other in July 2017, and three (37.5%) health care providers only received the guidelines in June 2018. The receipt date was not documented by four (33.3%) health providers.

Viral load service provision

The responses of health care providers to the provision of VL testing services are summarised in Tables 7 and 8. Nine out of 12 (75%) of the nurses were knowledgeable about the ARV guidelines, including the VL testing requirements. All twelve were knowledgeable on the VL threshold and interpretation of the test results and the consequent management of pregnant women living with HIV based on these results. Eight of the 12 (66.7%) nurses provided feedback to their patients on their VL results during group education talks and four (33.3%) during one-on-one consultations. Only one health facility, the provincial hospital had onsite VL testing services.

Table 7: Viral load service provision at selected health facilities in Mutare District, 2018

Variable	Response: number (%)			
	No	**Yes**	**Not recorded**	**Total**
*Health worker knowledge on the new guidance on VL testing in pregnancy**	1 (8.3)	9 (75.0)	2(16.7)	12
Knowledge of the VL threshold of <1000 copies/mL	-	12(100)	-	12
Feedback of VL results to pregnant women	-	12 (100)	-	12
Laboratory for VL testing onsite	11(91.7)	1(8.3)		12

* Health worker knowledge on VL testing was based on knowledge of the following 2 statements: 1) HIV Viral Load should be done on all pregnant women living with HIV who are on ART at first ANC visit and repeated 6-monthly thereafter and throughout the breastfeeding period. 2) For pregnant women not yet on ART or those newly diagnosed to be HIV-positive on the first ANC booking, these should be initiated on ART on the same day of first ANC booking and should get an HIV VL after 3 months of starting ART and six monthly thereafter

Table 8: Viral load collection and transportation, and results feedback

Variable	Response	n =12 (%)
Frequency of VL sample collection	Four times weekly	12 (100)
Mode of sample transportation	Ambulance	1 (8.3)
	Use Bikers	11 (91.7)
Mode of VL results feedback to pregnant women	Group health education talks	8 (66.7)
	One on one consultation	4 (33.3)

Additional information on VL testing and TAT is summarised in Table 9. Nine out of twelve (75%) facilities used dry blood samples (DBS). Paper-based results were distributed to all 12 facilities. None of these facilities received their results by telephone or text message. Viral load TAT was one to two weeks for six (50%) health facilities.

Table 9: Viral Load specimen type and turnaround time at selected health facilities, Mutare District, 2018

Variable	n=12 (%)
Type of VL sample collected	
Dry Blood Spots (DBS)	9 (75.0)
DBS and Whole blood samples	3 (25.0)
Ever encountered stockouts of VL request forms	
No	11 (91.7)
Yes	1 (8.3)
VL results turnaround time	
1 -2 week	6 (50.0)
2 - 4 weeks	5 (41.7)
4 - 8 weeks	1 (8.3)
Experience sample rejection by the laboratory	
No	3 (25.0)
Yes	7 (58.3)
Not recorded	2 (16.7)

Health facility and patient related challenges

Health facility and patient related challenges faced from a health worker perspective in the provision of VL services are listed in Table 10.

Table 10: Health facility and patient related challenges encountered in the provision of viral load testing services

Health facility related problems
Transport related reasons
• Lack of safe and reliable mode of transport for laboratory specimens • Fuel shortages impeded sample collection • Irregular sample collection from facilities • Transport challenges adversely affected VL turnaround time
Sample related issues
• Shortage of EDTA tubes for collecting whole blood samples for viral load testing • High rejection rate as a result poor sample quality due to delays in transporting whole blood samples from facilities to the laboratory • Not enough space for privacy to attend to a patient's needs (e.g. counselling a patient on HIV-related issues including need for viral load testing)
Data issues
• Non-availability of viral load registers to document when viral load tests were conducted, when viral load results were received and if clients received their results. Nurses improvised and utilised notebooks which resulted in incomplete entries • For those facilities with electronic systems, systems were not customised to capture viral load results; hence pregnant women living with HIV who were in the ePMS would not have any results highlighted in the systems, even though results may have been available at the facility. The information system showed the patients as not having viral load tests done.
Patient-related problems
• Patients sometimes gave health care providers incorrect telephone numbers and addresses • Challenges with contacting and follow-up of patients living outside the health facility catchment area • Some patients do not return for antenatal care visits and do not collect viral load results on time • Late booking for antenatal care and hence delays in having first VL tests • Failure of patients to understand their results

EDTA = Ethylenediamine tetra acetic acid

ePMS = electronic patient monitoring system

Interview with the laboratory scientist

In Manicaland province all VL testing is centralised at the provincial laboratory. The provincial laboratory had 10 laboratory scientists and one laboratory technologist. All had been trained to conduct VL testing. At the time of the interview, 225 facilities in the province submitted VL samples to the provincial laboratory of which 42 (18.7%) were from Mutare District. On average, 11,500 VL samples were received by the laboratory every month, of which 1 % were from pregnant women living with HIV.

The laboratory had four VL machines, two m2000 Abbot and two C4800 Roche machines with the maximum daily testing capacity per set of equipment for 8-hour shifts being 186 and 220 samples, respectively. The machines operated 15 hours a day and processed 760 samples per day, that is 348 and 412 per Abbot and Roche machines respectively. Turnaround time for results was on average 1- 2 weeks from receipt of sample to release of results. The rejection rate was around 1%. Reasons for sample rejection included unlabeled specimens, improperly packaged DBS samples, information mismatch between forms and samples, and missing forms or samples. Reasons for rejecting plasma specimens included poor specimen storage and delays in submitting specimens.

Laboratory challenges with the provision of VL testing services included shortage of laboratory staff particularly data clerks, sample sorters and laboratory scientists, limited operating space, and delays in submitting whole blood specimens from some facilities. The laboratory information management system was not linked to the clinical services health information system at the facilities. Consequently, results were not available at health facility level in real time. Paper-based results were returned to the health facility by the same means used to deliver the blood sample, that is by motorcycle delivery. This had an overall effect of extended TAT.

Furthermore, on average VL machines broke down approximately three to four times per year on both platforms; however, these were often resolved within 48 hours.

Discussion

Antenatal care is the key health care entry point for pregnant women to access an array of health services for improving fetal and maternal outcomes (WHO, 2016). WHO recommends that pregnant women have their first ANC contact within the first 12 weeks of gestation. In this study only 42 (11.0%) of pregnant women living with HIV presented for their ANC booking visits during the first trimester, lower than the findings of the Zimbabwe Demographic Health Survey (ZDHS, 2015/2016) which showed that 39% of pregnant women living with HIV and uninfected women booked in the first trimester. Another study completed in rural Mashonaland East province in 2017 showed that 29.2% of pregnant women booked during the first trimester, which is more than two-fold higher than this study, but still much lower than the national figure of 39% (Mhlanga, 2019). Late booking in women living with HIV implies that their HIV diagnosis and ART initiation could be delayed, increasing the risk of mother-to-child-transmission. Woldesenbet et al. (2020) in a study from South Africa observed that late ANC booking and late ART initiation were associated with failure to achieve viral suppression in pregnant women living with HIV. In this study delay in antenatal attendance was prevalent despite ANC and laboratory services being offered free of charge. Several studies in countries in the African region including South Africa (Ebonwu et al., 2018; Kaswa et al., 2018), Ethiopia (Grum et al., 2018) and Malawi (Manda-Taylor et al., 2017) identified a spectrum of patient and health-related factors associated with late booking, including poor health seeking behaviour, lack of knowledge regarding pregnancy and the importance of ANC, avoidance of HIV testing, unplanned or non-acceptance of the pregnancy, cultural and religious beliefs, lack of early engagement of women and communities even before the pregnancy, non-availability and unaffordable health services, inaccessible services and poor health worker attitudes.

Among the pregnant women living with HIV enrolled into ANC in this study, only 31.6% had a VL test done. Although this coverage is comparable to studies done in the East and Southern African region, this is unacceptably low given the fact that Manicaland province was among the first provinces in Zimbabwe to be supported to provide VL testing. Viral load testing in Manicaland province at the commencement of this service was initially focussed on pregnant and breastfeeding women, children and general clients with treatment failure then expanding to routine VL testing. (Komtenza et al., 2019; Kubheka et al., 2020; Maheu-Giroux et al., 2019; Peter et al., 2017). Viral load coverage at national level was higher at 44% and 54% in 2018 and 2019 respectively (Ministry of Health and Child Care (MOHCC), 2018). Another study in Zimbabwe recorded a VL testing coverage of 31.9% in a cohort of pregnant and breastfeeding women (Mahachi et al., 2019). Viral load coverage was 63.1%, almost two-fold higher in 16 women interviewed for this study between October 2019 and March 2020. Although this coverage was higher than the 31.6% recorded in the retrospective component completed in 2018 the sample size was very small. Thus, further study of a larger, more representative sample is needed to determine whether VL testing coverage in pregnant women on ART has increased over time. Additionally, a cohort analysis of PLHIV on ART in Manicaland Province in 2017 documented a VL testing coverage of 63% at sites continuously monitored by Médecins Sans Frontières (Nyagadza et al., 2019).

A high proportion (66.8%) of pregnant women living with HIV enrolled in this study were already on ART at their first ANC (booking) visit. This proportion is lower than the national level estimate of 87% (MOH Progress Report 2018). The Kebeho study in Rwanda found that 76.1% of women were already receiving ART at the first ANC visit, while a study conducted in KwaZulu Natal found 54% to be on ART at first ANC booking (Gill et al., 2016; Ntlantsana et al., 2019). This high proportion of pregnant women living with HIV already on ART at first

ANC booking is a good reflection of the improved coverage of ART in general among PLHIV and among pregnant women attributed to the previous Option B+ that the country had been implementing and more recently to the "Treat All" policy that Zimbabwe adopted in 2016. Of note is that a study in the Democratic Republic of Congo by Yotebieng et al. (2019) that demonstrated high ART coverage among pregnant and breastfeeding women, concluded that without substantial efforts to improve the quality of care for pregnant and breastfeeding women, high ART coverage is not a guarantee to high viral suppression and might not be enough to achieve the goal of eMTCT in high-burden and resource limited settings.

Women who were already on ART at the time of ANC booking had their VL tests done much earlier than the women who were newly started on ART. This was expected, since according to the Zimbabwean guidelines women who are already on ART would have a VL test done at first ANC booking, while for newly initiated women, VL testing was to be conducted three months after the first ANC booking. Of concern was that the median time from booking to having a VL test done for newly initiated women was 207 days meaning that such women had their VL test done a median of 6.9 months after ART initiation instead of the recommended 3 months after ART initiation. There is therefore a need for the guidelines to be revisited so that newly diagnosed pregnant women are offered HVL at the optimal time to effectively prevent MTCT.

The median TAT between VL specimen collection and receipt of VL results by the pregnant, HIV-infected women for this study was 14 (IQR, 7-30) days, this is still unacceptably high compared to the set target by the programme to ensure quick TAT for VL (Ministry of Health and Child Care (MOHCC), 2015). Point of care testing can shorten the TAT by providing same day results hence of benefit to unsuppressed women as they can get their results during the

same clinic visit and be managed appropriately. A study in Botswana concluded that use of POC testing is a feasible and reliable option for VL monitoring, even in rural settings and that this would provide same-day VL results, allow for immediate assessment of virologic failure and reduce loss to follow-up (Moyo et al., 2016). Although this study was conducted in PLHIV on ART it can be extrapolated that pregnant women living with HIV can also benefit from same day results especially when they book late or present in the last trimester.

Nicholas et al. (2019) evaluated the outcomes of the first four years of routine VL monitoring using POC in rural clinics in Malawi and concluded that high VL coverage can be achieved followed by same-day test results and shorter time-to-switch to new ARV regimens. The game-changing potential of POC-based VL testing compared to conventional testing was also demonstrated (Bianchi et al., 2019; Mwenda et al., 2018). Our study showed that the major challenges were unreliable transport for specimens to the laboratory and long TAT. These challenges can be solved with the introduction of onsite POC technology (Nyakura et al., 2019).

Of the pregnant women living with HIV who had viral load testing, 87.6% received their results and of these 87.7% had a VL <1000 copies/mL. This is a good outcome and indicates good adherence to ARVs among pregnant women living with HIV which can lead to reduction in MTCT. While this result is commendable, it was still below the 90-90-90 UNAIDS target for 2020 of 90% viral suppression target for patients on ART (Bain et al., 2017; Marsh et al., 2019). The levels of suppression using the national cut-off point of <1,000 for VL for PLHIV were 85% and 84% as of December 2018 and 2019 respectively (Ministry of Health and Child Care (MOHCC), 2018).

In our study of 106 who had VL testing 77 (72.6%) were virally suppressed to <50 copies/mL. Similar high viral load suppression rates (<50 copies/mL) were documented in the Rwanda study (Gill et al., 2016). However, in this study of women in the third trimester of pregnancy and those in the postnatal period, there was a higher likelihood of detectable VL (non-suppression) in women with lower gravid, no education, non-disclosure to their partners and those who experienced side effects. In our study factors associated with viral suppression were not assessed because of the relatively small sample of women who underwent VL testing. Another study completed in Ethiopia that assessed outcomes of ART initiated among pregnant women under Option B+ conditions, also demonstrated high viral suppression (<50 copies/mL) of 80.3% (Demissie et al., 2020; Tolossa et al., 2020). Similar findings were obtained in studies completed in Malawi (Chagomerana et al., 2018; Omonaiye et al., 2019)

Our results showed that VL specimens were less likely to be collected at local authority facilities compared to government facilities. There is need for more research to establish the actual reasons for the difference in testing practices. A similar study by Atuhaire et al. (2020) of data from 2015 of pregnant women living with HIV at five local authority health facilities also noted a difference in practices in VL testing among the facilities, however it was noted that more research was required to establish the cause of such differences. Lessons leamed from the Therapeutic Solidarity and Initiatives against AIDS, OPP-ERA project in five West African countries showed that disparities in VL sample collection can be due to multiple determinants including the number, training and availability of health staff, size of the HIV cohort at the facility, and organisation of the sample collection circuit (Solthis, 2019). In that study enabling factors for VL sample collection included the provision of a one stop shop for HIV services or the supermarket approach, where the pregnant women receive all their services under one roof from the same health worker and on the same day, provision of free ANC

services. Ease of collection and preparation of dry blood spot versus whole blood sample collection also facilitated the collection VL samples. Age, gravidity, parity and gestational age at ANC booking were not predictors for VL sample collection. The barriers affecting VL collection were mostly systemic and included staff shortages, non-availability of consumables and laboratory forms and weaknesses in sample transportation. Lecher et al. (2016) noted similar challenges during monitoring of progress with scale-up of HIV VL in seven Sub-Saharan African countries.

Findings from the interviews of nursing personnel indicated that they were aware of the national guidelines and indications for conducting VL testing in pregnant women, how to interpret results and manage pregnant women with VL results >1,000 copies/mL. Despite this knowledge VL testing coverage was very low. It was noted in a retrospective cohort analysis of patients eligible for routine VL testing between 2013 and 2017 in Malawi and a retrospective data review of routine reports from MSF-supported health facilities in Zimbabwe that despite health care providers being knowledgeable of the guidelines, there is need for regular staff training, mentorship and motivation, and continuous monitoring of the implementation of guidelines. Enablers such as reliable sample and result transport systems, quality-assured testing laboratories and demand creation are essential to the success of routine VL testing scale up (Nicholas et al., 2019; Nyagadza et al., 2019). Challenges faced by health care providers in the provision of VL testing should be addressed to scale up VL testing coverage. Where POC testing is not practical due to either small numbers of specimens, DBS collection should continue to be used but transport challenges should be addressed so that specimens reach the laboratory on time. In our study it was revealed that paper-based results were sent to facilities using motorbikes. In this technological era, use of mHealth to provide same-day results through

SMS technology will speed up the TAT and address the issue of unreliable transport to deliver results to facilities.

Although health care providers were fully aware of the 2016 ARV guidelines and had received training on these guidelines it was not clear if this was regular training or one-off training. For health care providers to be able to implement guidelines it is necessary to provide ongoing mentorship and regular supportive supervision. Despite having received copies of the guidelines it had taken a year to two before most of them had received these guidelines. Delay in guideline dissemination results in delay in implementation of the policies with the result that some pregnant women living with HIV did not receive the preferred services. As highlighted before, being knowledgeable on a subject or policy does not necessarily translate to implementation of guidelines as there are other factors that contribute to successful implementation (Mutabazi et al., 2017; Nicholas et al., 2019).

Both health care providers and women who were interviewed indicated that they were provided with or received information during group education talks or during consultation. However, the women interviewed felt that the health education talks given while the women were waiting to receive ANC were too brief and there was insufficient time for pregnant women to ask questions. In addition, though they appreciated the one-on-one consultation, they were still not given enough time to ask questions and discuss HIV-related issues including VL testing. Consultations were constrained by high patient volume. Van Bogaert et al. (2017) reported similar findings whereby nurses indicated that patient communication and information about diagnostics and treatment were brief and patients' questions and worries were neglected when the workload was heavy. The nurses also admitted that workload affected the quality of care, including patient safety. Filby et al. (2016) and Manyisa et al. (2017) also documented that

inadequate staffing levels and high workload were issues across both urban and rural settings resulting in excessive overtime work and hence compromised the safety of pregnant women under their care. Health managers should ensure that they match the number of nurses with the case load to avoid compromising the quality of care of pregnant women. Excessive workload is also recognised as a significant source of stress amongst health workers (Manyisa et al.,2017).

One of the best suggestions for improving VL testing practice that emerged from the nurse interviews was that VL sample collection be synchronised with either ANC visits or ARV resupply days. This recommendation should be considered for implementation along with other suggestions and their combined impact on VL testing should be evaluated in follow-up studies. Some facilities provided outreach services in hard-to-reach areas, thereby improving access to care for some pregnant women living with HIV. Outreach services is one of the recognized differentiated service delivery models in provision of HIV services (Trafford et al., 2018; Vrazo et al., 2018).

Strengths and Limitations of this study

This descriptive cross-sectional mixed methods study utilised routinely collected facility-level data that reflects routine clinical practice (Regnault et al., 2018) Although the retrospective component used an adequately powered, well represented sample, the prospective interviews were conducted on small samples. Additionally, the interviews of pregnant women living with HIV were limited to 10 of the 15 research sites. Thus, the findings may not be truly representative of the health worker population and population of pregnant women living with HIV in Manicaland province.

Data deficits were also cited by the nurses and observed by the researchers during data extraction and these data gaps from both paper-based registries and the electronic systems were attributed as a major contributor to the low VL testing coverages. For example, the non-availability of proper VL registers to capture information in one source, the non-customised ePMS to capture VL results for clients already entered in the ePMS at ANC booking resulted in many gaps. Additionally, due to the retrospective design there were limitations in the availability and completeness of demographic and clinical data. Gaps in routine data has been well documented in studies that have utilised retrospective data sources (Gill et al., 2016; Mahachi et al., 2019; Nicholas et al., 2019) and these limitations impacted the quality of the data for such studies.(Gill et al., 2016; Mahachi et al., 2019; Nicholas et al., 2019; Ntlantsana et al., 2019; Nyagadza et al., 2019).

The study was conducted when the health delivery system in the country was experiencing many challenges due to the continued unfavourable macro-economic situation. The salary incentive support that was being provided by some development partners had come to an end and health care providers were no longer able to go to work daily but were organised into shifts to ensure that patients were attended to. This meant that only one nurse per facility at 12 of the 15 study sites participated in the prospective interviews. The morale of health workers was very low at the time of the interviews. This may have impacted the responses of the nurses.

The cross-sectional mixed study design did not allow description of trends over time including the impact of the coronavirus disease 2019 on VL testing. Whether VL testing increased after 2018 as suggested by the response of 16 pregnant women living with HIV during the interviews could not be confirmed. Further study is needed to determine whether VL testing and factors associated with VL testing have changed over time.

Conclusion

Elimination of MTCT of HIV is part of the 2030 triple elimination agenda. With HIV VL testing being the gold standard for monitoring PLHIV including pregnant women living with HIV, its accessibility and availability for monitoring is of paramount importance. In our study, VL testing was sub-optimal with only 32% of women living with HIV presenting in ANC having a test done and 88% receiving back their VL results. Notably was that 77% of those who received a VL test were virally suppressed (<50 copies/mL). Much needs to be done to scale up the coverage of HIV VL testing among pregnant women living with HIV in the district.

The high level of knowledge among health workers on the guidelines on VL testing among women living with HIV including the need and benefits is commendable. It was also observed that being knowledgeable on a policy does not necessarily translate to implementation of the agreed guidelines as there are other contributory factors that need to be addressed. One of the best suggestions for improving VL testing practice that emerged from the nurse interviews was that VL sample collection be synchronised with either ANC visits or ARV resupply days. This recommendation should be considered for implementation along with other suggestions and their combined impact on VL testing should be evaluated in follow-up studies.

In our study it was noted that VL testing coverage was higher among women interviewed in 2019-2020 compared to that recorded in the retrospective component completed in 2018, however the sample size was very small. Thus, further study of a larger, more representative sample is needed to determine whether VL testing coverage in pregnant women on ART has increased over time in Mutare district. Benefits of same day VL testing using POC has only been studied in PLHIV and not among pregnant women in Zimbabwe, therefore such studies should be carried out. There was also a noticeable difference in practices in VL testing among

different health facilities, hence more research is required to establish the cause of such differences to inform programming.

Recommendations

The following recommendations should be considered by the MOH at the respective levels;-

- The MOH should consider disseminating ARV and PMTCT guidelines and other policy documents using electronic platforms versus the current physical distribution as these are more accessible and result in quicker dissemination, which may translate into faster implementation of new policies and policy updates.
- Given the low VL testing rates, regular mentorship and supportive supervision are also essential to ensure that policies and guidelines on PMTCT are implemented as well as to ensure that set targets are reached within the agreed timeframes so that positive outcomes can be observed for pregnant women living with HIV.
- Monitoring quality of care of services leads to improvement in services, therefore the provincial and district teams should ensure that quality improvement (QI) initiatives are put in place or scaled up so that indicators like VL testing coverage in pregnant women living with HIV are monitored during QI visits. This will ensure that policies are implemented.
- Given that countries are moving towards eliminating mother to child transmission of HIV, the PMTCT programme in Mutare district needs to ensure that ppregnant women living with HIV who come into contact with a health facility have their VL tests done in order to monitor VL suppression levels, provide appropriate management to women with unsuppressed VL results and minimise HIV transmission.
- There is need to have alerts within the ePMS or on the files of pregnant women living with HIV to ensure that VL testing is done on time so that missed testing opportunities are minimised particularly in newly identified pregnant women living with HIV.
- Expedite scale up of VL POC testing to ensure same day results for pregnant women living with HIV and delivery of proper management based on these results.

- The adoption of mHealth and the introduction of functional electronic laboratory management systems (eLMISs) to shorten the VL results turnaround time should be expedited.
- Given that human resource shortages will continue to be a challenge, it may be prudent that community health care providers be trained to deliver messages on HIV-related subjects including VL testing, so that community health workers can share such information within their communities such that by the time the pregnant women comes to the facility they are well versed and will not be disadvantaged if the health care providers do not give them adequate time for discussion.

References

Atuhaire, P., S. Brummel, S., Mmbaga, B. T., Angelidou, K., Fairlie, L., Violari, A., . . . Mubiana-Mbewe, M. (2020). The impact of short term Antiretroviral Therapy (ART) interruptions on longer term maternal health outcomes—A randomized clinical trial. *PloS One, 15*(1), e0228003.

Bain, L. E., Nkoke, C., & Noubiap, J. J. N. (2017). UNAIDS 90–90–90 targets to end the AIDS epidemic by 2020 are not realistic: comment on "Can the UNAIDS 90–90–90 target be achieved? A systematic analysis of national HIV treatment cascades". *BMJ global Health, 2*(2), e000227.

Barnabas, R. V., Revill, P., Tan, N., & Phillips, A. (2017). Cost-effectiveness of routine viral load monitoring in low-and middle-income countries: a systematic review. *Journal of the International AIDS Society, 20*, e25006.

Bianchi, F., Cohn, J., Sacks, E., Bailey, R., Lemaire, J.F., Machekano, R., Nzima V.N., Ekouévi, P.F., Makone, M., Odhiambo, C.O. & Chadambuka, A. (2019). Evaluation of a routine point-of-care intervention for early infant diagnosis of HIV: an observational study in eight African countries. *The Lancet HIV, 6*(6), e373-e381.

Biomeical, United States. National Commission for the Protection of Human Subjects of Biomedical, & Behavioral Research. (1978). *The Belmont Report: ethical principles and guidelines for the protection of human subjects of research* (Vol. 2). The Commission.

Chagomerana, M. B., Miller, W. C., Tang, J. H., Hoffman, I. F., Harrington, B. J., DiPrete, B.,Wallie A.,Limarzi L., & Hosseinipour, M. C. (2018). Prevalence of antiretroviral therapy treatment failure among HIV-infected pregnant women at first antenatal care: PMTCT Option B+ in Malawi. *PloS One, 13*(12). e0209052.

Cohen, M. S., Chen, Y. Q., McCauley, M., Gamble, T., Hosseinipour, M. C., Kumarasamy, N., Hakim J.G., Kumwenda J., Grinsztejn B., Pilotto J.H., & Godbole S.V. (2016). Antiretroviral therapy for the prevention of HIV-1 transmission. *New England Journal of Medicine, 375*(9), 830-839.

Council for International Organizations of Medical Sciences. (2017). International ethical guidelines for health-related research involving humans. *International ethical guidelines for health-related research involving humans.*

Demissie, D. B., Bulto, G. A., Mekuria, W. T., Dufera, F. N., & Gamshe, E. N. (2020). Evaluation of antiretroviral therapy initiated among pregnant women under Option B+ by viral load and CD4 count outcomes in selected hospitals of West Shewa Zone, Oromia Region, Ethiopia. *HIV/AIDS (Auckland, NZ), 12*, 127.

Dutta, A., Barker, C., & Kallarakal, A. (2015). The HIV treatment gap: estimates of the financial resources needed versus available for scale-up of antiretroviral therapy in 97 countries from 2015 to 2020. *PLoS Medicine, 12*(11), e1001907.

Ebonwu, J., Mumbauer, A., Uys, M., Wainberg, M. L., & Medina-Marino, A. (2018). Determinants of late antenatal care presentation in rural and peri-urban communities in South Africa: a cross-sectional study. *PloS One, 13*(3).

Estill, J., Aubriere, C., Egger, M., Johnson, L., Wood, R., Garone, D., Gsponer, T., Wandeler, G., Boulle, A., Davies, M.A. & Hallett, T. (2012). Viral load monitoring of antiretroviral therapy, cohort viral load and HIV transmission in Southern Africa: a mathematical modelling analysis. *AIDS (London, England), 26*(11), 1403.

Farquhar, C., Nduati, R., Haigwood, N., Sutton, W., Mbori-Ngacha, D., Richardson, B., & John-Stewart, G. (2005). High maternal HIV-1 viral load during pregnancy is associated with reduced placental transfer of measles IgG antibody. *Journal of Acquired Immune Deficiency Syndromes (1999), 40*(4), 494.

Faye, A. (2020). Early antiretroviral treatment of infants to attain HIV remission: Not just a matter of timing. *EClinicalMedicine, 20*.

Filby, A., McConville, F., & Portela, A. (2016). What prevents quality midwifery care? A systematic mapping of barriers in low and middle income countries from the provider perspective. *PloS One, 11*(5).

Garcia, P. M., Kalish, L. A., Pitt, J., Minkoff, H., Quinn, T. C., Burchett, S. K., Kornegay, J., Jackson, B., Moye, J., Hanson, C. & Zorrilla, C. (1999). Maternal levels of plasma human immunodeficiency virus type 1 RNA and the risk of perinatal transmission. *New England Journal of Medicine, 341*(6), 394-402.

Gill, M. M., Hoffman, H. J., Bobrow, E. A., Mugwaneza, P., Ndatimana, D., Ndayisaba, G. F., Baribwira, C., Guay, L., & Asiimwe, A. (2016). Detectable viral load in late pregnancy among women in the Rwanda option B+ PMTCT program: enrollment results from the Kabeho study. *PloS One, 11*(12).

Global Fund. (2015). New approach on HIV viral load testing. . [Press release]. Retrieved from http://www.theglobalfund.org/en/news/2015-06-10_New_

Grum, T., & Brhane, E. (2018). Magnitude and factors associated with late antenatal care booking on first visit among pregnant women in public health centers in central zone of Tigray Region, Ethiopia: A cross sectional study. *PloS One, 13*(12).

Gumede-Moyo, S., Filteau, S., Munthali, T., Todd, J., & Musonda, P. (2017). Implementation effectiveness of revised (post-2010) World Health Organization guidelines on prevention of mother-to-child transmission of HIV using routinely collected data in sub-Saharan Africa: a systematic literature review. *Medicine, 96*(40).

Hermans, L. E., Carmona, S., Nijhuis, M., Tempelman, H. A., Richman, D. D., Moorhouse, M., . . . Wensing, A. M. (2020). Virological suppression and clinical management in response to viremia in South African HIV treatment program: A multicenter cohort study. *PLoS Medicine, 17*(2), e1003037.

Holm, S. (2013). Declaration of Helsinki. *International Encyclopedia of Ethics*.

Houle, B., Clark, S. J., Kahn, K., Tollman, S., & Yamin, A. E. (2015). The impacts of maternal mortality and cause of death on children's risk of dying in rural South Africa: evidence from a population based surveillance study (1992-2013). *Reproductive Health, 12*(1), S7.

Ioannidis, J. P., Abrams, E. J., Ammann, A., Bulterys, M., Goedert, J. J., Gray, L., Korber, B.T., Mayaux, M.J., Mofenson, L.M., Newell, M.L. & Shapiro, D.E. (2001). Perinatal transmission of human immunodeficiency virus type 1 by pregnant women with RNA virus loads< 1000 copies/ml. *The Journal of Infectious Diseases, 183*(4), 539-545.

Jobanputra, K., Parker, L. A., Azih, C., Okello, V., Maphalala, G., Jouquet, G., Kerschberger, B., Mekeidje, C., Cyr, J., Mafikudze, A. & Han, W. (2014). Impact and programmatic implications of routine viral load monitoring in Swaziland. *Journal of Acquired Immune Deficiency Syndromes (1999), 67*(1), 45.

Joya, C., Won, S. H., Schofield, C., Lalani, T., Maves, R. C., Kronmann, K., Deiss, R., Okulicz, J., Agan, B.K. & Ganesan, A. (2019). Persistent low-level viremia while on antiretroviral therapy is an independent risk factor for virologic failure. *Clinical Infectious Diseases, 69*(12), 2145-2152.

Kaswa, R., Rupesinghe, G. F., & Longo-Mbenza, B. (2018). Exploring the pregnant women's perspective of late booking of antenatal care services at Mbekweni Health Centre in Eastern Cape, South Africa. *African Journal of Primary Health Care & Family Medicine, 10*(1), 1-9.

Keiser, O., Chi, B. H., Gsponer, T., Boulle, A., Orrell, C., Phiri, S., Maxwell, N., Maskew, M., Prozesky, H., Fox, M.P. & Westfall, A. (2011). Outcomes of antiretroviral treatment in programmes with and without routine viral load monitoring in Southern Africa. *AIDS (London, England), 25*(14), 1761.

Komtenza, B., Satyanarayana, S., Takarinda, K. C., Mukungunugwa, S. H., Mugurungi, O., Chonzi, P., Sithole, N., Bvochora, T., & Mushavi, A. (2019). Identifying high or low risk of mother to child transmission of HIV: How Harare City, Zimbabwe is doing? *PloS One, 14*(3). e0212848.

Kubheka, S. E., Archary, M., & Naidu, K. K. (2020). HIV viral load testing coverage and timeliness after implementation of the wellness anniversary in a paediatric and adolescent HIV clinic in KwaZulu-Natal, South Africa. *Southern African Journal of HIV Medicine, 21*(1), 1-5.

Kuhn, L., Strehlau, R., Shiau, S., Patel, F., Shen, Y., Technau, K.G., Burke, M., Sherman, G., Coovadia, A., Aldrovandi, G.M. & Hazra, R., (2020). Early antiretroviral treatment of infants to attain HIV remission. *EClinicalMedicine, 18*, 100241.

Landes, M., van Lettow, M., Nkhoma, E., Tippett Barr, B., Truwah, Z., Shouten, E., Jahn, A., Auld, A., Kalua, T., & van Oosterhout, J. J. (2019). Low detectable postpartum viral load is associated with HIV transmission in Malawi's prevention of mother-to-child transmission programme. *Journal of the International AIDS Society, 22*(6), e25290.

Lecher, S., Williams, J., Fonjungo, P. N., Kim, A. A., Ellenberger, D., Zhang, G., Toure, C.A., Agolory, S., Appiah-Pippim, G., Beard, S. & Borget, M.Y. (2016). Progress with scale-up of HIV viral load monitoring—seven sub-Saharan African countries, January 2015–June 2016. *Morbidity and Mortality Weekly Report, 65*(47), 1332-1335.

Liu, J., Liu, G., & Li, Z. (2017). Factors responsible for mother to child transmission (MTCT) of HIV-1-a review. *Eur Rev Med Pharmacol Sci, 21*(suppl 4), 74-78.

Maartens, G., Celum, C., & Lewin, S. R. (2014). HIV infection: epidemiology, pathogenesis, treatment, and prevention. *The Lancet, 384*(9939), 258-271.

Mahachi, N., Muchedzi, A., Tafuma, T. A., Mawora, P., Kariuki, L., Semo, B. W., Bateganya, M.H., Nyagura, T., Ncube, G., Merrigan, M.B., & Chabikuli, O.N. (2019). Sustained high HIV case-finding through index testing and partner notification services: experiences from three provinces in Zimbabwe. *Journal of the International AIDS Society, 22*, e25321.

Maheu-Giroux, M., Marsh, K., Doyle, C. M., Godin, A., Delaunay, C. L., Johnson, L. F., Jahn, A., Abo, K., Mbofana, F., Boily, M.C. & Buckeridge, D.L. (2019). National HIV testing and diagnosis coverage in sub-Saharan Africa: a new modeling tool for estimating the 'first 90'from program and survey data. *AIDS (London, England), 33*(Suppl 3), p.S255.

Manda-Taylor, L., Sealy, D., & Roberts, J. (2017). Factors associated with delayed Antenatal Care attendance in Malawi: Results from a Qualitative study. *Medical Journal of Zambia, 44*(1), 17-25.

Mandelbrot, L., Tubiana, R., Le Chenadec, J., Dollfus, C., Faye, A., Pannier, E., . . . Reliquet, V. (2015). No perinatal HIV-1 transmission from women with effective antiretroviral therapy starting before conception. *Clinical Infectious Diseases, 61*(11), 1715-1725.

Manyisa, Z. M., & van Aswegen, E. J. (2017). Factors affecting working conditions in public hospitals: A literature review. *International Journal of Africa Nursing Sciences, 6*, 28-38.

Marsh, K., Eaton, J. W., Mahy, M., Sabin, K., Autenrieth, C. S., Wanyeki, I., Daher, J., & Ghys, P. D. (2019). Global, regional and country-level 90–90–90 estimates for 2018: assessing progress towards the 2020 target. *AIDS (London, England), 33*(Suppl 3), p.S213.

Minchella, P. A., Chipungu, G., Kim, A. A., Sarr, A., Ali, H., Mwenda, R., Nkengasong, J.N., & Singer, D. (2017). Specimen origin, type and testing laboratory are linked to longer turnaround times for HIV viral load testing in Malawi. *PloS One*, *12*(2), e0173009.

Ministry of Health and Child Care (MOHCC), Government of Zimbabwe, (2015)*Zimbabwe HIV viral load scale-up plan 2015–2018*. Harare, Zimbabwe: MOHCC https://aidsfree.usaid.gov/sites/default/files/zimbabwe_vl_scaleup.pdf

Ministry of Health and Child Care (MOHCC). (2016). Guidelines for Antiretroviral Therapy for the Prevention and Treatment of HIV in Zimbabwe, 2016. Harare https://depts.washington.edu/edgh/zw/vl/project-resources/ZIM_ART_Guidelines_2016_-_review_final.pdf

Ministry of Health and Child Care (MOHCC) (2018). Zimbabwe Health Sector Performance Monitoring and Evaluation Policy Guidelines and Strategy. Retrieved from https://procurement-notices.undp.org/view_file.cfm?doc_id=171227

Moyo, S., Mohammed, T., Wirth, K. E., Prague, M., Bennett, K., Holme, M. P., Mupfumi, L., Sebogodi, P., Moraka, N.O., Boleo, C., & Maphorisa, C.N. (2016). Point-of-care Cepheid Xpert HIV-1 viral load test in rural African communities is feasible and reliable. *Journal of Clinical Microbiology*, *54*(12), 3050-3055.

Mukonda, E., Hsiao, N.-Y., Vojnov, L., Myer, L., & Lesosky, M. (2020). Mixed method estimation of population level HIV viral suppression rate in the Western Cape, South Africa. *medRxiv*.

Mutabazi, J. C., Zarowsky, C., & Trottier, H. (2017). The impact of programs for prevention of mother-to-child transmission of HIV on health care services and systems in sub-Saharan Africa-A review. *Public Health Reviews*, *38*(1), 28.

Mwenda, R., Fong, Y., Magombo, T., Saka, E., Midiani, D., Mwase, C., Kandulu, J., Wang, M., Thomas, R., Sherman, J., & Vojnov, L. (2018). Significant patient impact observed upon implementation of point-of-care early infant diagnosis technologies in an observational study in Malawi. *Clinical Infectious Diseases*, *67*(5), 701-707.

Myer, L., Essajee, S., Broyles, L. N., Watts, D. H., Lesosky, M., El-Sadr, W. M., & Abrams, E. J. (2017). Pregnant and breastfeeding women: a priority population for HIV viral load monitoring. *PLoS Medicine*, *14*(8).

Ngwende, S., Gombe, N. T., Midzi, S., Tshimanga, M., Shambira, G., & Chadambuka, A. (2013). Factors associated with HIV infection among children born to mothers on the prevention of mother to child transmission programme at Chitungwiza Hospital, Zimbabwe, 2008. *BMC Public Health*, *13*(1), 1181.

Nicholas, S., Poulet, E., Wolters, L., Wapling, J., Rakesh, A., Amoros, I., Szumilin, E., Gueguen, M., & Schramm, B. (2019). Point-of-care viral load monitoring: outcomes from a decentralized HIV programme in Malawi. *Journal of the International AIDS Society*, *22*(8), e25387.

Ntlantsana, V., Hift, R. J., & Mphatswe, W. P. (2019). HIV viraemia during pregnancy in women receiving preconception antiretroviral therapy in KwaDukuza, KwaZulu-Natal. *Southern African Journal of HIV Medicine*, *20*(1), 1-8.

Nyagadza, B., Kudya, N., Mbofana, E., Masaka, S., Garone, D., Chen, C.Y., Mulingwa, A., Uzande, C., Isaakidis, P., & Ndlovu, Z. (2019). Scaling up HIV viral load monitoring in Manicaland, Zimbabwe: challenges and opportunities from the field. *Public Health Action*, *9*(4), 177-181.

Nyakura, J., Shewade, H. D., Ade, S., Mushavi, A., Mukungunugwa, S. H., Chimwaza, A., Owiti, P., Senkoro, M., & Mugurungi, O. (2019). Viral load testing among women on 'option B+'in Mazowe, Zimbabwe: How well are we doing? *PloS One*, *14*(12). e0225476.

Omonaiye, O., Kusljic, S., Nicholson, P., Mohebbi, M., & Manias, E. (2019). Post Option B+ implementation programme in Nigeria: Determinants of adherence of antiretroviral therapy among pregnant women with HIV. *International Journal of Infectious Diseases*, *81*, 225-230.

Peter, T., Zeh, C., Katz, Z., Elbireer, A., Alemayehu, B., Vojnov, L., Costa, A., Doi, N., & Jani, I. (2017). Scaling up HIV viral load–lessons from the large-scale implementation of HIV early infant diagnosis and CD 4 testing. *Journal of the International AIDS Society*, *20*, e25008.

Phillips, A., Shroufi, A., Vojnov, L., Cohn, J., Roberts, T., Ellman, T., & Revill, P. (2015). Sustainable HIV treatment in Africa through viral-load-informed differentiated care. *Nature*, *528*(7580), S68-S76.

Phillips, A. N., Cambiano, V., Nakagawa, F., Bansi-Matharu, L., Sow, P. S., Ehrenkranz, P., Ford, D., Mugurungi, O., Apollo, T., Murungu, J. & Bangsberg, D.R. (2016). Cost effectiveness of potential ART adherence monitoring interventions in Sub-Saharan Africa. *PloS One*, *11*(12).

Phillips, A.N., Cambiano, V., Nakagawa, F., Bansi-Matharu, L., Sow, P.S., Ehrenkranz, P., Ford, D., Mugurungi, O., Apollo, T., Murungu, J. and Bangsberg, D.R., 2016. Cost effectiveness of potential ART adherence monitoring interventions in Sub-Saharan Africa. *PloS One*, *11*(12), p.e0167654.

Puthanakit, T., Thepnarong, N., Chaithongwongwatthana, S., Anugulruengkitt, S., Anunsittichai, O., Theerawit, T., Ubolyam, S., Pancharoen, C., & Phanuphak, P. (2018). Intensification of antiretroviral treatment with raltegravir for pregnant women living with HIV at high risk of vertical transmission. *Journal of Virus Eradication*, *4*(2), 61.

Regnault, A., Willgoss, T., Barbic, S., & International Society for Quality of Life Research (2018). Towards the use of mixed methods inquiry as best practice in health outcomes research. *Journal of Patient-reported Outcomes*, *2*(1), 19.

Roberts, T., Bygrave, H., Fajardo, E., & Ford, N. (2012). Challenges and opportunities for the implementation of virological testing in resource-limited settings. *Journal of the International AIDS Society*, *15*(2), 17324.

Roberts, T., Cohn, J., Bonner, K., & Hargreaves, S. (2016). Scale-up of routine viral load testing in resource-poor settings: current and future implementation challenges. *Clinical Infectious Diseases*, *62*(8), 1043-1048.

Solthis. (2019). HIV Viral Load Testing Operational Guide 60 Lessons Learned From The Open Polyvalent Platforms (OPP) for sustainable and quality access to VL in resource limited settings (OPP-ERA) Project. Retrieved from https://www.solthis.org/en/outils/hiv-viral-load-testing-operational-guide/

Thea, D. M., Steketee, R. W., Pliner, V., Bornschlegel, K., Brown, T., Orloff, S., Matheson, P.B., Abrams, E.J., Bamji, M., Lambert, G., & Schoenbaum, E.A. (1997). The effect of maternal viral load on the risk of perinatal transmission of HIV-1. *Aids*, *11*(4), 437-444.

Tolossa, T., Kassa, G. M., Chanie, H., Abajobir, A., & Mulisa, D. (2020). Incidence and predictors of lost to follow-up among women under Option B+ PMTCT program in western Ethiopia: a retrospective follow-up study. *BMC Research Notes*, *13*(1), 18.

Townsend, C. L., Cortina-Borja, M., Peckham, C. S., de Ruiter, A., Lyall, H., & Tookey, P. A. (2008). Low rates of mother-to-child transmission of HIV following effective pregnancy interventions in the United Kingdom and Ireland, 2000–2006. *Aids, 22*(8), 973-981.

Trafford, Z., Gomba, Y., Colvin, C. J., Iyun, V. O., Phillips, T. K., Brittain, K., Myer, L., Abrams, E.J., & Zerbe, A. (2018). Experiences of HIV-positive postpartum women and health workers involved with community-based antiretroviral therapy adherence clubs in Cape Town, South Africa. *BMC Public Health, 18*(1), 935.

Tubiana, R., Le Chenadec, J., Rouzioux, C., Mandelbrot, L., Hamrene, K., Dollfus, C., Faye, A., Delaugerre, C., Blanche, S., Warszawski, J., & ANRS French Perinatal Cohort (ANRS CO1/CO11). (2010). Factors associated with mother-to-child transmission of HIV-1 despite a maternal viral load< 500 copies/ml at delivery: a case-control study nested in the French perinatal cohort (EPF-ANRS CO1). *Clinical Infectious Diseases, 50*(4), 585-596.

UNAIDS. (2020). Progress towards the Start Free, Stay Free, AIDS Free targets 2020 report. Retrieved from https://www.unaids.org/sites/default/files/media_asset/start-free-stay-free-aids-free-2020-progress-report_en.pdf

United Nations. (2015). Sustainable Development Goal 3: Ensure healthy lives and promote well-being for all at all ages. United Nations, Geneva. Retrieved from https://www.un.org/sustainabledevelopment/health/

Van Bogaert, P., Peremans, L., Van Heusden, D., Verspuy, M., Kureckova, V., Van de Cruys, Z., & Franck, E. (2017). Predictors of burnout, work engagement and nurse reported job outcomes and quality of care: a mixed method study. *BMC Nursing, 16*(1), 5.

Vrazo, A. C., Sullivan, D., & Phelps, B. R. (2018). Eliminating mother-to-child transmission of HIV by 2030: 5 strategies to ensure continued progress. *Global Health: Science and Practice, 6*(2), 249-256.

Weiser, B., Nachman, S., Tropper, P., Viscosi, K. H., Grimson, R., Baxter, G., Fang, G., Reyelt, C., Hutcheon, N., & Burger, H. (1994). Quantitation of human immunodeficiency virus type 1 during pregnancy: relationship of viral titer to mother-to-child transmission and stability of viral load. *Proceedings of the National Academy of Sciences, 91*(17), 8037-8041.

Woldesenbet, S. A., Kufa, T., Barron, P., Chirombo, B. C., Cheyip, M., Ayalew, K., Lombard, C., Manda, S., Diallo, K., Pillay, Y,. & Puren, A.J. (2020). Viral suppression and factors associated with failure to achieve viral suppression among pregnant women in South Africa. *AIDS (London, England), 34*(4), 589.

World Health Organization. (2006). Taking stock: HIV in children: the state of affairs. World Health Organization. Retrieved from https://apps.who.int/iris/handle/10665/69760

World Health Organization. (2016a). Consolidated guidelines on the use of antiretroviral drugs for treating and preventing HIV infection: recommendations for a public health approach: Retrieved from https://apps.who.int/iris/handle/10665/85321

World Health Organization. (2016b). Progress report 2016: prevent HIV, test and treat all: WHO support for country impact. World Health Organization. Retrieved from https://apps.who.int/iris/handle/10665/251713

World Health Organization. (2017a). Global guidance on criteria and processes for validation: elimination of mother-to-child transmission of HIV and syphilis, 2nd edition. World Health Organization. https://apps.who.int/iris/handle/10665/259517. License: CC BY-NC-SA 3.0 IGO

World Health Organization. (2017b). Guidelines: Updates on HIV and infant feeding: the duration of breastfeeding, and support from health services to improve feeding practices

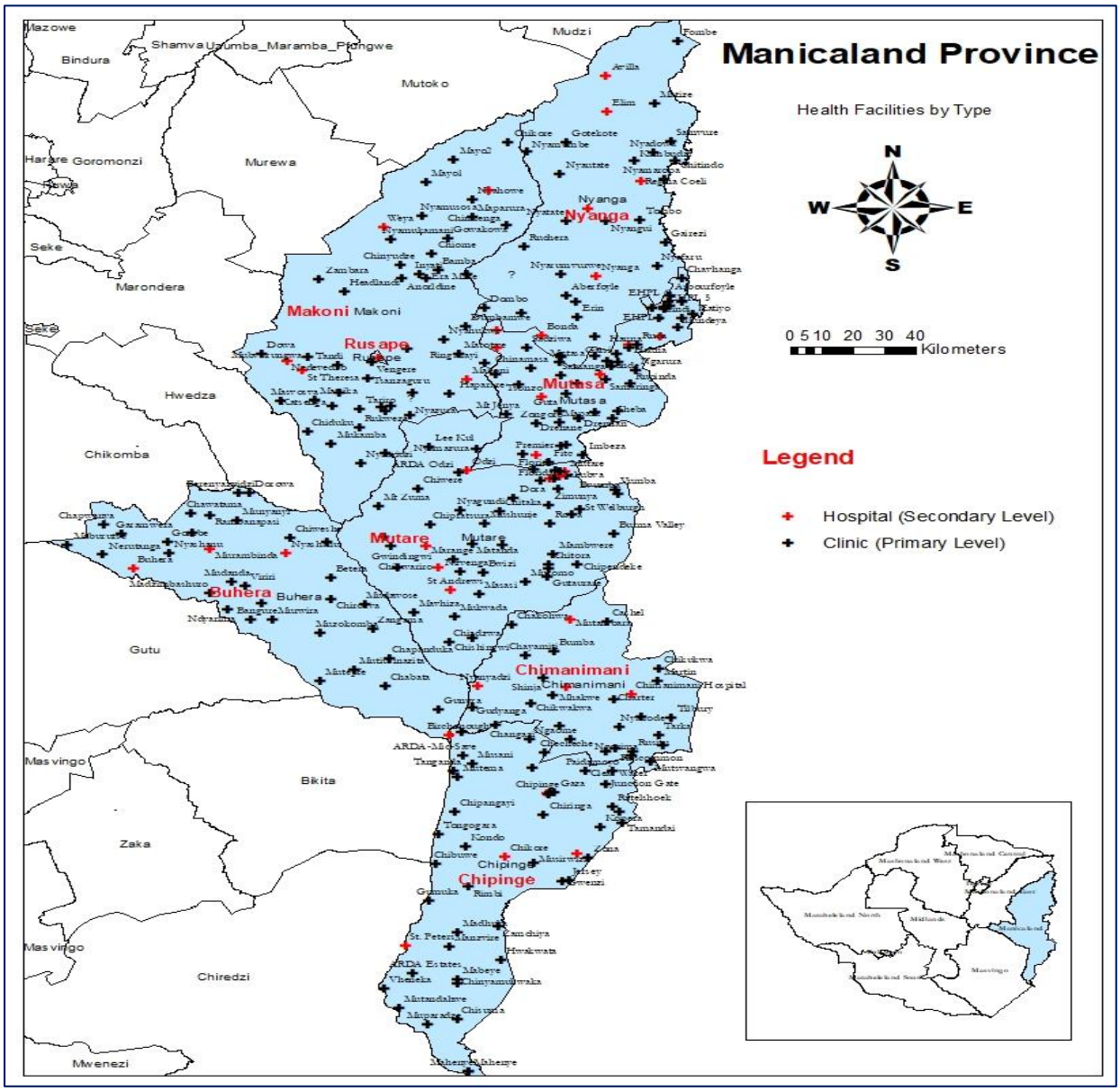
among mothers living with HIV. 2016. In *Available: apps. who. int/../9789241549707-eng. pdf on January* (Vol. 28).

Yotebieng, M., Mpody, C., Ravelomanana, N. L., Tabala, M., Malongo, F., Kawende, B., Ntangu, P., Behets, F., Okitolonda, E., & CQI-PMTCT study team. (2019). HIV viral suppression among pregnant and breastfeeding women in routine care in the Kinshasa province: a baseline evaluation of participants in CQI-PMTCT study. *Journal of the International AIDS Society, 22*(9), e25376.

Zhang, H. L., Omondi, M. W., Musyoka, A. M., Afwamba, I. A., Swai, R. P., Karia, F. P., Muiruri, C., Reddy, E.A., Crump., J.A. & Rubach, M. P. (2016). Challenges of maintaining good clinical laboratory practices in low-resource settings: a health program evaluation framework case study from East Africa. *American Journal of Clinical Pathology, 146*(2), 199-206.

Appendices

Appendix 1: Map of Mutare District in Manicaland Province, Zimbabwe



Appendix 2: Tool for Health Workers at facility level, ANC and Family Health Units

START THE INTERVIEW WITH THE FOLLOWING:
Hello! My name is _____. I am here on behalf of the Ministry of Health and Child Care (MOHCC) to seek information that will make us better understand the programmatic and operational issues in the provision of HIV Viral Load testing services among pregnant women in Mutare district. We will be asking you questions about various issues pertaining to provision of HIV Viral Load testing and the information we are going to get from your facility may be used by the MOHCC for planning service improvement. I am/We are asking for your help to ensure that the information we collect is accurate. If there is a question that you are not comfortable answering or someone else is the most appropriate person to provide the information, we would appreciate you introducing us to that person. All our discussions will be held confidentially and the information you provide will not be identified with you so feel free to share with us as much as is possible
Thank you

A: Background information
Name of Respondent (optional):…… ……

Designation:……Phone number ……Email:
Name of facility: ……..……
District:……Province:……
Others (Specify): ……

Facility Type:
01 Primary Health Care facility (rural/Urban)…….....1

02 Rural Hospital…….2

03 District/Mission Hospital; 3

04 Provincial Hospital……. 4

05Others (Specify): ……..……5

Managing Authority
Government ……1
Local Authority……..…..2
Private ……..…..…….3
Faith Based(Mission) ……..…….…….4
Other (Specify)……..……...….5

B. Human Resource Capacity in ANC and workload assessment (section B and C can be completed prior to interviews)			
1	How many health workers are within the ANC department?		
	Indicate the numbers of nurses		
	Indicate number of primary counsellors		
3	How many days per week do you offer ANC services		
	How many women do you see in ANC per month on average?		
	On average how many new women do you book per month		
C	**ANC Services**		
	Do pregnant women pay for ANC services at this facility?	YES	NO
	If YES, how much on average do they pay		
	Do ANC women pay for any laboratory tests?	YES	NO
	If YES, list the lab test that they pay for and indicate amount		
D	**2016 National ARV Guidelines**		
3	Do you know about the 2016 National ARV Guidelines?	YES	NO
	How were the guidelines disseminated	1. As hard copies 2. Electronically 3. Other (specify)	
4	Do you have copies of the guidelines at this facility	1.Observed 2.Reported, but not seen 3. Not available	
5	When did you receive the copies of the guidelines (state month and year)		
6	How did you get the copies of the guidelines?	1. Distributed through Natpharm with medicines 2. From the district team 3. From the provincial team 4. From the National team 5. During trainings 6. Others	
5	Have you been oriented or sensitized on the new guidelines?	YES	NO

	If Yes, how many among you have been sensitized on the new guidelines		
	How were the guidelines introduced to you at facility-level?		
	How long was the orientation/sensitization session - state number of hours or days		
	Who conducted the training		
	Was the training only on the guidelines or it was part of a comprehensive training package		
	Please tell me, since then have you (1) had any further other training on the guidelines (2) any type of mentorship or (3) supportive supervision		
	Are the guidelines easy to understand?	1. Very easy 2. Easy 3. Difficult 4. Very difficult	
	Do you know the new guidance on HIV Viral Load testing in pregnant women	YES	NO
	If YES, can you explain them to us 1) HIV Viral Load should be done on all HIV-positive pregnant women who are on ART at first ANC visit and repeated 6 monthly thereafter and throughout the breastfeeding period. 2) For pregnant women not yet on ART or those newly diagnosed to be HIV-positive on the first ANC booking, these should be initiated on ART on the same day of first ANC booking and should get an HIV VL after 3 months of starting ART and six monthly thereafter	1. Correct	2. Incorrect
	What is the cut-off point that indicate viral suppression in an HIV positive woman (answer <1,000 copies/ml?	1. Correct	2. Incorrect
	What is the recommended management of a woman with a HIV Viral Load of more than 1,000 copies/ml (>1,000)?	1. Correct	2. Incorrect
	Do you provide pregnant women with information on HIV Viral Load testing and monitoring	Yes	No
	If yes, how do you give the pregnant women with HIV infection information on HIV Viral Load testing and monitoring	1. Group health education talks 2. One on one consultation 3. Sharing IEC materials 4. Others (specify)	
E	**HIV Viral Load testing services**		

	Do you offer HIV Viral Load testing services at this facility?	YES	NO
	If yes, when did you start offering HIV Viral Load testing services (state month and year)		
	When did you start offering HIV Viral Load testing services for pregnant women living with HIV		
	Do pregnant women living with HIV pay for HIV Viral Load testing	YES	NO
	If yes, how much do they pay		
	Do you have a laboratory onsite that offers HIV Viral Load testing?		
	If No, where do you send your specimens to		
	How do you get your specimens to the laboratory?		
	How many times a week do you draw blood for HIV Viral Load testing at this facility for pregnant women	1. Once a week 2. Twice a week 3. Three times 4. Daily 5. Others (specify)	
	Which HIV Viral Load sample do you use?	1. Dry Blood Spots (DBS) 2. Plasma 3. Both 4. Other	
	Do you have HIV Viral Load request forms at this facility	Yes	No
	Have you experienced any stock outs of HIV Viral Load request forms in the past 6 months	Yes	No
	If yes, how then were you sending specimens to the laboratory (please explain		
	How easy is it to complete a HIV Viral Load request form	1. Very easy 2. Easy 3. Not easy	

	Do you have any challenges filling in the HIV Viral Load request form?	Yes	No
	If yes, kindly explain the challenges you face in completing the form		
	Do you have any suggestions on how the form can be improved?		
	How do you receive your results for HIV Viral Load (tick the appropriate)	1. Get paper result back 2. By SMS 3. Phone 4. Other (specify)	
	On average what is the turnaround time (TAT) for you to get the HIV Viral Load results	1. 1 -2 week 2. 2 - 4 weeks 3. 4 – 8 weeks 4. 8 - 12 weeks 5. > 12 weeks	
	Do you experience rejection of samples by the laboratory?	YES	NO
F	HIV Viral Load Results Feedback		
	After receiving the results when do you give them to the pregnant woman living with HIV	1. Immediately call the woman to come to facility 2. Wait for the woman to return for next visit 3. Other (specify)	
	On average how long do you take to provide the information on the results to the pregnant woman living with HIV (in minutes)		
	Please give us in detail of what information you cover when you deliver the HVL results to the pregnant woman living with HIV (probe)		
	Where do you provide the HVL test results Also comment if space mentioned provides privacy		
	Do you analyze your data on HIV Viral Load testing in pregnant woman living with HIV	YES	NO
	If no, what are the reasons for not analyzing it		

	What have you used the analyzed data for pregnant women living with HIV
	What challenges have you faced in the provision of HIV Viral Load testing for pregnant women living with HIV infection(health facility related, patient related etc. write response below)
	Do you have any suggestions on how HIV Viral Load testing services can be improved for pregnant women living with HIV?
	Do you have any questions you may want to ask us based on our discussion on HIV Viral Load testing services at this facility?
	We are done with the discussion. Thank you very much for your time END

Appendix 3: Tool for laboratory personnel at facility, district, and provincial level

START THE INTERVIEW WITH THE FOLLOWING:
Hello! My name is _____. I am here on behalf of the Ministry of Health and Child Care (MOHCC) to seek information that will make us better understand the programmatic and operational issues in the provision of HIV Viral Load testing services among pregnant women in Mutare district. We will be asking you questions about various issues pertaining to provision of HIV Viral Load testing and the information we are going to get from your facility may be used by the MOHCC for planning service improvement. I am/We are asking for your help to ensure that the information we collect is accurate. If there is a question that you are not comfortable answering or someone else is the most appropriate person to provide the information, we would appreciate you introducing us to that person. All our discussions will be held confidentially and the information you provide will not be identified with you so feel free to share with us as much as is possible
Thank you

A: Background information
Name of Respondent (optional): …… ……

Designation: ……Phone number ……Email:
Name of facility: ……
District: ……
Province: ……..……..
Others (Specify): ……

Facility Type:
01 Primary Health Care facility (rural/Urban)…….....1
02 Rural Hospital…….2
03 District/Mission Hospital; 3
04 Provincial Hospital……. 4
05 Others (Specify): ……5

Managing Authority
Government ……1
Local Authority……..…..2
Private ……..…..…….3
Faith Based (Mission) ……..…….4
Other (Specify)…….…….……..…..5

B. Human Resource Capacity in Laboratory for HIV Viral Load testing services			
1	Do you offer HIV Viral Load testing services at this facility?	YES	NO
	If yes when did you start offering the services (month and year)		
	How many platforms do you have (e.g. Abbot, Roche etc.)		
	List the platforms		
	How many laboratory personnel do you have in total?		
	a) Laboratory scientists		
	b) Laboratory technicians		
	c) Data entry clerks		
	d) General hands		
	e) Other (specify)		
	Of the laboratory staff, are there any who are dedicated to conducting HIV Viral Load testing	YES	NO
	If yes, how many scientists and technicians conduct HIV Viral Load testing	Lab scientists	Lab techs
	How many facilities in the province are submitting HIV Viral Load samples to your laboratory?		
	How many facilities in Mutare district are submitting HIV Viral Load samples to your laboratory		
	On average how many HIV Viral Load samples do you receive per month		
	Of the HIV Viral Load samples, you receive, what proportion is from pregnant women with HIV infection		
B	**HIV Viral Load testing services**		
	What is the maximum testing capacity of your machines per day?		
	On average how many samples do you process per day		
	How many hours a day does each machine operate		
	Which HIV Viral Load sample do you process?	1. Dry Blood Spots 2. (DBS) 3. Plasma 4. Both	

		5. Other	
	On average what is the turnaround time (TAT) to process HIV Viral Load results in the lab i.e. from time of receipt of specimen to release of results	1. 1 -2 week 2. 2 - 4 weeks 3. 4 – 8 weeks 4. 8 - 12 weeks 5. > 12 weeks	
	Does your laboratory have tracking system for specimens received in the laboratory	Yes	No
	If yes, describe the specimen tracking system for this lab		
	How do you send results for HIV Viral Load back to facilities (tick the appropriate)	1. paper result 2. by SMS 3. phone 4. other (specify)	
	Do you experience rejection of HIV Viral Load samples in the laboratory?	YES	NO
	On average what proportion of HIV Viral Load specimens are rejected per month		
	What are some of the reasons for the rejections?		
	If there are rejections, how is this information communicated to health facilities	1. written communication 2. by SMS 3. phone 4. other (specify)	
	After how long from sample rejection do you send the information to the facilities	1. Within a week 2. Within a month	
	How is your data stored	1. Paper based 2. Electronic	
	If electronic which system do you use		
	Do you analyze your data on HIV Viral Load testing in this laboratory?	YES	NO
	If yes, what proportion of the samples are from pregnant women with HIV infection		
	If yes, kindly show us the analysis you have done before		
	What have you used the analyzed data for		

	If no, what are the reasons for not analyzing the data	
	For the open challenges in VL testing question it has been rephrased to: What challenges have you faced in the provision of HIV Viral Load testing services in the province (describe in house challenges such as human resources, reagent and consumable supplies, machine breakdowns and those from facilities that submit specimens e.g. transport, quality of specimens) and any other challenges you may want to share.	
	How do you think HIV Viral Load testing services can be improved in the district and province?	
	Do you have any questions you may want to ask us based on our discussion on HIV Viral Load testing services at this facility?	
	We are done with the discussion. Thank you very much for your time END	

Appendix 4: Tool for pregnant women living with HIV at ANC and family health units

START THE INTERVIEW WITH THE FOLLOWING: Hello! My name is _____. I am here on behalf of the Ministry of Health and Child Care (MOHCC) to seek information that will make us better understand the services that you receive at this facility. I am/We are asking for your help to ensure that the information we collect is accurate. If there is a question that you are not comfortable answering, please indicate to us. All our discussions will be held confidentially and the information you provide will not be identified with you so feel free to share with us as much as is possible. I will go over the consent form and if you are agreeable then you sign the form and we start the interview. Thank you		
A: Background information		
1	Name of Respondent (optional or use initials)	
2	Name of facility	
3	District:	
4	Province	
5	Facility Type	
	1 Primary Health Care facility (rural/Urban) 2 Rural Hospital 3 District/Mission Hospital 4 Provincial Hospital 5 Others (specify)	
6	Managing Authority	
	1 Government 2 Local Authority 3 Faith Based (Mission) 4 Private 5 Other (specify)	

Demographic Information	
7	Date of birth (dd/mm/yy) or ask for age
8	**Level of education**
	1. None 2. Any Primary 3. Any Secondary 4. Tertiary plus 5. Do not know
9	**Employment status**
	1. Unemployed 2. Self-employed Formally employed
10	**Marital status**
	1. Single 2. Married 3. Divorced/Separated 4. Widowed 5. Cohabiting
11	**Religion**
	1. Roman Catholic 2. Protestant 3. Pentecostal 4. Apostolic Sect 5. Traditional 6. None 7. Other (specify)
Access to health services	
12	**How far is the clinic from your home (km)**
	1. 0 -5 km 2. 2. 6 -10 km 3. 11 - 15 km 4. 16 -20 5. >20
13	**How long does it take you to get to the clinic or hospital nearest to your home**

	1. 30 minutes or less 2. 2. 30 mins – 1 hour 3. 1-2 hours 4. >2 hours
14	**How do you get to the clinic/hospital**
	1. Walking 2. By minibus 3. By bus 4. By car 5. By scotch cart
15	**How much does it cost to and from the clinic/hospital**
	1. $ < 1 2. $ 2 3. $ 3 4. $ 4 5. $ 5 6. > $5
16	On average, how long do you wait before accessing ANC services at this facility or How much time did you have to wait to be seen at the facility? 1. <1 hour 2. 1 -2 hours 3. 2- 4 hours 4. > 4 hours
ANC data	
17	Gravidity (number of pregnancies you have had) 1. 1-2 2. 3-4 3. > 4
18	Gestational age at booking 1. <16 weeks 2. 2. 16-28 weeks 3. 3. 29- 36 weeks 4. 4. > 36 weeks

19	Gestational age at booking 1. <16 weeks 2. 16-28 weeks 3. 29- 36 weeks 4. > 36 weeks
20	Did you pay anything to book for ANC services? 1. Yes 2. No
21	If yes, how much did you pay 1. $ 0 (free) 2. $ 1-10 3. $ 11 -20 4. $ 21 -30 5. $ > 30
Access to testing services	
22	Did you have any blood tests done when you booked? 1. Yes 2. No
23	Have you had an HIV test done? 1. Yes 2. No
24	Did you pay for the HIV test? 1. Yes 2. No
25	Are you aware of your results? 1. Yes 2. No
26	If yes, are you on ARVs 1. Yes 2. No
27	If yes, where you on ARVs before this pregnancy 1. Yes 2. No
28	If yes, how long have you been on ART (state in months or years)
29	What ARV regimen are you on (check on patient's card and record regimen
30	Have you disclosed your HIV status? 1. Yes 2. No

31	If yes, to whom have you disclosed to 1. Spouse/partner 2. Sister 3. Mother in law 4. Friend 5. Other (specify)	
32	Besides an HIV test, which other blood tests were done that you were told by the nurse (tick as the client responses and probe the type of tests. Interviewer to also verify with client file)	1. Haemoglobin (level of your blood) 2. RPR/THPA (syphilis) 3. HIV Viral Load 4. Other (specify)
33	Do you pay for any of these blood tests? 1. Yes 2. No	
34	If yes how much do you pay on average per test?	
Knowledge of HIV Viral Load testing and monitoring services		
35	Have you heard about a HIV Viral Load test? 1. Yes 2. No	
36	If yes, where did you hear about the need to have a HIV Viral Load test	1. During consultation with a nurse 2. During group health education talks before receiving ANC services 3. From the village health worker 4. From a friend 5. Other (specify)
37	Please tell me what the nurse explained to you about the blood tests. (if the woman does not talk about viral load testing probe further and ask if she had blood taken for viral load test done)	

38	If information on HIV viral load testing was given during consultation, was it easy for you to understand what the viral load test is about and why it was being done	
39	Were you given a chance to ask questions if anything was not clear to you?	
40	If it was a group health education session how long was the session	
41	Were you given a chance to ask questions for clarification on Viral load testing during the group session	
42	If yes, can you please share with me what you would tell another pregnant woman about HIV Viral Load testing	
43	Have you had a HIV Viral Load test yourself? 1. Yes 2. No	
44	After how long did you get your results	1. After 1 month 2. 1 – 2 months 3. 2 – 3 months 4. > 3 months
45	How did you get your results	1. The nurse called me to come to the clinic when results were out 2. SMS or text message 3. During my next ANC visit 4. Other (specify)

47	Were the HIV Viral Load results explained to you 1. Yes 2. No	
48	What do you know or understand about your viral load test result? Please tell me what it means to have a low HIV Viral Load result (<1000 copies/ml), please explain? Probe more to get to know if woman understands such a result	
49		Please tell me what it means to have a high HIV Viral Load result (>1000 copies/ml), please explain? Probe more to get to know if woman understands such a result
50		What will change in your health care if you have a high HIV Viral Load result (>1000 copies/ml)
51	Can you explain how often you are you supposed to have a HIV Viral Load test done during pregnancy till time of delivery	a. woman to explain if she is already on ART before pregnancy b. Woman to explain if newly started on ARVs during this pregnancy
52	How many times have you had a HIV Viral Load test done to date	1. Once 2. Twice 3. 3 or more

Barriers to access to HIV Viral Load testing and monitoring

Facilitating factors

What are some of the things that make it easy for you to have HIV Viral Load testing done at this clinic

	Satisfaction with services				
53	Are you satisfied with the ANC services at this facility				
	Very unsatisfied	Not satisfied	Neutral	Satisfied	Very satisfied
					

55	Please describe the way health workers interact with you at this clinic/facility Probe: were you greeted, was what was happening explained to you, were you given an opportunity to ask questions? How long did you have to wait? Were there enough staff/nurses to see to the number of patients and spend time answering your questions				
56	Were you satisfied with the care and information, and service that you received?				
	Very unsatisfied	Not satisfied	Neutral	Satisfied	Very satisfied
					
57	Was there anything about the service or information that you were given that bothered you? (let the woman explain)				
58	If something bothered you, what could have been better for you, and why?				
58	Would you refer another pregnant woman to this facility? 1. Yes 2. No 3. Do not know				
59	If yes, why?				
60	If no, why?				
	Thank you very much for your time, we have come to the end of the interview				

Appendix 5: MRCZ Ethic Approval (2019 and 2020 copies)

.Telephone: 791193/08644073772
Telefax: (263) - 242 - 790715
E-mail: mrcz@mrcz.org.zw
Website: http://www.mrcz.org.zw

Medical Research Council of Zimbabwe
Josiah Tongogara / Mazowe Street
P. O. Box CY 573
Causeway
Harare

CONTINUING APPROVAL

MRCZ/B/1732 **01 September, 2020**

Dr Christine Chakanyuka Masanhu
World Health Organisation
P O Box HG 430
Highlands
Harare

RE: - To determine the accessibility, availabity and uptake of viral load testing among pregnant women at entry into the prevention of mother to child transmission of HIV services in Mutare district of Manicaland Province, Zimbabwe

Thank you for the application for review of Research Activity that you submitted to the Medical Research Council of Zimbabwe (MRCZ). Please be advised that the Medical Research Council of Zimbabwe has **reviewed** and **approved** your application to conduct the above titled study.

This approval is based on the review and approval of the following documents that were submitted to MRCZ for review: -

1. Completed MRCZ annual renewal form 102
2. Study protocol

- **APPROVAL NUMBER : MRCZ/B/1732**

This number should be used on all correspondence, consent forms and documents as appropriate.

- **TYPE OF MEETING : EXPEDITED**
- **APPROVAL DATE : 11 June, 2020**
- **EXPIRATION DATE : 10 June, 2021**

After this date, this project may only continue upon renewal. For purposes of renewal, a progress report on a standard form obtainable from the MRCZ offices should be submitted three months before the expiration date for continuing review.

•**SERIOUS ADVERSE EVENT REPORTING**: All serious problems having to do with subject safety must be reported to the Institutional Ethical Review Committee (IERC) as well as the MRCZ within 3 working days using standard forms obtainable from the MRCZ Offices or website.

•**MODIFICATIONS**: Prior MRCZ and IERC approval using standard forms obtainable from the MRCZ Offices is required before implementing any changes in the Protocol (including changes in the consent documents).

•**TERMINATION OF STUDY**: On termination of a study, a report has to be submitted to the MRCZ using standard forms obtainable from the MRCZ Offices or website.

•**QUESTIONS**: Please contact the MRCZ on Telephone No. (0242)791193, 08644073772 or by e-mail on mrcz@mrcz.org.zw

Other

- Please be reminded to send in copies of your research results for our records as well as for Health Research Database.
- You're also encouraged to submit electronic copies of your publications in peer-reviewed journals that may emanate from this study.
- In addition to this approval, all clinical trials involving drugs, devices and biologics (including other studies focusing on registered drugs) require approval of Medicines Control Authority of Zimbabwe (MCAZ) before commencement

Yours Faithfully

Signature Removed

.....

MRCZ SECRETARIAT
FOR CHAIRPERSON
MEDICAL RESEARCH COUNCIL OF ZIMBABWE

MEDICAL RESEARCH COUNCIL OF ZIMBABWE
2020 -06- 11
APPROVED
P.O. BOX CY 573 CAUSEWAY, HARARE

PROMOTING THE ETHICAL CONDUCT OF HEALTH RESEARCH

Telephone: 791792/791193
Telefax: (263) - 4 - 790715
E-mail: mrcz@mrcz.org.zw
Website: http://www.mrcz.org.zw

Medical Research Council of Zimbabwe
Josiah Tongogara / Mazoe Street
P. O. Box CY 573
Causeway
Harare

APPROVAL

REF: MRCZ/B/1732 **11 June 2019**

Dr Christine Chakanyuka Masanhu
World Health Organisation
P O Box HG 430
Highlands
Harare

RE: To determine the accessibility, availability and uptake of viral load testing amongst pregnant women at entry into the prevention of mother to child transmission of HIV services in Mutare district of Manicaland Province, Zimbawe.

Thank you for the application for review of Research Activity that you submitted to the Medical Research Council of Zimbabwe (MRCZ). Please be advised that the Medical Research Council of Zimbabwe has **reviewed** and **approved** your application to conduct the above titled study.

This approval is based on the review and approval of the following documents that were submitted to MRCZ for review:-

1. Completed MRCZ 101 form
2. Full protocol

- **APPROVAL NUMBER : MRCZ/B/1732**

This number should be used on all correspondence, consent forms and documents as appropriate.

- **TYPE OF MEETING : EXPEDITED**
- **APPROVAL DATE : 11 June 2019**
- **EXPIRATION DATE : 10 June 2020**

After this date, this project may only continue upon renewal. For purposes of renewal, a progress report on a standard form obtainable from the MRCZ Offices should be submitted three months before the expiration date for continuing review.

- **SERIOUS ADVERSE EVENT REPORTING**: All serious problems having to do with subject safety must be reported to the Institutional Ethical Review Committee (IERC) as well as the MRCZ within 3 working days using standard forms obtainable from the MRCZ Offices or website.
- **MODIFICATIONS**: Prior MRCZ and IERC approval using standard forms obtainable from the MRCZ Offices is required before implementing any changes in the Protocol (including changes in the consent documents).
- **TERMINATION OF STUDY**: On termination of a study, a report has to be submitted to the MRCZ using standard forms obtainable from the MRCZ Offices or website.
- **QUESTIONS**: Please contact the MRCZ on Telephone No. (0242) 791792, 791193 or by e-mail on mrcz@mrcz.org.zw

Other

- Please be reminded to send in copies of your research results for our records as well as for Health Research Database.
- You're also encouraged to submit electronic copies of your publications in peer-reviewed journals that may emanate from this study.
- In addition to this approval, all clinical trials involving drugs, devices and biologics (including other studies focusing on registered drugs) require approval of Medicines Control Authority of Zimbabwe (MCAZ) before commencement.

Yours Faithfully

Signature Removed

MRCZ SECRETARIAT
FOR CHAIRPERSON
MEDICAL RESEARCH COUNCIL OF ZIMBABWE

MEDICAL RESEARCH COUNCIL OF ZIMBABWE
2019 -06- 1 1
APPROVED
P.O. BOX CY 573 CAUSEWAY, HARARE

PROMOTING THE ETHICAL CONDUCT OF HEALTH RESEARCH

Appendix 6: UCT Ethic Board Approval (2019 and 2020 copies)

UNIVERSITY OF CAPE TOWN

FACULTY OF HEALTH SCIENCES
Human Research Ethics Committee

HUMAN RESEARCH ETHICS COMMITTEE
19 AUG 2020
HEALTH SCIENCES FACULTY
UNIVERSITY OF CAPE TOWN

FHS016: Annual Progress Report / Renewal

HREC office use only (FWA00001637; IRB00001538)			
This serves as notification of annual approval, including any documentation described below.			
☑ Approved	Annual progress report	Approved until/next renewal date	30-05-21
☐ Not approved	See attached comments		
Signature Chairperson of the HREC/ Designee	Signatures Removed	Date Signed	2/12/20

Note: Please note that incomplete submissions will not be reviewed.
Please email this form and supporting documents (if applicable) in a combined pdf-file to hrec-enquiries@uct.ac.za.
Please clarify your plan for research-related activities during COVID-19 lockdown

Comments to PI from
Thank you for the deviation document

Principal Investigator to complete the following:

1. Protocol information

Date (when submitting this form)	18 August 2020		
HREC REF Number	778/2018	Current Ethics Approval was granted until	30 May 2020
Protocol title	An exploratory study to determine the accessibility, availability and uptake of viral load testing amongst pregnant women at entry into the prevention of mother to child transmission of HIV services in Mutare district of Manicaland Province, Zimbabwe		
Protocol number (if applicable)			
Are there any sub-studies linked to this study?	☐ Yes ✓ No		
If yes, could you please provide the HREC Ref's for all sub-studies? Note: A separate FHS016 must be submitted for each sub-study			

(Note: Please complete the Closure form (FHS012) if the study is completed within the approval period)

UNIVERSITY OF CAPE TOWN
Faculty of Health Sciences
Human Research Ethics Committee

Room 553-46 Old Main Building
Groote Schuur Hospital
Observatory 7925
Telephone [021] 406 6492
Email: sumayyah.arieff@uct.ac.za
Website: www.health.uct.ac.za/fhs/research/humanethics/forms

30 April 2019

HREC REF: 778/2018

Prof S Eley
Paediatrics & Child Health
5th Floor, ICH Building, Room 520
Red Cross War Memorial Children's Hospital
Rondebosch

Dear Prof Eley

PROJECT TITLE: AN EXPLORATORY STUDY TO DETERMINE THE ACCESSIBILITY, AVAILABILITY AND UPTAKE OF VIRAL LOAD TESTING AMONGST PREGNANT WOMEN AT ENTRY INTO THE PREVENTION OF MOTHER TO CHILD TRANSMISSION OF HIV SERVICES IN MUTARE DISTRICT OF MANICALAND PROVINCE, ZIMBABWE (MPHIL CANDIDATE-DR C Musanhu)

Thank you for your response letter dated 20 April 2019, addressing the issues raised by the Human Research Ethics Committee.

It is a pleasure to inform you that the HREC has **formally approved** the above-mentioned study.

Approval is granted for one year until the 30 May 2020.

Please submit a progress form, using the standardised Annual Report Form if the study continues beyond the approval period. Please submit a Standard Closure form if the study is completed within the approval period.
(Forms can be found on our website: www.health.uct.ac.za/fhs/research/humanethics/forms)

We acknowledge that the student: Dr C Musanhu will also be involved in this study.

Please quote the HREC REF in all your correspondence.

Please note that the ongoing ethical conduct of the study remains the responsibility of the principal investigator.

Please note that for all studies approved by the HREC, the principal investigator **must** obtain appropriate institutional approval, where necessary, before the research may occur.

Yours sincerely

Signature Removed

PROFESSOR M BLOCKMAN
CHAIRPERSON, FHS HUMAN RESEARCH ETHICS COMMITTEE

Appendix 7*: Provincial Medical Director Approval*

Telephone: 60624/60655
Fax: 60698/64401

ZIMBABWE

Reference:

PROVINCIAL MEDICAL DIRECTOR
MANICALAND
P.O. Box 323
Mutare

04 October 2018

The District Medical Officer
Mutare District

Dear Dr Maravanyika

Re: Permission to carry out a study "To determine the accessibility, availability and uptake of viral load testing amongst pregnant women at entry into the prevention of mother to child transmission of HIV services in Mutare district of Manicaland Province, Zimbabwe by Christine Chakanyuka Musanhu

The above subject refers;

This is to confirm that Christine Chakanyuka Musanhu Student ID: (MSNCHR009) has been granted permission to carry out research in Mutare District; Manicaland Province. The title of the study is "To determine the accessibility, availability and uptake of viral load testing amongst pregnant women at entry into the prevention of mother to child transmission of HIV services in Mutare district of Manicaland Province, Zimbabwe".

Kindly assist her during the time she is conducting the research and ensure that the selected facilities are informed in advance of this study. The province is looking forward to receiving the results of this research as they will be needed for programmatic decision making.

Yours sincerely

PROVINCIAL MEDICAL DIRECTOR
MANICALAND
05 OCT 2018
P.O. BOX 323, MUTARE
ZIMBABWE TEL: 020-2060624

Dr P. T. Mafaune
PROVINCIAL MEDICAL DIRECTOR MANICALAND

Signature Removed

Telephone: 60624/60655
Fax: 60698/64401

ZIMBABWE

Reference:

PROVINCIAL MEDICAL DIRECTOR
MANICALAND
P.O. Box 323
Mutare

04/10/2018

The Medical Research Council of Zimbabwe
Harare

Dear Sir/Madam

Re: Permission to carry out a study "To determine the accessibility, availability and uptake of viral load testing amongst pregnant women at entry into the prevention of mother to child transmission of HIV services in Mutare district of Manicaland Province, Zimbabwe by Christine Chakanyuka Musanhu

The above subject refers;

This is to confirm that Christine Chakanyuka Musanhu Student ID: (MSNCHR009) has been granted permission to carry out research in Mutare District; Manicaland Province. The title of the study is "To determine the accessibility, availability and uptake of viral load testing amongst pregnant women at entry into the prevention of mother to child transmission of HIV services in Mutare district of Manicaland Province, Zimbabwe". The province is looking forward to receiving the results of this research as they will be needed for programmatic decision making.

Yours sincerely

PROVINCIAL MEDICAL DIRECTOR
MANICALAND
05 OCT 2018
P.O. BOX 323, MUTARE
ZIMBABWE TEL: 020-2060624

Dr P. T. Mafaune
PROVINCIAL MEDICAL DIRECTOR MANICALAND

Signature Removed

Telephone: 60624/60655
Fax: 60698/64401

ZIMBABWE

Reference:

PROVINCIAL MEDICAL DIRECTOR
MANICALAND
P.O. Box 323
Mutare

04/10/2018

The University of Cape Town
Department of Paediatrics and Child Health

Dear Sir/Madam

Re: Permission to carry out a study "To determine the accessibility, availability and uptake of viral load testing amongst pregnant women at entry into the prevention of mother to child transmission of HIV services in Mutare district of Manicaland Province, Zimbabwe by Christine Chakanyuka Musanhu

The above subject refers;

This is to confirm that Christine Chakanyuka Musanhu Student ID: (MSNCHR009) has been granted permission to carry out research in Mutare District; Manicaland Province. The title of the study is "To determine the accessibility, availability and uptake of viral load testing amongst pregnant women at entry into the prevention of mother to child transmission of HIV services in Mutare district of Manicaland Province, Zimbabwe". The province and the district are looking forward to receiving the results of this research as they will be needed for programmatic decision making.

Thank you

Yours sincerely

PROVINCIAL MEDICAL DIRECTOR
MANICALAND
05 OCT 2018
P.O. BOX 323, MUTARE
ZIMBABWE TEL: 020-20[illegible]624

Dr P. T. Mafaune
PROVINCIAL MEDICAL DIRECTOR MANICALAND

Appendix 8: Consent form for health workers for the in-depth interview

CONSENT FORM FOR HEALTH WORKERS

Title: To determine the accessibility, availability, and uptake of VL testing amongst pregnant women at entry into the prevention of mother to child transmission of HIV (PMTCT) services in Mutare district of Manicaland Province, Zimbabwe

INTRODUCTION

"Good morning/afternoon. My name is _____, we are conducting interviews with health workers to understand the experiences you have had with provision of viral load testing amongst pregnant women at entry into the prevention of mother to child transmission of HIV (PMTCT) services in Mutare district of Manicaland Province. Your participation is very important as it will contribute to the improvement of the provision of antenatal care services for pregnant women living with HIV in the country.

This interview will last about 30 minutes to an hour and I will be using a questionnaire to guide the process. I will be taking notes as we talk in order for me to remember questions that I want to ask you later. If you wish not to answer a question at any time, please say so and we will move on. If you wish to end the interview for any reason, please let me know and we will end immediately. If you need to use the bathroom at any time or rest for a few minutes, please let me know and we can take a short break."

Purpose of the study or Why is this study being conducted?
The Ministry of Health and Child Care adopted and adapted the 2016 WHO ARV guidelines, and these have now been introduced at facility level since January 2017. These ARV guidelines provide guidance on when viral load testing should be conducted in pregnancy women with HIV infection. It further goes on to give information on how to interpret viral load testing results and how to manage a patient once the results are available. The purpose of this study is therefore to determine the availability, accessibility, and uptake of HIV Viral Load testing among HIV positive pregnant at entry into PMTCT programme.

An application for ethical approval was submitted to the Medical Research Council of Zimbabwe and authority was granted. The Provincial Medical Director also gave approval for this study to be done in Mutare District and this is the letter from your PMD.

Before you agree to participate we are going to explain to you the objectives of the evaluation, the benefits to you, and the risks/discomforts as well as our expectations from you.
Please note that:

- Your participation in this study is entirely voluntary.
- Your decision to be or not to be a participant in the study does not in any way affect your work.
- If you wish to participate in this study, you must sign this consent form.

Procedures and duration
If you agree to be interviewed an interview guide will be used to guide the discussion. The interview will take approximately 30 minutes to an hour.

Risks and discomforts
We do not anticipate any risk to the security of your job because the results of the interview will not be linked to you. No specific results of the interview will be reported to your supervisor or in any document shared outside of the investigating team.

Benefits and / or compensation
There is no direct benefit to you when you chose to participate in this study. However, the information gained from this study will be important in improving PMTCT services in general, as the country moves towards the goal of eliminating mother to child transmission of HIV.

Will I be paid for my participation?
You will not be paid for your participation in this study.

Confidentiality
Your responses will be examined by the Principal investigator. The research ethics committee or regulatory authorities in Zimbabwe may check to ensure that this study is being done properly. You will be assigned a unique identification number so your name or personal information will not be identified with this study or used in any publication resulting from the research study. Study records that identify you will be kept confidential and will be secured in locked offices.

Your rights
Participation in this study is voluntary. If you decide not to participate in this study, your decision will not affect your future relations with the institution, its personnel and its associated institutions. If you decide to participate you are free to withdraw your consent and discontinue participation at any time without any penalty. If you agree to participate you are free not to answer any questions that make you uncomfortable. You may ask any questions about this study or this consent form now or in the future. If you have questions about this study, you may contact;

Dr Chakanyuka Musanhu, on telephone: 0712 722 585 or

Dr. Owen Mugurungi
Director HIV, TB, STI and Hepatitis Programme, Ministry of health and Child Care
AIDS and TB Unit, 2nd Floor, Mukwati Building, Box CY1122, Causeway, Harare
Phone: +263 4 792981
For questions about your rights as a research participant please contact:

The National Coordinator
Medical Research Council of Zimbabwe
National Institute of Health Research
Cnr Mazoe Street/ Josiah Tongogara Avenue
Harare
Telephone: +263 4 791792, 791193
Cell: +263 77 2 433 166

Authorization
You are making a decision whether or not to participate in this study. Your signature indicates that you have read and understood the information provided above, have had all your questions answered, and have decided to participate.

I have read and understood that terms of the consent form and agree to participate in this study.

_____ _____
Name of Participant Date:

_____ _____
Signature of Participant Date:

_____ _____
Signature of Person Obtaining Consent Date:

MRCZ Approval Date_____ Expiration Date_____
(To be completed by Investigators)

Appendix 9: Consent Form for pregnant women living with HIV

English Consent Form Version 1

Study Title: To determine the accessibility, availability and uptake of VL testing amongst pregnant women at entry into the prevention of mother to child transmission of HIV (PMTCT) services in Mutare district of Manicaland Province, Zimbabwe

Ministry of Health and Child Care Zimbabwe, Study Principal Investigator: Dr C Chakanyuka Musanhu

INTRODUCTION

"Good morning/afternoon. My name is Dr Christine Chakanyuka Musanhu, and I work with the Ministry of Health and Child Care here in Zimbabwe. I am conducting interviews with pregnant women with HIV infection to understand their experiences with antenatal care services at this facility. Your participation is very important as it will contribute to the improvement of the provision of antenatal care services for pregnant women living with HIV in the country"

This interview will last about 30 minutes to an hour and I will be using a questionnaire to guide the process. I will be taking notes as we talk in order for me to remember questions that I want to ask you later. If you wish not to answer a question at any time, please say so and we will move on. If you wish to end the interview for any reason, please let me know and we will end immediately. If you need to use the bathroom at any time or rest for a few minutes, please let me know and we can take a short break."

Before you make a decision to either take part or not, I will explain to you the purpose of the study, the benefits to you, and the risks/discomforts, as well as our expectations from you.

Purpose of Study - Why is this study being done?
The Zimbabwean government recently revised their guidelines for HIV management. These guidelines indicate that all pregnant women with HIV infection and breastfeeding women on antiretroviral therapy, should have an HIV Viral load test done at first antenatal visit. Furthermore, it goes on to say that for newly identified pregnant women living with HIV and those who initiate antiretroviral therapy on their current pregnancy, health workers should perform a viral load test after 3 months from date of starting antiretroviral therapy and then every six months thereafter throughout pregnancy and breastfeeding. The purpose of this study is to determine if this facility is offering you these services.

Please note that:

- Your taking part in this study is entirely voluntary.
- Your decision to take part or not to take part in the study does not in any way affect the way you are going to be treated or cared for at this health facility.
- If you wish to take part in this study, you will be asked to sign this form.
- If you decide to take part, you are free to choose to stop at any time and this will not affect your treatment.
- If you decide to withdraw from this study, you should notify the study focal person, Dr. Chakanyuka Musanhu, Phone: **0712 722 585** and the nurse in charge at this clinic

Procedures
If you agree to take part in this study, I will ask you to sign two copies of this consent form, one signed copy will be kept in a lockable cabinet at the clinic and you will be given a second copy to keep. If you are not able to read or write, this form will be read to you and explained in the language that you are most comfortable with. I will use a simple questionnaire to collect basic information, such as your age, gender, your knowledge on what antenatal clinic services you are to receive at this clinic, what tests you are to have, a list of the medicines you are currently taking among others. As for the results of your routine laboratory test for the purposes of this study, with your authority we will obtain them from your medical record. Your taking part in the study is limited to this visit.

What are the risks of taking part in the study? There are no major risks to taking part in this study. However, if you experience any distress or we observe any distress on our part, we will be able to offer you help at this clinic and if need be seek further assistance from the other levels for you.

What are the benefits of taking part in the study?
There is no material benefit to you for taking part in this study. However, the information gained from this study may lead to increased knowledge about the ability of Manicaland Province to provide services as per the national guidelines and also improve service delivery in your district
Will I be paid for taking part? You will not be paid for taking part in this study.

What about confidentiality?
Your records may be examined by study staff, the ethics committee or regulatory authorities in Zimbabwe who may check to ensure that this study is done properly. You will be assigned a unique identification number, so your name or personal information will not be identified with this study or used in any publication resulting from the study. We will link your unique identification number to your medical data and study records that identify you will be kept confidential and will be secured in locked cabinets in offices.

Your rights

Taking part in this study is voluntary. If you decide not to take part in this study, your decision will not affect health care. If you decide to take part, you are free to withdraw your consent and stop taking part at any time without any penalty. If you have questions, relating to your rights as a person taking part in this study you can phone the Medical Research Council of Zimbabwe (04-791792 or 04-791193 or 04-792747) or Research Council of Zimbabwe (04-379407/8), who are responsible for protecting persons taking part in studies. You can also write to the Chairperson, MRCZ, P.O. Box CY 573 Causeway, Harare.

Protecting your Privacy

Health records are confidential according to the laws of Zimbabwe. Your HIV status and your medical information will not be revealed to anyone without your consent. Your name will not be used in any reports that come from this study. The study will only report grouped results without revealing names of those taking part.

I have read and understood the terms of the consent form and agree to take part in this study. I have had the chance to ask questions and they have been answered to my satisfaction. I have been offered a copy of this form.

_____ _____

Signature of Participant Date:

Person obtaining Consent

I attest that the requirements for the informed consent for the medical survey described in this form have been satisfied, that I have discussed the study with the participant and explained to her in non-technical terms all of the information contained in this informed consent form, including any risks and adverse reactions that may occur. I further certify that I encouraged the participant to ask questions and that all questions asked were answered satisfactorily.

_____ _____

Signature of Person Obtaining Consent Date

_____ _____

Signature of Witness

(I have witnessed the entire consent process and the subject agrees to be in the study) Date

MRCZ Approval Date_____ Expiration Date_____

(To be completed by Investigators)