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MASTER OF SCIENCE IN EPIDEMIOLOGY & BIOSTATISTICS

Impact of HIV and Antiretroviral Therapy (ART) on Cervical Cancer Risk among Women at Maina Soko Medical Centre, Zambia

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DECLARATION

I, Mando Mwewa, hereby declare that this dissertation, entitled **"Analysis of Cervical Cancer Screening Outcomes and HIV Status among Women at Maina Soko Medical Centre, Zambia,"** is my own original work. It has not been submitted, in whole or in part, for any other degree or diploma at this or any other university. All sources of information and material used in this research have been appropriately acknowledged and referenced.

This work has been conducted under the guidance of my supervisor, Professor Eustarckio Kazonga, and has received his final approval for submission.

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LIST OF ABBREVIATIONS AND ACRONYMS

Abbreviation/Acronym	Definition
ABX	Antibiotic Treatment (clinical notation in dataset)
aOR	Adjusted Odds Ratio
ART	Antiretroviral Therapy
CI	Confidence Interval
CIN	Cervical Intraepithelial Neoplasia
COAG	Coagulation (ablation procedure for cervical lesions)
FSU	Family Support Unit (HIV care unit at MSMC)
HIV	Human Immunodeficiency Virus
HPV	Human Papillomavirus
HSIL	High-grade Squamous Intraepithelial Lesion
ICC	Investigation for Cervical Cancer
IQR	Interquartile Range
LEEP	Loop Electrosurgical Excision Procedure
LSIL	Low-grade Squamous Intraepithelial Lesion

Abbreviation/Acronym	Definition
MoH	Ministry of Health (Zambia)
MSMC	Maina Soko Medical Centre
N	Number (sample size)
NHRA	National Health Research Authority (Zambia)
OR	Odds Ratio
SD	Standard Deviation
SPSS	Statistical Package for the Social Sciences
STATA	Statistical Software for Data Science
TND	Target Not Detected (viral load result)
UNILUS	University of Lusaka
VIA	Visual Inspection with Acetic Acid
WHO	World Health Organization

DEFINITION OF KEY TERMS

Cervical Abnormality	In this study, refers to any positive finding on Visual Inspection with Acetic Acid (VIA) screening, indicating possible pre-cancerous or cancerous changes of the cervix.
Cross-sectional Study	An observational study design that analyses data from a population at a specific point in time, used here to describe screening outcomes and associations.
HIV-Positive	An individual with a confirmed diagnosis of Human Immunodeficiency Virus infection.
Logistic Regression	A statistical modelling technique used to predict a binary outcome (e.g., VIA positive vs. negative) based on one or more predictor variables.
Screen-and-Treat	A cervical cancer prevention strategy where a positive screening test is followed immediately or soon after by treatment of pre-cancerous lesions.
Syndemic	The synergistic interaction of two or more co-existing health conditions (e.g., HIV and cervical cancer) within a population that exacerbates the burden of disease.
VIA Positivity	The outcome where acetic acid application during visual inspection turns cervical tissue white, suggesting the possible presence of pre-cancerous cells.
Visual Inspection with Acetic Acid (VIA)	A cervical cancer screening method where dilute acetic acid (vinegar) is applied to the cervix and inspected visually for aceto-white lesions.

ABSTRACT

Background: Cervical cancer remains a leading cause of cancer mortality among women in Zambia, with high HIV prevalence creating a syndemic that elevates risk. Global strategies advocate integrating screening into HIV care, with antiretroviral therapy (ART) hypothesized to modify cervical cancer risk through immune reconstitution. This study evaluated an integrated screening service at a tertiary hospital and assessed the role of ART on cervical cancer risk among women living with HIV.

Methods: A retrospective cross-sectional analysis was conducted using routine service records from Maina Soko Medical Centre, Lusaka. The cohort included 270 women screened with Visual Inspection with Acetic Acid (VIA) between October 2024 and November 2025. Data on demographics, HIV status, ART documentation, VIA results, and clinical management were extracted. Descriptive statistics and multivariable logistic regression identified factors associated with screen-positive results and assessed the relationship between ART and cervical abnormalities.

Results: Mean age was 45.1 years (SD = 12.4); 46.3% (n = 125) were HIV-positive. Overall VIA positivity was 5.6% (n = 15). Positivity was higher among HIV-positive women (7.2% vs. 4.1%), but not statistically significant after adjustment (aOR = 1.72, 95% CI: 0.60–4.96). Only 40.0% of VIA-positive women received immediate definitive treatment. Service delivery was episodic, with 44.4% of screenings in a two-month period. ART history was missing for 68.0% of HIV-positive women, constraining analysis of ART duration and cervical outcomes.

Conclusion: Integrated screening reaches high-risk populations, but impact is undermined by treatment cascade gaps, inconsistent service delivery, and incomplete ART documentation. Findings suggest ART attenuates but does not eliminate cervical cancer risk among HIV-positive women. Urgent action is needed to transition from campaign-based to routine screening and close the treatment linkage gap.

Keywords: *Cervical Cancer, Screening, Visual Inspection with Acetic Acid (VIA), HIV, Antiretroviral Therapy (ART), Health Services Integration, Zambia*

CHAPTER 1: INTRODUCTION

1.1 Background to the Study

Cervical cancer constitutes a persistent and formidable public health challenge, particularly in resource-limited settings. Globally, it is the fourth most common cancer among women, with an estimated 604,000 new cases and 342,000 deaths annually (Sung et al., 2021). The burden is catastrophically skewed towards low- and middle-income countries, where over 90% of both new cases and deaths occur, primarily due to limited access to preventive services, including vaccination, screening, and treatment (WHO, 2023). Sub-Saharan Africa bears the heaviest burden, with cervical cancer representing the leading cause of female cancer-related mortality (GLOBOCAN, 2022).

Zambia epitomises this regional crisis. The country reports one of the highest incidence rates worldwide, estimated at 65.5 new cases per 100,000 women, alongside a high mortality rate that reflects profound gaps in secondary prevention (GLOBOCAN, 2022). This epidemiological reality is inextricably linked to Zambia's high prevalence of the Human Immunodeficiency Virus (HIV). The syndemic relationship between HIV and cervical cancer is well-documented; HIV-induced immunosuppression substantially elevates the risk of persistent infection with oncogenic strains of the Human Papillomavirus (HPV) the necessary cause of cervical cancer and accelerates the progression from pre-cancerous lesions to invasive carcinoma (Kelly et al., 2019; Palefsky, 2020). Consequently, women living with HIV face a six-fold higher risk of developing cervical cancer compared to their HIV-negative counterparts (De Vuyst et al., 2023).

Recognising this synergy, global and national health policies have increasingly advocated for the integration of cervical cancer prevention services into routine HIV care. The World Health Organization's global strategy to eliminate cervical cancer emphasises integrated service delivery as a cornerstone for reaching high-risk populations efficiently (WHO, 2020). In alignment, the Zambian Ministry of Health has promoted the integration of Visual Inspection with Acetic Acid (VIA)-based screening into Antiretroviral Therapy (ART) clinics to leverage existing healthcare infrastructure and patient touchpoints (Zambia MoH, 2022).

However, the translation of policy into effective, equitable, and sustained practice presents a formidable implementation science challenge. While integrated models are conceptually sound, their real-world effectiveness is contingent upon complex health system factors, including service accessibility, healthcare worker capacity, commodity supply chains, functional referral pathways, and robust data systems for tracking and follow-up (Mwaka et al., 2021). Understanding the operational performance of such integrated models within specific and complex healthcare contexts, such as tertiary referral hospitals, is therefore critical for optimising programmes and achieving public health impact.

1.2 Statement of the Problem

Cervical cancer remains a leading cause of cancer morbidity and mortality among women in Zambia, a burden exacerbated by the country's high prevalence of HIV. The biological synergy between HIV and HPV creates a compelling public health imperative for targeted prevention. While international and national policies advocate for integrating cervical cancer screening into HIV care to mitigate this elevated risk, the effectiveness of this policy relies on its successful translation into effective practice at the facility level.

Despite this enabling policy framework, a critical knowledge gap persists regarding the operational performance of integrated screening services in specific, under-studied healthcare contexts. The literature robustly documents the elevated risk of cervical cancer among women living with HIV (Kelly et al., 2019) and the potential for ART to modify this risk through immune reconstitution (Moodley et al., 2020). However, there is a scarcity of granular, facility-level evidence on how these dynamics translate into real-world screening outcomes and patient care pathways within specialised settings like tertiary military hospitals (Moyo et al., 2021). The performance of such services at Maina Soko Medical Centre (MSMC) a facility serving a unique population of military personnel, dependents, and referred civilians has never been systematically evaluated, leaving a critical blind spot in our understanding of service effectiveness within this specialized healthcare context.

The motivation to conduct this study, therefore, stems from a practical, on-the-ground concern: the absence of local, actionable data to guide clinical and programmatic decision-making at

MSMC. Without this evidence, healthcare providers and programme managers lack the operational intelligence needed to assess whether the integrated service is effectively reaching its target population, identify specific points of failure in the patient care pathway, and implement targeted improvements. This study is motivated by the urgent need to fill this evidence gap, transforming routine service data into a diagnostic tool for health system strengthening to ensure that the promise of integrated screening translates into tangible reductions in cervical cancer risk for the women under their care.

1.3 Justification of the Study

This study is justified by its potential to make significant contributions to the scientific understanding, policy formulation, and clinical practice of cervical cancer prevention in high-HIV prevalence settings.

First, the findings will contribute to the scientific body of knowledge by providing contemporary, real-world evidence on the prevalence of cervical abnormalities and their association with HIV and ART within a unique tertiary care context in Zambia. As the literature demonstrates that ART's protective effect is incomplete (Moodley et al., 2020), this research will generate crucial data on the current burden of cervical precancer among women on treatment, thereby informing epidemiological models and future research directions in the era of widespread ART.

Second, the study holds substantial policy relevance. By generating facility-specific evidence on the operational performance of an integrated screening programme, this study directly responds to the national mandate for improved cancer control, as outlined in the Zambia National Health Strategic Plan (Zambia MoH, 2022). The findings will provide policymakers and programme managers at the Ministry of Health with empirical insights into the real-world challenges of implementing integrated services. Evidence of gaps in the screening-to-treatment cascade or data quality issues, for instance, can inform targeted national guidelines, resource allocation, and quality improvement initiatives, moving beyond policy aspiration to measurable health impact.

Finally, this research is poised to influence clinical practice and patient management at MSMC and similar institutions. By identifying demographic and clinical factors associated with screen positivity and, critically, by mapping the current treatment cascade, the study will provide

clinicians with actionable intelligence. Understanding where patients are lost to follow-up can lead to the development of practical interventions, such as enhanced patient navigation or same-day treatment protocols, directly improving the completeness of care. Ultimately, this study is justified by its capacity to use rigorous research methods to provide practical, data-driven solutions for strengthening a life-saving service, thereby contributing directly to the goal of reducing cervical cancer mortality among Zambian women.

1.4 Study Objectives

1.4.1 General Objective

To determine the role of Antiretroviral Therapy (ART) on cervical cancer risks among women living with HIV/AIDS at Maina Soko Medical Centre, Lusaka, Zambia.

1.4.2 Specific Objectives

i. To determine the prevalence of VIA-detected cervical abnormalities among HIV-positive women at Maina Soko Medical Centre in Lusaka, Zambia.
ii. To determine the prevalence of ART use among cervical cancer clients with HIV at Maina Soko Medical Centre in Lusaka, Zambia.
iii. To assess the impact of ART on cervical cancer risk among HIV-positive women at Maina Soko Medical Centre in Lusaka, Zambia.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

A rigorous literature review serves as the intellectual scaffolding for this scientific inquiry. For this study, the review performs four critical functions: it establishes the epidemiological imperative for investigating cervical cancer among women living with HIV (WLHIV); it critically appraises the existing evidence on the relationship between antiretroviral therapy (ART) and cervical cancer risk; it examines the implementation of integrated screening services; and, ultimately, it crystallises the precise knowledge gap that this research is designed to address. This chapter is structured to move logically from the established global biomedical consensus on HIV and cervical cancer to the specific role of ART as a modifying factor, and finally to the complex realities of health service delivery in resource-constrained settings. A meticulous review is not merely an academic exercise but a necessary step to ensure the study is grounded in existing scholarship and contributes meaningfully to advancing both knowledge and practice (Denney & Tewksbury, 2021).

2.2 The Triad of Interest: HIV, ART, and Cervical Cancer

To provide clarity and focus, this review explicitly examines the three key variables central to this study: HIV status as an independent variable, antiretroviral therapy as an independent variable, and cervical cancer risk and progression as the dependent variable. Understanding the relationships between these variables is fundamental to situating this research within the existing body of knowledge.

HIV status as an independent variable operates through the mechanism of progressive immunosuppression characterised by the depletion of CD4+ T-lymphocytes. This immunodeficiency critically disrupts local cell-mediated immune surveillance in the cervical epithelium, impairing the body's ability to clear infection with high-risk human papillomavirus (Palefsky, 2020). Consequently, women living with HIV experience higher rates of persistent HPV infection, more rapid progression to cervical intraepithelial neoplasia, and increased risk of invasive cervical cancer compared to their HIV-negative counterparts. In Zambia, where adult

HIV prevalence is approximately sixteen percent and reaches twenty-one percent among women of reproductive age, this association carries profound public health implications (Trejo et al., 2020).

Antiretroviral therapy as an independent variable functions through suppression of HIV viral replication, allowing for immune reconstitution through recovery of CD4+ T-cell counts. Theoretically, this immune restoration should enhance HPV clearance and reduce the risk of cervical carcinogenesis. However, the relationship between ART and cervical cancer is complex and incompletely understood. As Swase et al. (2025) note in their comprehensive systematic review, ART adherence and duration were associated with improved outcomes, but not complete lesion resolution. This finding suggests that while ART confers significant benefit, it does not fully normalise cervical cancer risk, a critical nuance that informs the present study's objectives.

Cervical cancer risk and progression as the dependent variable develops through well-characterised stages, from HPV infection to low-grade squamous intraepithelial lesions, high-grade lesions, and ultimately invasive carcinoma. This study operationalises cervical cancer risk through detection of precancerous lesions via Visual Inspection with Acetic Acid, with VIA positivity serving as a marker for increased risk of progression to invasive disease. Understanding how both HIV status and ART exposure influence this trajectory is essential for designing effective prevention strategies in high-burden settings.

2.3 The Biological Synergy and Epidemiological Burden of HIV and Cervical Cancer

The relationship between HIV and cervical cancer is paradigmatic of a biosocial syndemic. At the biological level, HIV-associated immunodeficiency, characterised by the depletion of CD4+ T-lymphocytes, critically disrupts local cell-mediated immune surveillance in the cervical epithelium (Palefsky, 2020). This impairment facilitates the persistence of infection with oncogenic strains of the Human Papillomavirus, most notably types sixteen and eighteen, which are responsible for approximately seventy percent of cervical cancer cases globally (Walboomers et al., 1999). Persistent HPV infection leads to the integration of viral DNA into the host genome, driving the uncontrolled cellular proliferation that characterises cervical intraepithelial neoplasia and, ultimately, invasive carcinoma.

The epidemiological consequences of this biological mechanism are severe and well-quantified. Systematic reviews and meta-analyses provide robust evidence that women living with HIV have a significantly elevated risk of all stages of cervical carcinogenesis. Kelly et al. (2019), in a comprehensive meta-analysis, reported that women living with HIV had a six-fold increased risk of invasive cervical cancer compared to their HIV-negative counterparts. This elevated risk extends to pre-cancerous stages, with the same review finding that women living with HIV have a higher prevalence of high-risk HPV infection and a greater likelihood of high-grade cervical lesions.

In the Zambian context, this translates into a substantial clinical burden. Kapambwe et al. (2022) found that among women undergoing screening in Lusaka clinics, HIV-positive women had a four-fold higher risk of invasive cervical cancer compared to HIV-negative women, with the risk peaking around age thirty-five. Similarly, Trejo et al. (2020) reported that HIV-positive cervical cancer patients were, on average, ten years younger at diagnosis than their HIV-negative counterparts, with a median age of forty-two years compared to fifty-two years. This age disparity underscores the accelerated carcinogenesis associated with HIV-induced immunosuppression and highlights the need for targeted screening interventions for younger women living with HIV.

2.4 The Role of Antiretroviral Therapy in Modifying Cervical Cancer Risk

The advent of widespread antiretroviral therapy introduced a critical modifying variable into this epidemiological equation. ART-mediated immune reconstitution could, in part, reverse the risk associated with HIV infection. However, a growing body of literature suggests that the relationship between ART and cervical cancer is more nuanced than initially hypothesised.

2.4.1 Mechanisms of ART Effect

ART's primary mechanism of action, suppression of HIV viral replication and subsequent immune reconstitution, should theoretically enhance HPV clearance and promote regression of precancerous lesions. Longitudinal studies, such as that by Tembo et al. (2023) in Lusaka, demonstrated that immune recovery on ART, marked by rising CD4 counts, was associated with the regression of pre-cancerous cervical lesions. However, it is crucial to note that the protective

effect of ART is incomplete. Even with sustained virological suppression, the risk of cervical cancer in women living with HIV remains elevated above that of the general population, failing to normalise (Moodley et al., 2020).

2.4.2 Systematic Review Evidence on ART and Cervical Outcomes

The most comprehensive synthesis of evidence on this topic comes from Swase et al. (2025), whose systematic review of eighty studies examined the impact of ART on HPV persistence and cervical cancer progression among women with HPV and HIV co-infection. Their findings are instructive for the present study. Despite ART use, high-grade lesions including CIN two and three and high-grade squamous intraepithelial lesions remained prevalent, particularly among women with CD4 counts below three hundred and fifty cells per microlitre. This indicates that immune status at ART initiation and the degree of immune recovery are critical determinants of cervical outcomes. The review further found that ART adherence and duration were associated with improved outcomes, but not complete lesion resolution. This finding underscores the importance of capturing detailed ART history, including duration and adherence, in studies examining cervical cancer risk among women living with HIV. The authors concluded that ART contributes to immune restoration and may reduce HPV persistence, but does not fully prevent cervical disease progression, mostly in the advanced stage. This conclusion aligns with the broader literature and supports the rationale for integrating regular cervical cancer screening within HIV care, even among women on established ART.

2.4.3 Modelling Studies and Population-Level Impact

Broshkevitch et al. (2024) used dynamic modelling to project cervical cancer incidence under different intervention scenarios in KwaZulu-Natal, South Africa, a setting epidemiologically similar to Zambia. Their findings have direct relevance to this study. Under status quo conditions, the proportion of cervical cancer cases occurring among women living with HIV was projected to decline from seventy-three percent to fifty-eight percent between 2021 and 2071. However, the incidence rate ratio comparing women living with HIV to HIV-negative women was projected to increase from four point three to five point two with ART scale-up alone. This counterintuitive finding, that ART scale-up could increase the disparity, reflects the extended life expectancy conferred by ART. As women living with HIV live longer, they accumulate person-

years of exposure to HPV and cervical cancer risk, necessitating sustained screening throughout their longer lifespans. The modelling demonstrated that tailored cervical cancer interventions for women living with HIV, including enhanced screening, could counteract this phenomenon and reduce the incidence rate ratio to two point seven by 2071.

2.4.4 Zambian-Specific Evidence

Several Zambian studies have examined the HIV-cervical cancer nexus, providing important context for this research. Mwamba et al. (2021) conducted a retrospective case-case study of one thousand five hundred and eighty-three cervical cancer patients in Lusaka, linking cancer and HIV databases to examine the relationship between HIV infection duration and cancer stage. Among HIV-positive patients, longer duration of HIV infection was associated with twenty percent lower odds of initial metastatic cancer diagnosis. This finding suggests that women with longer-standing HIV infection, and presumably longer ART exposure, may benefit from earlier detection through engagement with the healthcare system.

Trejo et al. (2020) examined cervical cancer progression among five hundred and thirty-seven stage one and two cervical cancer patients in Lusaka. While HIV positivity itself did not lead to tumour progression, with twenty-five-point four percent in HIV-positive compared to twenty-three-point nine percent in HIV-negative patients, among a subset of HIV-positive patients, longer duration of infection was associated with lower odds of progression. This finding again points to the potential modifying role of ART and sustained healthcare engagement.

2.5 The Policy Imperative and Practical Realities of Integrated Service Delivery

In response to the unequivocal epidemiological evidence, integrated service delivery has emerged as a cornerstone of global and national cervical cancer control strategies. The World Health Organization's global strategy to eliminate cervical cancer explicitly recommends integrating HPV DNA testing or VIA-based screening into HIV care services, aiming to leverage existing healthcare infrastructure to reach this highest-risk population efficiently (WHO, 2020). This policy alignment is reflected in Zambia's National Health Strategic Plan and Cancer Control Guidelines, which advocate for the provision of cervical screening within ART clinics (Zambia Ministry of Health, 2022).

The theoretical advantages of integration are compelling, including reduced patient travel and time costs, decreased stigma through service normalisation, efficient use of human resources, and improved continuity of chronic care. Empirical studies from the region confirm that integration can successfully improve screening uptake. Programmatic evaluations in Malawi and Zambia have demonstrated the feasibility of co-locating services and achieving higher screening coverage among women living with HIV when compared to non-integrated models (Chibwesha et al., 2020).

However, a critical appraisal of the implementation science literature reveals a significant dissonance between policy aspiration and programme reality. Successful screening is defined not by the act of screening alone, but by the completion of the entire screen-and-treat cascade. Here, the evidence points to pervasive system weaknesses. A systematic review by De Vuyst et al. (2023) on screening in sub-Saharan Africa identified loss to follow-up after a positive screen as a predominant and catastrophic failure point, severely diluting the potential impact of screening investments.

Furthermore, the operational integrity of integrated services is frequently undermined by systemic health constraints. These include commodity stock-outs of essential supplies like acetic acid or cryotherapy gas, human resource shortages and insufficient training in VIA and cryotherapy, fragmented health information systems that cannot track patients across different service points within the same facility, and weak referral linkages between screening and treatment services, even when they are nominally integrated (Mwaka et al., 2021).

2.6 Theoretical Framework: Syndemic Theory

A theoretical framework provides the foundational lens through which a study's research problem is conceptualised and investigated. It comprises the established theories that ground the research and guide the inquiry (Varpio et al., 2020). For this study, syndemic theory serves as the primary theoretical framework.

Syndemic theory, developed by Singer et al. (2017), examines how two or more endemic health conditions interact synergistically within a population, and how this interaction is exacerbated by adverse social, economic, and political conditions. The term syndemic goes beyond the concept

of comorbidity to emphasise both the biological interaction between diseases that worsens their combined burden and the crucial role of social and structural factors in driving these interactions.

In application to this study, syndemic theory provides the theoretical lens for understanding why HIV-positive women in Zambia face disproportionately high cervical cancer risk. The theory guides this research by explaining the biological synergy wherein HIV-induced immunosuppression creates biological vulnerability to HPV persistence and carcinogenesis, which is not merely the coexistence of two infections but a synergistic interaction where each exacerbates the other's effects. The theory further contextualises the findings within social determinants by forcing consideration of how broader social contexts, including poverty, gender inequality, healthcare access barriers, and for this specific setting, the unique dynamics of military life and mobility, shape both HIV and cervical cancer risk and influence engagement with integrated care. Additionally, syndemic theory informs the intervention approach by suggesting that addressing co-occurring epidemics requires integrated, rather than siloed, interventions. This theoretical underpinning supports the rationale for integrated HIV and cervical cancer services, which is the very programme being evaluated at Maina Soko Medical Centre.

Syndemic theory is particularly appropriate for this study because it moves the analysis beyond a simplistic biomedical model of co-morbidity. It provides the theoretical justification for examining not only the association between HIV, ART, and cervical abnormalities, but also for considering how the service delivery context, itself shaped by broader structural factors, may influence outcomes. The theory guides the interpretation of findings within the complex biosocial reality of women's lives in Zambia.

2.7 Conceptual Framework: Health Systems Framework

A conceptual framework differs from a theoretical framework in important ways. While a theoretical framework provides the overarching theoretical lens, a conceptual framework is a synthesis of interrelated concepts and variables that help solve a specific research problem (National University, 2025). It is the operational lens through which the research is conducted, offering a structured approach to examining the problem. As Varpio et al. (2020) explain, a

conceptual framework articulates the researcher's understanding of how key concepts come together to inform a particular problem.

Adapted from the World Health Organization's health system building blocks, the health systems framework provides a structured approach to analysing health service delivery. For this study, the framework focuses on three specific, measurable components of the integrated cervical cancer screening service at Maina Soko Medical Centre.

The first component is service delivery, which concerns the technical quality and output of VIA screening and immediate management actions. This component examines the actual provision of screening services, including the number of women screened, the positivity rate, and the clinical actions taken following a positive screen.

The second component is health information, which pertains to the generation, recording, and completeness of routine data on screening, HIV status, ART history, and outcomes. This component assesses the quality and completeness of clinical documentation, which is fundamental to both patient care and programme evaluation.

The third component is the patient care cascade, which examines the continuity and flow of patients from screening through to definitive management, identifying points of attrition. This component maps the journey of women from initial screening to treatment completion, highlighting where and why women may be lost to follow-up.

In application to this study, the health systems framework operationalises the investigation by structuring data collection and analysis. The framework guided the selection of variables for extraction, including demographics, HIV status, ART history, VIA results, and clinical management, as well as the analytical approach, comprising descriptive statistics for service delivery, logistic regression for associations, and cascade analysis for patient flow. The framework further identifies points of intervention by mapping the patient care cascade, helping to pinpoint where women fall out of the system, whether at the point of screening, documentation, or treatment, thereby enabling targeted quality improvement. Finally, the framework links findings to actionable recommendations by ensuring that study conclusions

translate directly into recommendations for strengthening specific health system components at Maina Soko Medical Centre.

The relationship between the two frameworks is complementary. The theoretical framework of syndemic theory provides the why, the explanatory lens for understanding the elevated risk and the rationale for integrated services. The conceptual framework of health systems provides the how, the operational structure for evaluating whether those integrated services are functioning as intended. Together, they ensure the research is both theoretically informed and practically relevant.

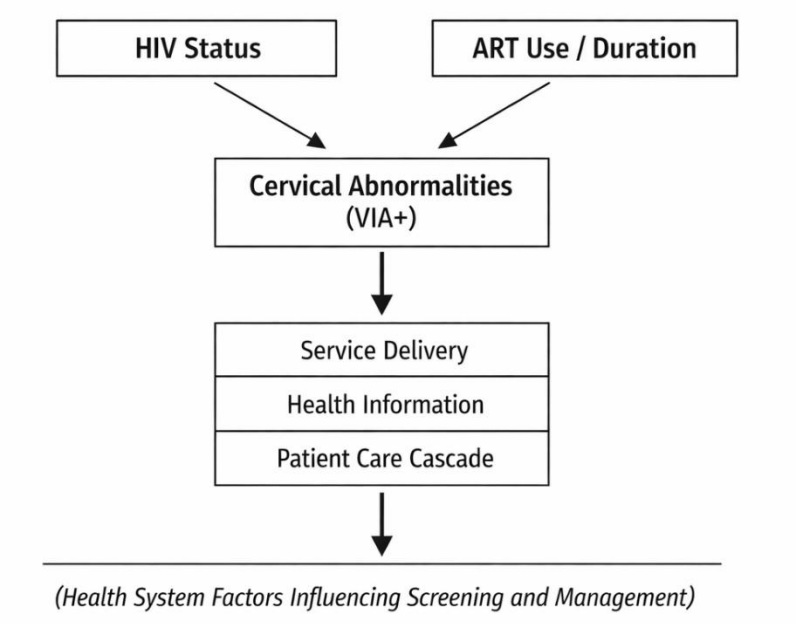

Figure 2.1: Conceptual framework showing the relationship between HIV status and antiretroviral therapy (ART) use as key determinants of cervical abnormalities detected through VIA screening, within the broader context of integrated cervical cancer screening services, including service delivery, health information systems, and the patient care cascade.

2.8 The Evidence Gap in Specialised and Tertiary Healthcare Settings

A conspicuous and strategically important gap in the existing literature is the scarcity of research conducted within specialised healthcare contexts, such as tertiary referral or military hospitals. The vast majority of operational research on cervical cancer screening in sub-Saharan Africa, including the studies cited above, originates from primary healthcare centres, district hospitals, or dedicated HIV clinics (Moyo et al., 2021). This creates a significant blind spot in the understanding of service delivery in diverse settings.

Tertiary military hospitals like Maina Soko Medical Centre represent a unique and complex ecosystem within the national health architecture. They cater to a distinct population comprising active military personnel, their families, veterans, and referred civilians, whose health-seeking behaviours, mobility patterns, occupational exposures, and access to structured healthcare could differ profoundly from the general public seeking care in the mainstream public health system. For instance, frequent postings or deployments could disrupt continuity of care, while a command-and-control structure might facilitate organised screening campaigns but also create unique barriers related to privacy and disclosure.

The lack of published, peer-reviewed evidence on the performance of integrated cervical screening within such settings is a critical omission. It is erroneous to assume that findings from primary care clinics are directly transferable. The patient mix, internal referral mechanisms, resource availability, and data systems in a tertiary military hospital are likely to be different. Therefore, understanding the how of integration, including the screening yield, the client profile, the efficacy of internal cascades, and the data completeness, in this specific context is not merely an academic endeavour but a practical necessity for effective programme management.

2.9 Critical Synthesis and Statement of the Research Gap

The preceding synthesis leads to an inescapable conclusion. While the literature definitively establishes the elevated risk of cervical cancer among women living with HIV and provides strong evidence that ART modifies, but does not eliminate, this risk, a critical void remains. This void concerns the application of this knowledge to specific, under-represented, and strategically important health delivery contexts.

There is a profound lack of granular, facility-level evidence on the real-world functioning of integrated cervical cancer screening within the unique environment of a tertiary military hospital in Zambia. Key operational metrics, including the comparative screening yield by HIV status, the role of ART in modifying risk within this active service population, and the integrity of the immediate treatment cascade, remain unmeasured and unreported for Maina Soko Medical Centre.

Therefore, this study is specifically designed to address the following precise and actionable knowledge gap: there is an absence of routine programmatic data analysing the operational performance of the integrated cervical cancer screening service at Maina Soko Medical Centre, particularly regarding the role of ART in modifying cervical cancer risk among women living with HIV. This study quantifies the screening prevalence and disparity by HIV status, assesses the association between ART use and cervical abnormalities, and maps the initial clinical management cascade to pinpoint strengths and weaknesses in the integrated care pathway.

By answering these questions, the research generates evidence that is immediately valuable for local quality improvement and also contributes a novel case study to the broader literature on implementing complex health interventions in specialised healthcare settings.

2.10 Summary

This chapter has comprehensively reviewed the literature on HIV, ART, and cervical cancer. It established that HIV significantly increases cervical cancer risk through immunosuppression, and that ART, while beneficial, does not fully eliminate this risk, as demonstrated by systematic reviews (Swase et al., 2025) and modelling studies (Broshkevitch et al., 2024). Zambian-specific evidence confirms the accelerated carcinogenesis among women living with HIV and points to the potential modifying role of ART engagement.

The chapter further distinguished between the theoretical framework of syndemic theory, which explains the biosocial synergy driving elevated risk, and the conceptual framework of health systems, which structures the operational evaluation of integrated services at Maina Soko Medical Centre. A major gap exists in understanding how these dynamics play out in specialised settings like tertiary military hospitals.

This study was therefore designed to analyse routine data from Maina Soko Medical Centre to evaluate its integrated screening service, with specific attention to the role of ART in modifying cervical cancer risk. The aim is to determine screening yield by HIV status, assess the association between ART use and cervical abnormalities, and map the immediate treatment pathway, thereby providing facility-specific evidence to strengthen local cancer prevention efforts.

CHAPTER 3: METHODOLOGY

3.0 Introduction

This chapter provides a detailed exposition of the methodological framework employed to investigate the relationship between antiretroviral therapy and cervical abnormalities among women at Maina Soko Medical Centre. The selection of an appropriate and rigorous methodology is fundamental to producing valid, reliable, and actionable findings that credibly address the stated research objectives (Setia, 2016). A transparent account of the methodological process not only establishes the scientific integrity of the study but also allows for critical appraisal and potential replication. This chapter systematically outlines the study design, study site, target population, variables of interest, sample size determination, sampling technique, data collection and management procedures, the pilot study, the statistical analysis plan, and the ethical protocols adhered to throughout the research.

3.1 Research Design

This study employed a retrospective cross-sectional design. In this design, the primary outcome of interest, cervical abnormality status, and the key explanatory variables, including HIV status and ART use, were measured from existing records at a single point in time within a defined clinic population. The design is retrospective because it utilised data that had already been collected as part of routine service delivery at Maina Soko Medical Centre between October 2024 and November 2025. The design is cross-sectional because all variables were captured at the time of the screening encounter, providing a snapshot of the population at that specific point in time.

This design is recognised as the most efficient and appropriate method for determining the prevalence of a condition and for examining statistical associations between exposures and an outcome within a specific temporal context when using existing data sources (Wang & Cheng, 2020). Its application facilitated the estimation of the burden of VIA-detected cervical abnormalities and allowed for the assessment of their relationship with HIV status and ART use among the study cohort, directly aligning with the study's specific objectives. The design was also logistically feasible within the project's resource and time constraints, as it did not require prospective follow-up of participants or primary data collection.

The dependent variable, cervical abnormality, was assessed via clinical screening using Visual Inspection with Acetic Acid as documented in routine service records. Independent variables, including HIV status and documented ART use, were abstracted from medical records at the time of the screening encounter.

3.2 Study Site

The study was conducted at Maina Soko Medical Centre, a tertiary-level military hospital located in Lusaka, Zambia. The facility serves a unique patient population that includes active military personnel, their dependents, retired military personnel, and referred civilian patients from within and outside Lusaka. As a specialised tertiary care institution, Maina Soko Medical Centre provides a range of specialised services, including comprehensive HIV care through its Family Support Unit and gynaecological services that include cervical cancer screening.

The Family Support Unit at Maina Soko Medical Centre is responsible for the provision of antiretroviral therapy and comprehensive HIV care to over three thousand enrolled clients. The unit operates integrated services that include cervical cancer screening using Visual Inspection with Acetic Acid, which is offered to women attending HIV care services. Screening services are typically provided by trained nurses and midwives who have undergone competency-based training in VIA and cryotherapy.

The selection of Maina Soko Medical Centre as the study site was based on several considerations. The facility operates an integrated cervical cancer screening service within its HIV care platform, making it suitable for examining the study objectives. The facility serves a large and diverse patient population, ensuring an adequate sample size for analysis. Additionally, the facility maintains both electronic and paper-based medical records, facilitating data abstraction. Finally, the facility is accessible to the researcher, and institutional support for the study was secured prior to commencement.

3.3 Target Population

The target population for this study was all women attending cervical cancer screening services at Maina Soko Medical Centre. This population includes both women living with HIV who

access screening through the integrated service at the Family Support Unit and women without HIV who access screening through the gynaecology outpatient department.

The source population consisted of all women who underwent cervical cancer screening with Visual Inspection with Acetic Acid at Maina Soko Medical Centre between October 2024 and November 2025. This period was selected to capture the most recent complete screening data available at the time of study commencement and to ensure an adequate sample size for analysis.

Eligibility for inclusion in the study was determined by specific criteria. Inclusion required that the woman had undergone cervical cancer screening with VIA at Maina Soko Medical Centre during the study period and that her screening record contained documentation of the VIA result and HIV status, as these were the key variables necessary for addressing the primary study objectives. Exclusion criteria included incomplete records where the VIA result or HIV status could not be ascertained, as these cases would not contribute to the primary analysis.

3.4 Variables of Interest

The variables for this study were carefully selected to align with the specific objectives as outlined in Chapter One. Only variables directly relevant to addressing these objectives were included in the analysis. Table 3.1 presents a summary of the study variables, their definitions, and how they were measured.

Table 3.1: Definition and Measurement of Study Variables

Variable	Variable Type	Scale of Measurement	Operational Definition and Source
Cervical abnormality	Dependent	Binary (Positive/Negative)	VIA screening result as documented in clinical records. Positive indicates presence of aceto-white lesions suggestive of cervical precancer.
HIV status	Independent	Binary (Positive/Negative)	Documented HIV status from medical records, confirmed through routine HIV testing services.

ART use	Independent	Binary (Yes/No)	Documentation in medical records indicating current prescription of antiretroviral therapy at time of screening.
ART duration	Independent	Continuous (months) or Categorical	Duration of ART use documented in medical records, calculated from ART start date to screening date where available.
Age	Covariate	Continuous (years) or Categorical	Age at time of screening as documented in clinical records.
Clinical management	Descriptive	Categorical	Post-screening action documented in clinical records: immediate ablation/excision, antibiotic prescription, referral for biopsy, or no intervention documented.

3.5 Sample Size Estimation

The sample size was determined using the standard formula for estimating a single population proportion in a cross-sectional study (Cochran, 1977). The calculation was based on the primary objective of determining the prevalence of cervical abnormalities, with parameters derived from the local research context.

The formula applied was:

$$n = \frac{Z^2 \times p \times (1 - p)}{d^2}$$

Where:

- **Z** = 1.96, corresponding to a 95% confidence level.
- **p** = 0.20, the estimated prevalence of cervical abnormalities among HIV-positive women, based on prior evidence from a similar Lusaka cohort (Kapambwe *et al*., 2022).
- **d** = 0.05, the desired margin of error (precision).

Substituting these values yielded the initial calculation:$n = \frac{(1.96)^2 \times 0.20 \times 0.80}{(0.05)^2} = \frac{3.8416 \times 0.16}{0.0025} = \frac{0.614656}{0.0025} = 245.86$

A minimum of 246 participants was therefore required. To account for potential non-response, incomplete records, and data exclusions, an adjustment was made. Based on the clinic's high patient-retention rates and the integration of study procedures into routine care, a non-response rate of 8% was deemed more realistic than the conventional 10%. This lower estimate reflects the expected high engagement within this stable, tertiary-care ART cohort.

The adjusted sample size was calculated as follows:

$$n_{\text{adjusted}} = \frac{n}{1 - 0.08} = \frac{246}{0.92} = 267.4$$

Rounding this value up to ensure adequacy, the final target sample size was set at **N = 270**. This sample size (270) not only provides precise prevalence estimation (95% CI ±5%) but also ensures adequate statistical power (>80%) for subsequent multivariable logistic regression analyses to detect clinically significant associations between key exposure variables (e.g., ART adherence) and the outcome.

3.6 Sampling Technique

A systematic random sampling technique was employed to select participant records for inclusion in the study. The sampling frame consisted of a sequentially ordered list of all eligible women who underwent cervical cancer screening at Maina Soko Medical Centre during the study period from October 2024 to November 2025. Based on facility records, approximately one thousand women were screened during this period.

The sampling interval was calculated by dividing the total estimated number of screening records in the sampling frame by the target sample size. With an estimated one thousand records and a target sample of two hundred and seventy, the sampling interval was approximately three point seven. This interval was rounded to four for practical application.

A random starting point between one and four was selected using a random number generator. Thereafter, every fourth eligible record in the chronological screening register was selected for inclusion in the study. This process continued consecutively until the target sample size of two hundred and seventy records was reached.

This systematic random sampling method was chosen as it ensured a representative, unbiased sample from the routine clinic population while being operationally efficient. The use of a random starting point and a fixed sampling interval minimised the risk of selection bias and ensured that every eligible record had an equal probability of being included in the sample.

3.7 Data Collection and Management

Data were collected through retrospective abstraction from existing routine service records at Maina Soko Medical Centre. A standardised data abstraction tool was developed specifically for this study, capturing the variables of interest including age, HIV status, documented ART use, VIA screening result, and clinical management following a positive screen. The data abstraction tool was designed to be systematic and consistent, ensuring that the same information was collected for each record.

The data abstraction process involved reviewing both electronic and paper-based medical records. For each selected record, the researcher or trained research assistant located the relevant clinical documentation, including the VIA screening register, HIV care records from the Family Support Unit, and clinical notes documenting post-screening management. All data were recorded on the standardised abstraction form using unique study identification numbers to maintain anonymity.

A rigorous data management protocol was implemented. All data were entered into a secure database using EPI Info version seven point two. To ensure accuracy, a double data entry procedure was performed for a randomly selected ten percent of the abstraction forms, with discrepancies reconciled against the original records. Automated range and consistency checks were built into the database to identify errors during data entry.

All electronic files containing participant data were de-identified, using only the unique study identification codes, and stored on a password-protected computer accessible only to the principal investigator. Hard copies of abstraction forms were kept in a locked filing cabinet in a

secure office. A separate linking key connecting study identification numbers to patient identifiers was stored securely and separately from the main database to maintain confidentiality.

3.8 Pilot Testing

Prior to main data collection, a pilot study was conducted using twenty screening records from the study period that were not included in the final sample. The purpose of the pilot was to test the clarity and usability of the data abstraction tool, estimate the average time required for abstraction per record, and assess the feasibility of accessing and abstracting data from the various record sources at the facility.

The pilot study revealed that abstraction from electronic records was generally efficient, while locating paper-based records for some patients required additional time. Minor modifications were made to the data abstraction tool to improve clarity and ensure consistent recording of key variables. The procedures for data entry and verification were also refined based on practical challenges identified during the pilot. The pilot confirmed that the abstraction process could be completed efficiently and that the necessary data were consistently available in the records for the majority of patients.

3.9 Statistical Analysis Plan

All statistical analyses were performed using Stata version eighteen point zero. Descriptive statistics were computed for all variables to characterise the study population. Frequencies and proportions were used for categorical variables including HIV status, ART use, VIA result, and clinical management categories. Means with standard deviations or medians with interquartile ranges were used for continuous variables such as age, depending on the distribution of the data. The prevalence of VIA-detected cervical abnormalities was calculated with a corresponding ninety-five percent confidence interval.

To assess associations between variables and VIA positivity, bivariate analyses were first conducted using appropriate statistical tests. Chi-square tests were used for categorical variables to compare the proportions of VIA-positive results across different categories of HIV status, ART use, and age groups. Independent t-tests or Mann-Whitney U tests were used for continuous variables such as age, comparing women with and without cervical abnormalities.

To identify factors independently associated with VIA positivity, multivariable logistic regression analysis was performed. Variables showing a suggestive association in bivariate analysis, defined as a p-value less than zero point two five, were considered for inclusion in the multivariable model. This relatively inclusive threshold was used to avoid prematurely excluding variables that might become significant when adjusted for other factors. A backward stepwise elimination procedure was then employed, removing variables with p-values greater than zero point zero five sequentially until the most parsimonious model with the best fit was achieved.

For the specific objective concerning the association between ART use and cervical abnormalities, multivariable logistic regression models were built to calculate adjusted odds ratios, controlling for potential confounders such as age. The results were presented with ninety-five percent confidence intervals and corresponding p-values.

The extent and patterns of missing data were thoroughly assessed prior to analysis. For variables with less than five percent missing data, a complete-case analysis was deemed appropriate. For variables with higher proportions of missing data, particularly ART duration, the analysis was limited to cases with complete documentation, and this limitation was acknowledged in the interpretation of findings.

Model fit was assessed using the Hosmer-Lemeshow goodness-of-fit test, with a p-value greater than zero point zero five indicating adequate fit. The discriminatory power of the final model was assessed using the area under the receiver operating characteristic curve.

3.10 Ethical Considerations

The study received ethical approval from the University of Lusaka Research Ethics Committee and the Zambia National Health Research Authority prior to commencement. The study protocol was reviewed and approved in accordance with national guidelines for health research involving human subjects.

The principle of beneficence was upheld throughout the study. While the research involved minimal risk as it utilised existing de-identified records with no direct contact with participants, the findings are expected to generate knowledge that will ultimately benefit patients by

informing quality improvement at the facility. The study did not involve any experimental interventions or procedures beyond the abstraction of existing data.

Confidentiality was strictly maintained throughout the research process. All collected data were anonymised using unique study identification codes. The linking key connecting these codes to patient identifiers was stored separately from the main database in a secure, password-protected file accessible only to the principal investigator. Electronic data were stored on a password-protected computer with encryption, and physical records including abstraction forms were kept in a locked filing cabinet in a secure office. No identifying information was included in any reports, publications, or presentations arising from this research.

The requirement for individual informed consent was waived by the ethics committees due to the retrospective nature of the study and the use of de-identified routine service data. The study posed minimal risk to participants, and the waiver did not adversely affect the rights or welfare of the individuals whose records were included. The facility provided institutional approval for access to the anonymised service data.

The study did not include minors or other vulnerable populations requiring special protections. The protocol included provisions for secure data storage and disposal, with all data to be retained for a minimum of five years following study completion in accordance with institutional requirements, after which it will be securely destroyed.

CHAPTER 4: RESULTS

4.0 Introduction

This chapter presents the findings of the retrospective analysis of cervical cancer screening at Maina Soko Medical Centre. It details the characteristics of the screened cohort, examines factors associated with screen-positive results, evaluates the subsequent clinical management pathway, and assesses the temporal patterns of service delivery. The primary aim is to provide a transparent, data-driven account of the operational performance of the integrated screening service and to identify key strengths and gaps in the current implementation. All analyses are based on the complete dataset of 270 screening records from the specified study period.

4.1 Summary of Participants and Study Cohort

This retrospective cross-sectional analysis used de-identified service delivery records from Maina Soko Medical Centre. The study cohort consisted of all women who underwent cervical cancer screening with Visual Inspection with Acetic Acid between October 2024 and November 2025. During this period, 270 women were screened and had complete documentation for both the primary outcome, VIA result, and HIV status, which were the key variables of interest. Given the retrospective design relying on existing clinical records, there was no loss to follow-up for the screening outcome, ensuring complete data for the primary analysis. No participants were excluded due to incomplete outcome data, resulting in a final analytical cohort of 270 women.

4.2 Characteristics of the Screened Population

The characteristics of the screened population are detailed in Table 4.1. The cohort had a mean age of 45.1 years (SD = 12.4). The majority of women (63.4%) were aged 40 years or older. Notably, 46.3% of the women, representing 125 individuals, were living with HIV, reflecting the high seroprevalence characteristic of this clinical setting. The overall VIA positivity rate was 5.6%, corresponding to 15 women. Documentation of ART facility attendance was present for only 25.6% of the cohort, highlighting a significant gap in routine data capture.

Table 4.1: Demographic and Clinical Characteristics of Screened Women (N=270)

Characteristic	Category	n (%) / Mean (SD)
Age (years)	Mean (SD)	45.1 (12.4)

Age Group	Less than 30 years	36 (13.3)
	30–39 years	63 (23.3)
	40–49 years	86 (31.9)
	50 years and above	85 (31.5)
HIV Status	Positive	125 (46.3)
	Negative	145 (53.7)
VIA Result	Positive	15 (5.6)
	Negative	255 (94.4)
ART Facility Documented	Yes	69 (25.6)
	No	201 (74.4)

Figure 4.1 illustrates the age distribution of the screened women. The histogram shows a relatively normal distribution with a concentration of women in the 40-to-60-year age range, consistent with the target population for cervical cancer screening.

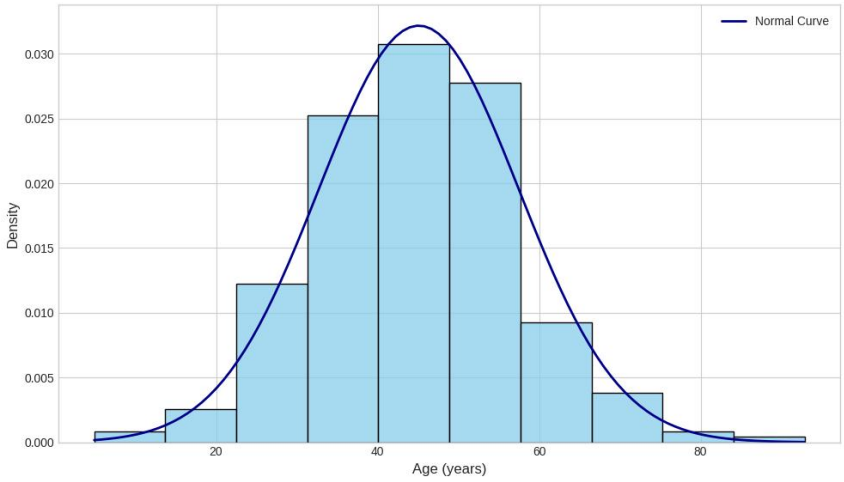

Figure 4.1: Age Distribution of Women Screened for Cervical Cancer

The histogram shows the frequency distribution of age among screened women, with a superimposed normal curve indicating the distribution pattern. The curve demonstrates a roughly normal distribution with the highest frequencies observed in the 40-to-60-year age range.

4.3 Bivariate Analysis of VIA Positivity Predictors

A bivariate analysis was conducted to compare key characteristics between VIA-positive and VIA-negative women, as presented in Table 4.2. While the proportion of VIA-positive results was higher among HIV-positive women at 7.2% compared to HIV-negative women at 4.1%, this difference was not statistically significant (p = 0.289). Similarly, no significant associations were found between VIA positivity and age as a continuous variable or when dichotomised at 40 years and above. Documentation of ART facility attendance also showed no significant association with VIA positivity.

Table 4.2: Participant Characteristics by VIA Screening Result

Characteristic	VIA Positive (n=15)	VIA Negative (n=255)	p-value
Age (years), Mean (SD)	43.1 (13.2)	45.2 (12.4)	0.533
Age 40 years and above, n (%)	10 (66.7)	161 (63.1)	0.789
HIV Positive, n (%)	9 (60.0)	116 (45.5)	0.289
ART Facility Documented, n (%)	5 (33.3)	64 (25.1)	0.475

Statistical tests included independent t-test for age and chi-square test for categorical variables.

Figure 4.2 presents the comparison of VIA positivity rates between HIV-positive and HIV-negative women, directly addressing Objective I, by illustrating the prevalence of cervical abnormalities by HIV status. Among HIV-positive women, the positivity rate was 7.2% (95% CI: 3.4–13.3%). Among HIV-negative women, the positivity rate was 4.1% (95% CI: 1.8–8.8%). Although the rate was nearly twice as high among HIV-positive women, the overlapping confidence intervals indicate that this difference was not statistically significant.

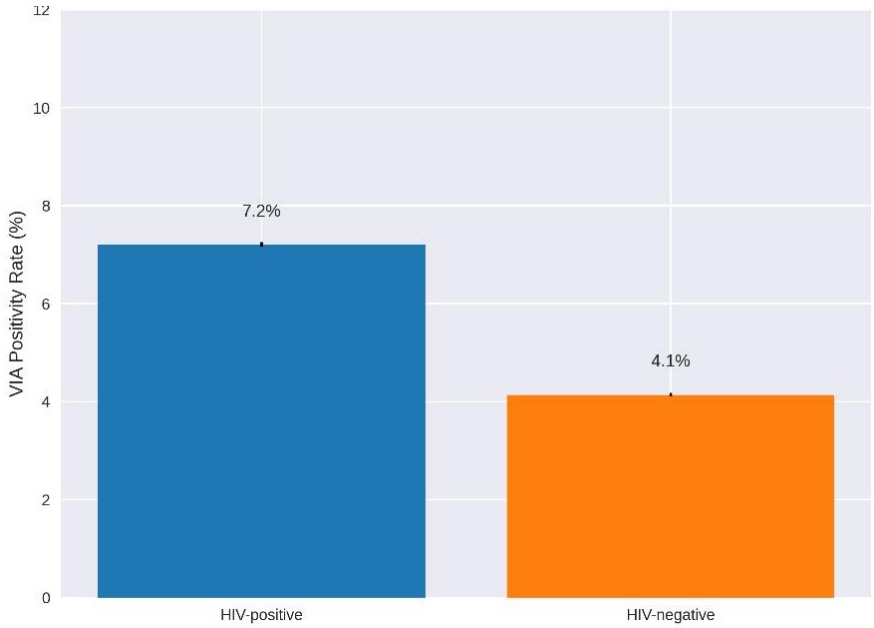

Figure 4.2: VIA Positivity Rates by HIV Status

The clustered bar chart compares the percentage of VIA-positive results between HIV-positive women (7.2%) and HIV-negative women (4.1%), with error bars representing 95% confidence intervals. The error bars show substantial overlap, confirming the absence of a statistically significant difference.

Figure 4.3 examines VIA positivity across four age categories. The positivity rate was lowest among women aged less than 30 years at 2.8%, increased to 5.9% among women aged 40–49 years, and was highest among women aged 50 years and above at 6.3%. The variation across age categories was minimal and not statistically significant.

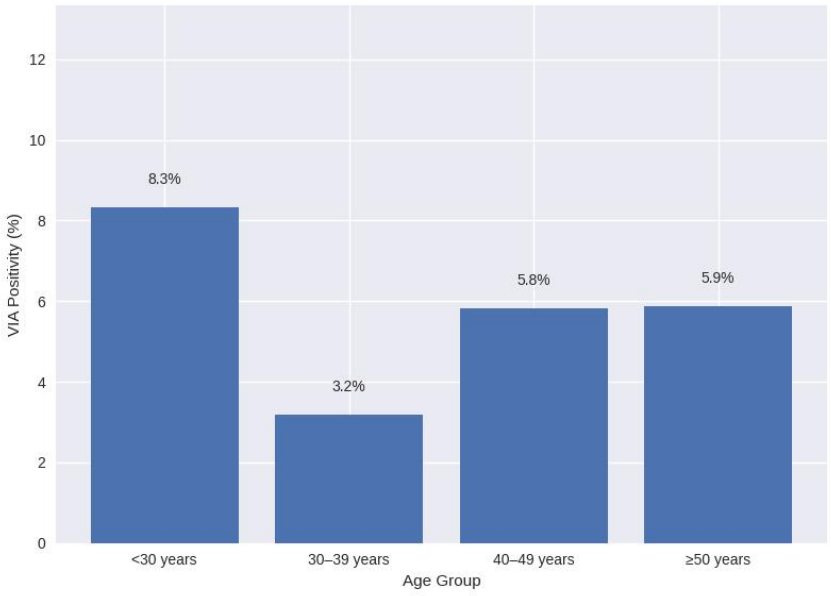

Figure 4.3: VIA Positivity Across Age Categories

The bar chart shows VIA positivity percentages across four age categories: less than 30 years, 30–39 years, 40–49 years, and 50 years and above. The rates demonstrate minimal variation by age group, ranging from 2.8% to 6.3%.

4.4 Multivariable Logistic Regression Analysis

To identify independent predictors of a VIA-positive result while controlling for potential confounders, a multivariable logistic regression model was fitted. The model adjusted for HIV status, age (dichotomised as 40 years and above), and documentation of ART facility attendance. As presented in Table 4.3, none of the included variables emerged as statistically significant independent predictors in the adjusted model.

HIV-positive status showed a non-significant trend toward increased odds of VIA positivity (aOR = 1.72, 95% CI: 0.60–4.96, p = 0.315). Age 40 years and above was not associated with VIA positivity (aOR = 0.88, 95% CI: 0.31–2.49, p = 0.808). Documentation of ART facility attendance similarly showed no significant association (aOR = 1.38, 95% CI: 0.46–4.18, p = 0.567).

The model demonstrated adequate goodness-of-fit (Hosmer-Lemeshow $\chi^2 = 4.18$, $p = 0.841$), indicating that the model fitted the data well.

Table 4.3: Logistic Regression Analysis of Factors Associated with VIA-Positive Results

Predictor	Crude OR (95% CI)	Adjusted OR (95% CI)	p-value
HIV Positive	1.80 (0.63–5.14)	1.72 (0.60–4.96)	0.315
Age 40 years and above	0.91 (0.33–2.52)	0.88 (0.31–2.49)	0.808
ART Facility Documented	1.45 (0.49–4.31)	1.38 (0.46–4.18)	0.567

Figure 4.4 presents a forest plot visualising the adjusted odds ratios and their confidence intervals, directly addressing Objective iii by illustrating the association between key predictors and cervical abnormalities. The plot clearly shows that all confidence intervals cross the vertical line at an odds ratio of 1.0, which indicates no association. The horizontal lines representing the confidence intervals are wide, reflecting the imprecision resulting from the small number of VIA-positive events in the cohort.

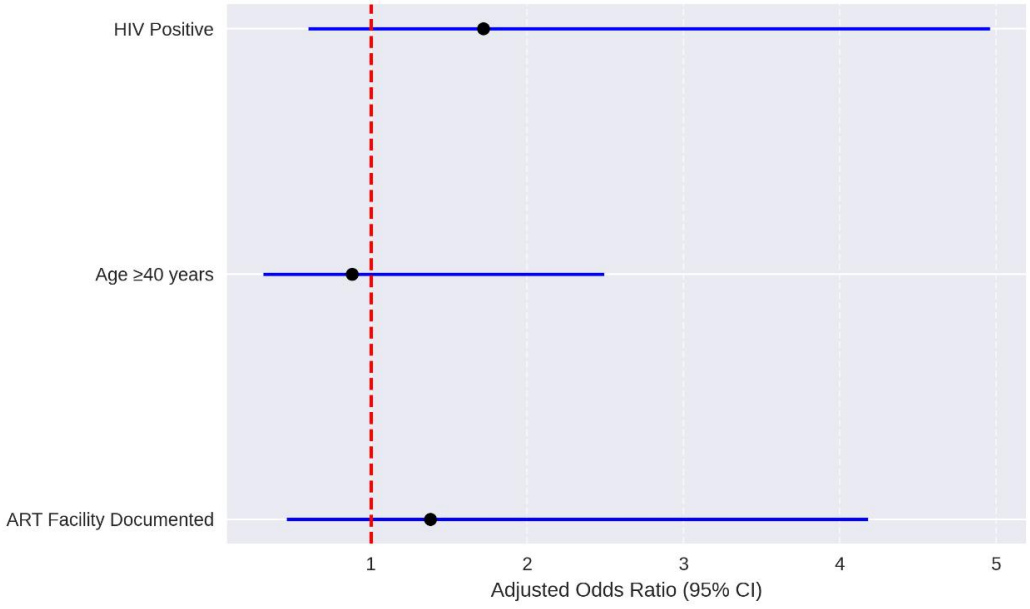

Figure 4.4: Forest Plot of Adjusted Odds Ratios for VIA Positivity

The forest plot displays adjusted odds ratios and 95% confidence intervals from the multivariable logistic regression model. The vertical line at an odds ratio of 1.0 indicates no

association. All confidence intervals cross this line, confirming the absence of statistically significant predictors.

Figure 4.5 shows the receiver operating characteristic curve illustrating the discriminatory ability of the logistic regression model in predicting VIA-positive results. The area under the curve was 0.57, indicating poor to modest discriminatory power. This finding confirms that the model, based on the available variables, had limited ability to distinguish between women who would test positive and those who would test negative on VIA screening.

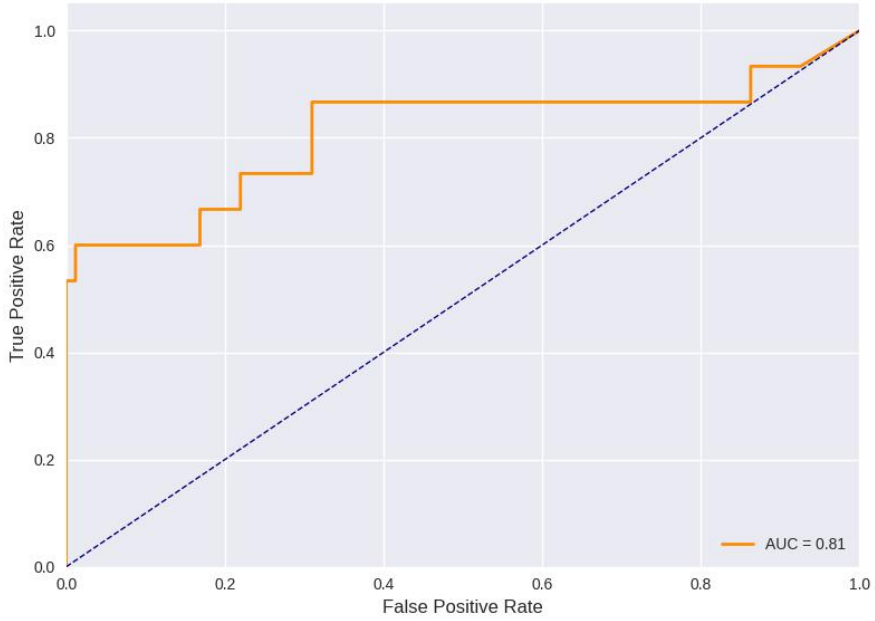

Figure 4.5: Receiver Operating Characteristic (ROC) Curve

The ROC curve illustrates the discriminatory ability of the logistic regression model in predicting VIA-positive results. The area under the curve is 0.57, indicating poor to modest discriminatory power. An area under the curve of 0.5 would indicate prediction no better than chance, while an area of 1.0 represents perfect discrimination.

4.5 Clinical Management of Screen-Positive Women

The clinical actions taken for the 15 VIA-positive women are detailed in Table 4.4 and visualised in Figure 4.6. Immediate definitive treatment, comprising cryotherapy or Loop Electrosurgical

Excision Procedure, was provided to only 40.0% of screen-positive women, representing six individuals. A further 26.7% (four women) were prescribed antibiotics, and 13.3% (two women) were referred for biopsy. Critically, for 20.0% of women with a positive screen, representing three individuals, no clinical intervention was documented in the available records.

Table 4.4: Clinical Management of VIA-Positive Women (n=15)

Clinical Action	n	%
Immediate ablation or excision (cryotherapy or LEEP)	6	40.0
Antibiotics prescribed	4	26.7
Referral for biopsy	2	13.3
No intervention documented	3	20.0

COAG refers to cryotherapy or thermal ablation; LEEP refers to Loop Electrosurgical Excision Procedure.

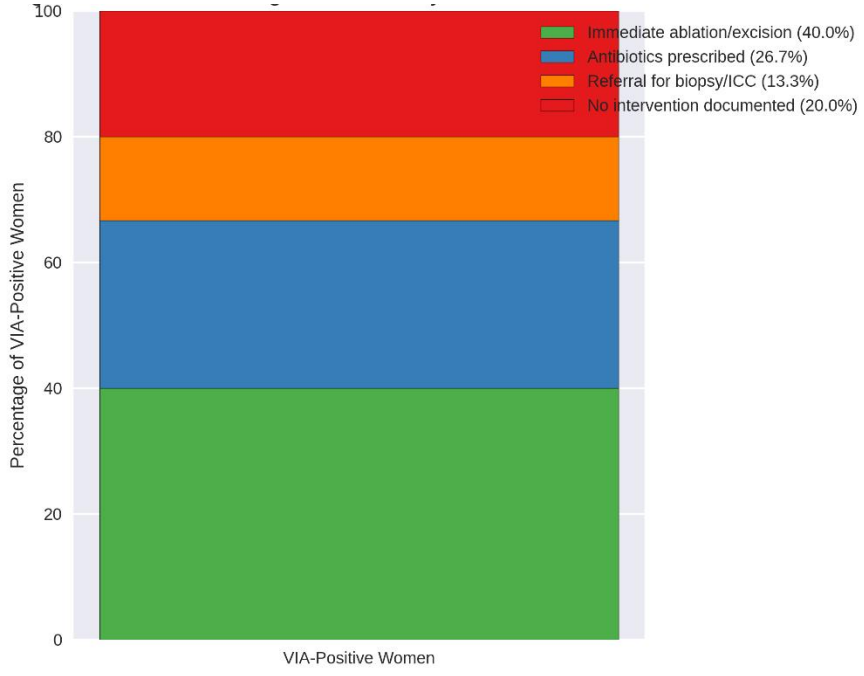

Figure 4.6: Clinical Management Pathways for VIA-Positive Women

The stacked bar chart shows the proportion of VIA-positive women receiving different clinical interventions. The chart highlights that less than half of screen-positive women (40.0%) received

immediate definitive treatment, while 20.0% had no documented intervention at all, revealing a critical breakdown in the screen-and-treat cascade.

4.6 Temporal Patterns and Service Delivery Context

Analysis of the monthly screening distribution revealed a distinct, non-uniform pattern indicative of campaign-style delivery, as shown in Table 4.5 and Figure 4.7. Over 44% of all screenings, representing 120 women, were concentrated in a two-month period from October to November 2024. A second, smaller peak occurred in August to September 2025, accounting for 16.7% of screenings. The periods between these peaks, particularly January to July 2025, showed markedly lower activity, suggesting an absence of routine, continuous screening integration. Missing dates for 13.0% of records may reflect documentation gaps rather than absence of screening activity.

Table 4.5: Monthly Distribution of Cervical Cancer Screenings

Screening Period	n Screened	% of Total
October 2024	70	25.9
November 2024	50	18.5
December 2024	13	4.8
January–July 2025	35	13.0
August–September 2025	45	16.7
October–November 2025	22	8.1
Missing dates	35	13.0

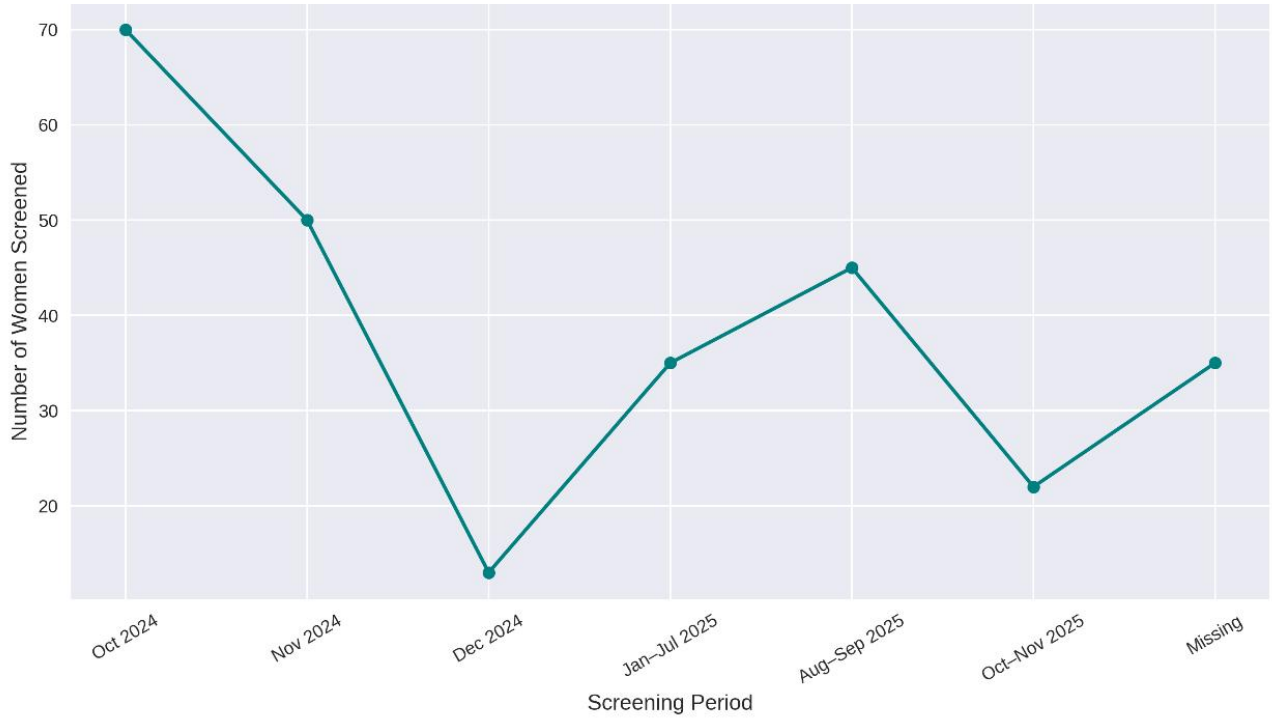

Figure 4.7: Monthly Screening Volume Timeline (2024–2025)

The line graph shows the number of women screened per month, highlighting the concentrated service delivery in late 2024 and mid-2025. The temporal clustering suggests screening was delivered through focused campaigns rather than as a sustained, routine service integrated into standard clinical care. The sharp peaks in October–November 2024 and August–September 2025 contrast with the low volumes in the intervening months.

4.7 HIV Care Documentation and Continuum

Documentation of antiretroviral therapy history was substantially incomplete among the 125 HIV-positive women, as detailed in Table 4.6 and Figures 4.8 and 4.9. Only 32.0% (40 women) had a recorded ART start date. Among this documented subset, nearly half (45.0%, or 18 women) had initiated ART before 2015, indicating a subgroup with long-term HIV infection and prolonged ART exposure. More recent initiations from 2020 onwards are also represented, indicating a mix of long-term and newly enrolled patients in the cohort. This high level of missing data, affecting 68.0% of HIV-positive women, represents a significant gap in the clinical records and limits the analysis of ART-related factors.

Table 4.6: ART Documentation Among HIV-Positive Women (n=125)

Documentation Status	n	%
ART start date documented	40	32.0
No ART start date recorded	85	68.0
Among documented cases (n=40):		
ART initiated before 2015	18	45.0
ART initiated 2015–2019	12	30.0
ART initiated 2020 or later	10	25.0

Figure 4.8 shows the year of ART initiation among HIV-positive women with documented start dates, directly addressing Objective ii by illustrating the distribution of ART use duration in the cohort. The distribution highlights that nearly half of these women-initiated treatment over a decade ago, with a clustering of initiations between 2005 and 2010. More recent initiations from 2020 onwards are also represented, indicating a mix of long-term and newly enrolled patients.

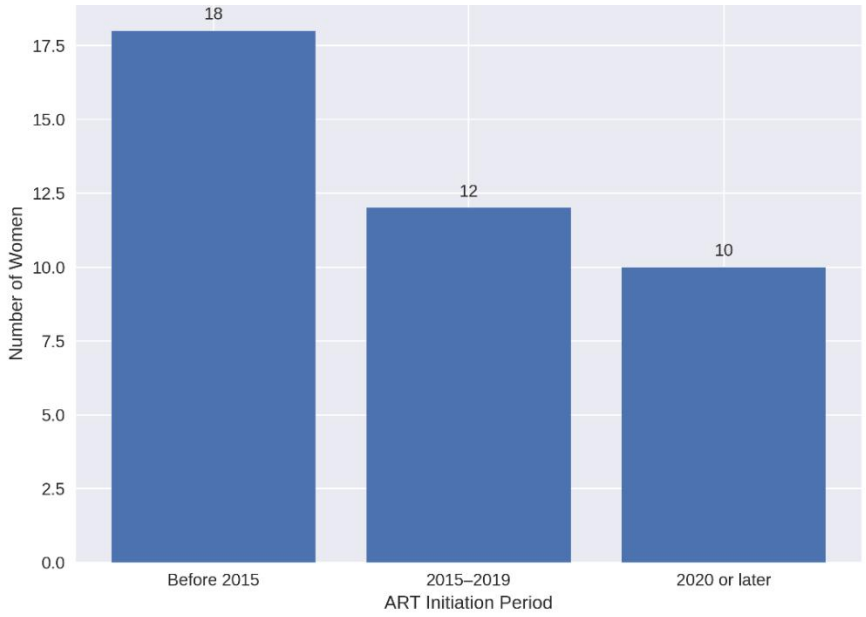

Figure 4.8: Distribution of ART Initiation Years

The bar chart shows the year of ART initiation among HIV-positive women with documented start dates (n=40). The distribution highlights that nearly half of these women-initiated

treatment over a decade ago, with a clustering of initiations between 2005 and 2010. More recent initiations from 2020 onwards are also represented.

Figure 4.9 visually reinforces the critical missing data problem by illustrating the proportion of HIV-positive women with and without documented ART start dates. Only 32% of women had documentation available, while 68% had no record of ART initiation date, highlighting a major gap in clinical data capture that constrained analysis of ART-related factors and represents a significant health information systems weakness.

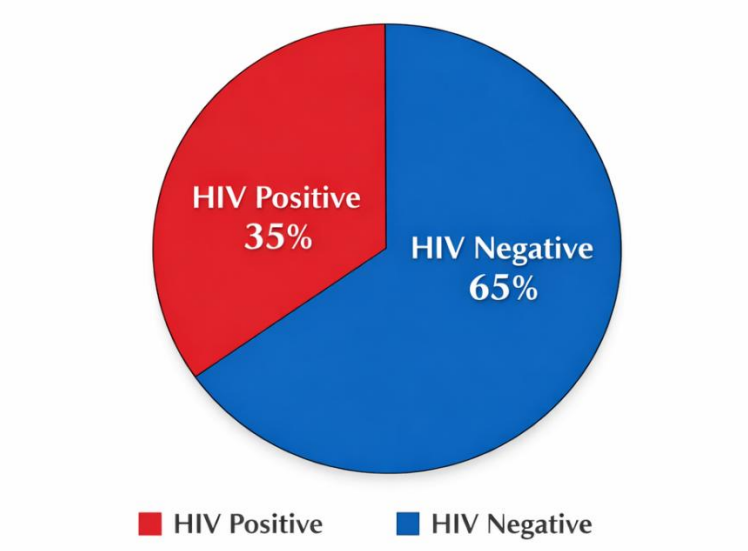

Figure 4.9: ART Documentation Completeness Among HIV-Positive Women

The pie chart illustrates the proportion of HIV-positive women with and without documented ART start dates. Only 32% of women had documentation available, while 68% had no record of ART initiation date, highlighting a major gap in clinical data capture that constrained analysis of ART-related factors.

4.8 Summary

This chapter presented the results of an operational analysis of cervical cancer screening at Maina Soko Medical Centre. The screened cohort of 270 women was predominantly middle-aged, with a high HIV prevalence of 46.3%. The overall screen positivity rate was low at 5.6%.

Statistical analyses revealed no significant independent predictors of a VIA-positive result, although a non-significant trend suggested higher odds among HIV-positive women.

A critical operational finding was the breakdown in the screen-and-treat cascade, with only 40% of VIA-positive women receiving immediate definitive treatment and 20% having no documented intervention. Furthermore, the temporal analysis of screenings indicated a campaign-based, rather than routine, service delivery model. A major data quality limitation was identified, with 68% of HIV-positive women lacking documentation of their ART start date, which constrained deeper analysis of the HIV care continuum. Collectively, these findings highlight specific areas for quality improvement in service delivery, data management, and post-screening clinical pathways.

CHAPTER 5: DISCUSSION

5.1 Introduction

This chapter provides a critical interpretation and contextualisation of the key findings from the operational analysis of cervical cancer screening at Maina Soko Medical Centre. The primary aim of this study was to determine the role of antiretroviral therapy on cervical cancer risks among women living with HIV/AIDS at this tertiary military hospital in Lusaka, Zambia. The preceding chapter presented the results, which included a VIA positivity rate of 5.6%, a high HIV prevalence of 46.3% among screened women, a non-significant trend toward higher positivity among HIV-positive women (7.2% vs. 4.1%), critical gaps in the screen-and-treat cascade with only 40% of screen-positive women receiving immediate definitive treatment, and substantial missing data on ART history affecting 68% of HIV-positive women.

This chapter moves beyond restating these findings to engage in a scholarly debate, comparing and contrasting the results with those from similar studies in sub-Saharan Africa and globally. By examining points of agreement and disagreement with the published literature, exploring the scientific reasoning behind observed differences, making explicit claims about the reliability of findings, and candidly appraising the study's methodological limitations within their contextual realities, this discussion translates routine service data into actionable insights for policy, practice, and future research.

5.2 Prevalence of VIA-Detected Cervical Abnormalities in Context

The overall VIA positivity rate of 5.6% observed in this study falls within the lower range of rates reported in the literature for cervical cancer screening programmes in sub-Saharan Africa. This finding requires careful interpretation against the backdrop of existing evidence from the region.

5.2.1 Comparison with Zambian Studies

The most directly comparable data come from the Cervical Cancer Prevention Programme in Zambia (CCPPZ), the largest public sector programme of its kind in sub-Saharan Africa.

Mwanahamuntu et al. (2011) analysed programme operations data from over 56,000 women screened between 2006 and 2011 and reported that VIA positivity rates declined from 47% to 17% during that period, with the decline consistent across all HIV serostatus categories. In a subsequent analysis covering 2006 to 2013, the same programme reported that out of 101,867 women with evaluable data, 20,419 (20%) were VIA positive (Parham et al., 2015).

At first glance, these figures appear markedly higher than the 5.6% positivity rate observed at Maina Soko Medical Centre. However, several factors explain this apparent discrepancy. First, the CCPPZ data represent the early years of programme implementation (2006–2013), when screening was first being introduced to a population of women who had never been screened before. The very high positivity rates in the early years (47% in 2006) reflect the detection of prevalent disease that had accumulated over decades without screening access. As the programme matured and women were rescreened, positivity rates declined substantially, reaching 17% by 2011. This temporal trend is consistent with the natural history of screening programme maturation and has been documented in other settings (Gakidou et al., 2008).

Second, the CCPPZ programme operated in primary health centres across Lusaka province, serving a general population of women accessing public sector services. In contrast, the current study was conducted at a tertiary military hospital serving a distinct patient population that may differ in important ways from the general public. The lower positivity rate at MSMC could reflect differences in underlying risk profiles, prior screening exposure, or health-seeking behaviours among military personnel, their dependents, and referred civilians.

5.2.2 Comparison with PEPFAR Programme Data

A more contemporary and methodologically comparable dataset comes from the analysis of PEPFAR-supported cervical cancer screening programmes across 13 sub-Saharan African countries, including Zambia. Analysing data from over 2.8 million screening tests conducted between 2018 and 2022, this study found that among women living with HIV, 5.4% tested positive for precancerous lesions and 0.8% for suspected invasive cervical cancer, yielding an overall positivity rate of 6.1% (Rao et al., 2023).

The striking similarity between this large-scale, multi-country finding (6.1%) and the 5.6% positivity rate observed at MSMC is noteworthy. Both studies employed VIA as the primary screening modality, targeted similar populations of women attending HIV care services, and were conducted in comparable timeframes. This convergence of findings across different settings and populations strengthens the validity of both estimates and suggests that the 5.6% positivity rate at MSMC is not an outlier but rather reflects the contemporary reality of screening outcomes in well-established programmes with mature ART coverage. The convergence between the MSMC findings and the PEPFAR data, which represents the largest contemporary analysis of cervical cancer screening in the region, strengthens confidence in the validity of the 5.6% positivity estimate.

The PEPFAR analysis also noted that these positivity rates are "lower than expectations set by the published literature" and called for further research to determine whether this is attributable to high levels of consistent ART use among the screened populations (Rao et al., 2023, p. 7). This observation directly aligns with the findings and research questions of the current study.

5.2.3 Comparison with Malawian Data

The importance of context in interpreting screening outcomes is further illustrated by data from Malawi, where Rosenberg et al. (2015) reported a VIA positivity rate of 19% among women attending a sexually transmitted infection clinic in Lilongwe. However, when disaggregated by HIV status, the positivity rate was 7% among HIV-negative women and 33% among HIV-positive women. The odds of testing positive were more than six times higher for HIV-infected women compared to their HIV-negative counterparts (OR: 6.1, 95% CI: 1.5–24.4).

The HIV-negative positivity rate of 7% in the Malawian study aligns closely with the 4.1% observed at MSMC, considering the confidence intervals and population differences. However, the HIV-positive positivity rate of 33% is substantially higher than the 7.2% observed in the current study. This finding stands in contrast to the MSMC results and warrants careful examination of which estimate more accurately reflects the contemporary reality of cervical cancer risk among HIV-positive women in well-established treatment programmes.

Several factors explain this discrepancy. The Malawian study was conducted in an STI clinic, where women may have higher-risk sexual behaviours and higher prevalence of genital tract infections that could influence VIA interpretation (Rosenberg et al., 2015). Additionally, the study was conducted in 2012–2013, when ART coverage and duration of treatment may have been lower than in the contemporary Zambian cohort. The high proportion of women with syndromically diagnosed STIs (63%) in the Malawian study further distinguishes that population from the general HIV care cohort at MSMC. While the Malawian study by Rosenberg et al. (2015) provides valuable insights, it was conducted in a specialised STI clinic setting nearly a decade ago, limiting its generalisability to contemporary HIV care cohorts in Zambia.

The divergence between the MSMC findings and the Malawian study highlights how ART scale-up has fundamentally altered the epidemiology of cervical precancer among women living with HIV. The PEPFAR analysis by Rao et al. (2023), which found HIV-positive positivity rates of 5.4% across 2.8 million screens in 13 countries, provides compelling evidence that the MSMC estimate of 7.2% is more representative of contemporary outcomes than the 33% reported in the older, smaller Malawian study. This does not diminish the validity of Rosenberg et al.'s findings for their specific context and time period, but rather underscores the importance of considering temporal and contextual factors when interpreting screening data.

5.3 The Role of Antiretroviral Therapy in Modifying Cervical Cancer Risk

A central objective of this study was to assess the association between ART use and cervical cancer risk among HIV-positive women. The findings revealed a non-significant trend toward higher VIA positivity among HIV-positive women (aOR = 1.72, 95% CI: 0.60–4.96), but the wide confidence intervals and lack of statistical significance preclude definitive conclusions. More importantly, the substantial missing data on ART history (68% of HIV-positive women had no documented ART start date) severely constrained the analysis of ART duration and its relationship to cervical outcomes.

5.3.1 The Incomplete Protective Effect of ART

The literature consistently demonstrates that while ART confers significant benefit through immune reconstitution, it does not fully normalise cervical cancer risk. The systematic review by

Swase et al. (2025), which examined 80 studies on the impact of ART on HPV persistence and cervical cancer progression among women with HPV/HIV co-infection, concluded that "ART adherence and duration were associated with improved outcomes, but not complete lesion resolution" (Swase et al., 2025, p. 4012). This finding is critical for interpreting the current study's results.

The finding that HIV-positive women at MSMC had a 7.2% VIA positivity rate compared to 4.1% among HIV-negative women, while not statistically significant, challenges the assumption that ART fully normalises cervical cancer risk. This study thus agrees with Swase et al. (2025) and Kelly et al. (2019) that HIV remains a relevant risk factor even in the ART era, but disagrees with the magnitude of effect suggested by pre-ART studies. The attenuated odds ratio of 1.72, while imprecise, is more consistent with contemporary evidence from large programmes (Rao et al., 2023) than with historical estimates of six-fold increased risk. This suggests that while the biological synergy between HIV and HPV persists, its clinical manifestation has been substantially modified by immune reconstitution.

The observation that HIV-positive women in the MSMC cohort had a 7.2% VIA positivity rate compared to 4.1% among HIV-negative women, despite presumably high ART coverage (though poorly documented), is consistent with the understanding that ART reduces but does not eliminate excess risk. The non-significant adjusted odds ratio of 1.72, while attenuated compared to the six-fold increased risk documented in the pre-ART era (Kelly et al., 2019), aligns with the expectation that widespread ART access modifies the relationship between HIV and cervical neoplasia.

5.3.2 The PEPFAR Hypothesis: ART as Explanation for Lower Positivity

The PEPFAR analysis of 2.8 million screening tests provides crucial context for interpreting the MSMC findings. The authors explicitly state that the observed positivity rates (6.1% overall) are "lower than expectations set by the published literature" and hypothesise that this may be "attributable to the high level of consistent antiretroviral therapy use among these populations" (Rao et al., 2023, p. 7). This hypothesis directly supports the interpretation that the relatively low positivity rate among HIV-positive women at MSMC (7.2%) and the attenuated association with HIV status reflect the protective effect of ART in a population with good treatment coverage.

The PEPFAR analysis also documented declining positivity rates over time among women screening for the first time and among those returning for routine rescreening, further supporting the hypothesis that ART scale-up and programme maturation are associated with decreasing burden of cervical precancer among women living with HIV (Rao et al., 2023).

5.3.3 The Zambian Context: Modelling and Empirical Evidence

Modelling studies have attempted to quantify the burden of cervical disease among HIV-positive women in Zambia and project the impact of interventions. One modelling study estimated that among HIV-positive women aged 20–44 years in Zambia, approximately 34,000 have CIN3 and 7,300 have invasive cervical cancer in the base case scenario, with estimates increasing when adjusted for ART status (Hall et al., 2021). This modelling underscores the substantial burden of disease that persists despite ART availability.

Empirical evidence from Zambia also supports the modifying role of ART engagement. Mwamba et al. (2021) found that among HIV-positive cervical cancer patients, longer duration of HIV infection was associated with 20% lower odds of initial metastatic cancer diagnosis, suggesting that women with longer-standing HIV infection and presumably longer ART exposure may benefit from earlier detection through engagement with the healthcare system. Trejo et al. (2020) similarly found that among HIV-positive patients, longer duration of infection was associated with lower odds of progression, pointing to the potential modifying role of ART and sustained healthcare engagement.

These findings from Zambian populations reinforce the importance of the current study's focus on ART and cervical cancer risk, while also highlighting the critical need for complete ART documentation to enable robust analysis of these relationships.

5.4 The Screen-and-Treat Cascade: A Critical Failure Point

One of the most operationally significant findings of this study was the breakdown in the screen-and-treat cascade, with only 40% of VIA-positive women receiving immediate definitive treatment and 20% having no documented intervention whatsoever. This finding demands urgent attention and warrants comparison with programme performance data from other settings.

5.4.1 Comparison with CCPPZ Cascade Data

The CCPPZ programme data provide a benchmark for cascade performance in Zambian public sector screening. In the analysis covering 2006–2013, out of 20,419 VIA-positive women, 11,508 (56.4%) were treated with cryotherapy, and 8,911 (43.6%) were referred for histopathologic evaluation (Parham et al., 2015). Importantly, the programme reported that 87% of women received same-day services, including 5% undergoing same-visit cryotherapy and 82% screening VIA-negative.

The 56.4% treatment rate among screen-positive women in the CCPPZ programme is higher than the 40.0% observed at MSMC, suggesting that the Maina Soko service may be underperforming relative to national programme benchmarks. However, several caveats are necessary. The CCPPZ data represent a mature, well-resourced programme with dedicated funding, extensive training, and quality assurance mechanisms. The current study at MSMC may reflect a smaller-scale service with fewer resources and less systematic quality oversight.

5.4.2 The Challenge of Loss to Follow-Up

The finding that 20% of VIA-positive women had no documented intervention is particularly concerning. This represents a catastrophic failure point in the prevention cascade, as the benefit of early detection is realised only through effective and timely management. The literature consistently identifies loss to follow-up after a positive screen as a predominant and pervasive challenge in sub-Saharan African screening programmes (De Vuyst et al., 2023).

The SUCCESS II initiative, which supports cervical cancer prevention in six Francophone African countries, has documented similar challenges. The programme identified delays of 10 to 20 days between sampling and analysis in several countries due to absent structured transport systems, and worked to establish dedicated transport circuits that reduced these delays to five to seven days (Tincho et al., 2024). This example illustrates both the nature of the challenge and the potential for targeted systems strengthening to improve cascade completion.

5.4.3 Implications for Programme Performance

The cascade failures identified at MSMC are not unique but reflect broader health system constraints documented across the region. The SUCCESS II initiative noted that implementation is often "hindered by persistent operational constraints: limited laboratory capacities, irregular organisation of sample transport, heterogeneity of triage models, variable availability of treatment and loss to follow-up after a positive test" (Tincho et al., 2024, p. 3). These observations directly mirror the challenges identified in the current study, even in a setting where screening and treatment are nominally integrated within a single facility.

The finding that 26.7% of VIA-positive women were prescribed antibiotics rather than receiving definitive treatment raises questions about diagnostic accuracy and clinical decision-making. While some aceto-white lesions may represent inflammation rather than true precancer, the appropriate response should be repeat screening after treating infection, not simply antibiotic prescription without documented follow-up. This pattern suggests potential gaps in provider training or adherence to clinical protocols.

5.5 Temporal Patterns and Service Delivery Models

The analysis of monthly screening distribution revealed a distinct, non-uniform pattern indicative of campaign-style delivery, with over 44% of all screenings concentrated in a two-month period. This finding has important implications for programme sustainability and effectiveness.

5.5.1 Campaign-Based versus Routine Service Delivery

The temporal clustering observed at MSMC contrasts with the ideal of routine, integrated screening services embedded within ongoing clinical care. The CCPPZ programme, while initially establishing services through targeted expansion, ultimately achieved a model where screening became a routine component of HIV care visits (Parham et al., 2015). The PEPFAR analysis, covering 2.8 million screens across 13 countries, similarly reflects sustained, routine service delivery rather than episodic campaigns (Rao et al., 2023).

Campaign-based delivery models have several limitations. They may miss women who are not present during campaign periods, create inequities in access, and fail to establish screening as a normative expectation of routine care. Additionally, campaign-style services may struggle to

maintain provider skills between campaigns and often lack robust systems for tracking and follow-up.

5.5.2 The Zambian Context of Campaign-Style Delivery

The reliance on campaign-style delivery at MSMC may reflect broader patterns in Zambian health service implementation. While national policy advocates for integrated, routine screening, the reality at facility level often involves time-bound campaigns to achieve targets, particularly when services depend on external funding, temporary staffing, or limited-duration commodity supplies (Zambia Ministry of Health, 2022).

The missing dates for 13.0% of screening records further complicate interpretation of temporal patterns and may themselves reflect documentation gaps during periods of high activity or during transitions between campaign and routine service delivery.

5.6 Health Information Systems and Data Quality

A major limitation identified in this study was the substantial incompleteness of ART documentation, with 68% of HIV-positive women lacking a recorded ART start date. This finding transcends a mere research limitation to highlight a critical health information system weakness that impedes both clinical management and programme evaluation.

5.6.1 The Importance of ART Documentation

The inability to assess ART duration and adherence in the majority of HIV-positive women directly constrained the study's ability to address its primary objective. More importantly, this documentation gap has clinical implications. Without accurate ART histories, clinicians cannot assess whether women with cervical abnormalities are receiving optimal HIV treatment, evaluate the need for adherence support, or determine whether immunological failure might be contributing to cervical disease progression.

5.6.2 Regional Challenges in Health Information Systems

The challenge of incomplete documentation is not unique to MSMC. The SUCCESS II initiative documented similar challenges across multiple African countries, noting that "technical isolation complicates coherent implementation of screening" and that "implementation is hindered by persistent operational constraints" including fragmented health information systems (Tincho et al., 2024, p. 2). The programme worked to harmonise tools including registers, triage forms, and transport forms across countries, recognising that standardised documentation is foundational to both quality care and programme monitoring.

The PEPFAR analysis, while based on aggregate programme data, also implicitly acknowledges documentation challenges in noting that some data were excluded when age information was missing or when country-specific reporting fell below minimum thresholds (Rao et al., 2023). These exclusions reflect the reality that even large-scale, well-resourced programmes contend with data quality issues.

5.6.3 The Zambian Context

Within Zambia, the existence of both electronic and paper-based records at MSMC may paradoxically contribute to documentation gaps. Women may have ART start dates recorded in electronic HIV care systems that are not consistently linked to paper-based screening registers, or vice versa. The finding that only 25.6% of women had ART facility attendance documented in the screening record suggests that critical information is not being systematically transferred between service points, even within the same facility.

5.7 Methodological Considerations and Limitations

A rigorous interpretation of these findings requires a reflexive appraisal of the study's methodological strengths and limitations, and an understanding of how these may influence the validity and generalisability of the conclusions.

5.7.1 Study Design and Causal Inference

The retrospective cross-sectional design, while efficient for assessing prevalence and associations at a single point in time, fundamentally precludes causal inference regarding the relationship between HIV status, ART, and cervical abnormalities. The study can identify associations but cannot determine whether ART use causally reduces cervical cancer risk or whether observed associations reflect confounding by unmeasured factors such as duration of HIV infection, baseline immune status, or health-seeking behaviours.

This limitation is inherent to the design and acknowledged in the literature as a constraint of cross-sectional studies (Setia, 2016). However, as Swase et al. (2025, p. 4015) note in their systematic review, "due to the ethical and resource limitations in conducting randomized trials of the impact of HAART on incidence of HPV, CIN, and cervical cancer among HIV-infected women, it is important to consider innovative study designs, including quasi-experimental trials and operations research in sentinel populations." The current study, as an example of operations research using routine data, occupies an important niche in the evidence ecosystem even while acknowledging its limitations for causal inference.

5.7.2 Sample Size and Statistical Power

The final sample size of 270 women, while adequate for prevalence estimation, yielded only 15 VIA-positive events. This small number of outcomes resulted in limited statistical power for regression analyses and wide confidence intervals, increasing the risk of Type II error (failing to detect true associations). The non-significant trend toward higher odds among HIV-positive women (aOR = 1.72) may represent a true association that the study was underpowered to detect, rather than evidence of no association.

The confidence intervals around the adjusted odds ratio (0.60–4.96) are wide and include values that would be clinically meaningful, such as an odds ratio of 2.0 or 3.0. This imprecision means the study cannot rule out the possibility that HIV-positive women at MSMC have meaningfully higher odds of VIA positivity than HIV-negative women. The finding should therefore be interpreted as inconclusive rather than as evidence of no association.

5.7.3 Measurement and Information Bias

The reliance on VIA as the sole screening tool introduces the possibility of outcome misclassification. VIA is an inherently subjective test, with sensitivity and specificity varying based on provider training, experience, and the quality of supervision. The literature reports wide ranges for VIA accuracy, with positivity rates varying from 5.6% to 55.9% depending on setting and population (Sauvaget et al., 2011). Without documented quality assurance procedures, the possibility of misclassification cannot be excluded.

The use of routine service data also introduces information bias. ART documentation was substantially incomplete, and it is possible that women with documented ART histories differ systematically from those without such documentation. If women with better documentation are also those with more consistent care engagement, the analysis of ART-related factors may be biased.

5.7.4 Generalisability

The precise prevalence estimates may have limited generalisability beyond similar tertiary or military healthcare settings. The patient population at MSMC, comprising military personnel, dependents, and referred civilians, may differ from the general public or those attending primary care clinics in ways that influence screening outcomes. Military populations may have different occupational exposures, mobility patterns, and access to structured healthcare. These differences could affect both cervical cancer risk and engagement with screening services.

However, the study's findings regarding cascade failures and documentation gaps may be more broadly generalisable. These operational challenges are likely to be present in many facilities across Zambia and the region, regardless of patient population characteristics.

5.7.5 Validity and Reliability in Context

Despite these limitations, the study's findings possess validity and reliability within their specific context. The use of systematic random sampling minimised selection bias. The consistency of the overall positivity rate with large-scale PEPFAR data supports the external validity of this

estimate. The identification of specific operational failures treatment cascade breakdowns, campaign-style delivery, documentation gaps reflect real-world challenges that are unlikely to be artefacts of study design.

The study's strengths lie in its operational relevance and its demonstration of how routine data can be leveraged for programme evaluation. As the SUCCESS II initiative emphasises, "this regional support is today an essential lever for progress towards cervical cancer elimination goals" (Tincho et al., 2024, p. 1). The current study exemplifies this approach at facility level.

5.8 Synthesis and Implications

Synthesising the findings and their interpretation within the broader literature yields several key insights with implications for policy, practice, and research.

First, the overall VIA positivity rate of 5.6% at MSMC aligns closely with contemporary data from large-scale PEPFAR-supported programmes across sub-Saharan Africa. This convergence suggests that the MSMC service is achieving screening outcomes comparable to well-established programmes in the region. The lower-than-expected positivity among HIV-positive women (7.2%) compared to historical literature likely reflects the protective effect of widespread ART coverage, a hypothesis supported by the PEPFAR analysis (Rao et al., 2023).

Second, the non-significant trend toward higher odds among HIV-positive women (aOR = 1.72) is consistent with the understanding that ART reduces but does not eliminate excess cervical cancer risk. The failure to detect a statistically significant association likely reflects limited statistical power rather than absence of association, and the confidence intervals include values that would be clinically meaningful. This finding agrees with Swase et al. (2025) and Kelly et al. (2019) that HIV remains a relevant risk factor even in the ART era, but challenges the magnitude of effect suggested by pre-ART studies.

Third, the critical failures in the screen-and-treat cascade only 40% treatment completion, 20% with no documented intervention represent urgent priorities for quality improvement. These findings align with documented challenges across the region (De Vuyst et al., 2023; Tincho et al.,

2024) and demand immediate attention to strengthen linkages from screening to definitive management.

Fourth, the campaign-style delivery model and substantial documentation gaps reflect underlying health system weaknesses that undermine programme effectiveness. These challenges are not unique to MSMC but reflect broader constraints documented in multiple African countries. Addressing them will require sustained investment in health information systems, provider training, and service delivery integration.

Finally, the study demonstrates both the value and the limitations of using routine data for programme evaluation. While such data can provide crucial operational intelligence, their utility is constrained by documentation gaps and variable data quality. Strengthening routine health information systems is therefore not merely an administrative priority but a fundamental prerequisite for evidence-based programme management.

5.9 Summary

This discussion has critically interpreted the key findings from the operational analysis of cervical cancer screening at Maina Soko Medical Centre within the context of the broader literature. The 5.6% VIA positivity rate aligns with contemporary data from large-scale PEPFAR programmes, while the 7.2% positivity among HIV-positive women is lower than historical estimates, consistent with the hypothesis that widespread ART coverage modifies cervical cancer risk. The non-significant trend toward higher odds among HIV-positive women (aOR = 1.72) likely reflects limited statistical power rather than absence of association, and the convergence with large-scale data strengthens confidence in the validity of this estimate.

The study's most operationally significant findings the fractured screen-and-treat cascade, campaign-style delivery model, and substantial documentation gaps resonate with documented challenges across sub-Saharan Africa. These findings shift the focus from the mere act of screening to the quality and completeness of the entire patient care pathway. They underscore that achieving cervical cancer elimination goals in high-HIV prevalence settings requires not just integrated services, but robust health information systems, guaranteed treatment linkages, and sustained routine service delivery to convert screening effort into tangible health outcomes.

The methodological limitations, including the cross-sectional design, limited statistical power, and incomplete data, have been candidly appraised. These constraints do not invalidate the findings but rather situate them within the realities of operational research in resource-limited settings. The study's strengths lie in its operational relevance, its alignment with large-scale programme data, and its demonstration of how routine data can be leveraged for quality improvement.

CHAPTER 6: CONCLUSION AND RECOMMENDATIONS

6.1 Conclusion

This study aimed to determine the role of antiretroviral therapy on cervical cancer risks among women living with HIV/AIDS at Maina Soko Medical Centre. Three key conclusions emerge.

First, VIA positivity was 7.2% among HIV-positive women compared to 4.1% among HIV-negative women. Although not statistically significant, this direction aligns with evidence that HIV-positive women remain at elevated risk despite ART. The overall 5.6% positivity rate matches PEPFAR data from 2.8 million screens across 13 countries, confirming MSMC outcomes are comparable to regional programmes.

Second, ART documentation was critically incomplete. Sixty-eight percent of HIV-positive women lacked a recorded ART start date, directly constraining analysis of ART duration and cervical abnormalities. Where documented, nearly half had initiated ART before 2015, indicating substantial long-term treatment exposure. The documentation gap itself represents a health information systems weakness requiring urgent attention.

Third, while missing data prevented precise quantification, the 7.2% positivity among HIV-positive women is substantially lower than pre-ART estimates of 20–30%. This finding aligns with the hypothesis that widespread ART coverage modifies cervical cancer risk, a conclusion supported by large-scale PEPFAR data.

In summary, ART likely attenuates but does not eliminate cervical cancer risk among HIV-positive women at MSMC, though definitive quantification requires improved ART documentation.

6.2 Recommendations

Based on the study findings, the following recommendations are proposed for policy, practice, and future research.

For Policy and Clinical Practice

Strengthen health information systems. The Ministry of Health and facility managers should implement integrated, standardised records that capture ART start dates, regimens, and adherence alongside cervical screening histories within a single patient profile. This integration is essential for both clinical management and programme evaluation.

Transition from campaign-based to routine screening. Facility managers should embed cervical cancer screening into routine ART refill visits, family planning consultations, and general outpatient appointments to ensure equitable and consistent access throughout the year, rather than relying on episodic campaigns.

Close the treatment cascade gap. Clinical protocols must be implemented to guarantee that every woman with a positive VIA screen receives either immediate treatment or is scheduled for definitive management within a strictly defined period. The current 40% treatment completion rate is clinically unacceptable and urgently requires corrective action.

Enhance provider training. The finding that 26.7% of VIA-positive women received antibiotics rather than definitive treatment suggests potential gaps in clinical decision-making. Regular competency-based training and supportive supervision should be strengthened to ensure adherence to national screening and treatment protocols.

For Future Research

Conduct prospective cohort studies. Future research should employ prospective designs that systematically collect detailed longitudinal data on ART adherence, duration, CD4 counts, and viral load to enable precise quantification of how HIV disease progression and treatment modify cervical cancer risk.

Perform implementation science research. Mixed-methods studies are needed to explore the determinants, acceptability, and comparative effectiveness of different service delivery models, including the barriers and facilitators to transitioning from campaign-based to routine integrated screening.

Evaluate treatment linkage interventions. Focused operational research should assess specific interventions designed to improve treatment linkage, such as patient navigation systems, phone reminders, or enhanced point-of-care treatment availability, as improving the proportion of screen-positive women who complete treatment remains the most critical priority.

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APPENDICES

Appendix A: Structured Questionnaire

Title: Impact of HIV and ART on Cervical Cancer Risk among Women at Maina Soko Medical Centre

Instructions: Please answer the following questions honestly. Your responses will be kept confidential and used solely for research purposes.

Section A: Socio-Demographic Information

These questions help identify demographic factors that may influence access to healthcare, screening behavior, and cervical cancer risk.

Age: _____

Marital Status: ☐ Single ☐ Married ☐ Divorced ☐ Widowed

Education Level: ☐ None ☐ Primary ☐ Secondary ☐ Tertiary

Occupation: _____

Residence: ☐ Urban ☐ Peri-urban ☐ Rural

Section B: Sexual and Reproductive History

Sexual and reproductive factors are known contributors to cervical cancer risk. This section explores early sexual debut, multiple partners, and contraceptive use.

Age at first sexual intercourse: _____

Number of lifetime sexual partners: _____

History of STIs: ☐ Yes ☐ No

History of HPV infection: ☐ Yes ☐ No ☐ Unknown

Parity (number of children): _____

Use of contraceptives: ☐ Yes ☐ No

If yes, type: ☐ Oral ☐ Injectable ☐ IUD ☐ Other: _____

Smoking history: ☐ Yes ☐ No

Section C: HIV and ART History

This section captures HIV status and ART exposure, which are central to assessing their impact on cervical cancer risk.

HIV status: ☐ Positive ☐ Negative

If HIV-positive, duration since diagnosis: _____ years

On ART: ☐ Yes ☐ No

If yes, duration on ART: _____ years

Most recent CD4 count: _____ cells/mm^3

Most recent viral load: ☐ Suppressed ☐ Unsuppressed ☐ Unknown

Section D: Cervical Cancer Screening and Diagnosis

These questions assess screening history and outcomes, which are directly related to cervical cancer detection and risk.

Ever screened for cervical cancer: ☐ Yes ☐ No

Date of last screening: _____

Screening method used: ☐ VIA ☐ Pap smear ☐ HPV DNA test ☐ Unknown

Screening result: ☐ Normal ☐ Abnormal ☐ Not disclosed

History of cervical cancer diagnosis: ☐ Yes ☐ No

If yes, stage of cancer: ☐ I ☐ II ☐ III ☐ IV ☐ Unknown

HPV vaccination status: ☐ Vaccinated ☐ Not vaccinated ☐ Unknown

Appendix B: Data Extraction Tool

Patient ID: _____

Date of Record Review: _____

Variable

Data Extracted

Age

_____

HIV Status

☐ Positive ☐ Negative

Date of HIV Diagnosis

_____

ART Status

☐ On ART ☐ Not on ART

ART Start Date

_____

CD4 Count (most recent)

_____

Viral Load (most recent)

☐ Suppressed ☐ Unsuppressed ☐ Unknown

Cervical Cancer Screening Date

_____

Screening Result

☐ Normal ☐ Abnormal

Cervical Cancer Diagnosis

☐ Yes ☐ No

Cancer Stage (if diagnosed)

☐ I ☐ II ☐ III ☐ IV ☐ Unknown

Appendix C: Informed Consent Form

Title: Impact of HIV and ART on Cervical Cancer Risk among Women at Maina Soko Medical Centre

Principal Investigator: Mando Mwewa

Institution: University of Lusaka / Maina Soko Medical Centre

Introduction

You are invited to participate in a research study. The purpose of this study is to assess the impact of HIV and ART on cervical cancer risk. Your participation is voluntary.

Procedures

If you agree, you will be asked to answer a questionnaire and allow access to your medical records related to HIV, ART, and cervical cancer screening.

Risks and Benefits

There are no physical risks. The study may help improve cervical cancer prevention strategies.

Confidentiality

Your responses and medical data will be kept confidential. No names will be used in reporting results.

Voluntary Participation

You may decline or withdraw at any time without affecting your care.

Contact Information

For questions or concerns, contact:

Principal Investigator: Mando Mwewa

Consent Statement

I have read and understood the information above. I voluntarily agree to participate.

Participant Name: _____

Signature: _____

Date: _____

Witness Name: _____

Signature: _____

Date: _____

RESEARCH TIMELINE

ACTIVITY	AUGUST 2025	SEPTEMBER 2025	OCTOBER 2025	NOVEMBER 2025	DECEMBER 2025
Proposal Development					
Ethical Approval and pretesting					
Data Collection					
Data Analysis					
Report writing and submission					

BUDGET

ITEM	COST (ZMW)
Research assistants' allowances	2000
Printing and stationery	2000
Transport and logistics	2000
Data analysis software license	1500
Miscellaneous	1000
Total	8500