DETERMINANTS OF SELECTED HEALTH OUTCOMES AMONG INFANTS ENROLLED FOR EARLY INFANT DIAGNOSIS SERVICES OF HIV IN HOSPITALS IN NAIROBI COUNTY, KENYA

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Determinants of Selected Health Outcomes Among Infants Enrolled for Early Infant Diagnosis Services of HIV in Hospitals In Nairobi County, Kenya

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DECLARATION

This thesis is my original work and has not been presented for a degree in any other university or institution.

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DEDICATION

This work is dedicated to my dear parents Mr. and Mrs. James P. Kiilu, my loving husband Paul and, my beloved son Adrian for the spiritual, moral, financial, and emotional support that you have all accorded to me during the period of my studies.

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ABBREVIATIONS AND ACRONYMS

AHR	Adjusted hazard ratio
AIDS	Acquired immune deficiency syndrome
ANC	Antenatal clinic
AOR	Adjusted odds ratio
ARR	Adjusted relative risk
ART	Antiretroviral therapy
ARV	Antiretroviral
BMI	Body mass index
CCC	Comprehensive Care Clinic
CDC	Center for Disease Control and Prevention
CTX	Cotrimoxazole
DBS	Dried blood sample
EID	Early infant diagnosis
eMTCT	Elimination of mother to child transmission
HAART	Highly active antiretroviral therapy
HIV	Human immunodeficiency virus
HEI	HIV exposed infant
HR	Hazard ratio

IDR	Incidence density rate
IRR	Incidence rate ratio
JKUAT	Jomo Kenyatta University of Science and Technology
KM	Kaplan Meier
KASF	Kenya AIDS Strategic Framework
LMIC	Lower and Middle Income Countries
LTFU	Loss-to-follow-up
MCH	Maternal child health
OR	Odds ratio
MOH	Ministry of Health
PCR	Polymerase chain reaction
PITC	Provider Initiated Testing and Counseling
PLHIV	People living with HIV/AIDS
PMTCT	Prevention of mother to child transmission
POC	Point-of-care
RR	Relative risk
TAT	Turn-around-time
UNAIDS	Joint United Nations Program on HIV/AIDS
VCT	Voluntary Counseling and Testing

WHO World Health Organization

OPERATIONAL DEFINITION OF TERMS

Caregiver	Mother of the infant responsible for bringing the infant for EID services.
Delayed initiation into EID	Scenario whereby initiation into EID happens after six weeks of the infant's life.
Early infant diagnosis (EID)	The practice of testing babies for HIV within the first 4–6 weeks of life or at the earliest opportunity thereafter, and returning the virological test to the mother-infant pair at the latest within 4 weeks and the fast track care and treatment.
High viral load	Viral load levels >1000 copies/mL of blood.
Infant health outcomes	The three health outcomes of the study include the infant HIV and nutitional status and infant survival over tweleve months follow-up period..
Infant survival	Infants remaining HIV free during the study duration.
Low viral load	Viral load levels between ≥50 copies/mL - ≤1000 copies/ mL of blood.
Maternal ART adherence	A mother's ability to follow a treatment plan, take medications at prescribed times, frequencies, and quantities.
Mother-infant pair	A HIV positive mother and her infant.
Patient satisfaction	Perceptions of the patients towards the services and/or products offered to them in terms of meeting or exceeding their level of expectations.

Retention over 12 months	Scenario whereby the mother-infant pair attend all the scheduled clinic appointments clinics over the 12-month duration.
Sample turn-around-time	Duration of time taken from sample collection from infants for PCR testing to the relay of results to caregivers and healthcare providers.
Timely initiation into EID (Timeiness)	Infant initiation into EID before or at 6 weeks of life for care and treatment.
Undetectable viral load (Viral suppression)	Maintenance of viral load levels at <50 copies per mL of blood.

ABSTRACT

Pediatric HIV infection continues to be a public health concern due to the morbidity and mortality associated with the disease. Globally, mother to child transmission (MTCT) rate stands at 9% with sub-Saharan Africa accounting for 90% of these infections. In Kenya, the national MTCT rates stood at 11.5% by the end of 2018 and accounted for 8.9% of the global MTCT rates, with Nairobi County having a MTCT rate of 8.5%. The objective of this study was to determine selected health outcomes among infants enrolled for early infant diagnosis (EID) in selected hospitals in Nairobi County. The study was conducted at Mathare North and Kibera South Health Centres, and Mbagathi County Hospital. A prospective cohort study design was adopted whereby infants born to HIV positive mothers were followed up for one year. Simple random sampling was used to select 166 infants for the study. Data collected from the mothers included socio-demographic and socio-economic data, characteristics during PMTCT, disclosure status, nutrition data, and antiretroviral therapy adherence data. Service organization data for EID was collected from the healthcare providers while the availability of materials and equipment for EID service provision were observed by the researcher. Data were collected from the mothers using semi-structured interviewer-administered questionnaires and focus group discussion guides. Key informant guides were used to collect data from healthcare providers, while observation checklists were used to assess EID service organization. Quantitative data were entered in MS-Excel spreadsheets while cleaning, and analysis were done using STATA 14 software. Categorical variables were analyzed using measures of central tendency and proportions. Fisher's exact and Log-rank tests were used to test associations at the bivariable level while Poisson regression, Logistic regression, and Cox-regression were used to analyze data at the multivariable level. Qualitative data were transcribed, entered, coded, and analyzed manually using MS-Excel spreadsheets, and presented according to the emerging themes. Ethical approval was sought from Kenya Medical Research Institute, Scientific Ethics Review Unit-KEMRI/SERU/CPHR/002/3525. HIV incidence rate among infants over one-year follow up was 9 cases per 100 person-years (95% CI: 5.465 – 16.290). Non-disclosure of HIV status increased the risk of infant HIV positivity at 6 months (RR=5.33 CI: 1.40-19.45) and 12 months (RR=4.54 CI: 1.62, 12.37). Infant stunting was the worst form of malnutrition experienced an indication of chronic malnutrition in utero and early childhood. Underweight mothers had higher odds of infant stunting at 6 months relative to mothers who had a normal BMI (AOR= 4.76 CI: 1.36, 16.65). Prognostic factors associated with poor infant survival included young maternal age (18-24 years) and mothers with a recent HIV diagnosis of ≤ 2 years prior to study onset (HR 5.97 CI: 1.20, 29.58) and (HR 6.97 CI: 1.96, 24.76), respectively. In conclusion, young maternal age, poor maternal and infant nutritional status, and non-disclosure of HIV status lead to poor infant survival and increased risk of infant HIV positivity. The study recommended the creation of a special package of care for young mothers which will have more rigorous adherence and nutritional counseling, integration of full nutritional services (early identification, screening, and management of malnutrition) into the PMTCT and EID cascades of care, and the formulation of an HIV stigma and discrimination policy with targeted behavioral and structural interventions.

CHAPTER ONE

INTRODUCTION

1.1 Background information

HIV/AIDS infection continues to be a global public health concern causing marked mortality and morbidity amongst populations with an estimated global prevalence of 37.79 million by the end of 2018 and mortality of 770,000 people (2.03%). Out of the 37.79 million people infected with HIV globally, 1.7 million (4.49%) are children aged less than 15 years old (WHO, 2019). In 2018, new HIV infections were 1.7million (95% CI: 1.6-2.7 million) which was a 16% reduction from a high of 2.1 million (95% CI: 1.6-2.3 million) in 2010, a reduction still far from the 2020 target of less than 500,000 annual new infections and less than 5% and 2% MTCT rates in breastfeeding and non-breastfeeding infants respectively (UNAIDS, 2019). HIV is a preventable disease if effective prevention interventions are put in place to ensure the reduction of disease spread amongst adults and children (Yah & Tambo, 2019). Sub-Saharan Africa remains most severely affected by HIV, with nearly 1 in every 25 adults (3.9%) living with HIV and accounting for nearly 70% of the people living with HIV worldwide (UNAIDS, 2019). Further, in Eastern and Southern Africa, people living with HIV by the end of 2018 were 20.6 million (95% CI: 18.2-23.2 million), accounting for 54% of the global burden of HIV. Kenya had an HIV prevalence of 1.5 million (95% CI: 1.2-1.8 million) which translated to about 4.9% by the end of 2018 and PMTCT coverage of 92.1% by the end of 2018 (GOK, 2018).

MTCT of HIV can occur at 3 key stages; during pregnancy, delivery, and breastfeeding period. Interventions put in place to minimize the risk of MTCT include the offering of PMTCT services (before pregnancy or within the first trimester of pregnancy) and EID services (infant HIV testing within 4–6 weeks of life or at the earliest opportunity thereafter to link infants to care and/or treatment) (Abrams *et al.,* 2017). EID interventions primarily involve antiretroviral treatment for the mother and a short course of prophylaxis (Zidovudine for 6 weeks and Neveapine for 12 weeks) for the

HIV exposed infant or ART for the HIV positive infant. It also includes appropriate breastfeeding and feeding practices for infants (Ashino, *et al.,* 2017).

Globally MTCT rates stood at 9% by the end of 2018 with Sub-Saharan Africa accounting for 90% of these infections (WHO, 2019). Kenya had a MTCT rate of 11.5% by the end of 2018 with Nairobi having a prevalence of 8.5% (GOK, 2018). These rates can be reduced to below 5% and 2% in breastfeeding and non-breastfeeding infants respectively, if the EID cascade of care is adhered to correctly. EID is a key point for the implementation of early initiation of antiretroviral therapy (ART) and prophylaxis and is associated with lower mortality and morbidity in HIV-infected and exposed infant's respectively (Abrams *et al.,* 2017). The EID cascade includes the offer and acceptance of EID testing among HIV-exposed infants, including those for whom HIV exposure was unknown, accurate specimen collection, transport, and laboratory processing, relay of results to both healthcare providers and infants' families/caregivers, and linkage to care and treatment (NASCOP, 2014). The PMTCT and EID cascades of care are contained in the Kenya framework for eMTCT of HIV and syphilis (GOK, 2016), Guidelines on Use of ARV drugs for preventing HIV infection in Kenya (GOK, 2016), among other County-specific guidelines.

1.2 Statement of the problem

Pediatric HIV is a disease of public health concern associated with increased morbidity and mortality whereby without proper and prompt interventions one-third of the infected infants will die before they celebrate their 1st birthday and half of HIV infected infants will die before their 2nd birthday (Abrams, *et al.,* 2017). Globally, MTCT rates stood at 9% with Sub-Saharan Africa accounting for almost 90% of these infections. In Southern and Eastern Africa, the rate of MTCT stood at 9% (8-13%) with an EID coverage of 68% (CI 56-91%) in 2018 (UNAIDS, 2016). This is good progress but still below the global target of reducing MTCT of HIV to 5% and 2% or less in breastfeeding and non-breastfeeding mothers respectively (Taylor, *et al.,* 2017).

Kenya has the fifth largest number of persons living with HIV in the world and had a MTCT rate of 11.5% by the end of 2018 (accounting for 8.9% of the global MTCT

rates) and an EID coverage of 80% while Nairobi County had a MTCT rate of 8.5% by the end of 2018 (GOK, 2018). Despite the great reduction of MTCT rates in Kenya from 22.4% in 2009 to 11.5% by the end of 2018, MTCT remains higher than the desired targets of reducing MTCT rates to 5% and 2% or below among breastfeeding and non-breastfeeding infants respectively by 2021 (Taylor, *et al.,* 2017). Further, Kenya is set for pre-validation of eMTCT by 2021 whereby it is expected that there be ≥95% ANC coverage among all pregnant women (at least one ANC visit), ≥95% coverage of HIV testing among all the pregnant women, ≥95% ART coverage among all HIV positive pregnant women, and <50 new pediatric infections per 100,000 live births (GOK, 2018).

Some of these targets are yet to be achieved in Kenya whereby by the end of 2018 ANC coverage was 97.3%, HIV testing among pregnant women was 90.3%, ART coverage was 92.1%, and new pediatric infections were 514 per 100,000 live births (GOK, 2018 and DHIS, 2018). Some of these targets have not been met which have contributed to the unacceptably high MTCT rate of (11.5%) undermining the efforts of eMTCT by 2021. Poor infant nutritional status, stigma, and discrimination, and non-disclosure of HIV status are additional factors that have further undermined the efforts of eMTCT and increased pediatric mortality and morbidity (Belay & Wubneh, 2019). These identified gaps in this study have necessitated the researcher to undertake this study to identify the factors that influence the MTCT of HIV among infants enrolled for EID services.

1.3 Justification

Disease progression occurs rapidly in infants who acquire HIV infection and often leads to death without a prompt diagnosis, care, and treatment (Taylor *et al.,* 2017). Timely and accurate diagnosis of HIV exposed infants within the first year of their lives and retaining them throughout the EID cascade determines their survival rates over the next five years of their lives (Essajee *et al.,* 2017). Without prompt ART administration to pregnant HIV positive women, the HIV transmission risk during the pregnancy period, labor, birth, and breastfeeding periods is between 15-45% (UNAIDS, 2016) and (GOK, 2016). However, the risk of transmission goes to below

1% if ART is properly administered as per the recommended guidelines (GOK, 2016). High MTCT (11.4%) rate in Kenya, GOK, (2016) is associated with increased maternal and infant morbidity and mortality and undermines the efforts of achieving Sustainable Development Goal 3 that targets the ending of preventable deaths in mothers and their infants due to HIV infection and its related co-morbidities. This high MTCT rate can be reduced to less than 5% and 2% in breastfeeding and non-breastfeeding infants respectively by ensuring that the EID and PMTCT cascades are properly adhered to (Taylor *et al.,* 2017).

This study, therefore, identified maternal and facility-level factors that influence infant HIV status, nutritional status, and infant survival over a 12-month follow-up period and provided information on the challenges facing the EID program in Nairobi County. This then led to the development of various recommendations and interventions on how to reduce MTCT rates and improve infant survival as they receive EID services. These identified gaps in the EID cascade of care in this study must be addressed urgently to fast track eMTCT by 2021as stipulated in the eMTCT policy, GOK, (2016) to avert infant mortality and morbidity associated with MTCT of HIV in Kenya.

1.4 Research hypothesis

1. $H_{0:}$ There is no significant association between maternal factors and infant HIV status.

1.5 Research questions

1. What are the maternal factors influencing the HIV status of infants enrolled for EID services in selected hospitals in Nairobi County?
2. What are the maternal factors influencing the nutritional status of infants enrolled for EID services in selected hospitals in Nairobi County?
3. What are the maternal factors influencing the 12-month survival of infants enrolled for EID services in selected hospitals in Nairobi County?
4. What are the maternal factors influencing the HIV and nutritional statuses of infants enrolled for EID services in selected hospitals in Nairobi County?

5. What are the facility-level factors influencing the HIV and nutritional statuses of infants enrolled for EID services in selected hospitals in Nairobi County?

1.6 Study objectives

1.6.1 Broad objective

To determine the factors influencing selected health outcomes among infants enrolled for early infant diagnosis services of HIV in selected hospitals in Nairobi County, Kenya.

1.6.2: Specific objectives

1. To determine maternal factors influencing the HIV status of infants enrolled for EID services in selected hospitals in Nairobi County.
2. To determine maternal factors influencing the nutritional status of infants enrolled for EID services in selected hospitals in Nairobi County.
3. To determine maternal factors influencing the 12-month survival of infants enrolled for EID services in selected hospitals in Nairobi County.
4. To determine maternal factors influencing HIV and nutritional statuses of infants enrolled for EID services in selected hospitals in Nairobi County.
5. To determine the facility-level factors influencing HIV and nutritional statuses of infants enrolled for EID services in selected hospitals in Nairobi County.

The first three objectives addressed the quantitative aspect of the study while objectives four and five addressed the qualitative aspect of the study.

1.7 Theoretical framework and conceptual framework

1.7.1 Theoretical framework

A Framework for women-centered HIV/AIDS services

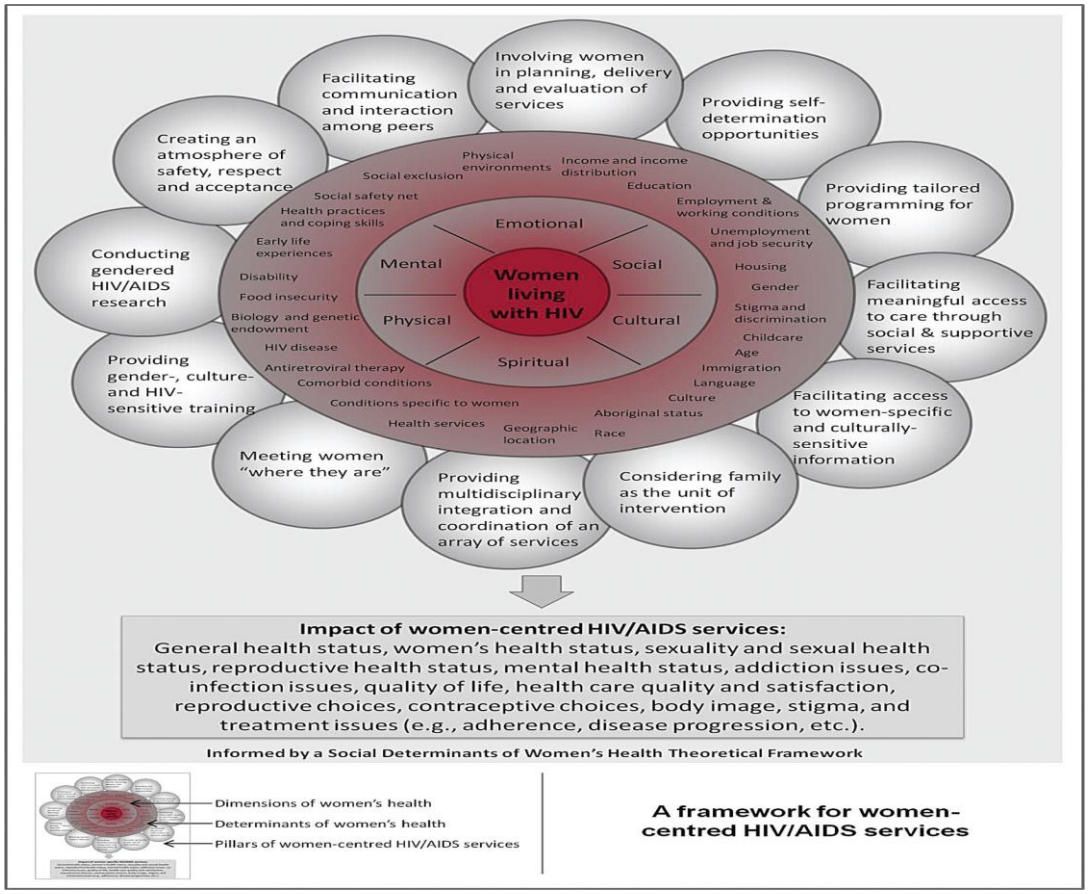


Figure 1.1: A summary of factors affecting the lives of HIV positive women

Source: Vancouver and Richmond Health Board, 2001.

The Framework for Women-Centred HIV/AIDS services was developed as a resource and guide to help with the planning and implementation of procedures, policies, and initiatives across the spectrum of health services affecting women in the various dimensions (Vancouver and Richmond Health Board, 2001). HIV positive women face many challenges that affect their health and their infants' health. Healthcare systems need to respond appropriately to provide comprehensive services that respond to their different requirements. Women's health involves their emotional, social, cultural, spiritual, and physical well being and is inherently determined by the social-cultural, biological, political, and economic contexts that they live in. Every woman should be given an opportunity to achieve, sustain, and maintain health as defined by the woman herself (Vancouver and Richmond Health Board, 2001). Further. a

woman's health will influence the health of her infant making it ncessary to improve maternal health for optimal infant health.

A woman's health is a product of several interconnected factors such as age, ethnicity, and culture, language, physiology, ability/ disability, financial circumstances, sexual orientation, religion and spirituality, education level, geography, housing, and access to information and services.

The three broad components of the framework for women-centered HIV/AIDS services include; Determinants of women's health, Dimensions of women's health, and Pillars for women-centered HIV/AIDS services.

1. Determinants of women's health

Determinants of women's health involve the following areas: Health matters such as co-morbid conditions, HIV/AIDS disease, biology, and genetic endowment, disability, health-seeking behavior/practices, physical environment, income, and income distribution, employment education, housing, gender issues such as age, culture and race, stigma and discrimination, aboriginal status, geographical location, social safety net, and social exclusion (Vancouver and Richmond Health Board, 2001). Women seek healthcare within the context and circumstances of their lives which affects how and when they seek services, and if they can access the services at all. Poverty is a limiting factor to women's access to service and is generally associated with ill health. Well scheduled appointment times around women working activities encourage good health-seeking behavior (Braveman *et al.,* 2011). Gender socialization encourages communication and understanding and women are also able to build friendships improving their self-esteem and reducing self-stigma and discrimination. Education not only provides a platform for employment but also provides a platform for self-development. Information shared and education offered to women need to be tailored to their needs (WHO, 2010). Living in a safe environment with access to good sanitary conditions is paramount to ensure good health behavior for women. A safe environment both at home and in healthcare facilities where patient confidentiality is

observed encourages women to seek services without fear of disclosing their HIV status (Bambra *et al*., 2010).

2. Dimensions of women's health

The dimensions of a woman's health encompass the physical, emotional, mental, spiritual, and social dimensions which affect her health-seeking behavior and ability to take care of herself and other family members. Poor social health can lead to feelings of isolation and emotional imbalance and can demotivate a person from engaging in physical activity and lead them to depression among other illnesses. This, in turn, affects their health, health-seeking behavior, and the health of those under their care.

3. Pillars for women-centered HIV/AIDS services

Pillars for women-centered HIV/AIDS services include involving women in planning, delivery, and evaluation of services, providing self-determination opportunities and women tailored programs, facilitating meaningful access to care through social and supportive services, providing gender, culture, and HIV-sensitive training, creating an atmosphere of safety, respect, and acceptance and finally facilitating communication and interaction among peers using programs such as mentor-mother (Vancouver and Richmond Health Board, 2001).

In conclusion, the above framework has been tailored to provide strategies to improve responses to the health needs of HIV positive women. Health is a product of the many interconnected factors listed above and rather than seeing these factors as "barriers," the Framework for Women-Centred HIV services attempts to recognize them as integral parts of each woman's life experience.

1.7.2 Conceptual framework

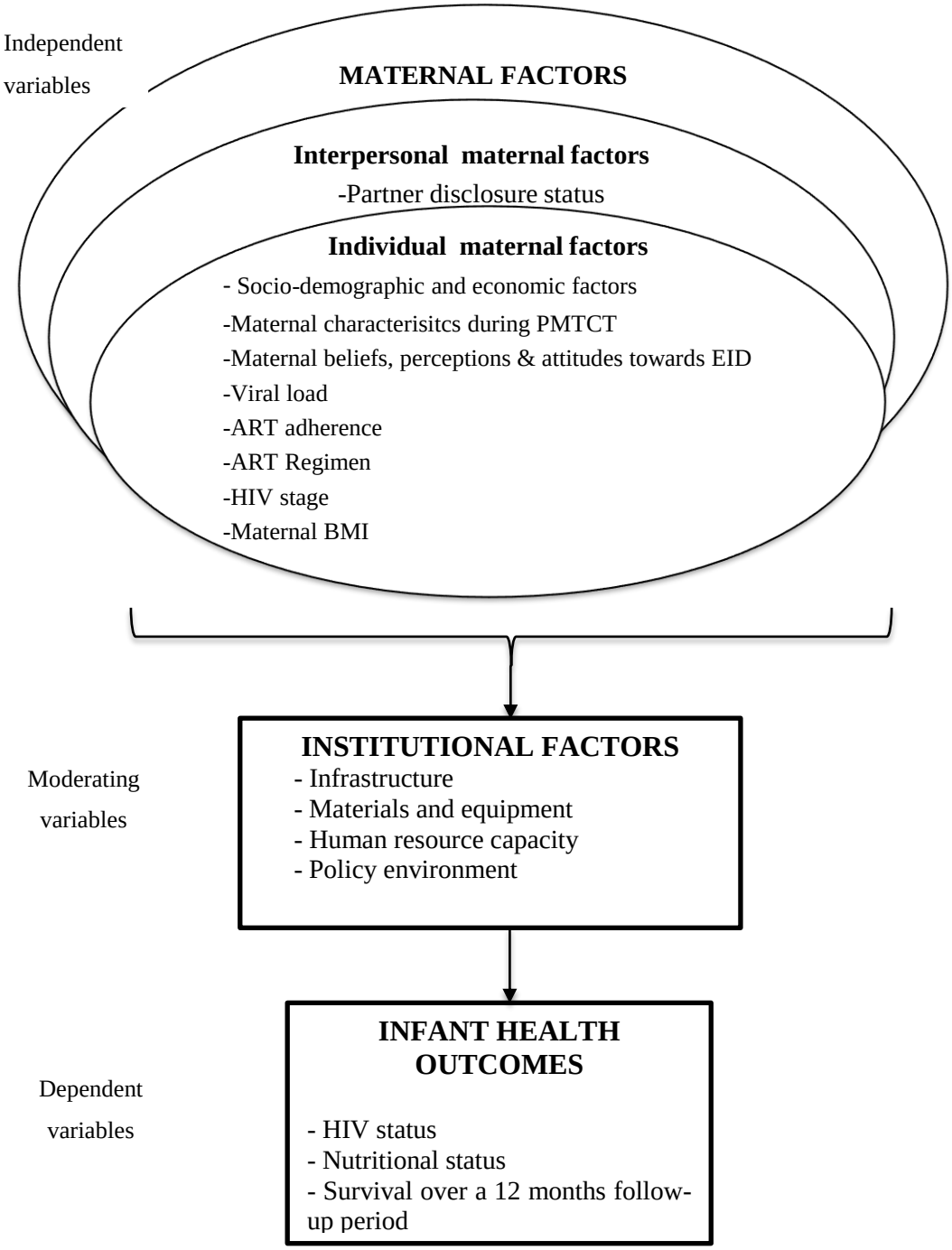


Figure 1.2: Conceptual framework on determinants of health outcomes among infants

Source: Modified from (Mosley & Chen, 1984) framework for child survival in developing countries.

The above Conceptual framework describes the research variables and how they interact as conceptualized by the researcher. HIV infected and exposed infants are completely dependent on the mothers to present them for initiation into the EID program for care and treatment therefore, the researcher must examine the factors that promote and/hinder the mothers as they bring the infants for the EID program. The actions of the mothers have a direct consequence on the infant health outcomes, therefore, strategies must be put into place to mitigate any challenges they face as they seek EID services for their infants and ensure that access to the EID program is acceptable and feasible for the mothers. Baseline maternal health parameters and outcomes were assessed to determine if they affected infant health outcomes included: ART adherence, maternal co-morbidities and opportunistic infections, maternal BMI, CD4 counts and viral load, HIV stage, awareness of HIV status before pregnancy, gestation at delivery, mode of delivery and partner disclosure.

Facility support factors refer to the work environment where the EID program is being undertaken. It involves the EID policies and SOP's put in place at the facility level, infrastructure for conducting EID services, materials and equipment for EID service delivery, and human resource capacity (in terms of training on EID and number of persons allocated to undertake EID service delivery). All these functions should be at an optimum to ensure the proper delivery of EID services, which in turn contributes to improved health outcomes for the infants.

Infant health outcomes that were observed included infant HIV status (positive or negative), infant nutritional status (wasting, underweight and stunting), and infant survival over 12 months follow-up. Infant survival event was the infant HIV negative status over a one-year follow-up. Specific parameters that were assessed included: (infant birth weight, height for age, weight for age, weight for height, breastfeeding and other feeding practices, viral load, number of hospitalizations, presence of any co-infections, ART/CTX adherence, clinic adherence, number of PCR tests done and the results). Infant follow-up was scheduled to coincide with the Kenya Expanded Program for Immunization (KEPI) timetable at 6, 10, and 14 weeks, and 12 months. The infants were also followed up 6 months as per the GOK EID schedule.

CHAPTER TWO

LITERATURE REVIEW

2.1 Overview of the HIV/AIDS pandemic and the global perspective of MTCT of HIV

Since the beginning of the HIV pandemic over 70 million people have been infected with HIV and about 35 million people have died of HIV. Globally, 36.7 million [95% CI: 34.0–39.8 million] people were HIV positive by the end of 2018. This translates to a global HIV prevalence of 0.48% [95% CI 0.45%-0.52%] (UNAIDS, 2019). Sub-Saharan Africa remains most severely affected, with nearly 1 in every 25 adults (4.0%) living with HIV and accounting for nearly 90% of the people living with HIV worldwide (UNAIDS, 2019). Southern and Eastern Africa contributed to 19.0 million (17.7 million–20.5 million) people living with HIV(PLHIV) globally, which is approximately half the number of PLHIV globally by the end of 2015, and also contributed to half of the new infections in 2015 globally amounting to 2.1 million (1.8 million–2.4 million) (UNAIDS, 2016). Kenya has the 5th largest number of persons living with HIV in the world UNAIDS, (2016) with a national adult HIV prevalence of 1.3 million (4.9%) (95% CI: 4.5%-5.3%) by the end of 2018. HIV prevalence among women was twice as high (6.6%) (95% CI: 6.0% 7.1%), compared to men at 3.1% (95% CI: 2.7% 3.5%) in Kenya (NASCOP, 2020).

Globally, by the end of 2018 MTCT of HIV accounted for 9% of all HIV infections whereby there were 1.3 [95% CI 1.0-1.6] million pregnant women with HIV in 2018 of which about 82% [95% CI 62%-95%] received ARV drugs for PMTCT of HIV. As of mid-2019, almost all of LMIC countries were fully implementing lifelong ART treatment following HIV diagnosis. Nearly all young children newly infected with HIV are infected through MTCT. The UNAIDS super fast-track targets aim at reducing new HIV infections among children to less than 40,000 by 2018 and less than 20,000 by 2020. This target is far from being reached since by end of 2018 there were 160,000 new infections (95% CI: 110,000 - 260,000) among children of which 86% of these were from Africa. This was a significant decline (41%) from what was seen in 2010

where 280,000 (95% CI: 190,000 - 430,000) children were newly infected by HIV. In 2018, 200,000 deaths were averted because of implementing PMTCT interventions globally in children under 5 years of age (WHO, 2020).

The global EID coverage in 2018 was as follows; in Central and Eastern Europe/Commonwealth Independent States (CEE/CIS) region had the highest coverage of EID of all regions at 72% (although the uncertainty range around the estimates is very wide from 49% to greater than 95%), followed by Southern and Eastern Africa at 51%, Caribbean and Latin America at 42% and the Pacific and East Asia at 30%, Central and West Africa at 9% while EID coverage in South Asia stood at only 2% (WHO, 2018).

In Eastern and Southern Africa, there were approximately 900,000 infants born of HIV positive mothers of which 92% (95% CI: 69%-95%) of these mothers received ART to prevent MTCT of HIV and to protect their own lives in 2018, a marked increase from 49% (95% CI 37%-59%) in 2010. Cumulatively, 68% (95% CI: 56%-91%) of these infants received a virological test by 8 weeks of age. The rate of MTCT decreased from 18% (95% CI: 15%-25%) in 2010 to 9% (95% CI 8%-13%) in 2018. EID coverage in the same year (2018) was recorded at 68% (95% CI: 56%-91%), this low coverage would be improved if point-of-care diagnostic technology was incorporated in the EID and PMTCT programs (UNAIDS, 2019).

Kenya is one of the 22 UNAIDS priority countries in the world accounting for 90% of MTCT of HIV and is focused on the eMTCT of HIV by 2021. In Kenya, the National MTCT rates stood at 11.5% by the end of 2018 (accounting for 8.9% of the global MTCT rates) with Nairobi County having an MTCT rate of 8.5% (GOK, 2018). Wajir had the highest MTCT rates of 32.6% with Mombasa County recording the lowest MTCT rates of 3.4%. To achieve eMTCT by 2021 Kenya needs to achieve less than 50 new infections per 100,000 live births and the 95:95:95 goal that encompasses 95% HIV testing for all pregnant women, 95% treatment ART coverage for HIV positive pregnant women, and 95% ANC coverage for all pregnant women (at least one ANC visit). Kenya's progress towards the achievement of these goals has been remarkable but still, some targets have not been achieved. The NASCOP (2020) Kenya

population-based HIV impact assessment (KENPHIA) report showed that by the end of 2018 ANC coverage was 97.3%, HIV testing among pregnant women was 96.0%, ART coverage was 92.1% while GOK, (2018) HIV progress report showed that PMTCT coverage was 77%. Despite most of these targets being met, the MTCT rates in Kenya continue to be unacceptably high (11.5%) undermining the efforts of eMTCT by 2021.

2.2 Global and Regional efforts towards the eMTCT of HIV

In 2011 UNAIDS launched the global plan towards the elimination of new HIV infections among children by 2015 and keeping their mothers alive, which prioritized a set of countries that accounted for 90% of the global number of pregnant women living with HIV. The 22 UNAIDS priority countries that account for 90% of all MTCT HIV infections and are targeted for interventions to reduce MTCT include Malawi, Swaziland, Botswana, India, Zambia, Democratic Republic of the Congo, Angola, United Republic of Tanzania, Lesotho, Cameroon, Mozambique, Ethiopia, Ghana, Nigeria, South Africa, Namibia, Burundi, Côte d'Ivoire, Uganda, Kenya and Chad (UNAIDS, 2016). The aim is to reduce MTCT to 5% and 2% or less among breastfeeding and non-breastfeeding women respectively by 2020 and eMTCT by 2030 (USAIDS, 2019). Globally, only 16 countries have been validated for achieving eMTCT by the end of 2019. These countries are in Asia and America and include Maldives, Sri-Lanka, Malaysia, Anguilla, Antigua, Barbuda, Bermuda, Cayman Islands, St. Christopher, Nevis, Armenia, Belarus, Thailand, and Cuba. Maldives and Sri-Lanka are the latest countries to achieve eMTCT in 2019 (UNAIDS, 2016).

WHO, (2019) certified Maldives as having eMTCT following confirmation and certification by national, regional, and global teams that no woman or infant was newly detected with HIV. Some strategies that have been used in the Maldives to eMTCT of HIV include universal access to ANC and HIV screening for all pregnant mothers with almost all births taking place in the healthcare facilities (UNAIDS, 2016). To sustain these achievements, the country needs to expand healthcare services to all migrant populations where many of these migrants come from countries with endemic

transmission of HIV. Expansion of universal coverage to ensure quality healthcare delivery is also key in maintaining eMTCT in the Maldives.

Sri Lanka has not reported any new cases of MTCT of HIV since 2017 and was certified to have eMTCT of HIV in December 2019. Strategies that were used to achieve the eMTCT of HIV included the screening of all pregnant women and ensuring 97% are on ART, ensuring accessible and stigma-free HIV services for all HIV positive women (WHO, 2019).

A HIV positive mother can transmit HIV to her infant during the pregnancy period, during labor, and delivery, or during the breastfeeding period. In the absence of any intervention, transmission rates range from 15% to 45% (GOK, 2016 and UNAIDS 2016). This rate can be reduced to below 5% with effective interventions during the periods of pregnancy, labor, delivery, and in the breastfeeding period (UNAIDS, 2016). These interventions primarily involve antiretroviral treatment for the mother and a short course of antiretroviral drugs for the baby. They also include measures to prevent HIV acquisition in the pregnant woman and appropriate breastfeeding practices (Kuona *et al.,* 2014). Antenatal screening for HIV and syphilis for all pregnant women and the treatment of HIV among infected women prevent MTCT of HIV and aligns with the sustainable development goal 3 (SDG 3) that targets to end preventable death among children under the age of 5 years. This facilitates universal access to reproductive healthcare services for all women and the achievement of universal health coverage (Taylor *et al.,* 2017).

Evidence has shown that diagnosing infants with HIV and starting antiretroviral therapy (ART) as early as possible improves their health outcomes in terms of morbidity and mortality attributed to HIV/AIDS (Ashino *et al.,* 2017). EID is the practice of testing babies for HIV within the first 4-6 weeks of life or at the earliest opportunity thereafter. WHO (2018) recommends that the test results from virological testing in infants should be returned to the healthcare providers and caregivers as soon as possible, but at the latest within two weeks of the sample collection. Positive test results should be fast-tracked to the mother-baby pair as soon as possible to enable prompt initiation of ART (UNAIDS, 2016). Subsequent tests should be undertaken at

6 months, 12 months, and 18 months. Additionally, mothers who continue breastfeeding after 18 months, an antibody test should be undertaken at 4 weeks after cessation of breastfeeding.

EID is a key-point for implementing early initiation of ART and is associated with lower mortality and morbidity in HIV-infected infants (Tejiokem *et al*., 2011). WHO (2016) recommends that infants exposed to HIV be tested at 4 to 6 weeks of age, using a virological test. ART should be started as soon as an infant is diagnosed with HIV, regardless of clinical and immune system status (GOK, 2016). Birth testing is being considered in many countries, especially in infants born to mothers who have not received PMTCT services. EID of HIV confers substantial benefits to HIV exposed infants', their families, and healthcare programs providing PMTCT services but have been challenging to implement in resource-limited settings (Alusio *et al.,* 2016).

To correctly inform caregivers of infant infection status and link HIV-infected infants to care and treatment, a successful cascade of events must occur and includes: the offer and acceptance of EID testing among HIV-exposed infants, accurate specimen collection, transport, and laboratory processing, relay of results to caregivers/parents and healthcare providers, and linkage to care and treatment for the HIV exposed infants (Ashino *et al.,* 2017).

2.3 Maternal factors influencing infant HIV status

2.3.1 Maternal health-seeking behavior during pregnancy

Since the first effective ART regimen for PMTCT of HIV was reported in 1994, the outlook for children born to HIV positive mothers has improved dramatically. In high-income countries, MTCT of HIV has been virtually eliminated (UNAIDS, 2016). Today, steadily expanding coverage of the most effective ARTs together with novel approaches to providing them, offer hope that MTCT can also be virtually eliminated in low-and middle-income countries. Reducing MTCT to less than 5% of breastfeeding infants and less than 2% of non-breastfeeding infants is an important target of the Global Plan (WHO, 2014). This means reaching about 1.5 million (95% CI 1.4

million–1.7 million) pregnant HIV positive women annually, based on 2016 estimates (UNAIDS, 2016).

Adequate maternal screening, treatment, and infant follow-up are the cornerstone for the eMTCT in all regions of the world. In the event that no interventions are put in place, approximately between 15% and 45% of infants born to HIV positive women will acquire HIV, 5–10% during pregnancy, 10–20% during labor and delivery, and 5–20% through breastfeeding (Bwana *et al.,* 2016). Great strides have been made in improving the quality of PMTCT services in Low and middle-income countries whereby approximately 900,000 (89%) HIV positive pregnant women were given ART for PMTCT in 2015 (Taylor, *et al.*, 2017). High maternal knowledge is attributed to improved EID, in a study conducted by Makau, *et al.,* (2015), which led to improved health-seeking behavior in the mothers and good infant health outcomes. Other maternal factors that undermine adequate health-seeking behavior include inadequate knowledge on PMTCT interventions, poor maternal adherence to ART, food insecurity, cultural barriers, inaccurate health information and social support, and overcrowded health systems that cause long waiting times (Nabwera, *et al.,* 2017).

2.3.2 Access to ART and adherence

Achieving optimum ART adherence remains a major challenge in many countries yet to sustain viral load suppression (WHO, 2014). HIV-infected children need high levels of adherence with a minimum of 90% of the prescribed medications being taken (UNAIDS, 2016). The WHO (2014) defines ART adherence as the extent of people's behavior in taking ART corresponds to the recommendations given by healthcare providers. ART adherence of above (90%) is essential in ensuring the suppression of viral replication and improving clinical and immunological outcomes, decreasing the risk of ART drug resistance, and reducing the risk of transmitting HIV. Multiple and cross-cutting factors influence ART adherence, including factors related to the healthcare systems, individual factors, and community-based factors (Buregyeya, *et al.*, 2017). Individual factors may include forgetting to take one's daily ART dose due to various reasons, substance abuse, depression, lack of desire to take ART, socio-economic challenges, and changes in daily routine. Medication-related factors

including drug side effects, adverse drug reactions, complexities of dosing schedules, pill burden, and dietary restrictions. Health system factors incuding direct and indirect costs of seeking ART, ART continuous availability, long waiting times, inappropriate clinic appointment schedules, and distance to the healthcare facilities offering ART (UNAIDS, 2016). Community-related factors which include stigma and discrimination, lack of community support, and issues related to disclosure of HIV status. In pregnant and post-partum women biological factors such as low appetite, nausea, and vomiting negatively affect treatment adherence (Buregyeya, *et al.*, 2017).

HIarlaithe *et al.,* (2014) identified transport costs as a barrier to accessing services, alongside other barriers such as disclosure, stigma, and discrimination. Observational studies in industrialized countries and a randomized clinical trial in South Africa showed that early initiation of HAART in infants dramatically reduces morbidity and mortality (WHO, 2016; Joint United Nations Programme on HIV/AIDS, 2011). WHO, therefore, recommends the systematic and early ART initiation for all HIV infected infants irrespective of their CD4 count or WHO clinical stage, within the first year of the infant's life. Thus, early diagnosis of HIV infection in infants is essential to reduce the morbidity and mortality associated with infant HIV infection.

In Malawi, in-depth interviews with HIV-infected pregnant women and mothers to identify barriers in accessing HIV testing and care for their infants were undertaken (Marie *et al*., 2012). The findigs showed that lack of knowledge about the importance of EID and ART, fear of HIV status disclosure, stigma from the community, lack of autonomy for the mothers in making decisions without their husbands' approval, lack of psychosocial support, and emotional triage (desire to reserve personal energy and resources for the children more likely to survive) were barriers to accessing HIV testing and care.

In Ethiopia, Biadgilign *et al*., (2009) study on HIV-infected pregnant women identified that lack of adequate knowledge on PMTCT interventions, fear of stigma and discrimination from the community, difficulty in disclosure of HIV status, lack of nutritional support, heavy pill burden, lack of adequate transportation and economic problems in the household were contributory barriers of accessing care and testing for

infants. Education and technology were factors that could be used to overcome some of these barriers. Queen *et al*., (2012) study showed that informational campaigns both in the community and on a provider-to-patient level could help improve knowledge about the importance of early initiation of ART in infants and consequently improve ART adherence. Additionally, the authors posited that the development of point-of-care HIV testing for infants would help minimize attrition due to parents never receiving test results.

Ebuy *et al.,* (2015) study showed that children whose mothers defaulted on their maternal ART doses showed a 20 fold increase in non-adherence compared to children whose mothers were adherent to their maternal ART regimens. The authors further found that children whose mothers defaulted on ART were at a higher risk of ART non-adherence and subsequent infant treatment failure. Since maternal ART non-adherence impacted negatively on children's ART adherence an opportunity exists to improve children's ART adherence by addressing the underlying causes that contribute to maternal non-adherence. Previous studies in populations of women and children similar to the study by Ebuy et al., (2015) have reported that underlying factors such as poverty, low levels of education, ignorance, and stigma reduce maternal ART adherence (Imbaya *et al.,* 2014). A study in Uganda by Izudi *et al.,* (2017) showed that late HIV diagnosis during pregnancy and absence of prophylaxis for PMTCT were significantly and independently associated with a higher risk of ''incomplete EID process''.

Christopher *et al.,* (2015) study in Kenya found that the overall adherence to ART among infants born to HIV positive women was 76 (91%) and that reasons for non-adherence included running out of drugs (commonest reason), forgetting to administer the drugs, worry of the side effects of the drugs to the infant (least common reason), baby refusing to take medication, on-looking strangers and family members, mother busy with other children and baby too ill to take medication. The authors also noted that poor maternal ART adherence leads to poor infant adherence whereby infants whose mothers skipped taking their maternal ARTs had up to 23-27 higher chances of failing to take their pediatric ART doses. Other child-related factors that the authors

tested included the method of delivery, gender, method of feeding, age, and birth weight and were found not to influence their ART adherence significantly. Maternal factors such as maternal age, family income, level of education, working status, and marital status were tested and also found not to influence ART adherence among the infants. Infants who were PCR positive and receiving HAART exhibited significantly higher levels of non-adherence compared to PCR negative infants that were receiving prophylactic ART regimens.

2.3.3 Stigma and discrimination

The UNAIDS (2019) defines stigma as a mark of shame, disapproval, or disgrace that results in one being excluded from participating in community activities or rejected because of being different or being perceived to be different. Discrimination is enacted stigma. HIV-related stigma is evident in fear-driven negative attitudes, judgments, and behaviors towards PLHIV, their partners, and families. Stigma and discrimination pose a barrier to access and adherence to treatment and programs that support PLHIV (Feyissa *et al.,* 2019). The global target to end the AIDS pandemic by 2030 can only be realized after addressing matters surrounding stigma and discrimination that hinder access to HIV services among PLHIV (Pulerwitz *et al.,* 2014; UNAIDS, 2019). Stigma and discrimination among PLHIV are manifested in various settings including in the healthcare setting, the community, and within the households.

Stigma and discrimination within the healthcare setting manifest in the form of delay or denial of treatment, unnecessary referrals because of a person's HIV status, breaching confidentiality, gossip, negligence, and excessive differential precautions (Stutterheim *et al.,* 2014). Hence, some PLHIV are not seeking healthcare services because of fear of stigma and discrimination. Stigma and discrimination are associated with poor mental and physical outcomes, reduced income for PLHIV, and low social support (Endeshaw *et al.,* 2014). Gesesew *et al.,* (2017) found that PLHIV who perceived stigma and discrimination at high levels were 2.4 times more likely to delay enrollment until they were very ill, which sometimes could lead to poor health outcomes due to delayed initiation into care and treatment.

In 2008, the Global Network of People living with HIV (GNP), the International Community of Women Living with HIV (ICW) and UNAIDS developed and launched a stigma index tool to determine the extent, magnitude, and effects of stigma and discrimination among PLHIV. Currently, over 100 countries have undertaken the stigma index surveys with over 100,000 PLHIV participating in the process. In countries with available data (19 countries globally), 25% of PLHIV reported having some form of stigma and discrimination within the healthcare set-up (GNP, 2020).

The Dominican Republic stigma index survey found that the most commonly reported manifestation of stigma and discrimination that the HIV positive women experienced was discriminatory remarks made by family members (27%) and non-family members (36%) (Dominican Republic, 2019). Recommendations given to reduce stigma and discrimination in the country included the sensitization of the community on the rights of PLHIV including the sensitization of employers on labor laws for PLHIV. Other recommendations included ensuring the availability of clinical and social services to support disclosure particularly among marginalized PLHIV and improving literacy on the rights of PLHIV, including the provision of psychosocial services and referral services for specialized mental healthcare.

In the Republic of Moldova, the stigma index conducted in 2018 revealed that 39.3% of the respondents experienced discrimination in the past 12 months. In particular, discriminatory treatments were subjected to young persons (18-24 years) (43.9%), those that had a recent HIV diagnosis of less than one year (48.1%), PLHIV for 15 years or more (55.4%), and those who were single (50.8%) (Republic of Moldova, 2018). Some of the consequences of stigma and discrimination that PLHIV faced in Moldova included difficulties to rent a home (10%), loss of jobs or some other sources of income (2.4%), and refusal to be offered sexual and reproductive rights within the healthcare set-up (2.0%).

A study conducted by NACC (2014) was among the first surveys to be conducted in Kenya to assess the HIV/AIDS stigma index nationwide in Kenya. NACC found that the stigma index was high at 45%. Key indicators that were assessed included: peoples fear of contracting HIV from non-invasive contact with PLHIV, people who blame or

judge PLHIV for their illness, PLHIV who have experienced stigma in the last year, PLHIV who are concerned about disclosing their HIV status, and PLHIV who experienced stigma's negative effects from their families or the community. Each of these indicators was scored on a 100-point scale. The indicators that had the worst outcomes were PLHIV who were concerned about disclosing their HIV status (70 units) and PLHIV who experienced stigma's negative effects from their families or the community (74 units). NACC recommended the creation of awareness on the existence of legal frameworks and institutions for PLHIV and targeted educational packages for communities and individuals to reduce stigma and discrimination. Currently, there is no specific policy or standard operating procedures for the reduction of stigma and discrimination in Kenya however the Kenya HIV/AIDS prevention and control Act 2006 stipulates the legal rights for PLHIV and protection against stigma and discrimination at the workplaces and within the community set-up. There also exists an HIV/AIDS tribunal of Kenya that fights for the rights of PLHIV including the right not to be stigmatized or discriminated upon.

The Kenya AIDS Strategic Framework (KASF) policy document has 4 key strategic objectives, one of which is to reduce stigma and discrimination related to HIV by 50% by the end of 2019 (GOK, 2014). Some recommendations that were given by KASF to reduce stigma and discrimination among PLHIV included improving access to legal and social justice and protection from stigma and discrimination in the public and private sectors, use of human rights approach to pursue zero tolerance to HIV-related stigma and discrimination, creation of awareness to sensitize communities and leaders on stigma reduction. Other interventions include equipping and utilizing peer educators and community outreach workers with commodities to effectively deliver stigma and discrimination prevention educational messages and offer referral services. KASF (2014) noted that the perceived impacts of stigma and discrimination include high death rates and increased workload in the community, increased number of orphaned and vulnerable children, and a high rate of HIV infection in the community. Additionally, PLHIV who are stigmatized and discriminated may often turn violent and indulge in criminal behavior such as defilement or rape.

2.4 Maternal factors influencing infant nutritional status

2.4.1 Overview of infant nutritional status globally and regionally.

Globally, 2.7 million (45%) of all deaths in children is attributed to undernutrition annually (WHO, 2019). Optimal nutrition in a child's first 2 years of life is the most crucial in ensuring reduction of mortality, morbidity, risk of chronic diseases, and ensure good development. Exclusively breastfeeding infants for 6 months has many benefits such as prevention of gastroenteritis and other diseases that increase infant mortality, improved development especially cognitive development. Overall, only about 36% of infants were exclusively breastfed for 6 months between 2007-2014 (WHO, 2019).

According to the joint malnutrition estimates by UNICEF, WHO, World Bank Group, (2019) Asia and Africa bear the greatest burden of all forms of malnutrition globally. Whereby, in 2018 more than half (55%) of all stunted children less than 5 years lived in Asia while 39% of all stunted children lived in Africa. More than two thirds (68%) of all wasted children lived in Asia, and more than a quarter (28%) lived in Africa in 2018. This translates to approximately 2 out of 3 stunted children in the world live in Southern Asia while wasting prevalence affects 1 in every 10 children below the age of 5 years.

In 2018, Eastern Africa had 574,000 thousand (4.1%) children below the age of 5 years who were wasted of the 14 million children that were wasted in Africa. Stunted children in the same region were 35.0% [31.4-39.3] (Buonomo *et al.*, 2016). A joint estimate by UNICEF, WHO, World Bank Group, (2019) showed that stunting affected 149 million (21.9%) children under the age of 5 years while wasting affected 49 million (7.3%) children globally. Stunting is the devastating result of poor nutrition in-utero and early childhood whereby stunted children may never attain their full possible heights in addition to cognitive deficiencies evident in learning difficulties in school and a possibility of earning less income in adulthood.

In Kenya, 26% of children below 5 years were stunted in 2017 which was more than the expected average (25%) for a developing country. In the same year, 4% of children below five years experienced wasting, which was less than the developing country average of 8.9% (UNICEF, WHO, World Bank Group, 2019).

In addition to the tremendous strides achieved in the EID program of HIV, it is paramount to determine ways to optimize the growth and development of infants born of HIV positive mothers since infant nutrition is an area of great public health importance. Maternal HIV reduces passive immunity that may increase the risk of infections and subsequent poor growth in HIV exposed and infected infants (McGrath *et al.,* 2012). According to McGrath *et al.,* 2012, breastfeeding (BF) is associated with reduced infant mortality and morbidity more so in developing countries, with shorter durations of BF associated with declines in weight, height, and development.

2.4.2 Feeding practices influencing infant nutritional status.

Poor nutrition leads to stunting, wasting, and underweight in children whereby stunting refers to a child who is too short for their age (UNICEF, WHO, World Bank Group, 2019). These stunted children can suffer irreversible physical and cognitive damage with lifetime effects that can even affect the next generation. Wasting refers to a child who is too thin for her height because of failure to gain weight or recent rapid weight loss. A severely or moderately wasted child has an increased risk of death but treatment is possible and effects reversible which is not the case in stunting. Underweight refers to a child who is too light for his age and like wasting is caused by rapid weight loss (WHO, 2019).

Wasting in children is a life-threatening result of inadequate intake and/or disease, which results in weakened immunity, developmental delays, and an increased risk of mortality(Buonomo *et al.,* 2016). Despite malnutrition manifesting in various forms, the path to management is the same and includes adequate maternal nutrition during pregnancy and lactation, exclusive breastfeeding in the first 6 months of the infants' life, optimal breastfeeding in the first 2 years of life, nutritious, diverse, and safe foods in early childhood, and a healthy environment including adequate sanitation, access to

safe drinking water, and proper hygiene (Buonomo *et al.,* 2016). These simple yet effective interventions will see a world free of childhood malnutrition but, effective and sustained multi-sectoral nutrition programming is paramount to see these initiatives put in place.

Infant feeding in the context of HIV is complex because of the major influence that feeding practices and nutrition have on child survival. Depending on the available interventions to reduce HIV transmission during pregnancy and delivery, HIV transmission through breastfeeding is responsible for between 30% and 60% of all HIV infections in children (Buonomo *et al.,* 2016). Women with a more advanced HIV illness or who have just become infected are more likely to transmit the virus. WHO (2010) demonstrated that ART interventions to either the HIV-infected mother or HIV-exposed infant can reduce the risk of postnatal transmission significantly.

Mothers known to be HIV-infected (and whose infants are HIV uninfected or of unknown HIV status) should breastfeed their infants for the first six months exclusively, gradually wean them at six months and continue breastfeeding them until two years of life (GOK, 2016). Halting breastfeeding at once could have adverse effects on the mother and her infant as they adjust to the new foods introduced. Infants who have been receiving prophylaxis should continue taking the prophylaxis for one week after breastfeeding is fully stopped (Nabwera *et al*., 2017).

If HIV-infected mothers breastfeeds their infants for two years without receiving any ART, then 14–20% of infants will become infected (Buonomo *et al.,* 2016). However, in many resource-limited settings, infants who do not breastfeed are up to six times more likely to die from malnutrition, pneumonia, and diarrheal diseases. The dilemma in settings where child mortality due to these conditions is relatively common, such as sub-Saharan Africa, the strategy has been to balance the risk of infants being infected with HIV postnatally through breastfeeding, with the risk of infants dying from other causes if they are not breastfed (WHO, 2010).

2.4.3 Factors influencing the choice of feeding options among HIV positive mothers

A South African study by Rendani *et al.*, (2010) on infant feeding practices and related factors among HIV-positive women at Gert Sibande assessed factors that affect the choice of infant feeding options, infant-feeding practices, and education, determinants of mixed feeding, psychosocial challenges, and attitudes of HIV-positive women with infants between ages 3–6 months. Rendani *et al.*, (2010) demonstrated that 50% of the infants were exclusively formula feeding, 35.6% breastfed exclusively and 12.4% mixed fed. Buonomo *et al.,* (2016) has also demonstrated that having per vaginal delivery, infant hospital admissions, and currently pregnant were associated with mixed feeding. While being older, knowing the HIV status of the infant and higher knowledge on HIV transmission through breastfeeding was associated with formula feeding. Buonomo *et al.,* (2016) identified a gap in infant feeding policy, which had an implication on infant feeding practices among the women and recommended that infant feeding counseling and support should be strongly integrated into the PMTCT services as well as post-natal services.

A similar study conducted in Ethiopia by Dagnachew *et al*., (2012) on infant feeding practices and associated factors among HIV positive women showed that out of 209 HIV positive women who were included in the study, 187 (89.5%) had followed the recommended infant feeding practices while (10.5%) had practiced mixed breastfeeding. Dagnachew *et al*., (2012) multivariate analysis demonstrated that, employment status, insufficient breast milk, and HIV status disclosure to partners, were found to be independently associated with the recommended infant feeding practices. Women who disclosed their HIV status to their partners were 7.7 times more likely to adhere to the recommended infant feeding practices. The daily laborers were 14.6 times more likely to adhere to the recommended infant feeding practices than the private/merchants. Work overload may have forced merchants to practice mixed breastfeeding unconsciously.

Across the global regions the proportion of mothers practicing mixed breastfeeding (10.5%) for the infant's first 6 months of life is almost similar to studies conducted in

Addis Ababa, Ethiopia (15.3%) and South Africa (12.4%) (Maru & Haidar, 2009) and (Rendani *et al*., 2010), respectively but lower than from India (29%) (Suryavanshi *et al*., 2003). The proportion of women who practice exclusive breastfeeding (83.7%) for the first 6 months was comparatively higher than the findings from Nigeria (68.3%), Uganda (24%), India (44%) and South Africa (35.6%) (Rendani *et al*., 2010; Suryavanshi *et al*., 2003; Adejuyigbe *et al*., 2008 and Fadnes *et al*., 2009), respectively. The differences observed could be because, in the South African and Nigerian studies, infant formula was supplied free of charge unlike in the Ethiopian context study. Stigma and discrimination associated with HIV, lack of resources, and lack of partner support were also found to influence the infant feeding options. The researchers recommended the strengthening of primary health systems through education on infant feeding that is aligned to the national policies, especially in situations where PMTCT of HIV is prioritized.

Sebalda *et al*., (2007) study in Tanzania demonstrated that 13 of the 20 study participants opted to exclusively breastfeed and seven opted to do replacement feed. Among the latter, three decided to feed the baby on infant formula while the remaining four decided to use cow's milk. The choice of infant feeding was closely dictated by the following factors; the mother's economic status, her dependence on close kin, and the status of partner disclosure. The 13 women who choose exclusive breastfeeding had not disclosed their HIV positive status to their partner or anyone else and practiced mixed feeding (such as adding some water, porridge, or cow's milk) before 6 months due to pressure from the society, loss of energy and subsequent weight loss that could alert the community that they were HIV positive, and the need to leave the child with other people as they go to work. Hence, out of the 20 mothers enrolled in the study, only 4 mothers exclusively breastfed within the first six months of the infants' life. The authors, therefore, found that feeding options may be difficult to adhere to, whether a mother chooses exclusive breastfeeding or exclusive replacement feeding due to the above factors, even though most of the mothers were counseled on the ideal method of infant feeding options depending on their different social and economic conditions. The tension between medical and social concerns, and between risk and

reputation, put HIV-positive women in a particularly demanding situation concerning infant feeding choice.

In Kenya Christopher *et al.,* (2015) showed that most of the children (94%) had been delivered through the spontaneous vaginal method with 54% of them being fed through the mixed breastfeeding method with a significant association between vaginal delivery and infant feeding options. The mode of delivery was therefore found to positively influence the infant feeding options. Lang'at *et al.,* (2018) study in Bomet County, Kenya demonstrated that some of the factors that influence infant feeding choices include financial challenges, HIV-related stigma and discrimination, cultural beliefs and practices, and knowledge on feeding practices among caregivers and healthcare providers. Non- disclosure of HIV status was also found to be affecting the choice of infant feeding whereby mothers would be forced to mix feed when pressured by the inlaws or partner when the baby cries a lot and is assumed to be hungry.

2.5 Maternal factors influencing infant survival over a 12-month follow-up period

There is limited data demonstrating the translation of the effects of maternal factors into survival outcomes in children. Furthermore, the limited data on child survival is mostly translated in terms of infant death with very little on infant HIV positive status as a measure of survival outcomes (Alusio *et al.,* 2016).

Globally, vertical transmission of HIV accounts for more than 200,000 new infections in children yearly with 90% of these infections happening in Sub-Saharan Africa. World Health Organization created a task force to eliminate MTCT of HIV and syphilis by 2030 and together with other development partners formed global criteria to validate the elimination of MTCT (WHO, 2018). HIV free survival was proposed as the gold standard for the measurement of PMTCT and EID program effectiveness based on maternal related factors, healthcare facility factors, and health system-related determinants. In 2017, Cuba became the first country (among the low and middle-income countries) to be validated as having successfully eliminated MTCT of HIV and

Syphilis. Other countries that achieved these milestones include the Republic of Moldova, Thailand, Belarus, and Armenia (WHO, 2018).

WHO (2018) cites that these accomplishments of eMTCT are due to the integration of MCH with sexual, reproductive health, and HIV services alongside the engagement of communities and outreach initiatives to reach the marginalized populations. The WHO recommendations to ensure eMTCT by 2030 included, early and life-long ART, and exclusive breastfeeding for 6 months where breastfeeding was the safest method of early infant feeding. Howerver, most of the infant HIV-free survival is usually based on facility-level data where mothers who seek EID services are evaluated, which could give an underestimation of the true eMTCT findings. WHO recommends population-based assessments of eMTCT to establish the progress towards the elimination of MTCT in addition to health facility-based findings mainly at 18 months of the infant's life.

Partner non-disclosure is a barrier to the uptake of PMTCT services and is associated with poor maternal ART adherence and subsequent poor infant survival (Kalembo *et al.*,2013). Numerous methodologies for improving male involvement have been suggested such as rigorous and continuous community sensitization, formal invitations for male partners, community-based partner-tracing, development of male-friendly clinic environments and varying VCT models have been used to attempt to improve partner involvement (Alusio *et al.*, 2016).

2.6 Facility level factors influencing infant health outcomes

The facility-level factors that were assessed in the current study included EID sample TAT, policy environment, human resource capacity and availability for EID service delivery, and the infrastructure necessary to ensure adequate implementation of EID services.

2.6.1 Sample turn-around-time

Sample turn-around-time (TAT) is the duration of time taken from the collection of blood specimens from the mother or infant up to the time the results are relayed back

to the healthcare providers, and the mother-infant pairs. On average, this should take 14 days or less so that health workers can make timely decisions and ensure patient retention in the clinics (WHO, 2019) in areas where point-of-care diagnostic tests are not available. Long sample TAT leads to poor EID uptake, low retention in the EID clinics, and poor linkages of HIV infected and or exposed infants (Sandbulte *et al.,* 2019).

Luke *et al*., (2015) retrospective study in India demonstrated that for cases where both specimens (for the first dried blood sample (DBS) test and a second confirmatory whole blood test for positive DBS results), the TAT for final confirmatory result ranged from 10-270 days (median: 46 days). This long TAT was attributed to delays in laboratory processing and inappropriate delays in starting positive children on life-saving ART. The authors recommended that another blood spot from the original sample card could be tested as opposed to drawing whole blood samples from the infants again. This method could help in faster confirmation and reporting of positives, and at the same time check reporting of false positives. The use of point-of-care (POC) diagnostics for EID was recommended as a long-term plan to reduce sample TAT by the authors. Taylor *et al.,* (2017) findings suggest that POC diagnostics like those validated by WHO in 2015 are key in the efforts towards the eMTCT.

Bianchi *et al.,* (2019) conducted a retrospective study in 8 African countries (Kenya, Cameroon, Rwanda, Côte d'Ivoire, Zimbabwe, Lesotho, Mozambique, and Swaziland) giving comparisons to evaluate data from HIV exposed infants who were tested using conventional testing methods versus infant's tested using POC testing. The results showed that several EID outcomes improved significantly with POC testing relative to conventional testing methods. For instance, the return of results to caregivers TAT was 0 days with POC testing versus 55 days with conventional testing ($p < 0.001$). The medium time from sample collection to ART initiation among HIV positive infants was 0 days with POC testing versus 49 days with conventional testing ($p < 0.001$). The study concluded that POC for EID improves TAT for results relay to caregivers and healthcare workers and facilitates early ART initiation, an approach that might reduce morbidity and mortality in HIV-infected or exposed infants.

Delays in sample TAT was evident in most countries that did not have POC diagnostics, for instance, Anirban *et al.*, (2011) study found that sample TAT in Namibia from the collection at the site to laboratory and averaged 1.38 days, 5.25 days in Cambodia, and 12.6 days in Uganda Namibia, with the shortest turnaround time, used only one EID testing laboratory but invested in overnight transportation of all samples from 37 local collection laboratories. Uganda with the most testing laboratories had the longest sample transport time. TAT for processing within laboratories averaged 9 days in Namibia, 18 days in Cambodia, and 3.33 weeks in Uganda. Uncoordinated referral mechanisms (from sample collection to results being presented to the caregiver and provider) in all the countries and inadequate diagnostic testing technologies contributed to long TAT.

In Mozambique, a study to determine the effect of POC for EID on ART initiation and retention of patients revealed that 89.7% (157 0f 174) infants were initiated on ART within 60 days of sample collection following POC testing whereas only 12.8% (13 out of 102) were initiated on ART within 60 days of standardized testing. The median time for sample collection to ART therapy initiation was less than 1 day (IQR 0-1) for POC testing and 127 days (44-154 days) for the standardized testing (Jani *et al.*, 2018). These findings demonstrate that POC testing fast-tracked initiation into care and treatment for infants that were infected or exposed to HIV and was also seen to improve infant retention into care and treatment.

The sample TAT for infant PCR testing for EID in Kenya is marred by several challenges from sample collection to the relay of results that cause delays in ART initiation. Some of the challenges include delays in the routine shipment to the designated central PCR testing laboratories (there are currently 7 testing laboratories in Kenya), courier service is delay or sample loss or damage (Sutcliffe *et al.*, 2014). Once the samples reach the central testing laboratory, they start to be processed and the delays that can occur at this stage include stock-outs of testing reagents, maintenance issues with automated PCR testing equipment, or inadequate staff to handle the volume of the samples (Gautney *et al.*, 2013). Once the results are available in the central laboratory, they are shipped to the facilities using either paper-based

results to the hospitals via courier services or sent via emails or short messaging services (SMS). Once the results are in the healthcare facilities clinical staff record them and communicate the findings to the mothers and healthcare providers. This process is very manual and accounts for additional delays at each step with possibilities of results being misplaced or mishandled which ultimately compromises the care, retention, and clinical outcomes of HIV exposed infants (Ciaranello *et al.*, 2016). Point-of-care for EID diagnosis can reduce all these delays as results are provided to the caregiver and healthcare provider within 24 hours, allowing immediate ART initiation within 24 hours.

In the absence of POC diagnostics, other innovative technologies that have been used that are less costly than POC diagnostics is the use of web-based HITSystem which is an eHealth intervention that alerts staff when services are overdue or results are delayed. The HITSystem is however also prone to challenges that can cause delays in the relay of results to the caregiver and health service providers due to issues such as electricity interruption, internet connectivity, and web-based ethical and security issues such as hacking and access by unauthorized persons (Finocchario-Kessler et al., 2015).

A qualitative study that was undertaken in Kenya on healthcare providers Wexler *et al.,* (2018) whereby, health workers discussed their perspectives regarding the implementation of POC for EID demonstrated that healthcare providers emphasized on the need for comprehensive training on POC for EID testing procedures, maternal counseling for acceptance of infant birth testing and provision of POC testing materials and equipment. These findings were similar to those of Dunning *et al.,* (2017) whereby POC for EID testing was found to be highly acceptable to healthcare providers as it reduced the waiting time for results and fast-tracked decision making for prompt infant ART initiation.

2.6.2 Policy environment

Globally, some of the policies and guidelines that have been put in place in response to the reduction of MTCT of HIV include: Global guidance on criteria and processes

for validation, eMTCT and Syphilis (WHO,2017), Guidelines on when to start antiretroviral therapy, and on pre-exposure prophylaxis for HIV (WHO, 2015), and Monitoring and evaluation framework for antiretroviral treatment for pregnant and breastfeeding women living with HIV and their infants (WHO, 2015). These guidelines among other policies in existence outline critical steps that should be followed to ensure that infants born of HIV positive mothers survive disease-free through strategies targeting the PMTCT. These policies guide countries to develop country-specific policies and guidelines depending on the various contexts and needs in each country.

In Kenya, NACC developed the Kenya AIDS Strategic Framework (KASF) 2014/15-2018/19 as a guide for the country's response to HIV at both National and county levels. It addressed the drivers of the HIV epidemic building on achievements of the previous country's strategic plans to contribute to the achievement of Vision 2030 goal of universal access to comprehensive HIV prevention, treatment, and care. The 4 objectives of KASF include; Reduce new HIV infections by 75%, Reduce AIDS-related mortality by 25%, reduce HIV-related stigma and discrimination by 50%, and finally to increase domestic financing of the HIV response to 50%. Later in 2016, the 46 counties in Kenya developed the County specific AIDS Plans (CASPS) adopted from the national KASF to combat the HIV epidemic at the County levels. There is a need to train and disseminate the CASPS to the various facilities in the counties to ensure its fruitful implementation.

The most current document aimed at the eMTCT in Kenya is the Kenya framework for the elimination of MTCT of HIV and syphilis 2016-2021 (GOK, 2016). This policy document gives directions on the roles of the various healthcare institutions and other stakeholders in the fights towards the eMTCT by 2021 by outlining the seven focus areas that need to be paid attention to. These seven areas include the elimination of HIV and syphilis related stigma and discrimination, focus on diagnostics, commodity security and workforce, sustained leadership, coordination and advocacy, equitable and quality prevention and treatment services, community empowerment partnerships and systems strengthening, and monitoring the progress towards the validation of

eMTCT of HIV. Other policy documents aimed at the eMTCT in Kenya include the guidelines on the use of ARV drugs for treating and preventing HIV infection in Kenya (GOK,2018) and toward the eMTCT of HIV and keeping their mothers' alive strategic framework (2012), among other county-specific guidelines and policies.

The current study assessed the availability and access to EID policies and guidelines in the selected healthcare institutions. Healthcare providers were asked to indicate whether they had received any training on the current policies and guidelines on eMTCT and to rate their knowledge and ability to undertake strategies put in place to reduce MTCT in Kenya.

2.6.3 Human resources and infrastructure for EID service delivery

Substantial investments to scale up EID have been put in place globally over the last decade including investments in physical infrastructure, human resources, specialized equipment, and specimen transportation. Despite these improvements in EID infrastructure and capacity building for human resources, the EID service delivery is still faced with numerous challenges (Essajee *et al.,* 2017). Many public health programs lack adequate means of identification of HIV exposed infants in need of EID services and also lack adequate information on transmission rates which constrains appropriate allocation of PMTCT resources and funding (Essajee *et al.,* 2017). Other challenges facing EID implementation include the high cost of technology for EID, the inadequate human workforce in terms of numbers and capacity, and inadequate resources for testing (such as stock-outs of testing reagents) and inadequate infrastructure for transport of EID samples to the central testing labs. These challenges have lead to poor linkage to care and low retention rates into care and treatment which currently range between 30%-80% (Hsiao *et al.,* 2013). Using POC diagnostics has markedly improved laboratory testing rates and the provision of results in a timely manner which has encouraged retention of infants and timely ART initiation (Bianchi *et al.,* 2019).

Berhan *et al.,* (2015) study in Ethiopia found that inadequate use of ART and insufficiently skilled healthcare providers contributed to the prevalence of infant HIV

infection in the country. Among women who utilized skilled delivery services, 12% went untested for HIV during their delivery or ANC clinic leading to missed opportunities for identifying HIV positive pregnant women and consequent late ART initiation. Modi *et al.,* (2019) state that there is a need to increase attention to healthcare workers' professional development to increase access to HIV-related services and healthcare services for mother-infant pairs.

Bobrow *et al.,* (2016) study in Malawi found that there was inadequate space at the healthcare centers for undertaking EID services which compromised patient privacy during a consultation. There was a poor transport system for sample transportation that lead to delays and sometimes loss of PCR results which consequently resulted in clients' LTFU and delayed ART initiation for the infants. Further, the healthcare workers reported that they experienced difficulties in obtaining blood specimens from infants for DBS testing. Some of the recommendations cited by the authors to improve EID service delivery in Malawi included healthcare providers capacity building through training on sample removal from infants, mentoring of healthcare providers who are less experienced alongside regular supportive supervision to reinforce skills and establish a good network of the transport system to ensure timely communication of results to healthcare providers and caregivers.

In rural Kenya, Kilifi County, there was a lack of knowledge and understanding of EID by healthcare providers who were inadequately prepared to implement EID despite having undergone PMTCT training. The healthcare providers also reported that they felt that EID knowledge was not adequately covered during ANC and PMTCT training and that they had not attended any training specifically on EID (Amin *et al*., 2012). Goggin *et al.,* (2016) study on six Kenyan government hospitals demonstrated that mothers who had received education on PMTCT and were informed about EID services by healthcare workers had better infant health outcomes and were initiated into EID on time (≤ 6weeks) relative to mothers who were told about their HIV status from other non-healthcare provider sources. The authors note that healthcare providers' support is crucial in ensuring that mothers are initiated on time and retained in the EID

clinics throughout and investments to improve human resource capacity are paramount.

CHAPTER THREE

MATERIALS AND METHODS

3.1 Study sites

The study was conducted in the following facilities: Mathare North Health Centre, Mbagathi County Hospital, and Kibera South Health Centre in Nairobi County within the catchment area of Kibra and Mathare informal settlements. These study sites were chosen because approximately 60-70% of urban dwellers in Kenya are believed to be living in the slum area (UN Habitat, 2014) with a 12% prevalence of HIV compared to 5% prevalence among non-slum dwellers. Further, women in informal settlements have a 38% higher HIV prevalence relative to their male counterparts (Corburn & Corburn, 2015). Kibera and Mathare slums are the two largest informal settlement areas in Kenya (Amnesty International, 2009). These three facilities were identified using the national ART registers and were the main healthcare facilities offering EID services within Kibera and Mathare catchment areas.

3.1.1 Kibera South Health Centre

Kibera South Health Center is a public hospital located at 1º18’21’’ S & 36º47’17’’ E coordinates, at Mugumo-ini, Nairobi, Kenya. At Kibera South Health Centre (KSHC), healthcare services offered include in-patient and out-patient services, 24-hour maternity and delivery care as well as ongoing treatment for diseases such as HIV and TB, which are prevalent in Kibra. Parents bring their children in for essential vaccinations, nutritional screening, and people who have been victims of sexual violence can get treatment, support, and, on-going counseling.

3.1.2 Mbagathi County hospital

Mbagathi County hospital is a well-established public hospital in Nairobi City County. The County occupies 695.1 square km and has a population of 3,138.375 as per the 2009 population census (KNBS, 2013). This health facility is located at 1º18’33’’ S 36º48’12’’ E coordinates.

Mbagathi County hospital started operations in 1956 as the infectious wing of the Kenyatta National Hospital and in 1997, it became the first district hospital of Nairobi. The hospital has a large catchment population of 380,739 people and a bed capacity of 200 beds. It offers the following healthcare services; dental, eye clinic, laboratory medicine, obstetrics and gynecology, pediatrics, pharmacy, physiotherapy, surgery, and x-ray. Additionally it has a CCC, for PLHIV, and offers EID services and Immunization services. It serves as a center of excellence for management of chest infections more so among PLHIV. It offers both in-patient and outpatient healthcare services.

3.1.3 Mathare North Health Centre

Mathare North Health Centre (MNHC) is a government health centre located in Ruaraka Sub-location, Ruaraka location, Kasarani Division, Kasarani Constituency in Nairobi County. This health facility is located at 1°15'14'' S 36°52'0'' E coordinates. It has a 24-bed capacity and offers the following services: Antenatal clinic, ART, family planning, growth monitoring, and promotion, HIV counseling and testing, home-based care, immunization, PMTCT service, and TB care and treatment.

3.2 Study design

The study adopted a prospective cohort study design approach whereby mother-infant pairs were followed up for 12 months. This design was chosen because it allowed the researcher to study multiple outcomes in the infant over a prolonged period as well as calculate HIV incidence among the infants at different time-points, and the attributable risk.

3.3 Study population

The study population was infants born of HIV positive mothers enrolled for EID services at Mathare North Health Center, Mbagathi County Hospital, and Kibera South Health Center in Nairobi County.

3.4 Sample size determination

The formula below was used to calculate the sample size for longitudinal studies across time-points.

$$n = \frac{\left[Z_{\propto}\sqrt{1+\frac{1}{m}p^{*}(1-p^{*})}+Z_{\beta\sqrt{p1}}\,(1-p1)/m+p2(1-p2)\right]2}{(p1-p2^{2})}$$

Whereby:

$Z_{\propto}$ = Standard normal variate for level of significance

m = Number of control subject per experimental subject

Z_{β} = Standard normal variate for power or type 2 error as explained in earlier section

p1 = Probability of events in control group

p2 = Probability of events in experimental group

Power of the study = 0.80

Level of significance = 0.05%

$$P^{*} = \frac{p2+mp1}{m+1}$$

$$n = \frac{\left[1.96\sqrt{1+\frac{1}{1}}0.30(1-0.30)+^{0.84}\sqrt{0.40}\,(1-0.40)/1+0.20(1-0.20)\right]2}{(0.40-.020)2} = 59.41 \text{ in}$$

each group

Therefore total sample size was 119 infants

Adjusting for 40% loss-to-follow-up to give a total sample size of **166 infants**

The distribution of infants in the three facilities is shown in (Table 3.1) whereby the infants were selected as based on the number of PMTCT mothers that were seen between October 2015 and October 2016. In MNHC 3834 of 8032 clients was 0.48%, in KSHC 2893 of 8032 clients was 0.36%, while in MDH 1305 of 8032 clients was 0.16%.

Table 3.1: Distribution by healthcare facilities

FACILITY NAME	Number of PMTCT clients OCT 2015-OCT 2016	Ratio and (%) per facility	No. of infants selected in each facility
Mathare North health centre (MNHC)	3834	0.48 (48%) of 166 infants	80 infants
Kibera South health centre (KSHC)	2893	0.36 (36%) of 166 infants	60 infants
Mbagathi County hospital (MDH)	1305	0.16 (16%) of 166 infants	26 infants
Total sample size	**8032**		**166 infants**

3.5 Sampling procedure

Simple random sampling technique was used to select the study participants. The postnatal register was used as a sampling frame from which participants who met the inclusion criteria were selected. The postnatal register in MNHC had 251 registered mother-infant pairs who met the inclusion criteria and 80 infants were sampled. KSHC had 187 mother-infant pairs who met the inclusion criteria and 60 infants were sampled while MDH had 101 mother-infant pairs and 26 infants were sampled. Infants who were in the postnatal register were randomly selected using a table of random numbers. The table of random numbers was generated using random numbers generator software. In each of the facilities numbers were allocated to the infants in the postnatal register for instance, in MNHC numbers were allocated from 001-251 in KSHC 001-187, and in MDH infants were allocated numbers ranging from 001-101. The table of random numbers was then used to select the required number of participants for each of the facilities.

Once the sampled infants were identified, the dates of the next visit were noted down on the mothers' comprehensive care clinic (CCC) file and a blue sticker placed on the file as an identifier and tracker for the mother-infant pairs throughout the 12-months study period. All the selected participants were contacted via telephone and the dates of the expected visit confirmed with the mother. They were then awaited to come for the EID clinic in the next visit where consent was sought and the semi-structured questionnaire administered. A total of 166 mother-infant pairs were selected to participate in the study with a response from 163 (98.2%) mother-infant pairs obtained at the beginning of the study. The 3 (1.8%) mother-infant pairs were censored from the study before 6 weeks of age as follows: at two and a half weeks one infant transferred out of Mathare North Health Center, at three weeks one infant died and at five weeks another one infant died.

3.6 Inclusion and exclusion criteria

3.6.1 Inclusion criteria

- Infants born of HIV positive mothers, at the age of 2 weeks post-delivery up to ≤ 6 weeks of age.
- Infants born of mothers who were registered in the CCC's of the selected facilities.
- Infants born of mothers who agreed to participate in the study.

3.6.2 Exclusion criteria

- Infants born of mothers who had visited the CCC's in the selected hospitals but were on transit. This could be verified from the mother's CCC card that has unique facility code identifier for every healthcare facility in the country.
- Infants born of mothers who were newly transferred (had been in the CCC for less than one year prior to the study onset) from other healthcare facilities.

3.7 Study variables

The independent variables were:

Maternal factors and were divided into four key areas:

Socio-demographic factors, which included age, employment status, marital status, education level, number of persons living in the household, and household income level.

Maternal characteristics during pregnancy, which included the year the mother was confirmed HIV positive, if the mother was given ART in pregnancy, stage ART was administered during pregnancy and the number of PMTCT visits the mother had attended.

Maternal disclosure status, which included knowledge of partners HIV status and maternal disclosure status to her partner.

Maternal factors at recruitment, 6 months, and 12 months were also assessed and included ART adherence, HIV staging, ART regimen, viral load, and maternal BMI.

Matenal factors explored included perceived barriers, perceived severity, perceived benefits, attitudes and knowledge on EID,cues to action and self-efficacy as they went through the EID program.

Facility support factors were also assessed and included, the policy environment for undertaking EID services, materials, and equipment for undertaking EID services and human resource factors.

The dependent variables were:

Infant HIV status (positive or negative)

Infant nutritional status (wasting, underweight, and stunting)

Infant survival over 12 months follow-up period (failure event was infant HIV positive status)

3.8 Follow-up of infants

Recruitment of infants into the study was conducted 2 weeks after delivery. The infants were followed up for 12 months to assess their HIV status, nutritional status, and survival status. Infant parameters that were assessed included infant birth weight, progressive weight and height, breastfeeding and other feeding practices, viral load, number of hospitalizations, presence of any co-infections, ART adherence, clinic adherence, number of PCR tests done, and the results. The health parameters assessed among the mothers were maternal health-seeking behavior during PMTCT, ART adherence, maternal co-morbidities and opportunistic infections, maternal weight/height, CD4 counts and viral load, HIV stage, BMI, awareness of HIV status before pregnancy, gestation at delivery, mode of delivery and disclosure status.

Infant follow-up was scheduled to coincide with the Kenya Expanded Program for Immunization (KEPI) timetable at 6, 10, and 14 weeks and 12 months. The infants were also followed up 6 months as per the GOK EID schedule (GOK, 2016). Results for the HIV virological testing and other health parameters were collected from HIV-exposed infants 6 weeks, 6 months, and 12 months. In the study, data on infant feeding was collected from the mothers at recruitment, 10 weeks, 14 weeks, and at 6 months. Infants who did not return for a follow-up visit within one week of the planned date were traced done via mobile phone. A scheduled visit was considered a delayed visit if the mother failed to return within one week of the scheduled appointment. The EID process from birth to the announcement of the infants' result to the mothers was considered to be ‘‘complete’’ if the PCR tests were performed at the scheduled time-points and the final PCR results provided to mothers at 12 months of the infant's age. The vital status of infants who did not return for a follow-up visit was determined by phone calls at 12 months, and an oral interview conducted to establish reasons for LTFU.

At baseline (recruitment) maternal health-seeking behavior during pregnancy was assessed (interventions and adherence during PMTCT/CCC) and maternal health parameters during pregnancy (viral load, BMI, ART adherence, HIV staging, co-morbidities, and co-infections). These were used to assess any association between

selected maternal factors during pregnancy and the infant health outcomes. This information was collected retrospectively from the mother's PMTCT/ANC records and maternal recall.

3.9 Data collection tools

Quantitative and qualitative data were collected and triangulation was done using the sequential explanatory design whereby, both qualitative and quantitative data types were interpreted during the data integration phase.

3.9.1 Quantitative data collection tools

3.9.1.1: Administration of questionnaires

Semi-structured interviewer-administered questionnaires (APPENDIX II) were used to collect information from the HIV positive mother by the researcher, who was assisted by the research assistants. Data collection was done at scheduled time-points at 6, 10, and 14 weeks, 6 months, and 12 months in the selected healthcare facilities. The semi-structured interviewer-administered questionnaires collected the following data: socio-demographic and socio-economic data of the mother, disclosure of HIV status, maternal characteristics during PMTCT, infant feeding practices, ART adherence, knowledge on methods of reduction of MTCT of HIV, attitudes towards EID services offered to the mother-infant pair, barriers towards EID services, and benefits of the EID services to the mother-infant pairs. The researcher designed the data collection tools based on MOH tools used to collect data from mothers in the CCC, PMTCT, and the EID clinic.

3.9.1.2 Data abstraction tool

A data abstraction tool (APPENDIX IV) was used to collect quantitative data from the mother's health records. The data abstraction tool collected information from the mothers' CCC follow-up file on maternal BMI, viral load count, HIV staging, ART adherence, ART regimen, and presence of opportunistic and co-infections in the mother.

3.9.2 Qualitative data collection tools

Qualitative data were collected using key informant interview (KII) guides, which were administered to Nurses and Clinical Officers offering EID services by the researcher. An observational checklist was used to assess the work environment in which EID services were being undertaken. Focused Group Discussions (FGDs) were also undertaken to collect data from the HIV positive mothers on challenges, barriers, and benefits of EID to the mother-infant pairs.

3.9.2.1 Key informant interviews (KIIs)

A KII (APPENDIX VI) was used to interview the healthcare providers who were directly offering EID services and included nurses and clinical officers. KII guide was chosen to help in gaining information from healthcare providers that offer the EID services such as knowledge and training on EID service delivery, EID service organization appropriateness, challenges faced while offering EID services, and recommendations from the providers on how to improve EID service delivery.

3.9.2.1.1 Selection of the KII participants

Each of the EID service delivery points was manned by 2-3 nurses and 1-2 clinical officers assisted by mentor mothers (non-clinical peer support mothers living with HIV). The criteria used to select the healthcare providers for the participation of KII were those who were directly offering EID services at the EID service delivery points. This was because it was believed that they had first-hand knowledge of issues surrounding EID service delivery and were directly interacting with the mother-infant pairs as they sought EID services.

A total of six healthcare providers, four nurses, and two clinical officers were selected to participate in the interview, two in each healthcare facility. The point of saturation was reached at six healthcare providers.

3.9.2.1.2 Undertaking the KII

Each KII lasted for about 15-20 minutes and was conducted face-to-face by the researcher. During the interviews, notes were taken on a pre-prepared KII guide. An audio recorder was also used to record the interviews and a report on the findings was then produced. The KII was conducted to identify healthcare facility-level factors that influenced infant health outcomes as they went through the EID process. Areas that were examined included: turn-around time for EID results to reach the facility, availability and/or accessibility of machines, equipment, and materials for use in conducting EID, staffing level for EID services, EID operations within the facility in terms of efficiency and effectiveness of the program, any challenges faced as the healthcare providers gave EID services, training(s) attended on EID, and patient response towards EID services offered to them in the healthcare facilities.

Data from the KII guides were transcribed, typed in MS-Excel spreadsheets, coded, and analyzed manually based on the main emerging themes. A Likert Scale was also used to score the healthcare providers' perspective on the organization of EID service delivery and results presented in terms of adequacy of EID service organization.

3.9.2.2 Observation for equipment needed to facilitate the EID process

The observation checklist (APPENDIX VII) was used by the researcher to check the presence or absence of machines, materials, infrastructure, and equipment needed to facilitate the EID process.

3.9.2.3 Focus group discussions (FGDs) guide

Six FGDs (APPENDIX V) were conducted by the researcher assisted by three research assistants. FGDs were collected to assess the perspective of the mothers pertaining to EID services offered to them. Aspects assessed in the FGD included: Exploring maternal knowledge and understanding of services that would be offered to the mother-infant pair during the EID program, feeding practices, infant ART and prophylaxis, and method of reduction of MTCT. Additionally, maternal attitudes towards the EID program, perceived benefits and challenges experienced while

seeking EID services, and ways to improve EID services offered to the mother-infant pair to meet their various needs and expectations were assessed.

3.9.2.3.1 Training of the research assistants

Prior to the actual data collection commencement, the researcher trained three women to assist in the FGD facilitation. The three women were selected because of their roles as facility mentor mothers and their influence in the community of the selected study areas. During the training, there was a review of written informed consent in both Swahili and English, review of research ethics, facilitation of the FGD with the use of a tape-recorder to ensure that the three women were well prepared, and note-taking were practiced.

3.9.2.3.2 Selection of participants

The researcher conducted the FGD on HIV positive women with infants aged below one year enrolled for EID services in the selected facilities. The researcher purposively selected the mothers who were thought to be able to give the most insight regarding perceived barriers, benefits, and perceived vulnerability regarding EID services they receive in the healthcare facilities. The other inclusion criterion for participation in the FGD was that the mothers were able to give consent and that they attended their scheduled CCC clinics in the selected hospitals.

3.9.2.3.3 Undertaking the FGDs

The focus groups in each of the three facilities were divided into two sessions, session one was scheduled for women aged 18-24 years and session two was scheduled for mothers between 25-44 years. The FGDs were conducted until a point of saturation was achieved, which was reached at six FGDs. All focus groups had 5-6 participants in each session and the FGDs lasted for about 30-40 minutes. All the participants were read an informed consent in both English and Swahili, depending on their preference, and written informed consent was obtained from all the participants. If a participant could not read or write, the consent form was read to her and an X on her form marked her consent, along with the signature of a witness. Participants were given a snack after

their participation and reimbursed transport costs as well. The FGD guides were translated to Swahili and participants were given a choice of whether to participate in English or Swahili. All FGDs were recorded using a tape recorder and note taking also conducted.

3.9.2.3.4 Data storage and retrieval

Data from the FGDs were stored in a password-protected computer and transcription done manually by the researcher. The researcher listened to all the recordings, read all focus group transcripts, and coded them according to the emerging themes, and entered them manually in the Excel spreadsheet. The Health Belief Model by Tarkang and Zotor (2015) was used to cluster the mothers' responses according to the themes outlined in the Health Belief Model (Table 3.2).

Table 3.2: Health belief model

Concept	Definition	Application
Perceived susceptibility	Mothers' opinion on chances of getting a condition or passing on the condition to the infant	Perceived heightened risk or low perceived risk of HIV transmission to the infant, based on personal traits or behaviors.
Perceived severity	Mothers' opinion of how serious a condition and its consequences are	Perceived consequences to the infant by virtue of the mother being HIV positive
Perceived benefits	Mothers' belief in the efficacy of the advised action to reduce the risk or seriousness of the impact	Perceived positive effects or benefits to be expected following the EID program initiation and completion.
Perceived barriers	The mothers' opinion of the tangible and psychological implications and costs of attending the EID program	Identify and reduce barriers through reassurance, incentives, and assistance.
Cues to Action	Strategies to activate readiness	Perceived solutions to the challenges that the mothers felt were affecting them and possible ways that could improve their experience as in the EID clinics.
Self-Efficacy	Confidence in one's ability to take action	Provide training and guidance in undertaking actions.

Source: Tarkang & Zotor (2015)

3.10 Quantitative data management and analysis

3.10.1 Data management

Quantitative data was entered into a computer software and kept safe under lock and key with a data backup. Data were entered in MS-Excel spreadsheets while cleaning, coding and analysis were done using STATA Version 14. The data entered was password-protected and was only accessed by the principal investigator. Quality checks for the data were maintained by undertaking data quality checks during data collection and having double data entry. Once the data collection and analysis process was completed, the data would be stored for a period not exceeding two years.

3.10.2 Data analysis

Data cleaning, coding, and analysis were done using STATA Version 14. Descriptive statistics were done to explore and summarize the data. Categorical variables were analyzed using measures of central tendency (mean and median), proportions, and frequencies. Fisher's exact test and Log-rank tests were used to test associations at the bivariable level while Poisson regression, Logistic regression, and Cox-regression were used to analyze data at the multivariable level. Data was presented in tables, charts, and graphs.

The first study outcome was to assess for HIV status of the infants at recruitment. Since this proportion was very small, the outcome was assumed to represent a count of the number of cases in the study population. To relate the count of the cases to predictors (socio-demographic and maternal factors), a Poison regression model was assumed in the form:

$\mathrm{E}\frac{y}{n} = \beta_0 + \beta_1 + \beta_1 + \beta_1 X$ where the term on the left of the equation was the log of the expected value of counts of disease which was modelled as a linear combination of the predictors (on the right of the equal sign). The model related the log of the expected value of counts of disease and a linear combination of one predictor in the univariable analysis at a significance level of $P \leq 0.1$. The model was subsequently extended to control for other predictors by including all significant variables at the bivariable and multivariable levels at a significance level of $P<0.05$ as follows:

$$\mathrm{E}\frac{y}{n} = \beta_0 + \beta_1 + \beta_1 + \beta_1 X + \ldots\ldots\beta_K \beta_K \ldots\ldots 1 \quad \text{(Fox, 2002)}$$

Where k was the number of predictors.

Multivariable modelling was carried out by using both backward and forward elimination strategy and involved checking of confounding and relevant interaction terms. During modelling, the statistical significance of the contribution of individual predictors (in univariable analyses) or groups of predictors (in multivariable analyses)

to the model was tested using the likelihood ratio test and the Bayesian predictors of best model selection.

The models were assessed for overall fit using $\chi 2$ goodness-of-fit tests computed as the sum of the squared deviance or Pearson residuals. The values of the two test statistics were compared to assess a lack of fit. As with all overall goodness-of-fit statistics, a P>0.05 (non-significant) indicates that the model fits the data well. For categorical variables, frequencies and proportions were reported in tables, and distributions were shown using bar graphs.

The second objective was assessing infant nutritional status and Fisher's exact test at the univariable level and logistic regression at the multivariable level were used. Logistic regression was chosen because the outcome of interest (nutritional status) had a binary outcome and because it is a good tool as it allows multiple explanatory variables to be analyzed simultaneously meanwhile reducing the effect of confounding factors. Caution was taken to ensure that the prognostic factors did not have high collinearity for instance correlation coefficient between independent variables were less than 0.9 (<0.9 the assumption was met) (Sperandei, 2014).

The logistic regression formulae is given as follows:

$$Log\ \frac{y}{(1-y)} = \beta_0+\beta_1X_1 + \beta_2X_2+\beta_3X_3 \dots \dots +\beta_nX_n$$ (Sperandei, 2014)

Where:

y = Probability of an event (wasting, stunting, and underweight)

β_i = Regression coefficient associated with the reference groups (sex- male, female)

X_i = Explanatory variables

The third objective, which was assessing the survival functions was assessed using Kaplan- Meier (gave a summary of the Survival function and Hazard functions) and Mantel Log-rank assessed if there was a statistical significance in the prognostic factors. Cox-proportional Hazard test at the multivariable level tested for the relative risk of the event occurring (infants converting from HIV negative to HIV positive).

The Z values and corresponding p-values were reported as well as the Hazard ratios and their corresponding confidence intervals. Finally, the proportional hazard assumption using the Schoenfield's residual was used to assess the best-fit model by ensuring that the Cox-hazard assumption was met. The level of significance was set at $P < 0.05$.

Table 3.3: Techniques used to analyze infant survival over 12 months

Technique	Goal
-Kaplan-Meier	-To estimate the probability of the infants surviving beyond 12 months follow-up period
-Log-rank test	-To compare the statistical significance of selected covariates
-Cox- Regression	-To identify covariates that contribute to the risk of infant HIV positive status and identify the best fit model at multivariable analysis

Figure 3.1 shows how infant survival will be analyzed over the one-year follow-up period at univariable and multivariable levels for the infants enrolled for EID services.

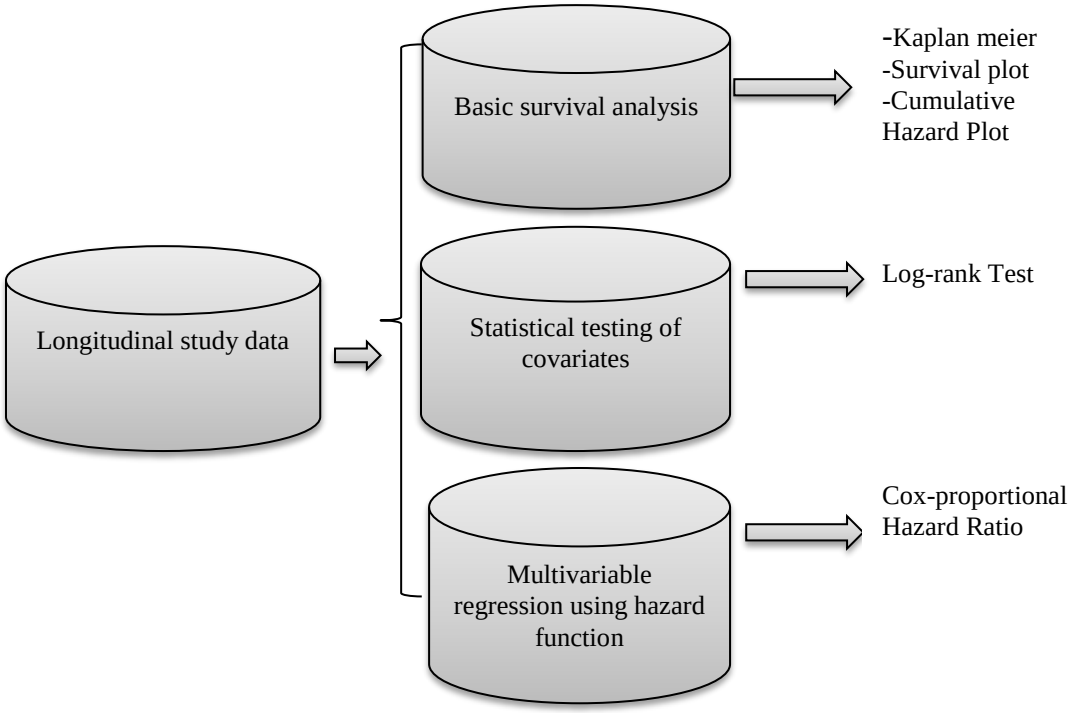


Figure 3.1: Techniques used in analyzing infant survival

The survival function and hazard function tests used to summarize the survival data is given by:

***Survival function* S(*t*)**

Survival function S (*t*) gives the probability that a person survives longer than some specified time *t.*

$S(t) = P\ (T \geq t) = 1 - \Pr(T < t)$ ... ... .2 (Fox, 2002)

Where : S(*t*) = Survival function

P = Probability

T = Failure time (time to infant HIV positivity)

t = Time origin

Characteristics of survival function S(*t*) are:

S(t)=1 if t = 0, $S(8) = \lim_{t \to 8} S(t) = 0$

S*(t)* is non-increasing in t

S*(t)* is left continuous

***Hazard function* h(*t*)**

The hazard function gives the instantaneous rate of failure, given that the individual has survived up to time *t*. It is also called the conditional failure rate or the hazard rate.

$$h(t) = \lim_{\Delta t \to 0} \frac{p(t \leq T < t + \Delta t | T \geq t)}{\Delta t} \ldots\ldots\ldots\ldots\ldots\ldots 3$$ (Bewick *et al.*, 2004)

Where:

H(*t*) = Hazard time

lim $_{\Delta t \to 0}$ = Instantaneous change in time

P = Probability

t = Time origin

T = Failure time (time to infant HIV positivity)

The numerator is the instantaneous potential for failure per unit time given survival up to time *t* (What is the probability that the infants' survival time is between time t and a little bit after time t (Δt) given that they survived until time t).

The denominator is the change in time (change per unit time).

Log-rank test

The log-rank test, which is a form of a Chi-square test distribution, was used to assess if there was a statistical significance of selected prognostic factors and the event of interest, which was the infant HIV positive status (Kleinbaum & Klein, 2012).

This was given by:

$$X^2(Log\ rank) = \frac{(O-E)^2}{E} \ldots\ldots\ldots\ldots\ldots\ldots 4$$ (Bewick *et al.*, 2004)

Where:

O = Number of total events that have been observed, within the groups

E = The expected number of events

Cox proportional hazard test

It is a regression method for survival data, which provides an estimate of the hazard ratio and its confidence interval. The hazard ratio is an estimate of the hazard rate based on a comparison of event rates. The hazard rate is the probability that if the event in question has not occurred (infant HIV positivity), it will occur in the next time interval, divided by the length of that interval. Usually, the time interval is very short so that the hazard rate is an instantaneous rate.

It is therefore given by:

$$\log h(t) = h_0(t) + b_1x_1 + b_2x_2 + \cdots + b_px_p \quad \text{....5 (Fox John, 2002)}$$

Where:

h(*t*) = hazard function within the limited time period of *t*

The covariates of $x_{1,}\ x_{2,\ldots\ldots}x_{p,}$ are the explanatory/predictor variables

$b_1\ b_2\ldots\ldots\ b_p$ are the coefficients of the explanatory variables

Modelling

The modelling to choose the most appropriate model from several other competing models was done using the Akaike's Information Criteria (AIC). AIC is applied to enable the selection of one best model from other competing models having the possibilities of various ranges of parameters. AIC of the lowest number in a model is the finest trigger in the betterment of a model (Symonds *et al*, 2011).

The AIC will be:

$$AIC = -2LL + 2(c + a) \ldots\ldots\ldots\ldots\ldots\ldots 5 \text{ (Bradbun } et\ al., 2003)$$

Where:

LL = The logarithm of the similarities of the model

c and a = Number of covariates and ancillary parameters respectively

The selection of covariates was done using both the backward and forward stepwise method, with the p-value set at p=<0.05.

3.11 Validity

To test the validity of the instrument, a pretest of the data collection tools was done at Langata Health Centre, which has a system almost similar to the selected hospitals and serves the Kibera and Mathare catchment population. In total 10% (16) of the questionnaires were used to assess the reliability of the questionnaires. The data that was collected was analyzed, summarized and the findings disseminated to the providers at Langata Health Centre. This analyzed data was not included in the main study.

Validity was conducted to determine the suitability, appropriateness, and clarity of the questionnaire items in addressing the variables under investigation. The pretesting of the instrument sought information from the participants to determine the degree of clarity of questions and to identify problem areas that needed attention. The pre-test provided an opportunity to detect and remedy any potential problems with the instrument including questions that respondents did not understand and questions that combined two or more issues in a single question and remedy the same. It also enhanced the training of the research assistants as they assisted in administering the research instruments.

According to Leedy and Ormrod, (2006) a pre-test is an excellent way to determine the feasibility of the study. A pre-test was conducted to assess the questions' validity and the likely reliability of the data that would be collected. Further, Cooper *et al.,* (2003) state that a pre-test is conducted to detect weaknesses in the design and instrumentation and provide proxy data for the selection of probability sample.

3.12 Data reliability

Standardized tools were used for all the participants such as a structured questionnaire for the mother-infant pair and KII for the healthcare providers. Cronbach's alpha technique Cronbach, (1951) was used to determine the reliability and internal consistency of the questionnaire whereby a Cronbach alpha value of between 0.70-

1.00 was considered an adequate measure of internal consistency (reliability). The Reliability indexes obtained were above 0.7 and deemed acceptable (Table 3.3).

Table 3.4: Reliability of the final instrument

Factor	No. of items	Cronbach Alpha value	Conclusion
Maternal ART adherence	8	0.86	Reliable
Disclosure status	2	0.70	Reliable
Maternal PMTCT clinic attendance (health-seeking behavior)	3	0.71	Reliable

3.13 Limitations and delimitations of the study

This study had several limitations. Firstly, exposure history was from the mother's self-report, and not all the history that was given could be corroborated from the maternal CCC file, IMCI booklet, and appointment booklets. Where it was not possible to corroborate the mothers self-report, the questionnaires were structured to counter-check the responses asked in a different format within the same questionnaire. Secondly, given the phrasing of the questionnaire, it was difficult to determine if the mothers were adherent to ART throughout the pregnancy period for instance if there were periods of cessation and non-adherence. Adherence, however, was also determined by observation of participant serial viral loads from pregnancy up to one-year post-partum. Due to the small sample size selected, the incidence rate of 9 cases per 100 person-years (95% CI: 5.465 – 16.290) may have been an underestimation of the true MTCT rates. Another limitation of our study was the lack of detailed data regarding clients that were lost-to-follow-up since it was not possible to reach them on the phone. Finally, nutrition data were collected at specific time-points (6 weeks, 6 months, and 12 months) making it difficult to capture the rapid fluctuations in the wasting and underweight nutrition parameters that can occur over a given year. However, these parameters were taken over time and were able to show trends and changes over time that could be useful in decision-making.

3.14 Ethical considerations

The researcher sought ethical approval to conduct the study from the Kenya Medical Research Institute (KEMRI) Scientific Ethics Review Unit (SERU), KEMRI/SERU/CPHR/002/3525. Clearance to carry out the study was given by the Board of Postgraduate Studies (BPS) of Jomo Kenyatta University of Agriculture, Science, and Technology (JKUAT). Permission was also sought from Nairobi County Ministry of Health and the Medical Superintendent of the facilities where the study was conducted. Informed consent was obtained and duly signed by the mothers. The current study did not have any participants below the age of 18 years.

Interviews were conducted in private, and instead of using real names, code identification was used and personal information from the interview was not released without written permission from the study participants. Consent forms and questionnaires were kept under key and lock to ensure a high level of confidentiality and privacy. Consent was also sought from the mother to draw 4mls of blood from her and the infant as well for viral load counts. Samples from this study were only identified by assigned identification numbers and were not linked to client identifiers, thus ensuring confidentiality. The procedure for sample collection was dully explained to the mother and any areas of concern were addressed adequately. The mothers' participation was voluntary and participants were free to withdraw from the study at any point without any consequences, penalties, or prejudicial consequences to them.

The data was consolidated into aggregate spreadsheets which contained no individual identifiers hence could not be linked with identifiable human subjects. All clients were given a patient information sheet detailing all aspects of the study including the title of the research project, invitation to participate in the research, purpose, and significance of the research, termination of participation, indication of voluntary contribution, risks involved, costs, and compensation, anonymity, and confidentiality.

The researcher did not anticipate any risks or major discomforts to the mother or infant during this study, however, there was minimal discomfort while drawing blood from the infant and the mother while drawing blood samples for the laboratory tests. This

study did not have direct benefits to the participants. However, it had the potential of improving the quality of EID services offered at healthcare facilities by demonstrating evidence-based and best practices for improving the health outcomes of the infants as they went through the EID process. Taking part in this study did not involve any payment for those procedures that were performed. Finally, the purpose and the expected outcome of the study were explained simply and honestly to the participants in the study.

CHAPTER FOUR

RESULTS

4.1 Socio-demographic and socio-economic characteristics of the HIV positive mothers

A total of 166 mother-infant pairs were recruited for the study and 163 (98.2%) mother-infant pairs participated at the beginning of the study (6 weeks). The 3 (1.8%) mother-infant pairs were censored from the study before 6 weeks of age as follows: at two and a half weeks one infant transferred out of Mathare North Health Center, at three weeks one infant died and at five weeks another one infant died. At six months, 22 mother-infant pairs were LTFU, and 10 more mothers were LTFU at 12 months. The median age of the mothers was 29 years (IQR: 25-33) with the majority 93 (56.0%) of them having an education level of primary level or below. Households consisted of 2-5 members mostly 121 (72.9%) at recruitment and 88 (67%) at the end-point. The majority of the mothers were married 141 (84.9%) at recruitment and 113 (86.3%) at the end-point. Most of the mothers had informal employment 108 (65.1%) at recruitment and 79 (60.3%) at end-point. The majority of the mothers 95 (57.2%) had a household income that ranged between Ksh. 6001-12000 (Table 4.1).

Table 4.1: Socio-demographic and socio-economic characteristics of HIV positive mothers

Maternal characteristics	Time-points	
	Recruitment (6 weeks)	Endpoint (12 months)
n=166	Frequency (%) (n=163)	Frequency (%) (n=131)
Age in completed years		
18-24	34(20.5)	27(20.6)
25-34	75(45.2)	58(44.3)
35-44	57(34.3)	46(35.1)
Highest Level of Education		
≤Primary	93(56.0)	75(57.3)
≥Secondary	73(44.0)	56(42.8)
No. of persons living in the household		
2-5	121(72.9)	88(67.2)
6-8	45(27.1)	43(32.8)
Respondent marital status		
Single	25(15.1)	18(12.7)
Married	141(84.9)	113(86.3)
Employment status		
Formal	27(16.3)	21(16.0)
Informal	108(65.1)	79(60.3)
Unemployed	31(18.6)	31(23.7)
Monthly income (Ksh.)		
≤6000	34(20.5)	37(28.2)
6001-12000	95(57.2)	67(51.2)
≥ 12001-18000	37(22.3)	27(20.6)

4.2 Incidence rate of HIV infection among infants over one a year follow-up period

The incidence rate of HIV infection among the infants over the one year follow-up period was 9 cases per 100 person-years (95% CI: 5.465, 16.290).

4.3 Maternal factors associated with HIV positive status of infants

4.3.1 Maternal socio-demographic and economic factors associated with HIV positive status of infants

Young maternal age (18-24 years) was associated with infant HIV positivity at 12 months (end-point) but was not seen to be associated with infant HIV positivity at

recruitment and 6 months. Being unemployed and having a household income of less than Ksh. 6000 was significantly associated with positive HIV status among infants attending EID services in selected hospitals in Nairobi County (Table 4.2).

Table 4.2: Maternal socio-demographic and economic factors associated with HIV positive status of infants

	Recruitment (n=163)			**Time-points 6 months (n=141)**			**12 months (n=131)**		
Maternal characteristics	**HIV -ve n (%)**	**HIV +ve n (%)**	**Fishers Exact p-value**	**HIV -ve n (%)**	**HIV +ve n (%)**	**Fishers Exact p-value**	**HIV -ve n (%)**	**HIV +ve n (%)**	**Fishers Exact p-value**
Age in years			0.224			0.356			**0.046**
18-24	29(90.6)	3(9.4)		26(87.7)	4(13.3)		20(76.9)	6(23.1)	
24-34	72(96.0)	3(4.0)		58(93.5)	4 (6.5)		54(91.5)	5 (8.5)	
35-44	55(98.2)	1(1.8)		47(95.9)	2 (4.1)		44(95.7)	2 (4.3)	
Highest level of Education			0.466			0.185			1.000
≤Primary	86(94.5)	5(5.5)		70(89.7)	8(10.3)		67(89.3)	8(10.7)	
≥Secondary	70(97.2)	2(2.8)		61(96.8)	2 (3.2)		51(91.1)	5(8.9)	
No. of persons living in the household			1.000			0.725			1.000
2-5	114(95.8)	5(4.2)		93(92.1)	8(7.9)		79(89.8)	9(10.2)	
6-8	42(95.5)	2(4.5)		38(95)	2(5)		39(90.7)	4(9.3)	
Respondent marital status			1.000			0.190			0.081
Single	23(95.8)	1(4.2)		19(86.4)	3(13.6)		14(77.8)	4(22.2)	
Married	133(95.7)	6(4.3)		112(94.1)	7(5.9)		104(92.0)	9(8.0)	
Employment status			**0.002**			**<0.001**			**<0.001**
Formal	26(96.3)	1(3.7)		21(95.4)	1(4.6)		19 (95.0)	1 (5.0)	
Informal	106(99)	1(1)		91(97.9)	2(2.2)		77(97.5)	2(2.5)	
Unemployed	24(82.8)	5(17.2)		19(73.1)	7(26.9)		21 (67.7)	10(32.3)	
Household income			**0.004**			**0.001**			**<0.001**
≤6000	27(84.4)	5(15.6)		23(76.7)	7(23.3)		27(73.0)	10(27.0)	
6001-12000	93(98.9)	1(1.2)		78(97.5)	2(2.5)		64(97.0)	2(3.0)	
≥12001-18000	36(97.3)	1(2.7)		30(96.8)	1(3.2)		26(96.3)	1(3.7)	

4.3.2 Maternal characteristics during PMTCT associated with HIV positive status of the infants

Giving mothers ART during pregnancy within the first trimester of pregnancy or even earlier was associated with lower infant HIV positivity. Ensuring that pregnant mothers attended more than three PMTCT visits was also associated with lower infant HIV positivity (Table 4.3).

Table 4.3: Maternal characteristics during PMTCT associated with the HIV positive status of infants

Maternal Characteristics	Time-points Recruitment (n=163)			6 months (n=141)			12 months (n=131)		
	HIV -ve n (%)	**HIV +ve n (%)**	**Fishers Exact p-value**	**HIV -ve n (%)**	**HIV +ve n (%)**	**Fishers Exact p-value**	**HIV -ve n (%)**	**HIV +ve n (%)**	**Fishers Exact p-value**
Year Confirmed Positive			**0.009**			**0.031**			**0.002**
> 2years prior to study onset	104(99.0)	1(1.0)		90(96.8)	3(3.2)		82(96.5)	3(3.5)	
≤ 2years prior to study onset	52(89.7)	6(10.3)		41(85.4)	7(14.6)		36(78.3)	10(21.7)	
Mode of Delivery			0.587			0.317			0.645
CS	18(94.7)	1(5.3)		14(87.5)	2(12.5)		13(86.7)	2 (13.3)	
SVD	138(95.8)	6(4.2)		117(93.6)	8(6.4)		105(90.5)	11(9.5)	
Given ART in pregnancy			**0.009**			**0.025**			**0.049**
No	2(50.0)	2(50.0)		2(50.0)	2(50.0)		2(50.0)	2(50.0)	
Yes	154(96.9)	5(3.1)		129(94.2)	8(5.8)		116(91.3)	11(8.7)	
Stage ART administered during pregnancy			**0.002**			**0.013**			**0.001**
1st Trimester	124(98.4)	2(1.6)		105(95.5)	5(4.5)		99(95.2)	5(4.8)	
2nd Trimester	24(92.3)	2(7.7)		20 (90.9)	2(9.1)		14(77.8)	4(22.2)	
3rd Trimester	8(72.3)	3(27.3)		6 (66.7)	3(33.3)		5(55.6)	4(44.4)	
Gestation at 1st PMTCT visit			0.881			1.000			1.000
1st Trimester	29(96.7)	1(3.3)		22(91.7)	2(8.3)		23(92.0)	2(8.0)	
2nd Trimester	75(96.2)	3(3.8)		63(92.7)	5(7.3)		55(90.2)	6(9.8)	
3rd Trimester	52(94.6)	3(4.6)		46(93.9)	3(6.1)		40(88.9)	5(11.1)	
No of PMTCT Visits			**<0.001**			**0.001**			**<0.001**
≤1	10(90.9)	1(9.1)		4(80.0)	1(20.0)		6(66.7)	3(33.3)	
2	15(75.0)	5(25.0)		11(68.8)	5(31.3)		10(66.7)	5(33.3)	
≥3	131(99.2)	1(0.8)		116(96.7)	4(3.3)		118(95.3)	5(4.7)	

4.3.3 Maternal HIV disclosure status associated with HIV positive status of infants

Mothers who had not disclosed their HIV status to their partners and did not know their partner’s HIV status experienced more infant HIV positivity relative to mothers who had disclosed their status to their partners and knew their partners' HIV status (Table 4.4).

Table 4.4: Maternal HIV disclosure status associated with HIV positive status of infants

Maternal characteristics	Time-points: Recruitment (n=163) HIV -ve n (%)	Recruitment (n=163) HIV +ve n (%)	Recruitment (n=163) Fishers Exact p-value	6 months (n=141) HIV -ve n (%)	6 months (n=141) HIV +ve n (%)	6 months (n=141) Fishers Exact p-value	12 months (n=131) HIV -ve n (%)	12 months (n=131) HIV +ve n (%)	12 months (n=131) Fishers Exact p-value
Have a partner			0.545			0.288			0.473
No	16(94.1)	1(5.9)		13(86.7)	2(13.3)		5 (83.3)	1(16.7)	
Yes	140(95.9)	6(4.1)		118(93.6)	8 (6.4)		113(90.4)	12(9.6)	
Disclosed status to partner			**0.116**			**0.036**			**0.011**
No	13(86.7)	2(13.3)		10(76.9)	3(23.1)		12(70.6)	5(29.4)	
Yes	127(97.0)	4(3.0)		108(95.6)	5(4.4)		101(93.5)	7(6.5)	
Know Partner HIV status			**0.048**			**0.033**			**0.004**
No	36(90.0)	4(10.0)		29(85.3)	5(14.7)		27(77.1)	8(22.9)	
Yes	104(98.1)	2(1.9)		89(96.7)	3(3.3)		86(95.6)	4(4.4)	
Spouse HIV Status			1.00			0.572			1.000
Negative	42(97.7)	1(2.3)		37(94.9)	2(5.1)		34(94.4)	2(5.6)	
Positive	62(98.4)	1(1.6)		52(98.1)	1(1.9)		52(96.3)	2(3.7)	

4.3.4 Maternal characteristics at various time-points associated with HIV positive status of infants

Mothers with poor ART adherence and high viral loads experienced more infant positivity than mothers with good ART adherence, and low viral loads respectively. Mothers on first-line ART regimen experienced more infant positivity than those on second-line therapy. Similarly, mothers who were in the second stage of HIV experienced more infant positivity relative to those who were in the first stage of HIV. Maternal BMI was associated with infant positivity at 6 months and 12 months only whereby, underweight mothers experienced more positivity relative to mothers who had normal BMI (Table 4.5).

Table 4.5: Maternal factors at various time-points associated HIV positive status of infants

Maternal Characteristics	Time-points Recruitment (n=163) HIV -ve n (%)	HIV +ve n (%)	Fishers Exact p-value	6 months (n=141) HIV -ve n (%)	HIV +ve n (%)	Fishers Exact p-value	12 months (n=131) HIV -ve n (%)	HIV +ve n (%)	Fishers Exact p-value
ART adherence			**0.001**			**<0.001**			**<0.001**
Good	95(99.0)	1 (1.0)		83(97.6)	2(2.4)		69(97.2)	2(2.8)	
Inadequate	50(96.2)	2 (3.8)		41(95.3)	2(4.7)		38(92.7)	3(7.3)	
Poor	11(73.3)	4(26.7)		7 (53.8)	6(46.2)		9 (52.9)	8(47.1)	
Maternal HIV Staging			**0.020**			**<0.001**			**<0.001**
I	13(97.8)	3(2.2)		106(99.1)	1(0.9)		94(97.9)	2(2.1)	
II	25(86.2)	4(13.8)		25(73.5)	9(26.5)		24(68.6)	11(31.4)	
ART Regimen			**<0.001**			**<0.001**			**<0.001**
First-line	150(98.7)	2(1.3)		125(97.7)	3(2.3)		114(96.6)	4 (3.4)	
Second-line	6(54.6)	5(45.4)		6(46.2)	7(53.8)		4(30.8)	9(69.2)	
Viral Load (VL)			**<0.001**			**<0.001**			**<0.001**
Undetectable VL	119(99.2)	1(0.8)		93(98.9)	1(1.1)		87(98.9)	1(1.14)	
Low VL	19(95.0)	1(5.0)		22(95.6)	1(4.4)		16(94.1)	1(5.9)	
High VL	18(78.3)	5(21.7)		16(66.7)	8(33.3)		15(57.7)	11(42.3)	
Maternal BMI			0.376			**0.117**			**0.006**
Underweight	8(88.9)	1(11.1)		10(76.9)	3(23.1)		6(54.5)	5(45.5)	
Normal	83(95.4)	4(4.6)		66(93.0)	5(7.0)		59(92.2)	5(7.8)	
Overweight	49(98.0)	1(2.0)		40(97.6)	1(2.4)		38(95.0)	2(5.0)	
Obese	16(94.1)	1(5.9)		15(93.7)	1(6.2)		15(93.8)	1(6.2)	

4.4 Socio-demographic and economic factors influencing the HIV positive status of infants over a one-year follow-up period

Maternal age was a significant factor only at 12 months (end-point) whereby younger mothers who were aged between 18-24 years had 5.31 times the risk of having a HIV positive infant relative to their older counterparts. Mothers who were employed and had a household income of between Ksh. 6001-12000 had a lower risk of having a HIV positive infant relative to those who were unemployed or had low household income levels of Ksh. ≤6000 (Table 4.6).

Table 4.6: RR and ARR for socio-demographic and economic factors influencing the HIV positive status of infants over a one-year follow-up period

	Time-points		
	6 weeks n= 161	6 months n= 141	12months n= 131
Maternal characteristics	**RR (95%CI)**	**RR (95%CI)**	**RR (95%CI)**
Age in years			
35-44 *(Ref)*			1.00
18-24			**5.31** (1.15,24.57)
25-34			1.95 (0.39,9.65)
Employment			
Unemployed*(Ref)*	1.00	1.00	1.00
Formal	0.22 (0.03,1.73)	0.17 (0.02,1.28)	0.16 (0.02,1.13)
Informal	**0.05** (0.01,0.45)	**0.08** (0.02,0.36)	**0.08** (0.02,0.34)
Income			
≤ 6000 *(Ref)*	1.00	1.00	1.00
6001-12000	**0.07** (0.01,0.57)	**0.11** (0.02,0.49)	**0.11** (0.03,0.05)
≥12001-18000	0.17 (0.02,1.41)	0.14 (0.02,1.06)	0.14 (0.02,1.02)

4.5 Maternal factors during PMTCT influencing the HIV positive status of infants over a one-year follow-up period

Mothers who were diagnosed to be HIV positive less than two years prior to study onset (recent diagnosis of less than two years) had a higher risk of having a HIV positive infant across all the time-points relative to mothers who had been diagnosed with HIV for more than two years since the study onset. Giving mothers ART during pregnancy and within the first trimester was seen as a protective factor with a lower risk of infant HIV positivity relative to mothers who had not been administered with ART during pregnancy or had late ART initiation (3^{rd} trimester) during pregnancy. Similarly, ensuring that mothers attended three or more PMTCT visits was a protective factor whereby infants had a lower risk of HIV infection relative to infants born to mothers that had attended fewer visits (only two) (Table 4.7).

Table 4.7: RR and ARR for maternal factors during PMTCT influencing the HIV positive status of infants over a one-year follow-up period

	Time-points		
	6 Weeks n=163	**6months n= 141**	**12months n= 131**
Maternal characteristics	**RR (95%CI)**	**RR (95%CI)**	**RR (95%CI)**
Year confirmed +ve			
> 2years prior to study onset *(Ref)*	1.00	1.00	1.00
≤ 2years prior to study onset	**10.86** (1.33,88.62)	**4.52** (1.22,16.78)	**6.16** (1.8,21.37)
Given ART in pregnancy			
No *(Ref)*	1.00	1.00	1.00
Yes	**ARR=0.06** (0.01,0.21)	**0.12** (0.04, 0.39)	**0.17** (0.06,0.54)
Stage ART first admin Pregnancy			
3rd Trimester (*Ref)*	1.00	1.00	1.00
1st Trimester	**ARR=0.07** (0.01,0.31)	**0.14** (0.04, 0.48)	**0.11** (0.04,0.34)
2nd Trimester	0.69 (0.20,2.35)	0.27 (0.05,1.38)	0.500 (0.16,1.56)
No. of PMTCT visits attended			
2 *(Ref)*	1.00	1.00	1.00
≤1	0.36 (0.05,2.75)	0.64 (0.10,4.30)	1.00 (0.31,3.23)
≥3	**0.03** (0.01,0.25)	**0.11** (0.03,0.36)	**0.14** (0.05,0.43)

4.6 Partner disclosure status influencing the HIV positive status of infants over a one-year follow-up period

Mothers who had not disclosed their HIV status to their partners had a higher risk of having more infant HIV positivity relative to mothers that had disclosed their HIV status at 6 months and 12 months. Across all the time-points, mothers who did not know their partners' HIV status had a higher risk of infant HIV positivity relative to mothers that knew their partners' HIV status (Table 4.8).

Table 4.8: RR and ARR for partner disclosure status influencing the HIV positive status of infants over a one-year follow-up period

	Time-points		
	Recruitment n=163	**6 months n= 141**	**12months n= 131**
Maternal characteristics	**RR (95%CI)**	**RR (95%CI)**	**RR(95%CI)**
Disclosed status			
Yes *(Ref)*	1.00	1.00	1.00
No	4.37 (0.87,22.00)	**5.22** (1.40,19.45)	**4.54** (1.62,12.73)
Know partner status			
Yes *(Ref)*	1.00	1.00	1.00
No	**5.3** (1.10,27.98)	**4.51** (1.13,17.96)	**5.14** (1.66,16.07)

4.7 Maternal characteristics at the various time-points influencing the HIV positive status of infants over a one-year follow-up period

Across all time-points, mothers who had good ART Adherence and had low viral loads had lower risks of experiencing infant HIV positivity relative to mothers who had poor ART adherence and high viral loads. Mothers who were in stage 2 of HIV infection had a higher risk of infant HIV positivity relative to mothers who were in stage 1 of HIV infection across all the time-points. Mothers who were on the first-line ART regimen had a lower risk of infant HIV positivity relative to mothers who were on the second-line ART regimen. Underweight mothers had a higher risk of infant HIV positivity relative to mothers with a normal BMI (Table 4.9).

Table 4.9: RR and ARR for maternal characteristics at the various time-points influencing the HIV positive status of infants over a one-year follow-up period

	Recruitment	Time-points	
	n= 163	6 months n= 141	12 months n= 131
Maternal characteristics	**RR (95%CI)**	**RR (95%CI)**	**RR (95%CI)**
ART Adherence			
Poor *(Ref)*	1.00	1.00	1.00
Good	**0.12** (0.03,0.33)	**ARR 0.15** (0.02,0.98)	**0.06** (0.01,0.26)
Inadequate	**0.11** (0.03,0.54)	**ARR 0.19** (0.04,0.85)	**0.16** (0.05,0.52)
HIV Staging			
I *(Ref)*	1.00	1.00	1.00
II	**6.16** (1.45,26.17)	**4.42** (1.36,14.2)	**ARR 7.17** (1.37,37.5)
Viral Load (VL)			
High VL *(Ref)*	1.00	1.00	1.00
Undetectable VL	**0.04** (0.01,0.32)	**0.06** (0.01,0.27)	**0.03** (0.01,0.20)
Low VL	0.23 (0.03,1.82)	0.21 (0.03,1.54)	**0.14** (0.02,0.99)
ART Regimen			
Second-line *(Ref)*	1.00	1.00	1.00
First-line	**ARR 0.04** (0.01,0.13)	**ARR 0.08** (0.02,0.45)	**ARR 0.10** (0.03,0.35)
Maternal BMI			
Normal *(Ref)*			1.00
Underweight			**5.82** (2.0,16.89)
Overweight			0.64 (0.13,3.16)
Obese			0.80 (0.10,6.43)

4.8 Parsimonious Poisson regression models for risk factors of infant HIV positivity at the various time-points

Significant variables in the Poisson regression models assessed the relationship between the logs of expected counts of infant HIV status at the various time-points and the associated risk factors. Modeling was arrived at by using both backward and forward stepwise method with the level of significance set at ($p = <0.05$).

4.8.1 Parsimonious Poisson regression model for risk factors of infant HIV positivity at recruitment

In the overall parsimonious model at recruitment, the three prognostic factors that best explained and most influenced infant HIV positivity at recruitment were as discussed below. The final model was selected as it had the lowest BIC (53.27) and had an overall good fit as measured using Pearson's Goodness of Fit test (Table 4.10).

ART being given during pregnancy was a protective factor whereby participants who had been administered with ART during pregnancy had a lower risk (ARR= 0.06) of getting HIV positive infants relative to those who had not received ART during pregnancy. Additionally, mothers who had been initiated on ART in the first trimester experienced a lower risk (ARR= 0.07) of getting a HIV positive infant than mothers who had been administered with ART in the third trimester

Therefore, administering ART as early as in the first trimester or sooner was a protective measure in reducing the risk of HIV transmission to the infant. Similarly, mothers who were on the first-line regimen experienced a lower risk (ARR= 0.04) of getting HIV infected infants compared to participants who were on the second-line regimen (95% CI 0.01, 0.11, $p \leq 0.001$) (Table 4.10).

Table 4.10: Parsimonious Poisson regression model for risk factors of infant HIV positivity at recruitment

Maternal characteristics	ARR	Robust Std. Err.	z	P>z	95% C.I Lower	95% C.I Upper	Prob > Chi2
Given ART during pregnancy							**<0.001**
No *(Ref)*	1.00						
Yes	0.06	0.04	-4.18	**≤0.001**	0.014	0.213	
Stage ART was first given in Pregnancy							
3rd Trimester *(Ref)*	1.00						
1st Trimester	0.07	0.05	-3.47	**0.001**	0.014	0.307	
2nd Trimester	0.69	0.43	-0.60	0.549	0.201	2.352	
ART regimen							
Second-line *(Ref)*	1.00						
First-line	0.04	0.02	-5.81	**≤0.001**	0.012	0.114	
_cons	18.37	11.59	4.62	0.003	5.34	63.23	

Summary for Parsimonious regression model at recruitment

No. of observations	Deviance G.O.F	Persons G.O.F	Log-Likelihood	AIC	BIC
n= 166	13.81	28.87	-13.90	37.81	53.27

4.8.2: Spearman test of collinearity for risk factors of infant HIV positivity at recruitment

Table 4.11 shows that there was no collinearity among the three variables in the parsimonious model at recruitment hence, a good model to explain the outcome variable of infant HIV status.

Table 4.11: Spearman correlation coefficient test for risk factors of infant HIV positivity

Explanatory variables	Given ART during pregnancy	Stage ART administered in pregnancy	Mothers ART regimen
Given ART during pregnancy	1.000		
Stage ART was administered in pregnancy	-0.0236	1.000	
Mothers ART regimen	-0.1154	0.098	1.000

4.8.3 Parsimonious Poisson regression model for risk factors of infant HIV positivity at 6 months

In the overall parsimonious model at 6 months, two prognostic factors best explained and most influenced infant HIV positivity at 6 months whereby mothers who were on the first-line ART regimen experienced a lower risk of infant HIV positivity relative to those on the second-line ART regimen (ARR= 0.08). Good maternal ART adherence was a protective factor whereby these mothers had a lower risk of HIV positivity in their infants (ARR= 0.15). These two prognostic factors were not collinear (Spearman Rho 0.0026) and the model had the lowest BIC (64.26) relative to the other competing models at 6 months (Table 4.12).

Table 4.12: Parsimonious Poisson regression model for risk factors of infant HIV positivity at 6 months

Maternal characteristics	ARR	Robust Std. Err.	z	P>z	95% C.I Lower	95% C.I Upper	Prob > Chi2
n = 141							**<0.001**
ART regimen							
Second-line *(Ref)*	1.00						
First-line	0.08	0.072	-2.88	**0.004**	0.016	0.454	
ART Adherence							
Poor (*Ref*)	1.00						
Good	0.15	0.142	-1.98	**0.047**	0.022	0.976	
Inadequate	0.19	0.146	-2.18	**0.029**	0.044	0.846	

Summary for Parsimonious regression model at 6 months

No. of observations	Deviance G.O.F	Persons G.O.F	Log-Likelihood	AIC	BIC	Spearman Rho
n= 141	24.46	75.55	-22.23	52.46	64.26	0.0026

4.8.4 Parsimonious Poisson regression model for risk factors of infant HIV positivity at 12 months

At 12 months, two prognostic factors best explained and most influenced infant HIV positivity whereby mothers who were in the second stage of HIV infection experienced a higher risk of infant HIV positivity relative to those who were in the first stage (ARR= 7.17). Mothers who were on the first-line ART regimen experienced a lower risk of infant HIV positivity relative to those on the second-line regimen (ARR= 0.10) These two prognostic factors were not collinear (Spearman Rho 0.0073) and the model had the lowest BIC (64.25) relative to the other competing models at 6 months (Table 4.13).

Table 4.13: Parsimonious Poisson regression model for risk factors of infant HIV positivity at 12 months

Maternal characteristics	ARR	Robust Std. Err.	z	P>z	95% C.I		Prob > Chi2
					Lower	Upper	
n=131							**<0.001**
HIV Staging							
I *(Ref)*	1.00						
II	7.17	6.053	2.33	**0.020**	1.372	37.497	
ART regimen							
Second-line *(Ref)*	1.00						
First-line	0.10	0.064	-3.57	**<0.001**	0.027	0.350	
_cons							

Summary for Parsimonious regression model at 12 months

No. of observations	Deviance G.O.F	Persons G.O.F	Log-Likelihood	AIC	BIC	Spearman Rho
n= 131	25.62	47.31	-25.81	57.62	66.25	0.0073

4.9 Nutritional status of infants enrolled for EID services of HIV

Infants' nutritional status was assessed at three time-points at 6 weeks, 6 months and at 12 months with the parameters being measured being infant weight for height (measuring wasting), infant weight for age (measuring underweight), and infant height for age (measuring stunting). Corresponding Z-scores for these three nutritional categories were recorded and reported accordingly. WHO growth standards and the corresponding Z-scores were used whereby stunting (length for age <-2 SD), wasting (weight for length <-2 SD), and underweight (weight for age <-2 SD) were the cut-offs used.

4.9.1 Overall infant nutritional status over 12 months follow-up period

Figure 4.1 shows the overall infant nutritional status over a 12-month follow-up period at the various time-points.

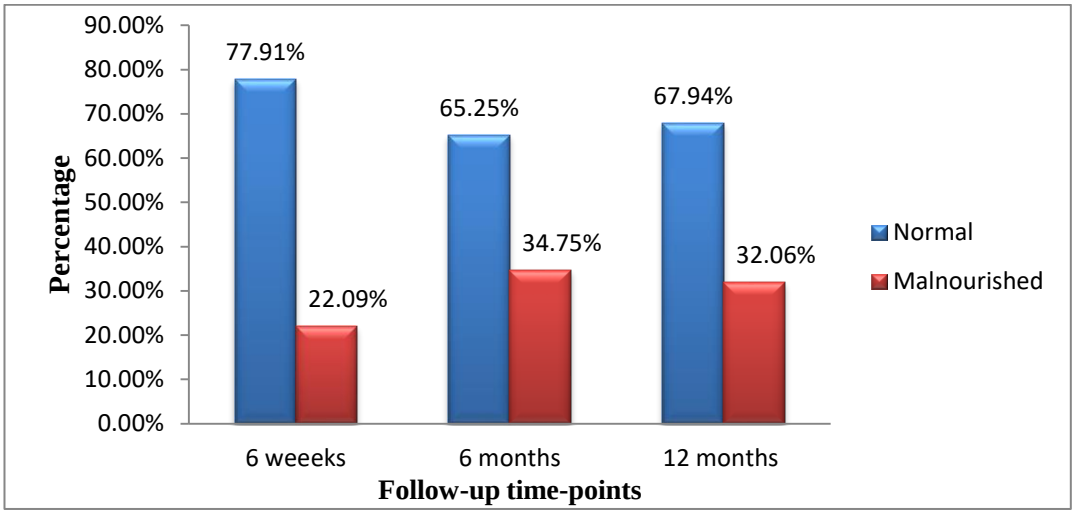
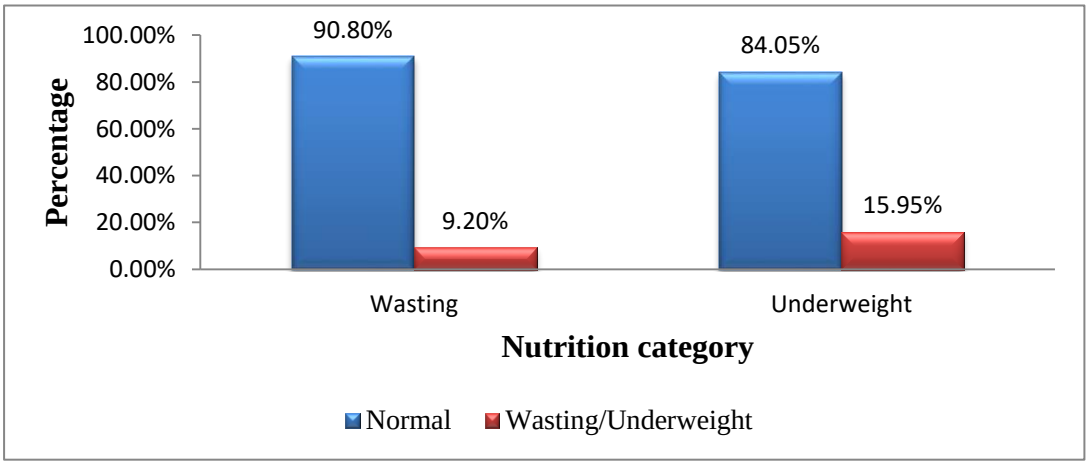


Figure 4.1: Overall infant nutritional status over 12 months follow-up

4.9.2 Infant nutritional status at recruitment

The nutritional status of 163 infants assessed at recruitment whereby, 15 (9.20%) of the infants were wasted while 26 (15.95%) were underweight (Figure 4.2).

Figure 4.2: Infant nutritional status at recruitment



4.9.3 Infant nutritional status at 6 months

The nutritional status of 141 infants assessed at 6 months whereby, 12 (8.51%) of the infants were wasted, 22 (15.60%) were underweight and 35 (24.82%) were stunted (Figure 4.3).

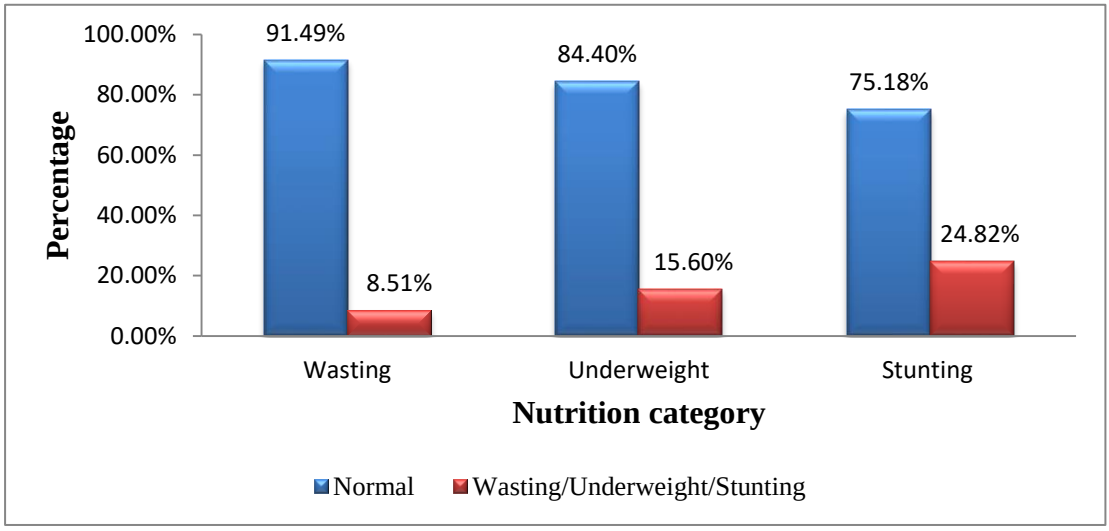


Figure 4.3: Infant nutritional status at 6 months

4.9.4: Infant nutritional status at 12 months

The nutritional status of 131 infants was assessed at 12 months whereby, 14 (10.69%) of the infants were wasted, 17 (12.98%) were stunted and 27 (20.61%) were underweight (Figure 4.4).

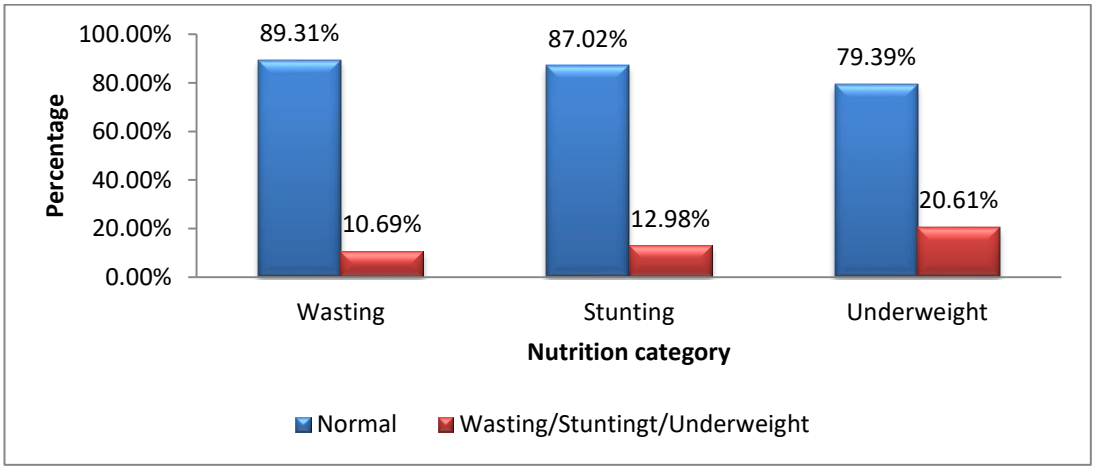


Figure 4.4: Infant nutritional status at 12 months

4.9.5 Infant nutritional status over 12 months follow-up

At recruitment, underweight infants were 26 (15.95%) while at 6 months stunting was the worst form of malnutrition with 35 (24.82%) of the infants experiencing stunting. At the end-point, underweight 27 (20.61%) was the most severe form of malnutrition followed closely by stunting 17 (12.98%) (Figure 4.5).

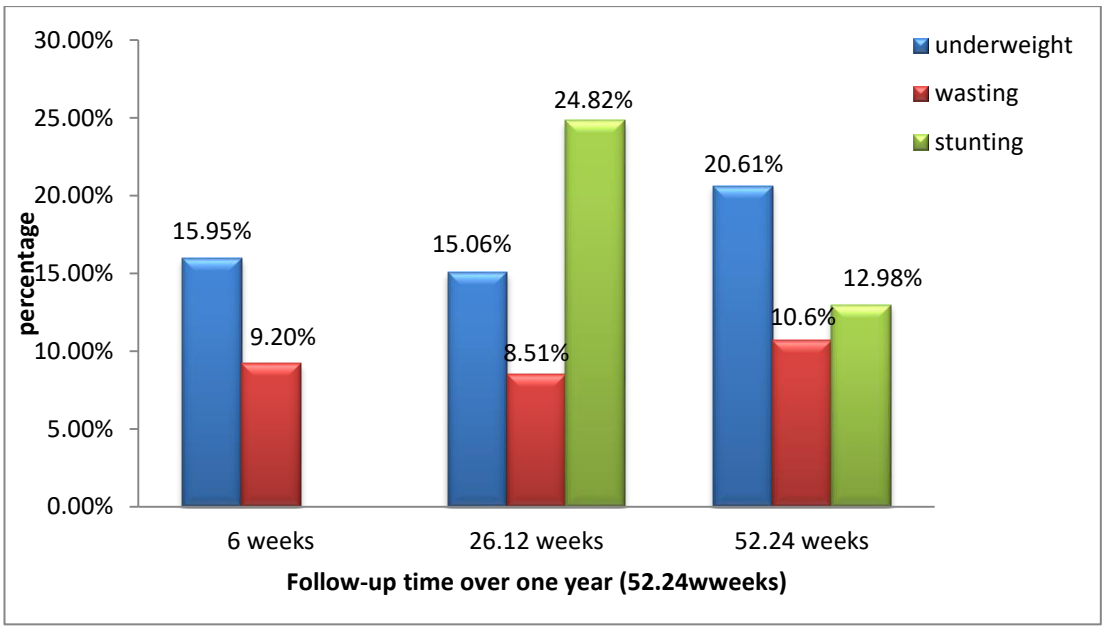


Figure 4.5: Infant nutritional status over 12 months of follow-up

4.10 Infant feeding practices

At recruitment 161 (97.0%) mothers were exclusively breastfeeding their infants while 3 (1.8%) did mixed feeding and 2 (1.2%) were on formula milk. Only 75 (53.2%) of the infants were exclusively breastfed for six months while 64 (45.4%) were mixed fed and 2 (1.4%) were on formula milk for the first six months of their lives. The reasons these mothers gave for not exclusively breastfeeding their infants for the first six months included lack of enough breast milk 48 (34.5%), sickness of breast 9 (6.3%), voluntary refusal of the baby to breastfeed 10 (7.1%), mother not wanting to pass HIV medicine 40 (28.1%) and work 34 (24%). Despite the majority of the mothers

163(98.9%) knowing that they should exclusively breastfeed their infants for the first 6 months, mothers still mixed fed their infants before six months were over. They cited varied reasons for mixed feeding, with the top two reasons being lack of enough breast milk 48 (34.5%) and fear of not wanting to infect their infant's with HIV 40 (28.1%) (Figure 4.6).

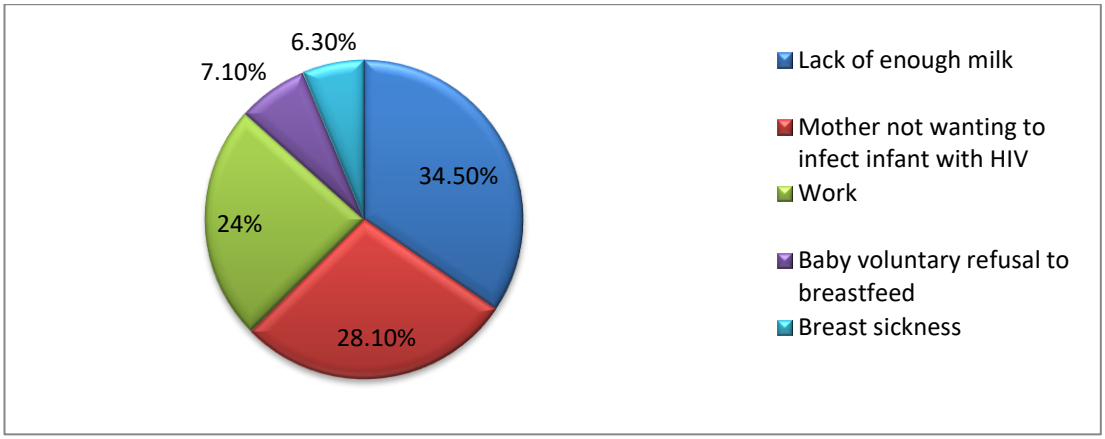


Figure 4.6: Mothers' reasons for not exclusively breastfeeding for 6 months

4.11 Maternal knowledge of infant feeding practices

To determine the mothers' knowledge on infant feeding practices, mothers were asked questions regarding their knowledge on the available feeding options, if they had been educated on the available feeding options, their source of information on feeding practices, and the feeding option the mother would settle for in the first six months of the infant's life (Appendix III B). Maternal knowledge on feeding practices was assessed at recruitment and found to be very high with 163 (98.9%) mothers aware that they should exclusively breastfeed their infants for 6 months, 164 (98.2%) choosing to do exclusive breastfeeding while 2 (1.2%) chose formula feeding. Most of the mothers 161 (97%) got information on feeding options from the ANC clinics.

4.12 Maternal factors associated with infant nutritional status at recruitment

4.12.1 Socio-demographic and economic factors associated with infant nutritional status

Maternal age was associated with wasting (p= 0.005) whereby younger mothers aged between 18-24 years experienced more infant wasting 8 (25%) relative to their older counterparts. Unemployment status and low monthly household income (≤ 6000) were associated with more infant wasting and underweight (p= 0.002 and p= 0.006) respectively (Table 4.14).

Table 4.14: Socio-demographic and economic factors associated with infant nutritional status at recruitment

Maternal characteristics (n=163)	**Infant nutritional status**					
	Wasting status			**Underweight status**		
	p-value	***Normal* n (%)**	***Wasted* n (%)**	***p-value***	***Normal* n (%)**	***Underweight* n (%)**
Age in years	**0.005**			0.591		
18-24		24(75.0)	8(25.0)		25(78.1)	7(21.9)
25-34		72(96.0%)	3(4.0)		64(85.3)	11(14.7)
35-44		52(92.9%)	4(7.1)		48(85.7)	8(14.3)
Highest level of Education	0.100			0.389		
≤Primary		86(94.5)	5(5.5)		74(81.3)	17(18.7)
≥Secondary		62(86.1)	10(13.9)		63(87.5)	9(12.5)
No. of persons living in household	0.761			0.057		
2-5		107(89.9)	12(10.1)		96(80.7)	23(19.3)
6-8		41(93.2)	3(6.8)		41(93.2)	3(6.8)
Respondent marital status	0.241			0.545		
Single		20(83.3)	4(16.7)		19(79.2)	5(20.8)
Married		128(92.1)	11(7.9)		118(84.9)	21(15.1)
Employment status	**0.002**			**0.004**		
Formal		25(92.6)	2(7.4)		24(88.9)	3(11.1)
Informal		102(95.3)	5(4.7)		95(88.8)	12(11.2)
Unemployed		21(72.4)	8(27.6)		18(62.1)	11(15.9)
Monthly household income	**0.006**			**0.010**		
≤6000		24(75.0)	8(25.0)		21(65.6)	11(34.4)
6001-12000		89(94.7)	5(5.3)		82(87.2)	12(12.8)
≥12001-18000		35(94.6)	2(5.4)		34(91.9)	3(8.1)

4.12.2 PMTCT factors associated with infant nutritional status at recruitment

None of the PMTCT factors were found to be associated with infant wasting or underweight status. PMTCT factors that were assessed included the year mother was confirmed to be HIV positive, mode of delivery, if the mother was given ART in pregnancy, the stage that ARTs were administered during pregnancy and the number of PMTCT visits the mother had attended.

4.12.3 Maternal disclosure status associated with infant nutritional status at recruitment

None of the disclosure factors were found to be associated with infant wasting or underweight status. Maternal disclosure status that was assessed included if the mother

had disclosed her HIV status to her partner and if the mother knew her partner's HIV status.

4.12.4 Maternal characteristics at recruitment associated with infant nutritional status

Mothers with poor ART adherence experienced more wasting and underweight in their infants 4 (26.7%) and 6 (40%) respectively, relative to those with good adherence. Similarly, mothers with a high viral load experienced more wasting and underweight in their infants 6 (26.1%) and 10 (43.5%) respectively, relative to those with undetectable viral loads (Table 4.15).

Table 4.15: Maternal characteristics at recruitment associated with infant nutritional status

Maternal characteristics	**Infant nutritional status**					
	Wasting status			**Underweight status**		
n=163	***p-value***	***Normal*** **n (%)**	***Wasted*** **n (%)**	***p-value***	***Normal*** **n (%)**	***Underweight*** **n (%)**
ART adherence	**0.024**			**0.013**		
Good		91(94.8)	5(5.2)		86(89.6)	10(10.4)
Inadequate		46(88.5)	6(11.5)		42(80.8)	10(19.2)
Poor		11(73.3)	4(26.7)		9(60.0)	6(40.0)
Maternal HIV Staging	0.147			0.785		
I		124(92.5)	10(7.5)		113(84.3)	21(15.7)
II		24(82.8)	5(17.2)		24(82.7)	5(17.3)
ART Regimen	0.067			0.077		
First-line		140(92.1)	12(7.9)		130(85.5)	22(14.5)
Second-line		8(72.7)	3(27.3)		7(63.6)	4(36.4)
Viral Load (VL)	**0.001**			**0.001**		
Undetectable VL		115(95.8)	5(4.2)		107(89.2)	13(10.8)
Low VL		16(80.0)	4(20.0)		17(85.0)	3(15.0)
High VL		17(73.9)	6(26.1)		13(56.5)	10(43.5)
Maternal BMI	0.059			0.268		
Underweight		7(77.8)	2(22.2)		6(66.7)	3(33.3)
Normal		76(87.4)	11(12.6)		72(82.8)	15(17.2)
Overweight		49(98.0)	1(2.0)		45(90.0)	5(10.0)
Obese		16(94.1)	1(5.9)		14(82.3)	3(17.7)

4.14.3 Maternal disclosure status associated with infant nutritional status at 12 months

There was no association between maternal disclosure status and infant nutritional status at 12 months. Maternal disclosure statuses that were assessed included if the mother had disclosed her HIV status to her partner and if the mother knew her partner's HIV status.

4.13 Maternal characteristics associated with infant nutritional status at 6 months

4.13.1 Socio-demographic and socio-economic factors associated with infant nutritional status at 6 months

Maternal age was associated with infant wasting and stunting at 6 months but was not associated with infant underweight status. Mothers who had a low household income and were unemployed experienced more wasting, stunting, and underweight in their infants' relative to those with higher income levels or those who were employed (Table 4.16).

Table 4.16: Socio-demographic and economic factors associated with infant nutritional status at 6 months

Maternal characteristics (n=141)	**Infant nutritional status**								
	Wasting			**Stunting**			**Underweight**		
	p-value	***Normal* n (%)**	***Wasted* n (%)**	***p-value***	***Normal* n (%)**	***Stunted* n (%)**	***p-value***	***Normal* n (%)**	***Underweight* n (%)**
Age in years	**0.008**			**0.039**			0.412		
18-24		23(76.7)	7(23.3)		17(56.7)	13(43.3)		23(76.7)	7(23.3)
25-34		59(96.7)	2(3.3)		48(78.7)	13(21.3)		52(85.3)	9(14.7)
35-44		47(94.0)	3(6.0)		41(82.0)	9(18.0)		44(88.0)	6(12.0)
Education	0.770			0.171			0.101		
≤Primary		71(92.2)	6(7.8)		54(70.1)	23(29.9)		61(79.2)	16(20.8)
≥Secondary		58(90.6)	6(9.4)		52(81.3)	12(18.8)		58(90.6)	6(9.4)
No. of persons living in household	0.509			0.518			0.310		
2-5		91(90.1)	10(9.9)		74(73.3)	27(26.7)		83(82.2)	18(17.8)
6-8		38(95.0)	2(5.0)		32(80.0)	8(20.0)		36(90.0)	4(10.0)
Marital status	0.400			0.791			1.000		
Single		19(86.4)	3(13.6)		16(72.7)	6(27.3)		19(86.4)	3(13.6)
Married		110(92.4)	9(7.6)		90(75.6)	29(24.4)		100(84.0)	19(16.0)
Employment status	**≤0.001**			**0.012**			**≤0.001**		
Formal		20(90.9)	2(9.1)		15(68.2)	7(31.8)		17(77.3)	5(22.7)
Informal		90(97.8)	2(2.2)		76(82.6)	16(17.4)		86(93.5)	6(6.5)
Unemployed		19(70.4)	8(29.6)		15(55.6)	12(44.4)		16(59.3)	11(40.7)
Household income	**0.001**			**0.014**			**0.001**		
≤6000		23(74.2)	8(25.8)		17(54.8)	14(45.2)		19(61.3)	12(38.7)
6001-12000		77(97.5)	2(2.5)		65(82.3)	14(17.7)		73(92.4)	6(7.6)
≥12001-18000		29(93.5)	2(6.5)		24(77.4)	7(22.6)		27(87.1)	4(12.9)

4.13.2 PMTCT factors associated with infant nutritional status at 6 months

None of the maternal PMTCT factors were associated with infant nutritional status. PMTCT factors that were assessed included the year mother was confirmed to be HIV positive, mode of delivery, if the mother was given ART in pregnancy, the stage that ARTs were administered during pregnancy and the number of PMTCT visits the mother had attended.

4.13.3 Maternal disclosure status associated with infant nutritional status at 6 months

There was no association between maternal disclosure status and infant nutritional status. Maternal disclosure status that was assessed included if the mother had disclosed her HIV status to her partner and if the mother knew her partner's HIV status.

4.13.4 Maternal characteristics at 6 months associated with infant nutritional status

Maternal ART adherence and viral load were associated with all forms of infant malnutrition at 6 months. However, the maternal ART regimen was only associated with infant stunting and underweight status. Maternal nutritional status (BMI) was associated with infant wasting and stunting status but was not associated with infant underweight status (Table 4.17).

Table 4.17: Maternal characteristics at 6 months associated with infant nutritional status

Maternal characteristics	**Infant nutritional status**								
	Wasting			**Stunting**			**Underweight**		
(n=141)	***p-value***	***Normal* n (%)**	***Wasted* n (%)**	***p-value***	***Normal* n (%)**	***Stunted* n (%)**	***p-value***	***Normal* n (%)**	***Underweight* n (%)**
ART adherence	**0.015**			**0.027**			**0.036**		
Good		79(95.2)	4(4.8)		67(80.7)	16(19.3)		74(89.2)	9(10.8)
Inadequate		39(90.7)	4(9.3)		31(72.1)	12(27.9)		35(81.4)	8(18.6)
Poor		9(69.2)	4(30.8)		6(46.1)	7(53.9)		8(61.5)	5(38.5)
HIV Staging	0.479			0.109			0.170		
I		98(92.5)	8(7.6)		83(78.3)	23(21.7)		92(86.8)	14(13.2)
II		29(87.9)	4(12.1)		21(63.6)	12(36.4)		25(75.8)	8(24.2)
ART Regimen	0.311			**0.004**			**0.007**		
First-line		116(92.1)	10(7.9)		99(78.6)	27(21.4)		110(87.3)	16(12.7)
Second-line		11(84.6)	2(15.4)		5(38.5)	8(61.5)		7(53.9)	6(46.2)
Viral Load (VL)	**0.002**			**0.003**			**0.009**		
Undetectable VL		88(95.7)	4(4.3)		74(80.4)	18(19.6)		82(89.1)	10(10.9)
Low VL		22(95.7)	1(4.4)		19(82.6)	4(17.4)		20(86.9)	3(13.1)
High VL		17(70.8)	7(29.2)		11(45.8)	13(54.2)		15(62.5)	9(37.5)
Maternal BMI	**0.003**			**0.011**			0.324		
Underweight		8(61.5)	5(38.5)		5(38.5)	8(61.5)		9(69.2)	4(30.8)
Normal		66(95.7)	3(4.3)		51(73.9)	18(25.1)		57(82.6)	12(17.4)
Overweight		39(95.1)	2(4.9)		35(85.4)	6(14.6)		36(87.8)	5(12.2)
Obese		14(87.5)	2(12.5)		13(81.3)	3(18.7)		15(93.8)	1(6.2)

4.14 Maternal characteristics associated with infant nutritional status at 12 months

4.14.1 Socio-demographic and economic factors associated with infant nutritional status at 12 months

Younger mothers aged 18-24 years experienced more wasting and stunting in their infants compared to their older counterparts 8 (30.8%) and 6 (23.1%) respectively. Low household income levels (≤6000) and unemployment were associated with poor infant nutritional status (Table 4.18).

Table 4.19: Maternal factors influencing infant nutritional status at recruitment

Maternal characteristics	**Infant nutritional status**								
	Wasting			**Stunting**			**Underweight**		
(n=131)	***p-value***	***Normal* n (%)**	***Wasted* n (%)**	***p-value***	***Normal* n (%)**	***Stunted* n (%)**	***p-value***	***Normal* n (%)**	***Underweight* n (%)**
Age in years	**0.003**			**0.030**			0.611		
18-24		18(69.2)	8(30.8)		20(76.9)	6(23.1)		19(73.1)	7(26.9)
25-34		56(94.9)	3(5.1)		56(94.9)	3(5.1)		47(79.7)	12(20.3)
35-44		43(93.5)	3(6.5)		38(82.6)	8(17.4)		38(82.6)	8(17.4)
Education	0.580			0.604			0.286		
≤Primary		68(90.7)	7(9.3)		64(85.3)	11(14.7)		57(76.0)	18(24.0)
≥Secondary		49(87.5)	7(12.5)		50(89.3)	6(10.7)		47(83.9)	9(16.1)
Number of persons living in household	1.000			1.000			1.000		
2-5		78(88.6)	10(11.4)		76(86.4)	12(13.6)		70(79.6)	18(20.4)
6-8		39(90.7)	4(9.3)		38(88.4)	5(11.6)		34(79.1)	9(20.9)
Marital status	0.103			0.252			1.000		
Single		14(77.8)	4(22.2)		14(77.8)	4(22.2)		15(83.3)	3(16.7)
Married		103(91.2)	10(8.8)		100(88.5)	13(11.5)		89(78.8)	24(21.2)
Employment status	**≤0.001**			**≤0.001**			**0.007**		
Formal		19(95.0)	1(5.0)		19(95.0)	1(5.0)		17(85.0)	3(15.0)
Informal		76(96.2)	3(3.8)		74(93.7)	5(6.3)		68(86.1)	11(13.9)
Unemployed		21(67.7)	10(32.3)		20(64.5)	11(35.5)		18(58.1)	13(41.9)
Monthly household income	**≤0.001**			**0.002**			**0.013**		
≤6000		26(70.3)	11(29.7)		26(70.3)	11(29.7)		23(62.2)	14(37.8)
6001-12000		64(96.9)	2(3.1)		61(92.4)	5(7.6)		56(84.9)	10(15.1)
≥12001-18000		26(96.3)	1(3.7)		26(96.3)	1(3.7)		24(88.9)	3(11.1)

4.14.2 Maternal PMTCT characteristics associated with infant nutritional status at 12 months

None of the maternal PMTCT factors were associated with infant nutritional status. PMTCT factors that were assessed included the year mother was confirmed to be HIV positive, mode of delivery, if the mother was given ART in pregnancy, the stage that

ARTs were administered during pregnancy and the number of PMTCT visits the mother had attended.

4.14.4 Maternal characteristics at 12 months associated with infant nutritional status

Poor maternal ART adherence and high viral load were associated with higher infant wasting, stunting, and underweight status. Mothers on the second-line ART regimen experienced more stunting and underweight 5 (38.5%) and 6(46.2%) respectively in their infants compared to those on the first-line regimen. Mothers who were underweight experienced more infant wasting and underweight status 5 (45.4%) and 5 (45.5%) respectively compared to those who had a normal BMI, overweight or were obese (Table 4.19).

Table 4.19: Maternal characteristics associated with infant nutritional status at 12 months

Maternal characteristics	**Infant nutritional status**								
	Wasting			**Stunting**			**Underweight**		
(n=131)	***p-value***	***Normal* n (%)**	***Wasted* n (%)**	***p-value***	***Normal* n (%)**	***Stunted* n (%)**	***p-value***	***Normal* n (%)**	***Underweight* n (%)**
ART adherence	**0.020**			**0.019**			**0.026**		
Good		67(94.4)	4(5.6)		65(91.6)	6(8.5)		58(81.7)	13(18.3)
Inadequate		36(87.8)	5(12.2)		36(87.8)	5(12.2)		35(85.4)	6(14.6)
Poor		12(70.6)	5(29.4)		11(64.7)	6(35.3)		9(52.9)	8(47.1)
HIV Staging	0.199			0.774			0.222		
I		88(91.7)	8(8.3)		84(87.5)	12(12.5)		79(82.3)	17(17.7)
II		29(82.9)	6(17.1)		30(85.7)	5(14.3)		25(71.4)	10(28.6)
ART Regimen	0.631			**0.014**			**0.027**		
First-line		106(89.8)	12(10.2)		106(89.8)	12(10.2)		97(82.2)	21(17.8)
Second-line		11(84.6)	2(15.4)		8(61.5)	5(38.5)		7(53.9)	6(46.2)
Viral Load	**0.019**			**0.012**			**0.032**		
Undetectable Viral Load		83(94.3)	5(5.7)		81(92.1)	7(7.9)		75(85.2)	13(14.8)
Low Viral Load		14(82.4)	3(17.6)		15(88.2)	2(11.8)		13(76.5)	4(23.5)
High Viral Load		20(76.9)	6(23.1)		18(69.2)	8(30.8)		16(61.5)	10(38.5)
Maternal BMI	**0.008**			0.333			**0.015**		
Underweight		6(54.6)	5(45.4)		8(72.7)	3(27.3)		6(54.5)	5(45.5)
Normal		58(90.6)	6(9.4)		55(85.9)	9(14.1)		50(78.1)	14(21.9)
Overweight		38(95.0)	2(5.0)		37(92.5)	3(7.5)		37(92.5)	3(7.5)
Obese		15(93.8)	1(6.3)		14(87.5)	12(12.5)		11(68.8)	5(31.2)

4.15 Maternal factors influencing infant nutritional tatus at various time-points

4.15.1 Maternal factors influencing nutritional status at recruitment

Younger mothers aged between 18-24 years had higher odds (AOR= 4.31) of getting wasted infants compared to their older counterparts. Having some form of employment was a protective factor with lower odds of infant wasting (OR= 0.13) and stunting (OR= 0.21). Similarly, higher household income levels were also a protective factor with lower odds of infant wasting (OR= 0.17) and underweight (OR= 0.17). Mothers with poor ART adherence and high viral loads experienced higher odds of getting wasted and underweight (Table 4.20).

Table 4.20: Maternal factors influencing infant nutritional status at recruitment

Maternal characteristics n=163	**Infant nutritional status**	
	Wasting OR (95% CI)	**Underweight OR (95% CI)**
Maternal Age		
35-44 *(Ref)*	1.00	
18-24	**AOR 4.31** (1.11, 1.83)	
5-44	0.53(0.11, 2.56)	
Employment status		
Unemployed *(Ref)*	1.00	1.00
Formal	0.21(0.40, 1.10)	**0.21**(0.05, 0.85)
Informal	**0.13** (0.04, 0.43)	**0.21**(0.08, 0.54)
Income		
≤ 6000 *(Ref)*	1.00	1.00
6001-12000	**0.17** (0.05, 0.56)	**0.28**(0.11, 0.72)
≥12001-18000	**0.17** (0.03, 0.88)	**0.17**(0.48, 0.68)
ART Adherence		
Good *(Ref)*	1.00	1.00
Inadequate	2.84(0.72, 11.14)	2.05 (0.79, 5.32)
Poor	**AOR 5.99** (1.29, 27.93)	**5.73** (1.68, 19.55)
Viral Load (VL)		
Undetectable (VL) *(Ref)*	1.00	1.00
Low VL	**5.75**(1.39,23.77)	1.45 (0.37, 5.66)
High VL	**8.12**(2.22,29.65)	**AOR 6.33** (2.31, 17.36)

4.15.2 Maternal factors influencing infant nutritional status 6 months

Younger mothers aged between 18-24 years had higher odds (AOR= 5.46) of getting wasted and stunted infants (AOR= 3.40) compared to their older counterparts. Having some form of employment was a protective factor with lower odds of infant wasting

(AOR= 0.05), stunting (OR= 0.26), and underweight (AOR= 0.10). Similarly, higher household income levels were also a protective factor with lower odds of infant wasting (OR= 0.08), stunting (OR= 0.26), and underweight (OR= 0.13) in comparison to mothers with an income of Ksh. ≤6000. Relative to mothers with good ART adherence, mothers who had poor ART adherence experience higher odds of infant wasting (OR= 8.78), stunting (OR= 4.89), and underweight (OR= 5.89). Mothers on the second-line ART regimen experienced higher odds of infant stunting (AOR= 5.49) and underweight status (OR= 5.89) in comparison to mothers on the first-line ART regimen. Mothers with high viral loads experienced higher odds of infant wasting (OR= 9.06), stunting (OR= 4.86), and underweight status (OR= 4.92) relative to mothers with undetectable viral loads. Underweight mothers had higher odds of infant wasting (OR= 13.75) and stunting (AOR= 4.76) infants in comparison to mothers who had a normal BMI (Table 4.21).

Table 4.21: Maternal factors influencing infant nutritional status at 6 months

Maternal characteristics	Infant nutritional status		
	Wasting	Stunting	Underweight
n=141	OR (95%CI)	OR (95%CI)	OR (95%CI)
Maternal Age			
35-44 *(Ref)*	1.00	1.00	
18-24	**AOR= 5.46** (1.09, 27.34)	**3.40** (1.22, 9.48)	
25-34	0.51 (0.08, 3.35)	1.23 (0.48, 3.19)	
Employment			
Unemployed *(Ref)*	1.00	1.00	1.00
Formal	0.45 (0.07, 3.00)	0.58 (0.18, 1.90)	0.43 (0.12, 1.51)
Informal	**AOR=0.05** (0.01,0.26)	**0.26** (0.10, 0.67)	**AOR=0.10** (0.03, 0.32)
Income			
≤6000 *(Ref)*	1.00	1.00	1.00
6001-12000	**0.08** (0.01, 0.38)	**0.26** (0.11, 0.65)	**0.13** (0.04, 0.39)
≥12001-18000	**0.20** (0.34, 1.03)	0.35 (0.12, 1.07)	0.24 (0.07, 0.84)
ART Adherence			
Good *(Ref)*	1.00	1.00	1.00
Inadequate	2.03 (0.48, 8.56)	1.62 (0.68, 3.85)	1.88 (0.67, 5.30)
Poor	**8.78** (1.86, 41.5)	**4.89** (1.44,16.61)	**5.14** (1.37,19.22)
ART Regimen			
First-line *(Ref)*		1.00	1.00
Second-line		**AOR= 5.49** (1.64,18.38)	**5.89** (1.75,19.85)
Viral Load (VL)			
Undetectable (*Ref)*	1.00	1.00	1.00
Low VL	1.00 (0.11, 9.48)	0.87 (0.26, 2.87)	1.23 (0.31, 4.91)
High VL	**9.06** (2.38,34.55)	**4.86** (1.87,12.66)	**4.92** (1.71,14.19)
Mother BMI			
Normal *(Ref)*	1.00	1.00	
Underweight	**13.75** (2.74, 69.08)	**AOR= 4.76** (1.36,16.65)	
Overweight	1.13 (0.18, 7.08)	0.55 (0.19, 1.55)	
Obese	3.14 (0.48, 20.73)	0.72 (0.16, 3.22)	

4.15.3 Maternal factors influencing infant nutritional status at 12 months

Younger mothers aged between 18-24 years had higher odds (AOR= 6.83) of infant wasting compared to their older counterparts however, maternal age did not influence infant stunting or underweight status. Having some form of employment was a protective factor with lower odds of infant wasting (OR= 0.08), stunting (OR= 0.10), and underweight (AOR= 0.22). Similarly, higher household income level was also a protective factor with lower odds of infant wasting (OR= 0.07 and 0.09), stunting (OR= 0.19 and 0.09), and underweight (OR= 0.20) in comparison to mothers with an income of Ksh. ≤6000. Relative to mothers with good ART adherence, mothers who had poor ART adherence experience higher odds of infant wasting (AOR= 7.03), stunting (AOR= 4.11), and underweight (OR= 3.97). Mothers with on the second-line

ART regimen experienced higher odds of infant stunting (AOR= 3.68) and underweight status (OR= 3.96) relative to mothers on the first-line ART regimen. Mothers with high viral loads experienced higher odds of infant wasting (OR= 4.98), stunting (OR= 5.14), and underweight (OR= 3.61) relative to mothers with undetectable viral loads. Underweight mothers had higher odds of infant wasting (OR= 8.06) infants in comparison to mothers who had a normal BMI. Maternal BMI did not influence infant stunting or underweight status at 12 months (Table 4.22).

Table 4.22: Maternal factors influencing infant nutritional status at 12 months

Maternal characteristics	Infant nutritional status		
	Wasting	**Stunting**	**Underweight**
	OR (95%CI)	**OR (95%CI)**	**OR (95%CI)**
Maternal Age			
35-44 *(Ref)*	1.00	1.00	
18-24	**AOR= 6.83** (1.41,32.93)	1.43 (0.43, 4.70)	
25-34	0.84 (0.15,4.74)	0.25 (0.06,1.02)	
Employment			
Unemployed *(Ref)*	1.00	1.00	1.00
Formal	**0.11** (0.01, 0.95)	**0.10** (0.01, 0.82)	0.24 (0.06, 1.02)
Informal	**0.08** (0.02,0.33)	**0.12 (0.04,0.40)**	**AOR= 0.22** (0.09, 0.59)
Income			
≤ 6000 *(Ref)*	1.00	1.00	1.00
6001-12000	**0.07** (0.02,0.36)	**0.19** (0.06, 0.62)	0.29 (0.11,0.76)
≥12001-18000	**0.09** (0.01, 0.76)	**0.09** (0.01, 0.76)	**0.20** (0.05, 0.81)
ART Adherence			
Good *(Ref)*	1.00	1.00	1.00
Inadequate	2.77 (0.68,11.24)	1.21 (0.32, 4.64)	0.77 (0.27, 2.20)
Poor	**AOR= 7.03** (1.29,38.24)	**4.11** (1.14,14.82)	**3.97** (1.28, 12.3)
ART Regimen			
First-line *(Ref)*		1.00	1.00
Second-line		**3.68** (1.09,12.49)	**3.96** (1.20,13.05)
Viral Load (VL)			
Undetectable *(Ref)*	1.00	1.00	1.00
Low VL	3.58 (0.76,16.68)	1.54 (0.29, 8.21)	1.78 (0.50, 6.33)
High VL	**4.98** (1.37,18.06)	**5.14** (1.65,16.08)	**3.61** (1.34, 9.70)
Mother BMI			
Normal *(Ref)*	1.00	1.00	
Underweight	**8.06** (1.87,34.68)	2.29 (0.51,10.36)	
Overweight	0.51 (0.10, 2.67)	0.50 (0.13, 1.96)	
Obese	0.64 (0.07, 5.81)	0.87 (0.17, 4.53)	

4.16 Post-estimation using the information criterion method of modelling for maternal factors influencing infant HIV positive status

Post-estimation was done using the Akaike Information Criterion (AIC) and the Bayesian Information Criterion (also called the Schwarz Bayesian Criterion - SBC) for selecting the best model among several competing models. Modelling was done using both backward and forward stepwise methods and the final model was selected using the BIC because it generally penalizes free parameters more strongly than the AIC (Bahat and Kumar, 2010). Additionally, the BIC takes care of the overfitting of models caused by the addition of prognostic factors by introducing a penalty term for the number of prognostic factors in the model. The smaller the BIC the better the model fit. The BIC modelling formula is as follows:

$$\text{BIC} = -2\log p(l) + p\log(n) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 1$$

Where: l = Log-likelihood of the model

p = Number of independent parameters (prognostic factors)

n = Sample size

4.16.1 Models for maternal factors influencing infant wasting at the various time-points

The final model for wasting at the various time-points of the follow-up period is as shown in Table 4.23 with their corresponding BIC values. Maternal age influenced infant wasting across all the three time-points whereby younger mothers aged between 18-24 years experienced higher odds of wasting in their infants relative to their older counterparts. Mothers with poor ART adherence at 6 months and 12 months also experienced higher odds of wasting in their infants compared to mothers with good ART adherence. At six months, mothers who were employed had lower odds of getting wasted infants, compared to unemployed mothers (Table 4.23).

Table 4.23: Final models for maternal factors influencing infant wasting at the various time-points

Maternal characteristics n=139	AOR	Robust Std. Err.	z	P>z	[95%C.I] Lower	Upper	Prob > Chi2
			Final model for wasting at recruitment				
Maternal Age							**0.015**
35-44 *(Ref)*	1.00						
18-24	4.31	2.99	2.11	**0.035**	1.11	1.83	
25-34	0.53	0.42	-0.80	0.426	0.11	2.56	
ART Adherence							
Good *(Ref)*	1.000						
Inadequate	2.84	1.98	1.49	0.136	0.72	11.14	
Poor	5.99	4.70	2.28	**0.023**	1.29	27.93	
			Final model for wasting at 6 months				
Maternal Age							**<0.001**
35-44 *(Ref)*	1.00						
18-24	5.46	4.49	2.07	**0.039**	1.09	27.34	
25-34	0.51	0.49	-0.70	0.487	0.08	3.35	
Employment status							
Unemployed *(Ref)*	1.00						
Formal	0.45	0.43	-0.83	0.406	0.07	3.00	
Informal	0.05	0.04	-3.59	**<0.001**	0.01	0.26	
			Final model for wasting at 12 months				
Maternal Age							**0.002**
35-44 *(Ref)*	1.00						
18-24	6.83	5.49	2.39	**0.017**	1.41	32.973	
25-34	0.84	0.74	-0.20	0.843	0.15	4.739	
ART Adherence							
Good *(Ref)*	1.00						
Inadequate	2.77	1.98	1.43	0.153	0.68	11.24	
Poor	7.03	6.07	2.26	**0.024**	1.29	38.24	

Summary for wasting models

Timepoint	n	Log-Likelihood	AIC	BIC	Persons GOF X^2	GOF p-value	DF
Recruitment	n= 163	-42.13	94.26	109.74	6.98	0.137	5
6 months	n= 139	-28.36	66.73	81.41	1.98	0.74	5
12 months	n=129	-35.75	81.51	95.81	4.45	0.35	5

4.16.2 Models at the various time-points for maternal factors influencing infant stunting at the various time-points

Mothers who were on second-line ART regimen had higher odds of infant stunting at 6 and 12 months relative to mothers who were on the first-line ART regimen. Underweight mothers also had higher odds of infant stunting at 6 months relative to mothers who had a normal BMI. Similarly, mothers with poor ART adherence experienced higher odds of stunting in their infants relative to mothers that had good ART adherence (Table 4.24).

Table 4.24: Final models for maternal factors influencing infant stunting at the various time-points

Maternal characteristics	AOR	Robust Std. Err.	z	P>z	[95%C.I]		Prob > Chi2
					Lower	Upper	
Final model for stunting at 6 months							
ART Regimen							**0.002**
First-line *(Ref)*	1.00						
Second-line	5.49	3.37	2.76	**0.006**	1.64	18.379	
Mother BMI							
Normal *(Ref)*	1.00						
Underweight	4.76	3.04	2.44	**0.015**	1.36	16.65	
Overweight	0.55	0.29	-1.14	0.256	0.19	1.55	
Obese	0.72	0.55	-0.43	0.665	0.16	3.22	
Final model for stunting at 12 months							
ART Adherence							**0.010**
Good *(Ref)*	1.00						
Inadequate	1.21	0.83	0.28	0.782	0.32	4.639	
Poor	4.11	2.69	2.16	**0.031**	1.14	14.815	
ART Regimen							
First-line *(Ref)*	1.00						
Second-line	3.68	2.30	2.09	**0.036**	1.09	12.49	
Summary for stunting models							
Timepoint	**n**	**Log-Likelihood**	**AIC**	**BIC**	**Persons GOF X^2**	**GOF pvalue**	**DF**
6 months	n= 139	-69.39	148.78	163.45	1.56	0.669	**3**
12 months	n=129	-45.21	98.42	109.86	2.88	0.236	**2**

4.16.3 Models at the various time-points for maternal factors influencing infant underweight status at the various time-points

Mothers with a high viral load experienced higher odds of infant underweight status relative to mothers with undetectable viral loads at recruitment. At 6 and 12 months, mothers who had some form of employment had lower odds of infant underweight status hence employment was seen as a protective factor (Table 4.25).

Table 4.25: Final models for maternal factors influencing infant underweight status at the various time-points

Maternal characteristics	AOR	Robust Std. Err.	z	P>z	[95%C.I] Lower	Upper	Prob > Chi2
		Final model for Underweight at recruitment					
Viral Load (VL)							**0.002**
Undetectable (VL) *(Ref)*	1.00						
Low VL	1.45	1.01	0.54	0.591	0.37	5.66	
High VL	6.33	3.26	3.59	**<0.001**	2.31	17.36	
		Final model for Underweight at 6 months					
Employment status							**<0.001**
Unemployed *(Ref)*	1.00						
Formal	0.43	0.28	-1.32	0.188	0.12	1.51	
Informal	0.10	0.06	-3.96	**<0.001**	0.03	0.32	
		Final model for Underweight at 12 months					
Employment status							**0.007**
Unemployed *(Ref)*	1.00						
Formal	0.24	0.18	-1.94	0.053	0.06	1.02	
Informal	0.22	0.11	-3.05	**0.002**	0.09	0.59	

Summary for underweight models

Timepoint	n	Log-Likelihood	AIC	BIC	DF
Recruitment	n=163	12.98	136.72	146.00	3
6 months	n=141	15.80	110.441	119.29	3
12 months	n=130	10.06	128.84	137.44	3

4.17 Survival analysis for infants born to HIV positive mothers

Survival analysis involves the modelling and data analysis having a well-defined endpoint and the time-to-event. The study applied right censoring and an incidence rate was 9 cases per 100 person-years (CI 5.43, 6.10) was obtained at the end of the 12-month study period. During the study period, 3 (0.05%) infants had died, 3 (0.05%) had transferred out, 35 (22.1%) had been lost-to-follow-up and 131 (78.9%) had completed the protocol. The failure event was defined as infant HIV positive status with total failures being 13 (9.41%) at the end of the study time point (12 months). Slightly above half 85 (52.15%) of the infants had timely recruitment (≤ 6 weeks) for EID service delivery (Table 4.26). Infant death was tested to find out if it was a competing risk factor but was found to be insignificant (i.e. was not a competing risk factor).

Table 4.26: Survival analysis events for infants born to HIV positive mothers

CHARACTERISTICS	FINDINGS
No. of subjects	166
Total person-time at risk over one year follow-up period (person-years)	139.023
Failure event	Infant HIV positive status
Total failures	13 (9.41%)
Analysis time _t unit (Time period)	365.25
Subjects with gaps or multiple entries	0 (None)
Incidence rate per 100 person-years	0.09350 cases per person-year which translated to 9 cases per 100 person-years (95% CI 5.43, 16.10)
Total deaths	3 (0.05%)
Censoring method	Right censoring
Timeliness into EID enrollment at recruitment (6 weeks)	85 infants (52.15%)
Retention rate at 6 months	141 infants (84.94%)
Retention rate at 12 months	131 infants (78.92%)

4.18 Kaplan-Meier survival estimates curves

Kaplan-Meier survival estimate curves were used to estimate the probability of the infants surviving over a 12-month follow-up period. Figures 4.7 and 48 below show the survival estimate time for the infants over a one-year follow-up period along with the number of infants at risk at each time-point, and the corresponding confidence bands.

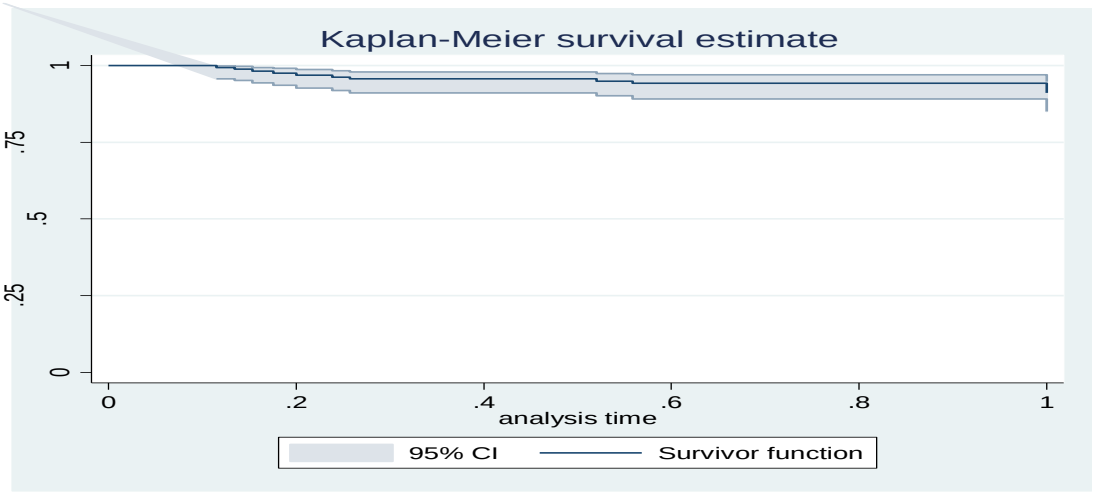


Figure 4.7: Original Kaplan-Meier infant survival estimate over a one-year follow-up period

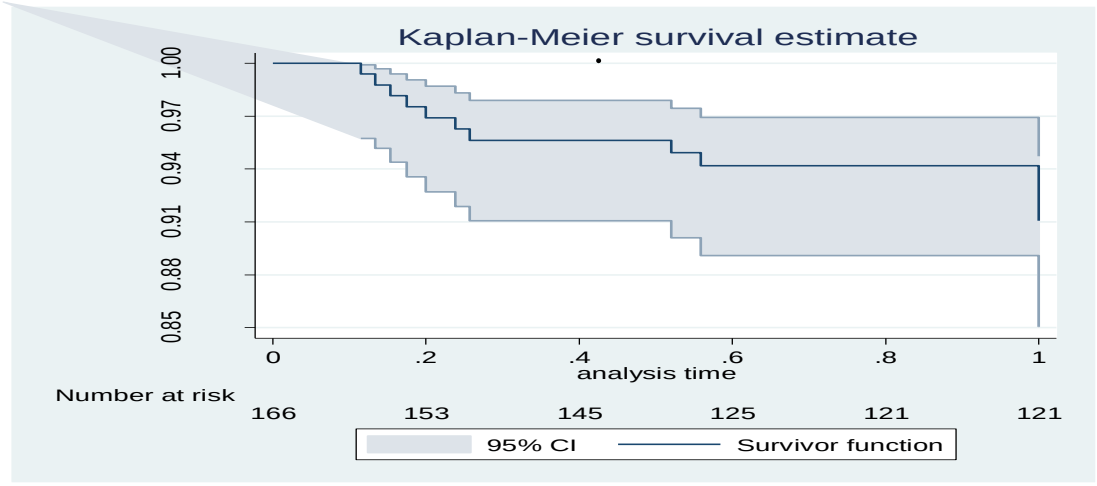


Figure 4.8: The expanded Kaplan-Meier infant survival estimate over a one-year follow-up period

4.22.1 Cox PH for socio-demographic and economic factors influencing infant survival

Younger mothers aged between 18-24 years had a higher hazard ratio (HR= 5.97) of getting HIV positive infants relative to their older counterparts aged 36-47 years. Mothers who had some form of employment had a lower hazard ratio (HR= 0.07) of infant HIV positivity relative to those who were unemployed. Similarly, mothers who

had higher income levels (Ksh. >6000) had a lower hazard ratio of getting HIV positive infants (Table 4.28).

Table 4.28: Cox-PH analysis of socio-demographic and economic factors influencing infant survival

Maternal characteristics	**Hazard Ratio**	**Robust Std. Err.**	**z**	**P>z**	**[95%C.I]**		**LR Chi2**	**Prob > Chi2**
					Lower	**Upper**		
Age in years							6.29	**0.043**
35-44 (*(Ref)*	1.00							
18-24	5.97	4.87	2.19	**0.029**	1.203	29.580		
25-34	1.96	1.64	0.80	0.422	0.379	10.125		
Employment status							14.41	**0.001**
Unemployed *(Ref)*	1.00							
Formal	0.14	0.15	-1.87	0.061	0.017	1.095		
Informal	0.07	0.05	-3.50	**<0.001**	0.015	0.307		
Income							12.00	**0.003**
≤6000 *(Ref)*	1.00							
6001-12000	0.10	0.07	-3.05	**0.002**	0.022	0.435		
≥12001-18000	0.12	0.01	-2.00	**0.046**	0.015	0.096		

4.19 Kaplan-Meier infant failure estimate curves over a one-year follow-up

Kaplan-Meier failure estimate curves were used to estimate the probability of the infants getting the outcome of interest, which was infant HIV positive status over 12 months follow-up. Thirteen infants turned HIV positive over the 12 months follow-up period. Figures 4.9 and 4.10 below show the failure estimate time for the infants, over a one-year follow-up period along with the number of infants at risk at each time-point, and the corresponding confidence bands.

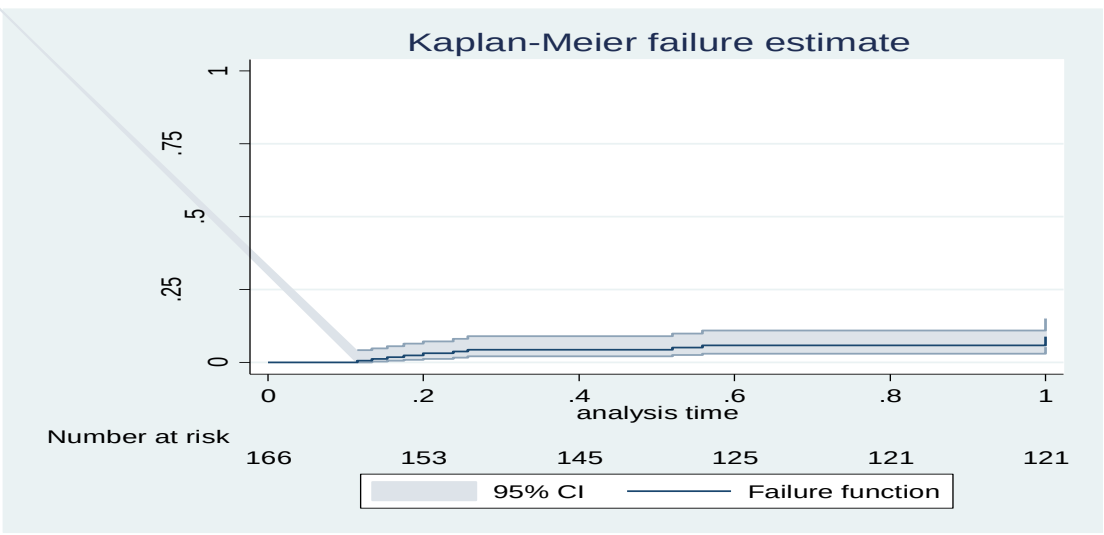


Figure 4.9: Original Kaplan-Meier infant Hazard failure estimate over a one-year follow-up period

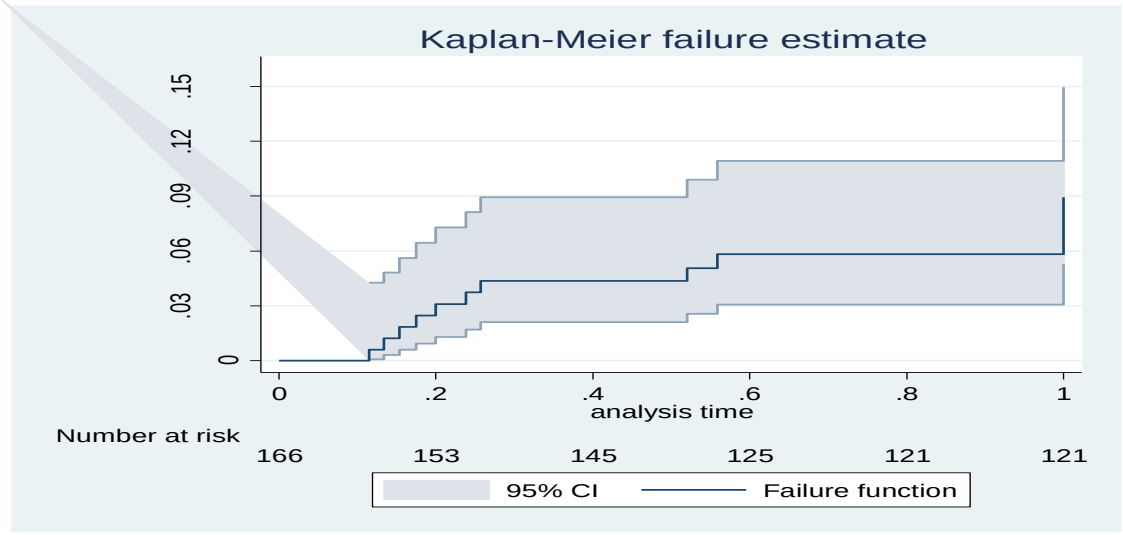


Figure 4.10: Expanded Kaplan-Meier infant hazard failure estimate over a one-year follow-up period

4.20 Life-tables for infant survival and infant failure function with censor points

The life table shown in Figure 4.11 demonstrates the infant survival function with the various censor time-points over a one year follow-up period. The life table shown in Figure 4.12 demonstrates the infant failure function with the various censor time-points over a one year follow-up period.

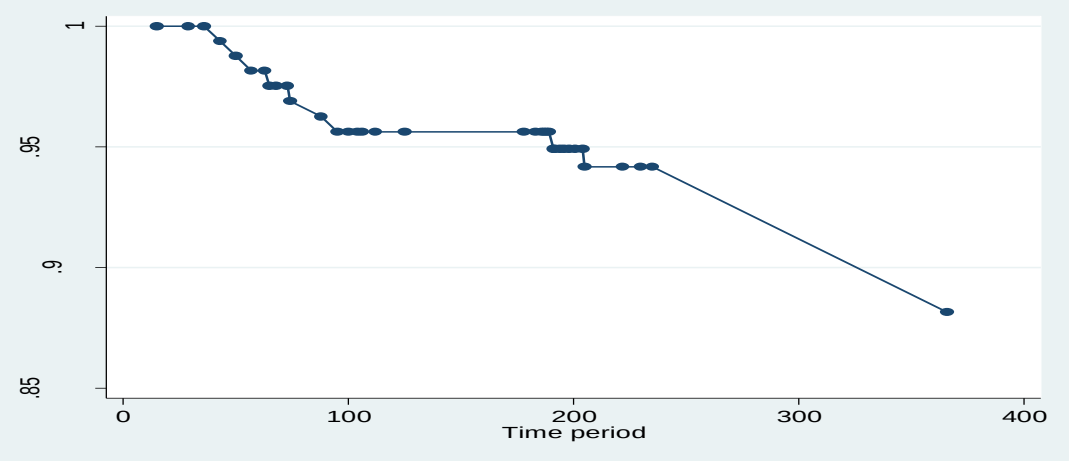


Figure 4.11: Life-table for infant survival function with censor points

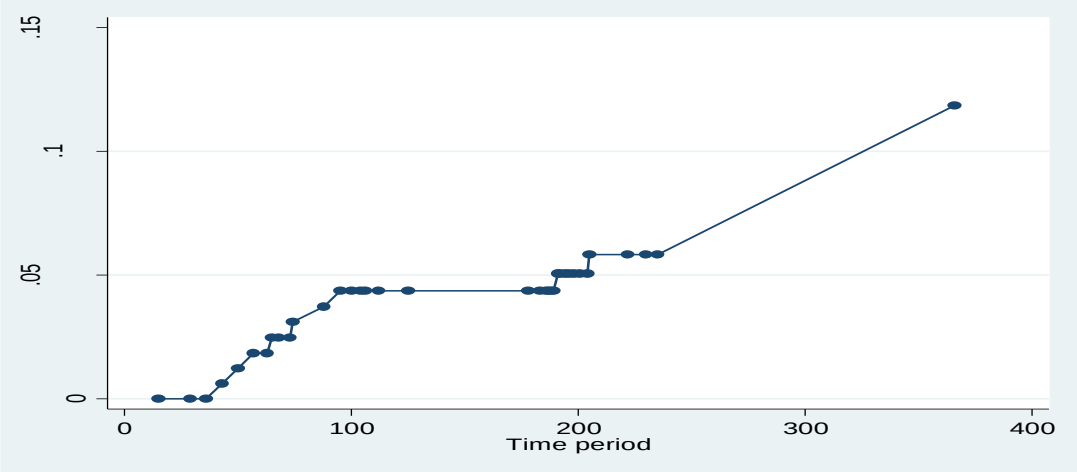


Figure 4.12: Life-table for infant failure function with censor points

4.21 Mantel log-rank survival estimates for HIV exposed infants over a one-year follow-up period

Mantel log-rank was used to assess if there was a statistical significance (p= <0.05) of selected prognostic factors and the event of interest, which was infant HIV positive status. Socio-demographic and economic factors that were found to have a statistical significance that influenced infant survival (which was the infant HIV positive status) included maternal age, maternal employment status, and household income levels (p= 0.025), (p= ≤0.001) and (p= 0.001) respectively. Maternal characteristics during PMTCT that influenced infant survival included the year the mother was confirmed positive (p= ≤0.001), if the mother was given ART during pregnancy (p= ≤0.001), the stage or trimester ART was administered during pregnancy (p= ≤0.001) and the number of PMTCT visits the mother attended the during pregnancy period (p= ≤0.001).

Mothers disclosing their HIV status to their partners and knowing their partner's HIV status also influenced infant survival (p=0.002) and (p=0.001) respectively. Maternal characteristics at 12 months that influenced infant survival included maternal adherence to ART, the HIV stage of the mother, the ART regimen that the mother was on, maternal viral load count, and the BMI of the mother. The cut-off time for timeliness for enrollment into EID was 6 weeks as per the GOK 2016 guidelines whereby timeliness was found to significantly influence infant survival over 12 months (p= 0.002) (Table 4.27).

Table 4.27: Mantel Log-rank test for maternal factors associated with infant survival

Prognostic factors (n = 131)	Chi-square test	p-value	DF
Mantel Log-rank tests for maternal Socio-demographic and economic characteristics			
Age in completed years	7.39	**0.025**	2
Highest Level of Education	0.12	0.733	1
No. of persons living in the household	0.04	0.841	1
Respondent marital status	3.41	0.065	1
Employment status	23.93	**<0.001**	2
Household Monthly income (Ksh.)	17.98	**0.001**	2
Mantel Log-rank tests for maternal characteristics during PMTCT			
Year Confirmed Positive	11.86	**<0.001**	1
Mode of Delivery	0.18	0.668	1
Given ART in pregnancy	12.66	**<0.001**	1
Stage ART administered in pregnancy	20.66	**<0.001**	2
Gestation of pregnancy at 1st PMTCT visit	0.16	0.923	2
No of PMTCT Visits	19.58	**<0.001**	2
Mantel Log-rank tests for maternal disclosure status			
Have a partner	0.24	0.627	1
Disclosed status to partner	9.64	**0.002**	1
Know Partner HIV status	10.80	**0.001**	1
Spouse HIV Status	0.17	0.678	1
Mantel Log-rank tests for maternal characteristics at 12 M			
ART adherence (Morisky Score)	33.71	**<0.001**	2
Maternal HIV Staging	26.94	**<0.001**	1
ART Regimen	81.58	**<0.001**	1
Viral Load (VL)	42.24	**<0.001**	2
Maternal BMI	17.23	**0.001**	3
Timelines into EID enrollment at 6 weeks (recruitment) among exposed infants			
Timelines at 6 weeks (recruitment)	5.22	**0.022**	1

4.22 Cox -proportional hazard test for maternal factors influencing infant survival

The Cox-proportional hazard (Cox PH) test is a regression method that was used to provide an estimate of the hazard ratio of the prognostic factors based on a comparison of the event rates, for instance, infant HIV positivity rate.

4.22.2 Cox PH test for maternal characteristics during PMTCT influencing infant survival over one-year followup-period

Mothers who had a recent diagnosis of HIV (within two years of study onset) had a higher hazard ratio (HR= 6.97) of infant HIV positivity relative to mothers that had an HIV diagnosis made more than two years of study onset. Ensuring mothers were on ART during pregnancy and were put on ART within the first trimester of pregnancy lessened the hazard ratio of infant HIV positivity (HR= 0.11) and (HR= 0.09) respectively relative to mothers who were never put on ART or had late ART initiation in the third trimester. Mothers who attended more than three PMTCT visits had a lower hazard ratio (HR= 0.12) of infant positivity relative to mothers who had attended only 2 visits (Table 4.29 below).

Table 4.29: Cox PH analysis of maternal characteristics during PMTCT influencing infant survival

Maternal characteristics	Hazard Ratio	Robust Std. Err.	z	P>z	[95%C.I] Lower	[95%C.I] Upper	LR Chi2(1)	Prob > Chi2
Year confirmed +ve								
> 2years prior to study onset *(Ref)*	1.00						9.00	**0.003**
≤ 2years prior to study onset	6.97	4.51	3.00	**0.003**	1.96	24.76		
Given ART during pregnancy							7.67	**0.006**
No *(Ref)*	1.00							
Yes	0.11	0.09	-2.77	**0.006**	0.02	0.52		
Stage ART admin in Pregnancy							14.40	**0.001**
3rd Trimester *(Ref)*	1.00							
1st Trimester	0.09	0.06	-3.73	**<0.001**	0.02	0.31		
2nd Trimester	0.38	0.26	-1.41	0.159	0.10	1.47		
No. of PMTCT visits							14.05	**0.001**
2 *(Ref)*	1.00							
≤1	0.86	0.59	-0.23	0.821	0.225	3.26		
≥3	0.12	0.07	-3.38	**0.001**	0.033	0.403		

4.22.3 Cox PH for maternal disclosure status influencing infant survival

Mothers who had not disclosed their HIV status to their partners nor knew their partner's HIV status experienced a higher hazard ratio (HR= 5.10) and (HR= 5.87)

respectively of getting a HIV positive infant relative to mothers that had disclosed their status and knew their partners HIV status as well (Table 4.30).

Table 4.30: Cox PH analysis of maternal disclosure status influencing infant survival

	Hazard				[95%C.I]			
Maternal characteristics	**Ratio**	**Robust Std. Err.**	**z**	**P>z**	**Lower**	**Upper**	**LR Chi2(1)**	**Prob > Chi2**
Disclosed status to partner							7.97	**0.005**
Yes *(Ref)*	1.00							
No	5.10	2.95	2.82	**0.005**	1.65	15.82		
Know partner's HIV status							8.59	**0.003**
Yes *(Ref)*	1.00							
No	5.87	3.54	2.93	**0.003**	1.80	19.16		

4.22.4 Cox PH for maternal characteristics at 12 months influencing infant survival

Good maternal ART adherence presented a lower hazard ratio (HR= 0.05) of experiencing infant HIV positivity relative to mothers who had poor ART adherence. Mothers who were in stage 2 of HIV infection had a higher hazard ratio (HR= 17.84) of experiencing infant HIV positivity relative to mothers who were in stage 1 of HIV infection. Undetectable maternal viral load presented a lower hazard ratio (HR= 0.02) of infant HIV positivity relative to mothers with a high viral load. Mothers who were on first-line ART regimen had a lower hazard ratio (HR= 0.03) of experiencing HIV positivity relative to mothers who were on the second-line ART regimen. Underweight mothers had a higher hazard ratio (HR= 6.29) of having HIV positive infants relative to the mothers with a normal BMI. Mothers who did not enroll their infants for EID by 6 weeks of the infants' life had a higher hazard ratio (4.00) of experiencing infant HIV positivity relative to mothers who had enrolled their infants for EID at 6 weeks or earlier. This is to say that delayed enrollment (>6weeks) into EID led to poor infant survival (Table 4.31).

Table 4.31: Cox PH analysis of maternal characteristics at 12 months influencing infant survival

Maternal characteristics	Hazard Ratio	Robust Std. Err.	z	P>z	[95%C.I] Lower	Upper	LR Chi2(1)	Prob > Chi2
ART Adherence							20.01	**<0.001**
Poor *(Ref)*	1.000							
Good	0.05	0.04	-3.86	**<0.001**	0.011	0.226		**<0.001**
Inadequate	0.14	0.09	-3.01	**0.003**	0.036	0.495		
HIV Staging							13.96	**0.002**
I *(Ref)*	1.00							
II	17.84	13.76	3.74	**<0.001**	3.936	80.888		
Viral Load (VL)							16.53	**<0.001**
High VL *(Ref)*	1.00							
Undetectable VL	0.02	0.02	-3.64	**<0.001**	0.003	0.173		
Low VL	0.12	0.12	-2.06	**0.039**	0.015	0.899		
ART Regimen							36.38	**<0.001**
Second-line *(Ref)*	1.00							
First-line	0.03	0.02	-6.03	**<0.001**	0.010	0.095		
Maternal BMI							14.29	**0.003**
Normal *(Ref)*	1.00							
Underweight	6.29	3.79	3.05	**0.002**	1.933	20.469		
Overweight	0.64	0.53	-0.54	0.589	0.124	3.275		
Obese	0.80	0.88	-0.21	0.836	0.092	6.904		
Timeliness into EID enrollment							4.54	**0.033**
Timely (EID enrollment at 6weeks) *(Ref)*	1.00							
Delayed (EID enrollment >6weeks)	4.00	2.60	2.13	**0.033**	1.117	14.323		

4.22.5 Cox PH for socio-economic/demographic and PMTCT factors showing HR and AHR over 12 months follow-up

Table 4.32 gives a summary of the Cox PH regression analysis for socio-demographic and socio-economic factors, and maternal factors during PMTCT and the corresponding hazard ratios and adjusted hazard ratios.

Table 4.32: Cox PH analysis of socio-economic/demographic, and PMTCT factors showing HR and AHR over 12 months follow-up

Timepoint (n= 166)	**Infant Survival over the 12-month follow-up period**	
Maternal characteristics	**HR (95%CI)**	**AHR (95%CI)**
Age in years		
35-44 *(Ref)*	1.00	
18-24	**5.97(1.20, 29.58)**	
25-34	1.96 (0.38, 10.13)	
Employment		
Unemployed*(Ref)*	1.00	
Formal	0.14 (0.02, 1.10)	
Informal	**0.07 (0.02, 0.31)**	
Income		
≤ 6000 *(Ref)*	1.00	
6001-12000	**0.10 (0.02, 0.44)**	
≥12001-18000	**0.12 (0.02, 0.10)**	
Year confirmed +ve		
> 2years prior to study onset	1.00	
≤ 2years prior to study onset	**6.97(1.96, 24.76)**	
Given ART during pregnancy		
No *(Ref)*	1.00	
Yes	**0.11 (0.02, 0.52)**	
Stage ART admin in Pregnancy		
Third Trimester *(Ref)*	1.00	
Frist Trimester	**0.09 (0.02, 0.31)**	
Second Trimester	0.38 (0.10, 1.45)	
No. of PMTCT visits attended		
2 *(Ref)*	1.00	
≤1	0.86 (0.23, 3.26)	
≥3	**0.12 (0.03, 0.40)**	**0.04 (0.01, 0.25)**

4.22.6 Cox PH for disclosure status and factors at 12 months showing HR and AHR over 12 months follow-up

Table 4.33 gives a summary of the Cox PH regression analysis for maternal disclosure status and maternal factors at 12 months and the corresponding hazard ratios and adjusted hazard ratios.

Table 4.33: Cox PH analysis for disclosure status and factors at 12 months showing HR and ARH over 12 months follow-up

Timepoint (n= 166)	Infant Survival over 12M follow-up period	
Maternal characteristics	**HR (95%CI)**	**AHR (95%CI)**
Disclosed status to partner		
Yes *(Ref)*	1.00	
No	**5.10 (1.65, 15.82)**	
Know partner's HIV status		
Yes *(Ref)*	1.00	1.00
No	**5.87 (1.80, 19.16)**	**4.56(1.27, 16.45)**
ART Adherence		
Poor *(Ref)*	1.00	
Good	**0.05 (0.01, 0.23)**	
Inadequate	**0.14 (0.04, 0.50)**	
HIV Staging		
I *(Ref)*	1.00	
II	**17.84 (3.94, 80.89)**	
Viral Load (VL)		
High VL *(Ref)*	1.00	
Undetectable VL	**0.02 (0.01, 0.17)**	
Low VL	**0.12 (0.02,0.90)**	
ART Regimen		
Second-line *(Ref)*	1.00	1.00
First-line	**0.03 (0.01, 0.10)**	**0.03 (0.01, 0.08)**
Maternal BMI		
Normal *(Ref)*	1.00	
Underweight	**6.29 (1.93, 20.47)**	
Overweight	0.64 (0.12, 3.26)	
Obese	0.80 (0.09, 6.90)	
Timeliness into EID enrollment		
Timely (≤6weeks) *(Ref)*	1.00	
Delayed (>6weeks)	**4.00 (1.12, 14.32)**	

4.23 Model adequacy assessment using the Schoenfeld residual test for maternal factors influencing infant survival

4.23.1 Two prognostic factors modelling of maternal factors influencing infant survival

All significant variables at p= <0.1 were used in the forward and backward modelling process to determine the best model using only two prognostic variables. The Schoenfeld residual test was used to assess if the Cox-hazard proportion assumption was met for each model that was created. The final selected two-level variables models with the lowest BIC value (Table 4.34).

Table 4.34: Two-level prognostic factors modelling of maternal factors influencing infant survival

Prognostic factors (Maternal characteristics)	Model p-value	Log-Likelihood value	AIC value	BIC value	Schoenfeld residual test (df)
Model 1 ART Adherence + ART Regimen	<0.001	-40.93	87.86	96.43	0.4009 (3)
Model 2 HIV staging + No. of PMTCT visits	<0.001	-40.39	86.78	95.41	0.8464 (3)
Model 3 HIV staging + ART Regimen	**<0.001**	**-40.17**	**84.34**	**90.09**	**0.9299 (2)**
Model 4 Viral load + No. of PMTCT visits	**<0.001**	**-38.19**	**84.39**	**95.89**	**0.6507 (4)**
Model 5 ART Regimen + No. of PMTCT visits	**<0.001**	**-39.66**	**85.32**	**93.95**	**0.5386 (3)**
Model 6 ART Regimen + Disclosed to partner	**<0.001**	**-39.65**	**83.29**	**88.95**	**0.9970 (2)**
Model 7 ART Regimen + Know partner status	**<0.001**	**-38.81**	**81.63**	**87.28**	**0.9818 (2)**

4.23.2 Three prognostic factors modelling of maternal factors influencing infant survival

Models 3, 4,5, 6, and 7 were chosen as the best models in the two variables level category and were moved to the next level of modelling which was the three variables level modelling. Model 1 and 2 were eliminated from the next phase of modelling due to large AIC/BIC values. The final best three-level variables models summary is as shown in Table 4.35.

Table 4.35: Three-level prognostic factors modelling of maternal factors influencing infant survival

Prognostic factors (Maternal characteristics)	Model p-value	Log-Likelihood value	AIC value	BIC value	Schoenfeld residual test (df)
Model 1 Viral load + No. of PMTCT visits + Stage ART administered in pregnancy	<0.001	-33.85	79.69	96.94	0.683 (6)
Model 2 Viral load + No. of PMTCT visits + HIV Staging	<0.001	-32.78	75.56	89.94	0.802 (5)
Model 3 Viral load + No. of PMTCT visits + ART Regimen	<0.001	-35.93	81.86	96.24	0.582 (5)
Model 4 **ART Regimen + No. of PMTCT visits + Know partner status**	**<0.001**	**-30.15**	**68.32**	**79.62**	**0.859 (4)**
Model 6 ART Regimen + No. of PMTCT visits + HIV Staging	<0.001	-30.95	68.91	79.41	0.900 (4)
Model 7 ART Regimen + Know partner status + ART adherence	<0.001	-33.37	74.74	85.99	0.709 (4)

4.23.3 Final Cox-PH model selection of maternal factors influencing infant survival

Model 4 above was chosen as the best-fit model in this three-variable level modelling and the overall best model to explain infant survival. This is because it had the lowest BIC value (BIC= 79.62) and was found to satisfy the Cox-hazard proportion assumption (0.86). The four and five-level variable modelling was done and was not found to improve the models any further hence the modelling process was stopped there.

In the final survival model, mothers on first-line ART regimen and had attended more than three PMTCT visits and, knew their partners HIV status had lower hazard ratios of experiencing infant HIV positivity, relative to mothers that were on the second-line ART regimen, had attended fewer ANC visits and did not know their partners HIV status respectively (Table 4.36).

Table 4.36: Final survival model of maternal factors influencing infant survival

Maternal characteristics	Hazard Ratio	Robust Std. Err.	z	P>z	[95%C.I] Lower	Upper	Prob > Chi2
							<0.001
ART Regimen							
Second-line *(Ref)*	1.000						
First-line	0.028	0.016	-6.37	**<0.001**	0.0091	0.083	
No. of PMTCT visits							
2 *(Ref)*	1.000						
≤1	0.536	0.485	-0.69	0.491	0.091	3.162	
≥3	0.046	0.040	-3.53	**<0.001**	0.008	0.255	
Know partner's HIV status							
Yes *(Ref)*	1.000						
No	4.564	2.9853	2.32	**0.020**	1.266	16.448	
Summary of final survival model at 12 months							
Model p-value	**n**	**Log-Likelihood**	**AIC**	**BIC**	**Schoenfeld residual test**		**DF**
<0.001	131	-30.15	68.32	79.62	0.86		4

4.24 Graphical assessment of the Cox PH assumption for the final model of maternal factors influencing infant survival

The cox-proportional hazard assumption for the final model shown above in (Table 4.36) was met (0.86) and was graphically assessed in Figures 4.13, 4.14, and 4.15.

4.24.1 Graphical assessment of the Cox PH assumption for the final model by maternal ART regimen

Figure 4.14 shows the graphical assessment of the Cox PH assumption for the final model by the maternal ART regimen adjusting for the number of visits attended during PMTCT and maternal knowledge of the partner's HIV status.

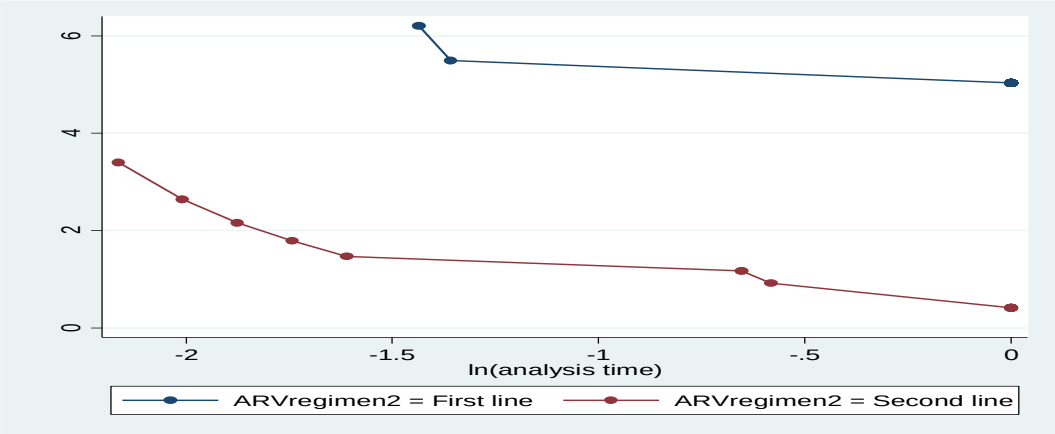


Figure 4.13: Graphical Cox PH assumption for the final model by maternal ART regimen

4.24.2 Graphical assessment of the Cox PH assumption for the final model by maternal knowledge of partner's HIV status

Figure 4.14 shows the graphical assessment of the Cox PH assumption for the final model by the maternal knowledge of the partner's HIV status adjusting for the number of PMTCT visits and maternal ART adherence.

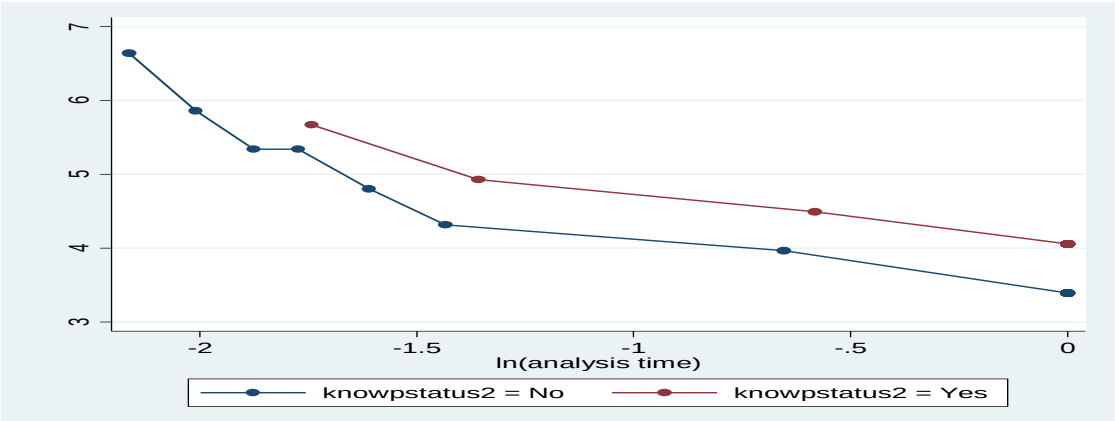


Figure 4.14: Graphical Cox PH assumption for the final model by maternal knowledge of partner's HIV status

4.24.3 Graphical assessment of the Cox PH assumption for the final model by the number of PMTCT visits

Figure 4.15 shows the graphical assessment of the Cox PH assumption for the final model by the number of PMTCT visits adjusting for maternal knowledge of the partner's HIV status and maternal ART adherence.

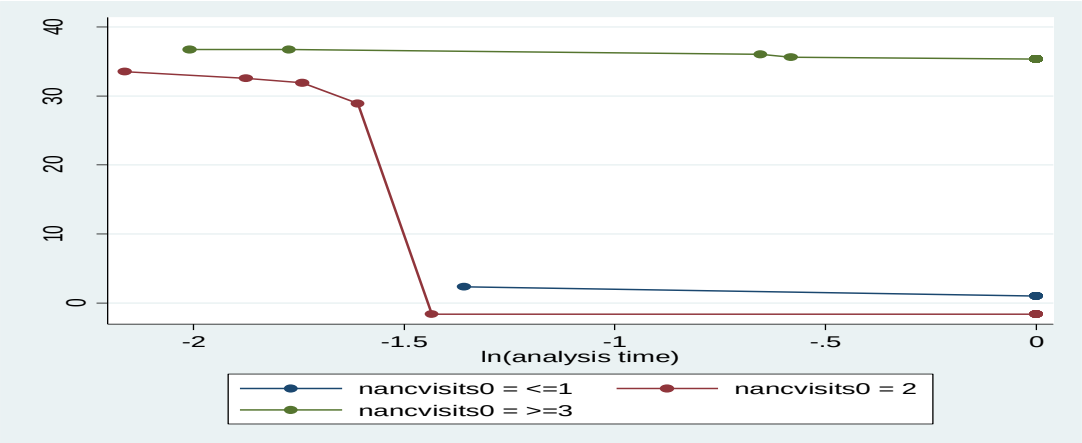


Figure 4.15: graphical assessment of the cox ph assumption for the final model by the number of pmtct visits.

4.25 Research hypothesis and test result findings

The research hypothesis and test results findings are as shown in Table 4.37 below.

Table 4.37: Research hypothesis and test result

Research objective	Null hypothesis	Type of analysis	Interpretation	Test result
1. To determine maternal factors influencing the HIV status of infants enrolled for EID services in selected hospitals in Nairobi County.	There is no significant association between maternal factors and infant HIV status	-Fishers exact at bivariable level -Poisson regression at multivariable level	$p < 0.05$ reject null $p \geq 0.05$fail to reject null	Null hypothesis rejected

4.26 Qualitative findings

Table 4.38: Socio-demographic characteristics of the FGD participants

Participant characteristics	Number (percentage)
Age categories	
18-24	18 (50.0%)
25-44	18 (50.0%)
Education	
≤Primary	20 (55.6%)
≥Secondary	16 (44.4%)
Marital status	
Single	11 (30.6%)
Married	25 (69.4%)

Qualitative data was collected using the following data collection tools: Key informant interview (KII) guides, Focused Group Discussions (FGDs), and Observational Checklists. The findings were as stipulated below:

4.26.1 Focused group discussions findings: Maternal factors influencing health outcomes among infants enrolled for EID services

Six FGDs were conducted, two FGDs in each of the three selected facilities, and saturation was reached at six FGDs. In each of the FGDs women were classified into two groups based on their ages, which was between 18-24 and 25-44 years (Table 4.38). The FGDs were interpreted using the Health Belief Model (Tarkang & Zotor, 2015) (Table 3.2) and presented according to the emerging themes.

4.26.1.1 Thematic areas assessed

The FGD guides explored the following thematic areas which were adopted from the Health Belief Model:

- Perceived severity of HIV infection i.e. perceived risk of infection to their infants
- Perceived benefits of the EID program
- Perceived barriers as the mothers seek EID services

- Cues to action - perceived ways to improve EID services to suit the various needs and expectations of the mothers
- Self-efficacy – mothers confidence in her ability to reduce her risk of MTCT
- Maternal knowledge and attitudes as they seek EID services

All focus group participants were asked the same questions, and emerging themes were noted. The quotes are representative of what was said about the particular theme by the majority of the mothers. The frequencies of the emerging themes were entered, coded, and presented according to the emerging themes in an excel spreadsheet.

4.26.1.2 Theme one - Perceived susceptibility of HIV transmission to the infant

The mothers' perceived susceptibility was used to assess their perceived heightened risk or low perceived risk of HIV transmission to the infant, based on personal traits or behaviors. The findings were as follows:

The majority of the mothers were aware that their infants stood a risk of HIV infection through various modes of transmission due to the mothers' HIV positive status (Table 4.39).

Table 4.39: Perceived susceptibility of HIV transmission to the infant

Age category **Theme & sub-themes**	**18-24 years**	**25-44 years**
Theme: Perceived susceptibility	**Main responses by age group**	
Sub-themes:		
1. Breastfeeding practices	**FGD1:** "*If one has cracked nipples you should not breastfeed the baby because the baby might get infected …*"	**FGD4:***"…breastfeeding exclusively will prevent passing HIV infection to the infant…"*
2. ART adherence	**FGD2**: "*…Taking ARVs well is important so that one can keep the amount of virus in the body low so that you do not pass the virus to the infant during breastfeeding…*	**FGD6:** *"…One should take ARVs at the right time every day to prevent passing the infection to the infant…"*

4.26.1.3: Theme two - Perceived severity and risk of HIV transmission to the infant

This theme was used to assess the mothers' opinion of how they perceived the magnitude and effects of living with HIV and the consequences of maternal HIV positive status to their infants. The majority of the mothers were aware of the severity of their illness the consequence of the disease to themselves, their infants, and their partners as well. None of the mothers wanted their infants or HIV negative partners to acquire the disease due to the burden associate with living with HIV (Table 4.40).

Table 4.40: Perceived severity and risk of HIV transmission to the infant

Age category	**18-24 years**	**25-44 years**
	Main responses by age group	
Theme: Perceived severity	**FGD1:** "*…HIV is not an easy disease to live with because you have to take ARVs every day to keep you alive...*"	**FGD 5:** *"…your life depends on these drugs…you stop taking them you die…"*
	FGD2: *"...If you don't take your ARVs well, your viral load will become high and the risk passing on the virus to the infant whilst breastfeeding will increase…"*	**FGD 6***: "…high viral load means you are not taking drugs as prescribed, your and life is in danger..."*
	FGD3: *"...partner is HIV negative, so we have to use condoms so as not to pass on the virus, however, they sometimes refuse to wear a condom, ..., if we both die, who will take care of our children?..."*	

4.26.1.4 Theme three - Perceived benefits of enrolling infants for EID services

This theme looked into the perceived positive effects or outcomes that the mother-infant pairs experienced or expected to get following enrollment into EID service delivery. Most of the mothers reported having benefited in more than one way by enrolling their infants for EID services. This included education on PMTCT interventions, strategies to ensure good ART adherence, and appropriate feeding practices for their infants' (Table 4.41).

Table 4.41: Perceived benefits of enrolling infants for EID services

Age category Theme and sub-themes	18-24 years Main responses by age group	25-44 years Main responses by age group
Theme: Perceived benefits		
Sub-themes:		
1. Benefits to the mother	**FGD2:** *"…We are given ARVs and educated on feeding practices and how to survive with this disease by living positively…."*	**FGD4:** *"…had lost all hope as did not even want this pregnancy in the first place, but the providers gave a lot of hope and encouragement, enabling us with the continuation of the EID program well thereafter….".*
	FGD3: *"…When we come to the clinic we meet other HIV positive mothers and we encourage each other, we give each other hope and the mentor mothers also encourage us…."*	**FGD6:** *"…had even stopped taking my ARVs but …healthcare providers gave encouragement and hope to restart ARVs, now we are well the infant.".*
		FGD6: *"…were given education on giving prophylaxis, appropriate feeding practices and PMTCT infections…."*
2. Benefits to the infant	**FGD1**: "….*did not have a lot of milk and almost wanted to do mixed feeding a few weeks after delivery…healthcare providers encouraged us to kee p breastfeeding to increase milk supply…."*	**FGD4:** *"….We were taught on good infant feeding practices by the healthcare providers and ways of reducing MTCT…."*
	FGD2: *"…our babies will be HIV free as long as we follow the instructions given by the healthcare providers…"*	**FGD5:***"…the other babies were always sick….good education on raising the baby well, and close baby monitoring has helped current baby…"*

4.26.1.5 Theme Four - Perceived barriers encountered while seeking EID services

This involved the mothers' experienced and anticipated challenges as they sought EID services. It also involved any barriers to access to EID services that the mother-infant pair may have encountered. The majority of the mothers from both age groups reported that most of the time they lacked finances to facilitate their attendance of EID clinics, which would then consequently interfere with ART adherence. Mothers were probed further and asked why they did not attend the nearby healthcare facilities for EID and

CCC services to reduce the burden of transport costs, which resulted in missing their scheduled clinics. The majority of the mothers responded that attending the nearby clinics was not an option due to fear of stigma and discrimination if relatives and neighbors found out their HIV status. Economic barriers were more pronounced among the younger age group since the majority of them were fully dependent on their parents or partners for financial support.

Most of the mothers reported having experienced some form of stigma and discrimination from family members, their partners, or neighbors, which affected their ART adherence. Non-disclosure of HIV status to significant others was a major barrier to ART adherence and access to EID services, more so in the younger age group (Table 4.42). The majority of the mothers were not aware of the presence of HIV tribunals and other legal frameworks and institutions that support access to justice for afflicted PLHIV and did not know where to seek help if they encountered stigma and discrimination especially at their places of work.

Lack of partner support was yet another challenge that affected the majority of the mothers and was more pronounced among the younger mothers, who had reduced negotiating power of condom use during intercourse. Most of the younger mothers were also not aware of their partners' HIV status with a few of them having difficulty in disclosing their HIV status. The older age group, on the other hand, reported that some of their partners only took their ART if the mothers went and picked for them their medicine from CCC. The majority of the mothers reported delays in receiving PCR results or viral load results. Long waiting times to receive some EID services were reported by the majority of the mothers as a major barrier of access to EID services (Table 4.42 and 4.43).

Table 4.42: Perceived barriers encountered while seeking EID services

Age category Theme & sub-themes	18-24 years Main responses by age group	25-44 years Main responses by age group
Theme: Perceived barriers		
Sub-themes:		
1. Economic barriers	**FGD2:** *"...Sometimes getting bus fare is a big challenge ...we borrow to be able to attend the scheduled clinics…"* **FGD3:** *"…depend on parents to facilitate EID attendance, sometimes they don't have money, so we miss appointments…"*	**FGD5***: "…husbands will not give us a coin to come for appointments, we are unemployed and dependent on them…"*
2. Stigma and discrimination	**FGD1:** *"…really discriminated and stigmatized by the nuclear family after disclosure of HIV which caused defaulting from care and treatment …"* **FGD2:** "*…we don't know where to seek legal help when our rights are violated*"	**FGD4**: *"…Some of our partners are HIV negative…sometimes stigmatize us by blaming us for our HIV status,*
3. Nutritional challenges	**FGD1:** *"…husband ensures that the baby food is available but doesn't bother to ensure that the rest of us get a balanced meal."* **FGD2:** *"…Sometimes we don't get enough food for ourselves …ARVs give one a lot of dizziness, nausea, and sometimes vomiting if you take them on an empty stomach..."*	**FGD5:***"…some neighbors even insult us pertaining to our HIV status and we feel very bad because we did not ask for this disease…".*
4. Disclosure of HIV status	**FGD1:**"*…Being students, we sometimes delay taking medicine because we get delayed in school. We have not disclosed HIV status to any person in school so we cannot carry medicine to school…*" **FGD2:***"….disclosed my status to the nuclear family members and they were very supportive…."* **FGD3:***"….have not disclosed HIV status to anyone else other than husband, would like help in disclosing to significant others …."*	**FGD6:** *"Sometimes getting food is a big challenge even for the baby…"* **FGD4:** *"….since disclosure of HIV status has not been done, this forced us to remove the ARV tablets from the medicine bottle and put in a paper and hide under the mattress, the viral load went very high ..This practice was discouraged by the healthcare providers…"* **FGD6:** *"….husband has been very supportive since disclosure of HIV status…*"

Table 4.43: Continuation of perceived barriers encountered while seeking EID services

Age category **Themes & sub-theme**	**18-24 years**	**25-44 years**
Theme: Perceived barriers	**Main responses by age group**	
Sub-themes:		
1. Lack of partner support	**FGD1***: "….husbands have refused to take medicine and attend CCC …."*	**FGD4:** *"…if we don't pick medication for our husbands they will not go for them…"*
	FGD1:*"…husbands knew their HIV status after disclosing our HIV status. They have however refused to go for testing …"*	**FGD5:** *"…we never discuss matters pertaining HIV….everyone goes to pick their medicine and life goes on…"*
	FGD2:*"…aware that partner has multiple partners and but they refuse to use a condom, there is nothing much we can do about that…"*	**FGD6:** *"…condoms are only used when our partners want, we have no say in the matter…"*
	FGD2: *"…partners have refused to come for testing...we don't know their HIV status and they don't take ARVs..."*	
	FDG3: *"…partners have completely refused to use condoms…If we insist that we will not have sex, they say that they will go and seek sex elsewhere…."*	
	FGD3: *"…knew HIV status with this current pregnancy…after disclosure to husband, he was very angry and said not to bring up the topic again…."*	
2. Healthcare system challenges	**FGD3:***"….The delays in the general CCC and long waiting time in the general CCC made husbands to stop coming for the drugs because they said that it wastes too much time and this could make him get fired from their workplaces…."*	**FGD6:** *"….Often the consultation room services begin very late …."*
		FGD6:*"….The healthcare providers take very long health breaks delaying our treatment hence long waiting times. So we don't come early, we finish our work first in the house then come at noon so that we don't stay for too long in the hospital…."*

4.26.1.6 Theme five - Cues to action for mitigating participants perceived barriers to accessing EID services

This referred to the mother's perceived solutions to the challenges that were affecting them as they sought the EID services. The mothers gave various solutions for the challenges they experienced as they sought EID services. This included proper service organization to reduce long waiting times and reduce the cost of seeking care, provider assisted disclosure to reduce stigma and discrimination, and telephone reminders to improve adherence (Table 4.44).

Table 4.44: Cues to action for mitigating participants perceived barriers to accessing EID services

Age category **Themes & sub-themes**	**18-24 years**	**25-44 years**
Theme: Cues to action	**Main responses by age group**	
Sub-themes:		
1. Reduction of waiting times	**FGD1:** *"….Patients should be seen in the order they have come and not skipping other patients…."* **FGD2:** *"…have separate sample collection site from the main laboratory to reduce waiting times caused by long queues…"* **FGD3:** *"…Start clinics on time so that mothers can leave on time as well…."*	**FGD5:** *"…There are too many processes before one is done… services should all be offered under the same room…"* **FGD6:** *"….Separating drug dispensing points for HIV patients and the general population to reduce waiting times…."*
2. To ease the cost of transport	**FGD2:** *"…If we can be given a little money to come for clinic appointments, this would go a long way in ensuring that we do not miss our scheduled appointments due to lack of bus fare*	**FGD5:** *"…Giving long appointment dates such as 3 months or 6 months can reduce the cost of coming to the hospital by reducing the number of hospital visits…"*
3. To improve partner support	**FGD1:** *"…Invite our partners to come for counseling for them to understand more about HIV… especially our negative partners, this will reduce stigma and discrimination and assist in disclosure…"*	**FGD4:** *"…Schedule our appointments and our partners' appointments on the same day to encourage continued counseling together with our partners…"*
4. To improve ART and clinic adherence	**FGD2:** *"If you hear of any casual work kindly let me know so that we can generate our own money… we can then afford to cater for our clinic attendance and support ourselves…"*	**FGD6:** *"Telephone reminders two or three days before the appointment days would go a long way in ensuring we keep our scheduled appointments..."*

4.26.1.7 Theme six- Self-efficacy

Most of the mothers were aware of at least one way of reducing MTCT of HIV such as ART adherence and good infant feeding practices. They were confident that they would not pass on the virus to their infants if they adhered to the education and instructions given to them by the healthcare providers. A few of the mothers, however, felt that in addition to the routine hospital education they received, additional take away materials to read at home would increase their awareness on various PMTCT interventions and additionally, involve their partners' in the 'fight' of eliminating MTCT of HIV (Table 4.45).

Table 4.45: Self-efficacy

Age category	**18-24 years**	**25-44 years**
	Main responses by age group	
Theme: Self-efficacy	**FGD1:** *"… aware of how to take our ARVs to reduce the chances of infant HIV transmission …"*	**FGD 4:** *"…we appreciate all the education given to prevent HIV infection to our infants …additional reading material to take home would also be very nice…"*
	FGD3: *"...we try very much to follow all instructions given by the healthcare providers like proper ART adherence and good infant feeding practices….it is for our own benefit and our infants after all …"*	**FGD 6***: "…our partners should also be involved in the EID clinics so that they can assist us in this fight ... not only us mothers are responsible for the health of our infants …"*

4.26.1.8 Theme seven- Maternal knowledge and attitudes towards EID service delivery

Most of the mothers knew at least one way of preventing MTCT infections during the antenatal, delivery, and breastfeeding periods. However, there was limited knowledge in the majority of the mothers in both age categories on the types of ART the mothers were taking, and the type of prophylaxis/ART their infants were taking. In a few of the mothers, dosing schedules for infant prophylaxis were incorrect and inconsistent according to the prescriptions given. The majority of the mothers knew the appropriate

feeding practices for their infants with most of them satisfied with the services offered to them by the healthcare providers at the EID clinic (Table 4.46).

Table 4.46: Maternal knowledge and attitudes towards EID services offered

Age category	**18-24 years**	**25-44 years**
Theme and sub-themes	**Main responses by age group**	
Theme: Maternal knowledge and attitudes towards EID service delivery		
Sub-themes:		
1. Knowledge on how to reduce MTCT	**FGD1:** *"…given prophylaxis for the infant during pregnancy but cannot remember their names…"* **FGD3: "**….*One should avoid rubbing children's gums with traditional medicine to relieve teething pain as this could pass on the virus …."*	**FGD5:** *"…we need to ensure we deliver in the hospital for safe delivery of my infant…"* **FGD4**:"…*We ensure that we take ARVs very well to reduce the chances of infection to the baby and also give the baby prophylaxis on time every day…*"
2. Knowledge in maternal ART and infant prophylaxis	**FGD1**: *"….we can't remember the names of the drugs that we give to the baby, but we know the dosing since we are given the instructions for use in the hospital…."*	**FGD5:** *"We do not know when we should stop the drugs for the baby but we will continue to give the baby prophylaxis drugs until the healthcare provider tells us to stop"*
3. Knowledge in infant feeding practices	**FGD3**: "….*we can't remember the names of the ARVs, we only remember septrin as one of the drugs that we take….*" **FGD2:** *"…will do exclusive breastfeeding for six months but not sure what foods to start giving the baby thereafter…"*	**FGD6:** *"…we practiced exclusive breastfeeding for 6 months and introduced other feeds at 6 months…."*
4. Exploring maternal attitude towards EID service delivery	***FGD1:*** *"…in th laboratory you have to wait in the qeue like any other patient. It takes a very long time which is disheartening , they need to have separate areas for us* **FGD2: "***…the services here are good, the healthcare providers are friendly and you can talk to them about anything …"*	**FGD4:** "…*Sometimes laboratory results get misplaced and you are forced to repeat the test…this is costly and frustrating"* ***FGD5:*** *"….we received our 6 weeks PCR results when the baby was four and a half months…I don't understand the reason for the delays"*
	FGD3: *"…we are happy with the services and attitudes of the healthcare providers in the EID program. We wish we could be retained here and not discharged back to the main CCC after the 18 months…"*	**FGD6**: *"…our ARVs and baby prophylaxis drugs always available but drugs for other ailments rarely available, the pharmacy should stock the basic drugs for us…"*

Table 4.47: Characteristics of the KII participants

Characteristics of the respondents	Distribution of healthcare providers in the EID service delivery points	Healthcare providers selected for the KII participation
Gender		
Male	3	2
Female	5	4
Age categories (years)		
25-34	4	3
35-44	3	2
45-54	1	1
Cadre		
Nurses	5	4
Clinical officers	3	2
Level of education		
Diploma	8	6

4.26.2 Key informant interview findings: Facility-level factors influencing EID service delivery by healthcare providers

Two healthcare providers from each facility were chosen to participate in the KII hence, six healthcare providers were interviewed using the KII guides out of a possible eight healthcare providers offering EID services. Saturation was reached at six healthcare providers. In all the three healthcare facilities, the healthcare providers attached there were not on a full-time basis and would only go during the EID scheduled clinic days. This was deemed as a problem since if the mother-infant pair sought services on unscheduled days, they would have to be seen in the outpatient department or sent where a clinician is available. This practice disrupted the continuum of care and integration of service delivery for the mother-infant pairs.

Thematic areas assessed

The following thematic areas were assessed:

Knowledge and training of healthcare providers on EID

Healthcare providers' perception of the service organization of EID.

Barriers/challenges encountered while offering EID services.

Possible recommendations for the barriers/challenges encountered including ways EID service delivery can be improved.

4.26.2.1 Assessing service organization for EID

The KII guide also explored how the healthcare providers perceived EID service organization in the various healthcare facilities. A Likert scale was used to measure the adequacy of EID service organization as follows: **0**-Not adequate at all; **1**- present but not adequate; **2**-adequate; **3**- Highly adequate where:

0 point = Not adequate at all: Meaning non-existent or not present at all

1 point = Present but not adequate: Meaning is existent but not functional or not in use

2 points = Adequate: Meaning is existent, may have occasional stock-outs, functional and in use however not always or to the required standards, and resources to enforce fully may not be adequate.

3 points = Highly adequate: Systems are fully functional and producing optimal results. Commodities are always available. No stock-outs at any time.

Conclusion of service organization of EID findings:

The overall score was 17 points out of a possible 27 points with a verdict of service organization being adequate but not always to the required standards. Additionally, resources to fully enforce EID services were inadequate whereby there was a lack of privacy in the consultation rooms, inadequate integration of nutritional services into EID service delivery, inadequate staffing, long sample TAT of more than 14 days, and inadequate patient referral system especially for nutritional services (Table 4.48).

Table 4.48: Service organization for EID overall scores and final interpretation

Item to observe		Obtained scores	Expected scores
1.	Availability of clinical staff permanently allocated to EID service delivery (nurse, nutritionists, doctors, and clinical officer)	2	3
2.	Availability of non-clinical staff permanently allocated to EID service delivery (counselors, peer educators)	2	3
3.	Clinic days (appropriateness of clinic days)	2	3
4.	Intergration of nutritional services into EID	2	3
5.	Privacy in consultation room	1	3
6.	Sample Turn-Around Time (TAT) -within 14 days of sample removal	2	3
7.	Patient referral systems	2	3
8.	Availability of manuals and or guidelines on EID	2	3
9.	Awareness of the contents of the EID manuals provided by the MoH	2	3
	Total score	**17 points**	**27points**

Overall observation checklist score key:

0 - 6 points: Not adequate at all: Meaning non-existent or not present at all.

7 - 13 points: Present but not adequate: Meaning is existent but not functional or not in use.

14 - 20 points: Adequate: Meaning is existent, may have occasional stock-outs, functional and in use, however, not always or to the required standards, and resources to enforce fully may not be adequate.

21 - 27 points: Highly adequate: Systems are fully functional and producing optimal results. All commodities are always available without stock-outs at any point in time.

4.26.2.2 Assessing challenges faced while offering EID services

The healthcare providers highlighted several challenges that they undergo as they offer EID services. Some of the challenges that were highlighted included:

1. The inadequate number of staff attached to offer EID services. One of the healthcare providers reported that he was the only clinical staff attached to offer the EID services during the designated clinic days, and serves up to a tune of 70 mother-infant pairs in a given clinic day. He reported that he was only

assisted by mentor mothers who are non-clinical staff and could only assist in record keeping.

Healthcare providers from the other two facilities also reported inadequate staffing levels whereby at any given time they either were offering services alone or assisted temporarily by another nurse or clinician, when the patient queue became too overwhelming and the clients started to complain of long waiting times.

2. Inadequate working space was also another challenge reported by the healthcare providers in all the 3 healthcare facilities. The small rooms did not allow for privacy for clients who had personal issues to discuss with the healthcare provider since the mothers had to be attended while inside the small room available.
3. Delay in sample return receiving results for maternal viral load counts and infant PCR results. The healthcare providers reported that sometimes it would take too long to get results for specimens removed from the clients. On average, the results would take up to 2 weeks and sometimes even a full month. This often delayed interventions and interrupted the EID cascade of care.
4. Defaulter tracing for mother-infant pairs that missed their appointments was also a challenge that cut across all the three healthcare facilities. When clients failed to come for their scheduled appointments, tracing them was a big challenge because of a lack of funds to trace them since defaulter tracing required follow-up phone calls and home visits if the clients were not traceable via the telephone. Additionally, most mother-infant pairs missed appointments due to economic challenges:

   "…Sometimes clients miss their appointments and when we call them as part of defaulter tracing they indicate that they did not have transport money to attend the clinic and that they will come once they get money. This is dangerous since the mother may not have enough drugs and may end up with poor drug adherence…" (Nurse, KII 2).

Healthcare providers' perspectives on how to improve EID service utilization.

The Researcher sought to find out from the healthcare providers offering EID services ways of improving EID service utilization to improve retention into care and treatment, ultimately improving health outcomes for both the mother and her infant.

Some of the recommendations cited by the healthcare providers included:

i. Increasing the number of healthcare providers attached to the EID clinic and have at least one staff attached to the clinic on a full-time basis.

ii. Providing regular training and timely updates on EID service delivery.

iii. Facilitation of defaulter tracing by ensuring monetary allocations for the same, with telephone and home-visits as a package for defaulter tracing.

iv. Increase the number of mentor mothers so that they can also be attached to the community for purposes of treatment support and defaulter tracing as well.

4.26.3 Observation checklist

An observation checklist was used to assess the facility factors that influence infant health outcomes and the mother-infant pair goes through the EID process.

Facility support factors were assessed using observation checklists and scored on a Likert scale as follows: **0**-Not adequate at all; **1**- present but not adequate; **2**-adequate; **3**- Highly adequate where:

0 point = Not adequate at all: Meaning non-existent or not present at all

1 point = Present but not adequate: Meaning is existent but not functional or not in use

2 points = Adequate: Meaning is existent, may have occasional stock-outs, functional and in use however not always or to the required standards, and/or resources to enforce fully may not be adequate.

3 points = Highly adequate: Systems are fully functional and producing optimal results. Commodities are always available. No stock-outs at any time.

Manuals and guidelines were found to be present but put in the in-charges office where accessibility would sometimes be a challenge if the healthcare providers wanted to refer to it while attending to a client. The healthcare providers would have to move from the service delivery point to go and collect the manuals from the office for use. They were also limited in number whereby you would find one or two copies for use by the entire hospital.

Healthcare providers allocated in the delivery points were inadequate whereby there was one nurse and one clinical officer but were not permanently stationed in the EID service delivery room and only came during EID clinic days. On any other days other than the EID clinic days the mothers seeking EID services would be referred to the outpatient clinic.

Only one out of the three facilities had a CD4 machine and even so it frequently broke down. None of the three facilities had a viral load machine and clients were referred elsewhere for these services. The consultation rooms for EID service delivery had inadequate space for service delivery in all the hospitals whereby you would find two to three service providers seated in the same room, reducing privacy for the clients during consultations.

All adult and pediatric ART drugs were highly adequate with no reports of stock-outs in the current and preceding one year of the study in all the three healthcare facilities. EID forms and registers were adequate but not always available, forcing healthcare providers to improvise forms for use in case of stock-outs. The integration of pediatric nutritional services with EID services was present but not adequate in that only partial screening for malnutrition was done through weight and height measurement in all the three facilities. Other malnutrition screening services such as the measurement of head circumference and mid-upper arm circumference (MUAC) measurement were not assessed in the EID service delivery area but rather infants were referred to the nutritional clinic in a different service delivery section. Similarly, the treatment and

follow-up for infants with malnutrition were undertaken at the nutritional clinic where all other patients within the hospital were also attended. This was found to prolong waiting times leading to poor retention of HIV exposed or infected infants within the malnutrition program.

Infant samples for PCR were taken at six weeks or at the first contact thereafter. The mean sample TAT in the three facilities was 63 days (95% CI 55-70 days), ±0.03 (SEM) whereby 61 (37.4%) of the infant PCR samples had a TAT of ≤14 days and 102 (62.6%) had a TAT of > 14 days. This depicted a delay of between 8 weeks -16 weeks which lead to missed opportunities for ART initiation when infant mortality usually peaks between 8-12 weeks among the HIV exposed infants.

4.26.3.1 Conclusion for findings obtained during the observation of facility support systems

The overall score was 22 out of a possible 39 points with a verdict of **adequate facility-level factors** which translated to: existent, may have occasional stock-outs, functional and in use, however, not always or to the required standards, and resources to enforce fully may not be adequate (Table 4.49).

Table 4.49: Observation checklist scores overall scores and final interpretation

S/No.	Item to observe		Obtained scores	Expected scores
1.	Manuals/guidelines on EID		1	3
2.	Healthcare providers allocated to EID service delivery		1	3
3.	CD4 Machine		0	3
4.	Viral load machine		0	3
5.	Consultation room space		1	3
6.	Privacy in the counseling room(s)		1	3
7.	Availability of ARVs (adult)		3	3
8.	Availability of CTX (adult)		3	3
9.	Availability of ARVs (pediatric formulation)		3	3
10.	Availability of CTX (pediatric formulation)		3	3
11.	Availability of EID forms/registers		2	3
12.	Integration of EID services with nutritional services		2	3
13.	Sample turn-around time (Viral load) -within 14 days of sample removal		2	3
	Total score		**22 points**	**39 points**
PCR sample turn-around-time (TAT)				
14.	Infant records at 6 weeks (n=163)	No. of samples with TAT <14 days. **61 (37.4%)**	No. of samples with TAT ≥ 14 days. **102 (62.6%)**	

Overall Observation checklist score key:

1-10 points: Not adequate at all: Meaning non-existent or not present at all.

11-19 points: Present but not adequate: Meaning is existent but not functional or not in use.

20-28 points: Adequate: Meaning is existent, may have occasional stock-outs, functional and in use however, not always or to the required standards, and resources to enforce fully may not be adequate.

29-39 points: Highly adequate: Systems are fully functional and producing optimal results. All commodities are always available without stock-outs at any point in time.

CHAPTER FIVE

DISCUSSION, CONCLUSIONS, AND RECOMMENDATIONS

5.1 Discussion

5.1.1 Socio-demographic and socio-economic characteristics of HIV positive mothers

The current study was a 12-month follow-up study of 166 mother-infant pairs selected to participate, with a response from 163 (98.2%) mother-infant pairs. The socio-demographic and economic characteristics of the mothers were: The median age of the mothers was 29 years (IQR: 25-33) with most of the mothers having an education level of primary level or below 91 (55.8%) a finding similar to that of (Sirengo *et al.,* 2014 and Ebuy *et al.,* 2014). Most of the mothers were married 141(84.9) with similar findings in an Ethiopian study (85.9%) (Berhan *et al.,* 2014). Most mothers were informally employed with majority 94 (57.7%) of the mothers having low household incomes of between Ksh. 6001-12000. Low levels of education were closely related to low levels of income as seen in the current study and other studies in low and middle-income countries (Carneiro, Meghir, & Parey, 2013) and the high-income countries as well (Erola, Jalonen, & Lehti, 2016). Low levels of education amongst HIV positive mothers were also seen in a similar study by (Sirengo *et al.,* 2014) in Kenya.

5.1.2 Infant HIV incidence rate over a 12-month follow-up period

The overall infant HIV incidence rate at the end of the 12 months follow-up period was 9 cases per 100 person-years (95% CI: 5.465, 16.290) with similar findings observed in Ethiopia (Berhan *et al.,* (2015), in the South-Rift region of Kenya (Ashino *et al.,* 2017), and Turkana (Ongaki *et al.,*2019).

5.1.3 Maternal socio-demographic and socio-economic factors influencing infant HIV status

Maternal age influenced infant HIV status only at the end-point of the study (12 months) where younger mothers aged between 18-24 years had a higher risk (RR= 5.31) of infant HIV positivity relative to their older counterparts (36-47 years). However, maternal age was insignificant at recruitment (6 weeks) and mid-study (6 months). These findings were similar to those of Makau *et al.,* (2015) study in Nairobi, Kenya's informal settlements whereby young maternal age (<20 years) was significantly associated with infant HIV status at 6 weeks.

Mothers who were employed and had a household income of between Ksh. 6001-12000 had a lower risk of having a HIV positive infant, relative to those who were unemployed or had low household income levels Ksh. ≤6000. Inadequate household income was a barrier to accessing EID scheduled clinics leading to poor maternal ART adherence and increased risk of infant HIV infection. An FGD conducted on the mothers showed that economic constraints were a big barrier to the access of EID services whereby despite being unemployed some partners would refuse to facilitate transport costs forcing the mothers to borrow from friends and relatives. This was not sustainable since one cannot borrow each time. Most of the mothers recommended that they should be given long appointment times (up to six months) to reduce the frequency of hospital visits and the subsequent costs of the visits. Thomson *et al.,* (2018) qualitative study showed that lack of resources and poverty is a major contributor to risky sexual behavior among women such as commercial sex work which can increase the vertical transmission of HIV incidence.

A KII conducted on healthcare providers managing the EID clinic also revealed economic challenges as a barrier to access to service delivery, which could lead to poor ART adherence and increased the risk of HIV transmission to the infants. The healthcare providers would undertake defaulter tracing and upon reaching the mothers, most of the mothers cited lack of transport money as the main reason for clinic non-adherence. The healthcare providers saw this as a big challenge, which caused poor ART adherence and high maternal viral loads, which increased the risk of vertical

transmission of HIV to the infant. A Sub-Saharan study by Bwana *et al.,* (2016) revealed that maternal individual factors, poverty, and low-income levels reduced access to EID services and increased vulnerability to infant HIV positivity. In Kenya, (Goggin, *et al.,* 2016) found that maternal education did not influence infant HIV status among mothers that had very late initiation into EID but low levels of income and unemployment were significantly associated with infant HIV positive status.

5.1.4 Maternal characteristics during PMTCT Clinic influencing infant HIV positive status

A recent HIV diagnosis of ≤ 2years before the onset of the study increased the risk of infant HIV positivity relative to mothers that had had been diagnosed much earlier > 2years before study onset. This revealed gaps in the PMTCT cascade of care when HIV infection remains undiagnosed. Finocchario-Kessler *et al.,* (2016) study revealed that recent maternal HIV diagnosis (during pregnancy) is associated with poor ART adherence that consequently increased the risk of HIV transmission to the infant relative to mothers who are diagnosed much earlier before pregnancy.

Mothers who received ART in pregnancy had a significantly lower risk of infant HIV positivity (RR= 0.06) across all time-points relative to infants whose mothers did not receive ART during pregnancy, a finding similar to that of (Ashino *et al.,* 2017). Maternal ART utilization in Sub-Saharan Africa remains suboptimal, which subsequently increases the risk of MTCT in both early and late childhood (UNAIDS, 2016). McGreath *et al.,* (2018) reported higher odds of HIV transmission rates in infants whose mothers did not receive ART in pregnancy, delivery, and in the post-partum period. Similarly, a study by Finocchario-Kessler *et al.,* (2016) showed that mothers who had not received ART during pregnancy had higher odds of HIV infection among their infants relative to mothers who had received ART during pregnancy. Interventions to scale up life-long ART to HIV positive pregnant and breastfeeding mothers will reduce the MTCT rates (GOK, 2018).

Early maternal ART initiation within the first trimester of pregnancy had lower odds of infant HIV positivity across all time-points relative to those mothers that started

ART in the third trimester. Delay in ART initiation during the pregnancy period increases the risk of HIV infection due to high maternal viral load. In a prospective study done in North-Central Nigeria by Agudu *et al.,* (2017), mothers who were initiated on ART in the third trimester of pregnancy had higher odds of infant HIV positivity (AOR= 2.1 CI: 1.1, 4.0) and delayed infant initiation into the EID relative to those who were initiated in the third trimester. Delayed maternal ART initiation was therefore seen to undermine PMTCT interventions to the mother-infant pairs. There were no reported ART or prophylaxis stock outs (for both the mother and the infant) as observed by the researcher hence, maternal failure to take ART within the first trimester or during pregnancy was due to other factors non-related to ART and prophylaxis stock-outs. Mothers also reported adequate ART availability during the FGDs where the majority of the mothers reported they had never experienced ART stock-outs during their clinic visits. Late ART initiation or short duration of ART administration among HIV positive mothers is associated with increased odds of infant HIV positive status (Berhan *et al.,* 2014).

Across all time-points mothers who had attended more than three PMTCT visits, exhibited a lower risk of infant positivity relative to mothers who had attended lesser visits, for instance, one or two visits. In Northern Ethiopia, low PMTCT attendance (one or two visits) was associated with poor maternal ART adherence. Attendance of at least one PMTCT visit was all the same found to be beneficial according to a study conducted in Turkana by Ongaki *et al.,* (2019) which revealed that having at least one PMTCT visit was associated with increased uptake of other PMTCT services (OR= 2.78, 95% CI 1.25-6.17) and increased infant prophylaxis enrollment.

Bwana *et al.,* (2016) cited that stigma and discrimination is one of the main factors that hinder access to PMTCT and EID services due to fear of community stigma and discrimination, a factor that was supported by another study in Tanzania (Mwendo *et al.,* 2014). In the current study, mothers also cited stigma and discrimination as a barrier to access to EID services. The majority of the mothers reported at least one incident of stigma and discrimination in the past year of the study onset. Mothers were stigmatized and/or discriminated by relatives, partners, or neighbors. The effects of

stigma and discrimination as reported by the mothers included non-adherence to ART, high viral load counts due to poor adherence, and non-disclosure of HIV status to significant others findings similar to (Adeniyi *et al.,* 2015).

The majority of the mothers reported that they were not aware of where to seek justice for violation of their human rights such as stigma and discrimination at the workplace, healthcare centers, and within the community. This had implications on the access of HIV services and maybe hindered disclosure of HIV status. In three countries that have most recently been validated for eMTCT, the mothers had high levels of knowledge of organizations/groups that provide legal support for those experiencing stigma and discrimination (95%) in Greece, (80.2%) in Moldova, and two-thirds (75%) in the Dominican Republic (Greek Association of PLHIV, 2017) (Republic of Moldova, 2018) and (Dominican Republic, 2019) respectively. In all three countries, the mothers reported low levels of stigma and discrimination and high levels of disclosure of HIV status to their partners or significant others. WHO, (2019) states that for the world to realize the goal of zero new HIV infections by 2030, stigma and discrimination towards PLHIV should be eliminated.

A Kenyan study by NACC (2014) on HIV stigma and discrimination index found that none of the study respondents knew of the existence of HIV tribunals and other legal support institutions that facilitate access to justice for affiliated PLHIV. This was found to increase incidents of stigma and discrimination and delayed justice for the afflicted PLHIV. KASF (2014) report demonstrated that women living with HIV reported higher stigma levels (4.9%) compared to men (2.7%). Further, the report pointed out that people experiencing stigma and discrimination were four times more likely to report poor access to care and treatment, and that high levels of stigma in Kenya (45%) inhibited seeking of HIV healthcare services in the healthcare facilities.

5.1.5 HIV disclosure status influencing infant HIV positive status

Mothers' non-disclosure of HIV status to their partners had an increased risk of infant HIV transmission (RR= 4.1) relative to mothers who had disclosed their HIV status. A comparative study at the national level and in Western Kenya by McGrath *et al.,*

(2018) had similar findings whereby maternal non-disclosure of HIV was associated with a significantly increased risk of infant HIV infection and hindered both maternal and infant ART uptake. Partner disclosure was associated with good ART adherence (AOR= 4.2, 95% CI 1.07-16.33) (Ebuy *et al.,* 2014). In the Dominican Republic, the majority of the respondents had disclosed their HIV status to their partners/spouses 436 (52%) or relatives 597(67%) which was a much higher rate of disclosure than observed in the current study 5(29.4%) (among mothers with HIV positive infants) at the study end-point (Dominican Republic, 2019). Provider assisted disclosure was found to be a common practice that enabled partner disclosure among those that had disclosed their HIV status. The rest of the persons who had not disclosed their HIV status to their partners in the current study cited fear of stigma and discrimination as the principal reason for non-disclosure findings similar (Adeniyi *et al.,* 2015).

Non-disclosure can lead to poor ART adherence as reported by the mothers in the FGDs conducted whereby some mothers experienced delays in taking their ART when persons who did not know their HIV status were around, a few of the mothers' experienced stigma and discrimination from their partners after disclosure which resulted to poor ART adherence. Republic of Moldova (2018) stigma index survey found that majority of the study participants 288 (61.6%) reported that disclosure of HIV status had helped them to deal with the disease better. Those who had not disclosed their HIV status to anyone cited fear of rejection from spouse/partner and fear of stigma and discrimination as the principal reasons for non-disclosure. In Greece, the stigma index survey of 2017 showed that 296 (66%) of the respondents had disclosed their HIV status to their partners and those who had not disclosed was mostly due to fear of stigma and discrimination by family members and friends (Greek Association of PLHIV, 2017). The PLHIV who had experienced stigma and discrimination in Greece reported that the reasons why they thought they were being stigmatized and discriminated stemmed from the fear of getting infected 186 (42.0%) and lack of adequate understanding of modes of HIV transmission 104(23.0%) by the general public. Awareness creation to the general population was the main intervention that was recommended to aid in the reduction of stigma and discrimination against PLHIV.

Male partner involvement through provider-assisted disclosure ensures improved PMTCT uptake and reduces stigma and discrimination (Bwana *et al.,* 2016). Further, Adeniyi *et al.,* (2015) stated that community interventions to reduce stigma and discrimination among people living with HIV would reduce barriers towards access to PMTCT services. Armenia which was validated for eMTCT in 2016 used male partner testing and treatment and provider assisted disclosure as one of the key strategies for achieving eMTCT (Taylor *et al.,* 2017).

In the current study mothers' key recommendations to improve partner support, partner disclosure, and reduce stigma and discrimination included provider assisted disclosure of HIV status, scheduling the same clinic days for the mothers and their partners to encourage male partner involvement, and scheduled appointments with partners for counseling. NACC (2014) stated that HIV related stigma and discrimination leads to low self-esteem, depression, and suicidal tendencies among PLHIV. Further, stigma was found to create a low demand and uptake of HIV services and is a violation of human rights for PLHIV.

5.1.6 Maternal factors at 6 weeks, 6 months and 12 months influencing infant HIV positive status

Despite the 100% availability of both pediatric and adult ART drugs as observed by the observation checklist in the three healthcare facilities in the past 24 months, maternal ART adherence was still a challenge across all time-points of the study. Mothers with good ART adherence had lower risks of infant HIV positivity relative to mothers with poor ART adherence across all the time-points. Non-adherence to ART increases the risk of treatment failure and vertical transmission, maternal HIV disease, and the potential of drug resistance to ART (Ebuy *et al.,* 2014). The authors recommend that more ART preparation at the mother's first visit and addressing barriers related to non-adherence will improve ART adherence levels.

Facility support factors have been found to affect ART adherence such as long TAT for results for maternal virological test and PCR test results. Long TAT causes non-adherence and delays in interventions such as starting pediatric ART or switching

maternal ART regimens (Altan *et al.,* 2016). UNAIDS (2016) recommends that sample TAT should be immediate or not more than 14 days. Most mothers cited delays in receiving their infants' PCR test results as well as delays in the lab for sample removal in the FGDs undertaken. The mothers recommended that the sample removal be done in the EID clinics instead of having to queue in the general laboratory which had long waiting times.

Long sample TAT was corroborated by the researcher while undertaking a facility observation using an observation checklist whereby it was observed that 102 (62.5%) PCR samples collected from the infants at 6 weeks had a sample TAT longer than the recommended 14 days. The KII conducted on healthcare providers at the various facilities also reported that often there were delays in sample TAT of more than two weeks, and sometimes up to two months which caused delays in interventions and interrupted the EID cascade of care. Mortality among HIV exposed infants peaks at the infants' first 2-3 months of life (Sandbut *et al.,* 2019), therefore, infant HIV diagnosis using the HIV PCR test at 6 weeks as is the standard protocol in Kenya is often late to mitigate mortality in early life when the sample TAT exceeds this duration.

Mothers who were in stage 2 (late HIV stage) of HIV infection had a higher risk of infant HIV positivity relative to mothers who were in stage 1 (early HIV stage) across all the time-points. Ebuy *et al.,* (2014) study in Northern Ethiopia found that mothers who were in the late HIV stages were more non-adherent to ART and experience more infant positivity.

Mothers with undetectable viral loads presented lower risks of infant HIV transmission relative to mothers with high viral loads. This was also seen in a study by McGrath *et al.,* (2018) whereby high maternal viral load increased the risk of infant HIV infection and was seen as the key driver of vertical transmission, especially during the breastfeeding period. The absence of ART during PMTCT increased maternal viremia hence the authors recommended enhanced screening methods to identify acute HIV infection during pregnancy and breastfeeding periods to reduce MTCT rates. It is, however, important to note that all mothers in the three healthcare facilities had at least

one viral load test result during the 12 months observation period despite not having viral load machines on-site (as seen from the observation checklist findings) in any of the three healthcare facilities. However, the sample TAT was more than the recommended 14 days with, and this could cause delays in starting HIV positive children on life-saving ART. Humphrey *et al.*, (2019) study in Western Kenya found that mothers who were not virally suppressed had higher odds (2.40, 95% CI: 1.86, 3.10) of also having virally unsuppressed infants increasing the risk of mortality and morbidity among the infants.

Mothers on the first-line regimen of ART experienced a lower risk of infant HIV positivity relative to mothers on the second-line ART regimen. Continuous and good ART adherence reduces the chances of infant HIV infection by ensuring maternal viral suppression and reducing the need to change from the first-line to the second-line regimens (Ashino *et al.,* 2017). Further, switching mother from the first line to second-line is characterized by periods of high viremia which increase the chances of vertical transmission.

At the study end-point (12 months), maternal BMI was found to influence infant HIV status whereby infants born of underweight mothers had an increased risk of infant HIV infection relative to mothers that had a normal BMI. However, maternal BMI did not influence infant HIV status at recruitment (6 weeks) or mid-study (6 months). Nabwera *et al.,* (2017) stated that poor nutritional status in HIV positive mothers may additionally impair immunity and weaken the epithelial integrity, which is associated with vertical transmission of HIV. Further, infants born of mothers with poor nutritional status are more prone to being born underweight increasing their risk of HIV infection (Chalashika *et al.,* 2017).

5.1.7 Maternal factors influencing infant nutritional status

Evidence has demonstrated that HIV exposed uninfected infants have worse nutritional status than HIV unexposed infants even when their mothers are receiving life-long ART (Chalashika *et al.,* 2017). Exposure to HIV and ART in-utero (especially protease inhibitor-based regimens) has been linked to increased low birth weight and preterm

birth which are universal risk factors for increased morbidity and mortality among infants (Skyler *et al.,* 2014).

Exclusive breastfeeding was done in 161 (97.0%) of the infants at 6 weeks but rapidly declined over six months whereby only 75 (53.2%) of the infants were exclusively breastfed up to six months of the infants' life. This was a much lower level than that of women in Cameroon who had up to 243 (89%) of their infants breastfed for the first five months of life (Altan *et al.,* 2016). Despite the majority of the mothers 163 (98.9%) knowing that they should exclusively breastfeed their infants for the first 6 months, mothers still mixed fed their infants before six months were over. They cited varied reasons for mixed feeding, with the top two reasons being lack of enough breast milk 48 (34.5%) and fear of not wanting to infect their infant's with HIV 40 (28.1%). Mixed feeding before six months of the infant's life increases the risk of infant HIV positivity (Berhan *et al.,* 2014). In the FGDs conducted in the current study, most of the mothers knew that they should exclusively breastfeed their infants for six months hence the mixed feeding observed before completion of six months was not due to lack of knowledge on appropriate feeding practices. There were however some gaps in feeding practices beyond the six months as a few of the mothers were not aware of when to stop breastfeeding their infants and the majority of the mothers not aware of the appropriate foods to start weaning their infants on.

A Meta-Analysis in Ethiopia revealed that exclusively breastfed infants for the first six months and continued breastfeeding up to one year significantly prevents infectious diseases, malnutrition, and mortality in comparison with non-breastfed infants (Belay & Wubneh, 2019). The authors cited that the reasons for high (80%) breastfeeding prevalence in Ethiopia were the low socio-economic status in Ethiopia where the only option was to breastfeed, stigma and discrimination, and the fact that breastfeeding was a cultural practice in Ethiopia. In Cameroon, Atlan *et al.,* (2016) found that the overall infant nutrition was good up to six months with only 1.5% of the infants being underweight a finding the authors attributed to high breastfeeding rates (89%) in the region, relative to infants in this study that had 20.6% underweight infants at 6 months. However, following weaning at 6 months, the infants in Cameroon stated to experience

adverse infant nutritional status whereby by 12 months 33.6% of the infants were stunted relative to 12.98% stunting in infants in this study which, was much lower. Atlan *et al.,* (2016) state that prolonged breastfeeding beyond 6 months was likely to improve these adverse nutritional outcomes in the Cameroon infants and reduce infant mortality as well.

Maternal sociodemographic factors that influenced infant nutritional status were maternal age, employment status, and household income. Maternal education levels and marital status were not associated with infant nutritional status, a finding similar to that of (Chalashika *et al.,* 2017) but differed with McGrath *et al.,* (2012) which found that higher levels of maternal educational attainment were associated with a decreased risk of stunting ($p < 0.01$) in the infant's first two years of life. Maternal age influenced infant nutritional status whereby younger mothers aged between 18-24 years experienced higher odds of wasting and stunting relative to their older counterparts at recruitment, 6 months, and 12 months. This finding differed from those of McDonald *et al.,* (2012) whereby maternal age was not a prognostic factor of infant nutritional status.

Mothers with poor socio-economic status experienced more adverse nutritional status and experienced more stunting in their infants due to inadequate intake of the required nutrients (Kuona *et al.,* 2014). These findings were consistent with our current study where mothers with low household income levels and were unemployed experienced more stunting, underweight, and wasting in their infants. McDonald *et al.,* (2012) also had similar findings whereby they found that low maternal household possessions in resource-limited settings were associated with infant stunting, underweight, and wasting which resulted in impaired infant growth and health.

In the FGDs conducted during the study period, the majority of the mothers cited that lack of money to buy food was a big problem and interfered with their ART adherence since taking ART on an empty stomach caused side effects such as dizziness, nausea, and sometimes vomiting. Poor maternal ART adherence lead to poor nutritional outcomes (stunting, underweight, and wasting) relative good maternal ART adherence, a finding similar to a study conducted by (Buonomo *et al.,* 2016) in Malawi.

The authors further state that poor malnutrition status in infants leads to delayed motor and cognitive development.

Mothers who were on the second-line regimen of ART experienced higher odds of infant stunting and underweight (AOR= 3.68 and AOR= 3.96 respectively). Mothers being switched from the first-line to the second-line regimen is characterized by periods of high viremia during the ART switching period that is more often than not related to ART non-adherence. Continous and good ART adherence improves infant nutritional status during pregnancy and the breastfeeding period (Ditekemena *et al.,* 2015).

Across all time-points mothers with high viral load counts had higher odds of infant wasting, stunting, and underweight. McGrath *et al.,* (2012) study showed that maternal high viral load increased the risk of stunting in infants similar to a study by Liotta *et al.,* (2015) that showed high maternal viral load (immunosuppression) was associated with infant stunting and underweight. Viral load counts results need to be returned to the mother-infant pair as soon as possible (with a TAT of less than 14 days) to ensure timely management, and decision making for the mother-infant pairs (UNAIDS, 2016). This, however, was a challenge in the current study due to the unavailability of viral load machines within the healthcare facilities to conduct the viral load counts as observed by the researcher. Samples had to be sent to other viral load testing centers and lead to delays in receiving results back. Sample TAT for viral load counts results was found to be on average 63 days affecting EID service delivery.

Maternal BMI was associated with an increased risk of infant wasting and stunting at 6 months and underweight and wasting at 12 months in the current study. Nabwera *et al.,* (2017) found that poor nutritional status in HIV positive mothers may additionally impair immunity and weaken the epithelial integrity, which is associated with vertical transmission of HIV. In Mozambique HIV positive mothers are put on nutritional supplementation during the pregnancy and lactating period and these have been seen to improve infant nutritional outcomes, maternal retention in the PMTCT programs, reduction of premature deliveries, and reduction of infant low birth weight (Liotta *et al.,* 2015). Mothers were also encouraged to participate in nutritional classes and were

educated on the infant weaning process. Belarus was validated for eMTCT in 2016 and one of the strategies they used to achieve this was the provision of free formula milk to all infants born of HIV positive women (Taylor *et al.,* 2017) to reduce infant malnutrition and consequently reduce the rates of MTCT.

5.1.8 Maternal factors influencing infant survival outcomes over a 12-months' follow-up period

Infant survival in HIV exposed or infected infants is one of the most important measures of PMTCT and EID program effectiveness, which not only acknowledges the availability, and effectiveness of therapeutic interventions but also the competing threats to infant survival (GOK, 2016). Survivorship in this study was defined in terms of infant HIV status at the end of 12 months whereby the infant is HIV free between 6 weeks and 12 months of age. HIV-free survival among the HIV exposed infants was estimated at 90.7% (with a total person-time of 139.02 days, 95% CI 5.43, 16.10) for the infants aged between 6 weeks and 12 months a finding similar to that in Rwanda 91.9% (Ruton *et al.,* 2012) but much higher than Cameroon (72.6%; 95% CI: 62.3, 80.5), South Africa (77.7%; 95% CI: 72.5, 82.1) and Zambia (83.1%; 95% CI: 78.4, 86.8), (Stringer *et al.,* 2013).

Maternal age influenced infant survival status over the 12 months follow-up period whereby younger mothers aged between 18-24 years had a higher hazard ratio (5.97) of infant positivity relative to their older counterparts 36-47 years, a finding similar to that of (Ruton *et al.,* 2012). This however differed with findings of Ditekemena *et al.,* (2015) whereby younger maternal age was associated with positive child outcomes in terms of child morbidity and mortality and better EID uptake.

Mothers who had some form of employment and had higher household income levels had a lower hazard ratio (HR= 0.07) of infant HIV positivity, relative to those who were unemployed and had a low household income of Ksh. <6000. Ditekemena *et al.,* (2015) state that poverty is a driver of poor infant survival and interventions to economically empower the HIV positive women would improve their health and subsequent infant survival. Mothers recommended that they should be given long

appointment dates to reduce the cost of seeking care (in terms of cost of transport which was a barrier to adherence to EID clinics) as they come for EID services in the FGDs conducted.

Diagnosing mothers early before pregnancy and putting them on ART improves infant survival and reduces infant chances of HIV infection. This was supported by Abrahams *et al.,* (2017) where the authors found that failure to diagnose HIV infection during early pregnancy was a primary reason for missing both PMTCT and EID interventions contributing disproportionately to pediatric new infections. In the current study, mothers who had a recent diagnosis of HIV (within two years of study onset) had a higher hazard ratio (HR= 6.97) of infant HIV positivity relative to mothers that had an HIV diagnosis made more than two years of study onset. Diagnosis during pregnancy poses a challenge of disclosure and increases the risk of vertical transmission Agudu *et al.,* (2017) and was seen in the FGDs conducted in the current study whereby a few of the mothers stated that they knew their HIV status with the current pregnancy and disclosure of HIV status to their partners was a challenge.

Mothers who received ART in pregnancy had a lower hazard (HR=0.11) of infant HIV infection relative to mothers that had not received ART in pregnancy a finding similar to a Rwanda study Ruton *et al.,* (2012) that found lower odds (AOR 0.4 CI 0.1, 0.96) of infant HIV positivity in mothers who had received ART in pregnancy. Derebe *et al.,* (2014) further add to say that detection of maternal HIV status in early pregnancy through voluntary counseling and testing is a key factor in ensuring infant survival because then ART can be started as early as possible reducing the chances of vertical transmission.

Attending more than three PMTCT visits had a lower hazard ratio (HR= 0.12) of infant positivity relative to mothers who had attended lesser visits, for instance, only two visits. In a retrospective study conducted in Zambia by Buzdugan *et al.,* (2015) mothers that received ANC yielded an estimated 89.8% (95% CI: 86.8, 92.2) HIV-free infant survival and a lower MTCT rate. The authors also found that early identification of HIV positive mothers and starting PMTCT visits within the first trimester of pregnancy was associated with higher retention rates in the PMTCT clinics. Ongaki *et*

al., (2019) found that mothers who attended more than one PMTCT clinic had higher odds of 2.78 (CI: 1.25, 6.17) of administering prophylaxis to their infants relative to mothers who had attended less than one PMTCT visit.

In the current study, mothers who failed to disclose their HIV status to their partners nor knew their partner's HIV status experienced a higher hazard ratio (HR= 5.10) and (HR= 5.87) respectively of getting an HIV positive infant relative to mothers that had disclosed their status and knew their partners HIV status. Male partner involvement through participation in ANC attendance has been associated with enhanced uptake of PMTCT specifically, improvements in HIV testing and partner disclosure, ART adherence, and improved infant feeding strategies (Alusio *et al.,* 2016). Alusio *et al.,* (2016) found that lack of male partner participation resulted in reduced infant survival (HR= 3.95, 95% CI: 1.21, 12.89; p=0.023), which was maintained when adjusting for maternal and infant ARV use (AHR=3.79, 95% CI: 1.15, 12.42). A study conducted in Papua New Guinea revealed lower infant survival (in terms of infant death and infant HIV positive status) and loss to follow-up in mothers that had reported untested or unknown partner HIV status (Carmone, *et al.,* 2014). However, in Mali, Kalembo *et al.,* (2013) failed to show lower vertical transmission risks with male partner involvement.

Non-disclosure of maternal HIV status to their partners and lack of knowledge of their partner's HIV status in the current study had higher hazards of infant HIV positivity, a finding corroborated by Alusio *et al.,* (2016) whereby male partners who had disclosed their HIV status to the mothers had a greater likelihood of PMTCT involvement and were more involved with the infant. These partners were also found to provide access to medical services whenever the mothers needed it. Adeniyi *et al.,*(2015) found that fear of stigma relating to maternal HIV status was associated with high levels of non-disclosure that affected ART adherence and PMTCT attendance, factors that negatively affected infant survival. The authors recommended community education to reduce stigma and discrimination and male partner involvement during PMTCT to enhance HIV disclosure. Yah & Tambo, (2019) also demonstrated that male participation during PMTCT improved maternal sexual and reproductive health,

reduced stigma and discrimination, and consequently improved infant health outcomes. The authors further stated that male involvement increased the incidence of HIV testing and counseling and facilitated partner disclosure. Non-disclosure of maternal HIV status was associated with an increased risk of vertical transmission of HIV to the infants and high maternal viral load (Tshweneagae *et al.,* 2015).

In the FGDs conducted, most mothers reported that non-disclosure of HIV status had affected their life negatively and more so adherence to ART. This was an indication that disclosure needs to be provider-assisted, accompanied by intensive community sensitization to ensure the reduction of stigma and discrimination among PLHIV. Fear of stigma and discrimination has been demonstrated to lead to non-disclosure of maternal HIV status to their significant others, affecting ART adherence and viral load counts (Ongaki *et al.,* 2019). This then affects infant survival, increasing the risk of vertical transmission during pregnancy and the breastfeeding period. A few mothers however reported tremendous partner support following the disclosure of their HIV status in the current study.

Partner involvement and support through adherence counseling and other PMTCT interventions improve overall maternal adherence and retention in the EID clinic ultimately improving infant survival (Imbaya *et al.,* 2014). In the FGDs conducted non-involvement of male partners in PMTCT interventions such as condom use and male partner ART adherence affected the mothers' ART adherence and viral load. A few of the mothers reported that their partners had multiple sexual partners but still refused to wear condoms during sexual intercourse. Thomson *et al.,* (2018) also found that women in sub-Saharan Africa reported that they faced difficulty in negotiating the use of condoms with their male partners despite the fact that they were aware that some of their partners had multiple sexual partners. A few mothers reported that their partners refused to take their ART, and some even refused to go for HIV testing. All these negative male partner behaviors put both the mothers and infants at increased risk of high viral loads and vertical transmission, respectively.

In the current study, mothers with more advanced disease of HIV infection, for instance, those in Stage 2 had a higher hazard ratio of experiencing infant HIV

positivity relative to mothers that were in stage 1 of HIV infection. These findings were similar to those of Abrahams *et al.,* (2017) where mothers with advanced disease experienced lower infant survival compared to mothers with less advanced disease who had CD4 counts ≥ 350 cells/ml. Undetectable and low maternal viral loads lead to a lower hazard of infant positivity relative to mothers with high viral load levels in the current study. These findings were similar to those of Buzdugan, *et al.,* (2015) whereby mothers with advanced disease had increased mortality and morbidity in their infants. However, Abrahams *et al.,* (2017) study in South Africa, maternal viral load was only significantly associated with infant survival at the bi-variable level and was no longer a predictive factor of infant survival at the multivariable level.

Mothers on the first-line ART regimen in the current study experienced a lower hazard of infant HIV positivity relative to mothers on the second-line regimen. PMTCT regimens act to lower maternal and infant viral load limiting the establishment of the infant viral reservoir, lowering the maternal viral load and HIV progression, therefore, in the periods when the HIV positive mother is being switched from the first to second-line regimens there is usually periods of high maternal viremia that could increase the risk of vertical transmission to the infant (Abrahams *et al.,* 2017). However, other non-biological explanations also play a role in infant HIV positivity. Humphrey *et al.,* (2019) found that mothers who were changed from one regimen to another during pregnancy or breastfeeding for any reason had high odds of infant HIV positivity and their positive infants were also virally unsuppressed (AOR 1.82 CI: 1.21, 2.27).

In the current study, mothers reported food inadequacy in the FGDs conducted which led to an insufficient amount of breast milk and undernourishment of their infants which increased the risk of vertical transmission to the infants. Underweight mothers had a higher hazard ratio (HR= 6.29) of having HIV positive infants relative to the mothers with a normal BMI. Nabwera *et al.,* (2017) study showed that poor nutritional status in HIV positive mothers may impair immunity by weakening the epithelial integrity of the body cells, which in turn increases the risk of infant HIV infection.

Close to a half 81 (48.0%) of the infants had late initiation into the EID (> 6weeks of age) which led to a higher hazard ratio (4.00) of infant HIV positivity relative to

mothers who had enrolled their infants for EID at 6 weeks or earlier. Globally, it is estimated that nearly half of HIV exposed infants receive an EID test within the first two months but with wide variations in initiation timeliness in various countries (Essajee *et al.,* 2017). The success of infant HIV testing programs is highly dependent on the early identification and enrollment of infants into the PMTCT services and systematic follow-up until the final determination of the infant's HIV status upon cessation of breastfeeding (Modi *et al.*, 2019). A study conducted in four countries in Asia and Africa (Cambodia, Senegal, Namibia, and Uganda) by Anirban, *et al.*, (2011) elicited that the median age of testing among infants referred from PMTCT services was approximately 2 months over the life of the program, with less than 50% of these infants being tested well after 2 months of age.

A retrospective study in Tamil by Hanna, *et al*., (2015) found that the median age at initiation into EID at the time of sampling was 4 months. Only 13% of the positive babies were tested within 6 weeks of birth, 29% had their first test by 4 months, 52% by 6 months, and 85% by 12 months. Although guidelines recommend testing of exposed children at 6 weeks of age, the study found that less than one-fifth of eligible infants were tested at this time. Long turn-around times between the first PCR test and the second confirmatory PCR test resulted in high attrition for the mother-infant pair, which caused inappropriate delays in starting positive children on life-saving ART. The authors recommended that DBS positive results should be used to start the infants on ART immediately as opposed to delaying treatment as a second confirmatory full blood test is awaited to capitalize on the overwhelming benefits of early ART initiation for infants and reduce the numbers of LTFU.

In Rural Kenya, Amin *et al*., (2012) found out that out of the 233 infants enrolled in the EID program only 75 (32%) were enrolled for care within the first two months of life. The median age for enrollment was 5 months. Moreover 60 (43%) of the 139 drop-outs occurred within 2 months after enrolment with only 74 (32%) of the infants retained up to 18months. Factors that attributed to late initiation, LTFU, and drop out included younger mothers, inadequate caregiver knowledge on EID processes and interpretation of the same, lack of appropriate social support structures to facilitate

disclosure and handle stigma, indirect costs as one travels for the test results, and drugs in the healthcare facility. Other factors included denial by the caregiver especially if the infant is found to have a positive virological test, concerns about the pricking during testing being painful for the infant, and poor interpersonal relationships with the healthcare providers.

5.1.9 Sample turn-around-time for EID among HIV exposed infants

Mortality among HIV exposed infants peaks at the infants' first 8 weeks - 12 weeks of life. Therefore, infant HIV diagnosis using the HIV PCR test at 6 weeks as is the standard protocol in Kenya is often late to mitigate mortality in early infant life, Sandbut *et al.,* (2019) due to long sample TAT that takes an average of 63 days (95% CI 55-70 days) following sample removal. Infant survival and the success of ART initiation is pegged on early diagnosis and timely ART initiation. One barrier to early ART initiation that was found in the current study was long sample TAT with an average of 63 days (95% CI: 55 days - 70 days) which was found to be longer than the recommended sample TAT of 14 days (GOK, 2016 and USAID, 2016). This TAT was much longer than what was observed by Phiri *et al.,* (2017) and Kayumba *et al.,* (2016) whereby the sample TAT was between 16 days -24 days, with a median of approximately 20 days. Wexler *et al.,* (2017) found that POC diagnostics for EID testing reduced unnecessary delays caused by transportation of samples to testing centers and relay of results from testing centers, to the healthcare facilities laboratories, to the healthcare providers and the caregivers.

5.2 Conclusions

1. Maternal non-disclosure of HIV status and lack of knowledge of their partners' HIV status were found to reduce ART adherence, which consequently increased the risk of infant HIV vertical transmission across all the time-points
2. Inadequate maternal nutrition during pregnancy resulted in childhood stunting which was the most severe form of malnutrition experienced among the infants. This indicated chronic malnutrition in utero and early childhood, which consequently increased the risk of vertical transmission of HIV.

3. Maternal prognostic factors associated with poor infant survival over the one-year follow-up period were young maternal age (18-24) and recent maternal HIV diagnosis of ≤ 2 years prior to study onset.
4. Stigma, discrimination, and low awareness levels of the existence of legal support for PLHIV were challenges inhibiting access of EID services, which often lead to ART and clinic non-adherence.
5. Long sample TAT that took an average of 63 days from sample removal to the relay of results, caused delays in decision making on care and treatment for the mother-infant pairs.

5.3 Recommendations

1. Provider assisted disclosure of HIV status should be incorporated into the EID policies as part of the cascade of care to remove barriers brought about by non-disclosure of HIV statuses such as poor ART and prophylaxis adherence among mother-infant pairs.
2. Integration of the full nutritional package into the PMTCT and EID policies to facilitate early screening and management of malnutrition in pregnant and breastfeeding women, and their infants which will decrease the risk of vertical transmission of HIV.
3. Creation of a special package of care for young mothers and mothers with recent HIV diagnoses which will have more rigorous adherence and nutritional counseling, with close monitoring of these mother-infant pairs.
4. Formulation of a stigma and discrimination policy for people living with HIV with targeted behavioral and structural interventions for healthcare providers, PLHIV, partners of PLHIV, families, and communities. An action plan for mitigating stigma and discrimination was developed by the researcher to pave way for the development of a policy brief, that will trigger the formation of a stigma and discrimination policy for PLHIV.
5. Strengthening of infrastructure for EID service delivery through the acquisition of point-of-care diagnostic equipment to reduce sample TAT and facilitate

timely care and treatment decisions by the healthcare providers for the mother-infant pairs.

5.4 Suggestions for further research

Further research needs to be conducted on “the role of male partner involvement in the reduction of MTCT of HIV in the EID program.”

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APPENDICES

Appendix I: Consent form

Study title

DETERMINANTS OF HEALTH OUTCOMES AMONG INFANTS ENROLLED FOR EARLY INFANT DIAGNOSIS SERVICES OF HIV IN SELECTED HOSPITALS IN NAIROBI COUNTY, KENYA

PART A

Introduction

You are being asked to participate in this study on 'Determinants of health outcomes among infants enrolled for EID services of HIV, which is being conducted in selected facilities in Nairobi County'. The objective of this study is to determine factors that influence EID service delivery and uptake by the healthcare providers and mother respectively, as well as the outcomes of the infants as they seek EID services. You have been selected as a possible participant in this study. The reason why you have been selected for the study is because the study targets mothers who are HIV positive to study and follow-up their exposed infants. We ask that you read this form and ask any questions you may have before agreeing to be in the study and feel free to ask any questions regarding the study.

Purpose of the study

The purpose of this study is to determine factors influencing health outcomes among infants enrolled for EID services of HIV in selected hospitals in Nairobi County.

Study procedures

If you agree to take part in this study, we shall ask you detailed questions regarding your health status, your infant's health status, and collect blood samples from you and your infant for laboratory testing purposes.

The procedure for drawing blood from the infant will be as follows:

Application of an alcohol swab to the entire heel and allow the site to air dry. This will be followed by the puncturing of the skin with one quick prick, ensuring a continuous and deliberate stroke, to achieve a good flow of blood to prevent the need to repeat the puncture. The first drop of blood will be wiped off because it may be contaminated by fluids, which will be followed by squeezing the heel lightly and collection of the blood sample. Once the blood collection procedure is complete, firm pressure will be applied to the sight to stop the bleeding.

The procedure for drawing blood from the mother will be as follows:

Application of an alcohol swab to the cubital area and allow the site to air dry. Application of a tourniquet about 4-5 fingers width above the venipuncture site and re-examination of the vein. Once the vein is located, it will be punctured, the tourniquet removed and blood drawn. The sample will be put in a container (vacutainer) with an anti-coagulant substance and labeled.

Both infant and mother blood samples will be clearly labeled accompanied by duly filled lab request forms. The samples will then be packed safely in a leak-proof bag with an outside compartment for the laboratory request form to avoid contamination. They will then be transported to the KEMRI HIV lab using the normal sample delivery methods of the respective facilities.

Withdrawal from the study

You have the choice to or not to participate in this research study. If you choose not to participate in this study or to leave the study during the interview process, you may do so freely without consequences against you.

Risks/and or discomfort of study participation

We do not anticipate any risks or major discomforts to you or your infant during this study, however, there will be minimal discomfort while drawing blood from your

infant and yourself for conducting blood tests. Although we shall write your details on paper, no other person will be allowed to read this information except the ones directly involved in this study. We will make every effort to protect your privacy and confidentiality while you are participating in the study.

Benefits

By participating in this study and answering our questions, you will help to increase our understanding of the determinants health outcomes among infants enrolled for EID services in this facility. Your participation in this study is voluntary and you have the right to refuse to participate or to answer any questions that you feel uncomfortable with. If you change your mind, you have the right to withdraw at any time. If anything is not clear or if you need further information, we shall provide it to you.

This study does not have direct benefits to the participants. However, it has the potential of improving the quality of EID services offered at healthcare facilities like this.

Additionally, whether or not you choose to participate, you will be provided with a standard package of education on EID to improve the health outcomes for you and your child.

Study costs

Taking part in this study will not involve any payment for those procedures we perform.

Confidentiality

The records of this study will be kept private. The privacy will be enhanced by the use of a lockable cabinet. Any publications or presentations arising from this study will not include any information that will make it possible to identify you as a subject. However, your record for the study may be reviewed by officials from the Institute of Tropical Medicine and Infectious Diseases (ITROMID, KEMRI) or Jomo Kenyatta

University of Agriculture and Technology (JKUAT). If the records are reviewed, the officials will protect your privacy.

Contacts and questions

The researcher conducting this study is Elizabeth Mueke Kiilu. You may ask any questions you have now, or if you have questions later, you are encouraged to contact her through telephone number: 0721-724 580, E-mail elisakiilu09@gmail.com
If you have any questions or concerns regarding the study and would like to talk to someone other than the researcher(s), you are encouraged to contact the following:

The Director, Institute of tropical medicine and infectious diseases (ITROMID),

Jomo Kenyatta University of Agriculture and Technology,

P. O. Box 62000 00200 Nairobi.

Tel. 067 – 52711,

E-mail: itromid@nairobi.mimcom.net

Or

The Chairman KEMRI Scientific Ethics Review Unit (SERU)

P.O BOX 54840 – 00200 NAIROBI, KENYA.

TEL: (254) (020) 2722541, 2713349, 0722-205901, 0733-400003;

E-mail: info@kemri.org

KEMRI SERU is the oversight body that will ensure that your rights are protected during the study, and that there will be no harm done to you and your infant, and that further, you and your infant will be ultimately benefiting from of the study.

You will be given a copy of this form to keep for your record.

PART B: Consent form

Please read the information sheet (PART A) or have the information read to you carefully before completing and signing this consent form. If you have questions about the study, please ask the investigator prior to signing your consent form.

Declaration of the volunteer

I Mr, Miss, Mrs……..hereby give consent to …….. to include me in the proposed study entitled; Determinants of health outcomes among infants enrolled for EID services in selected hospitals in Nairobi County. I have read the information sheet concerning this study, I understand the aim of the study and what will be required of me if I take part in the study. The risks and benefits if any have been explained to me. Any questions I have concerning the study have been adequately answered. I understand that at any time that I may wish to withdraw from this study I can do so without giving any reason and without affecting my access to normal healthcare and management.

I realize that I will be interviewed several times. I consent voluntarily to participate in this study.

Subject's name/thumbprint…… Signature……..Date……...

Name of person taking consent…….....Signature……Date……...

Name of investigator……..Signature…….Date…….

Appendix II: Mother-infant pair recruitment questionnaire

A: Semi-Structured Questionnaire for HIV positive women at recruitment

(A) Basic information

Questionnaire Serial Number			
Research assistant name			
Date of interview	Day	Month	Year
Mothers CCC number			
Infant HEI number Infant MBP number			

(B) Socio-Demographic information

1. Where is your place of residence?
   a) Sub-County……Location……Estate …….
2. Mobile number of mother…….
3. Mobile number of next of kin and relationship……
4. Age in completed years

   a) 18-24 [ ]
   b) 25-34 [ ]
   c) 35-44 [ ]

5. What is the highest level of education completed?
   a) ≤Primary education [ ]
   b) ≥Secondary education [ ]
6. What is the size of your family or the number of people who sleep in your house?
   a) 2-5 [ ]
   b) 6-8 [ ]

7. What is your current marital status?

   a) Single [ ]

   b) Married [ ]

8. What is your current employment status?

   a) Formal employment [ ]

   b) In-formal employment [ ]

   c) Unemployed [ ]

9. What is your household income in Ksh.?

   a) ≤6000 [ ]
   b) 6001-12000 [ ]
   c) ≥ 12001-18000 [ ]

B. Maternal biomedical information at baseline (Confirm from CCC file/maternal ANC booklet)

INDICATOR	STATUS	DATE TAKEN
Confirm form mothers CCC file		
Date when the mother was 1st initiated on ART		
Weight (Kgs)		
Height (Centimetres)		
BMI (Kg/M^2)		
CD4 Count (Cells/mm3)		
Viral Load ((IU/mL)		
HB Level (g/dl)		
HIV staging		
Mother's adherence to the last clinic given	Appointment date: Visit date:	
Presence of opportunistic infections		
Presence of co-infections		
Confirm form mothers ANC booklet		
Mode of delivery for this infant		
Gestation at delivery for this infant		
Gestation of pregnancy at **1st** PMTCT/ANC visit for this infant		
Number of PMTCT visits during pregnancy for this infant		
Number of appointments missed during pregnancy		

C. Information on HIV status and disclosure status *(please remember that whatever will be discussed here will be confidential)*

10. Which year were you confirmed to be HIV positive
    a. > 2years prior to study onset [ ]
    b. ≤ 2years prior to study onset [ ]
11. Where were you tested for HIV?
    a) At the hospital during antenatal care (this pregnancy) [ ]
    b) At hospital when sick [ ]
    c) At VCT facility [ ]
    d) Provider Initiated Testing and Counseling (PITC) [ ]
    e) Other (Specify) ……
12. Do you have a partner? (confirm response with question 7)
    a) Yes
    b) No

    If No, skip to question 17, If yes continue with question 13

13. Have you disclosed your HIV status to your partner?
    a) Yes [ ]
    b) No [ ]
14. Do you know your partner's HIV status?
    a) Yes [ ]
    b) No [ ]

    If No, skip to question 17
15. What is your partner's status?
    a) Positive [ ]
    b) Negative [ ]

16. How did your spouse/partner know his HIV status?

a) Own voluntary testing [ ]
b) After knowledge of the mother's HIV status [ ]
c) Routine medical check-up [ ]
d) Others

(Specify)…….

D. Information on maternal history during PMTCT attendance and ART adherence

17. Did you attend any PMTCT visits during this pregnancy?

a) Yes [ ]
b) No [ ]

If yes, how many visits for the entire pregnancy? (Indicate number)……

If No go to question 19

18. What services were you given during the PMTCT visit (let the mother give you the responses then probe by reading out responses a-f)

a) HIV testing [ ]
b) Pre and post-test counseling [ ]
c) ARVs [ ]
d) Prophylaxis (Cotrimoxazole) [ ]
e) None [ ]
f) Others

(Indicate)……

19. Have you been given any ART during this pregnancy?

a) Yes [ ]
b) No [ ]

If Yes go to question 20 if No go to the Morisky Scale

20. What stage in your pregnancy were the ART administered (Gestation at first PMTCT visit)?
    a) 1st Trimester [ ]
    b) 2nd Trimester [ ]
    c) 3rd Trimester [ ]

Morisky Medication ART adherence scale (MMAS-8) - Circle appropriately

	QUESTION	**YES**	**NO**
1.	Do you sometimes find it difficult to remember to take your ART daily?	1	0
2.	Do you ever forget to take your medicine sometimes?	1	0
3.	Sometimes if you feel worse when you take the medicine, do you stop taking it?	1	0
4.	When you feel better, do you sometimes stop taking your medicine?	1	0
5.	Did you take your medicine yesterday?	0	1
6.	When you feel like your symptoms are under control, do you sometimes stop taking your medicine?	1	0
7.	Taking medication every day can be a real inconvenience for some people. Do you ever feel under pressure about sticking to your treatment plan?	1	0
8.	How often do you have difficulty remembering to take all your medications? (Please circle the correct number) A) Never/Rarely B) Once in a while C) Sometimes D) Usually E) All the time	POINTS: A) 0 B) ¼ C) ½ D) ¾ E) 1	

Adapted from guidelines on use of ART and Prevention of HIV infection in Kenya – 2018 Edition

21. Have you been hospitalized during this pregnancy?

    a) Yes [ ]

    b) No [ ]

    If yes, indicate reason(s)…….

    If no, go to question 23, If Yes continue with number 22

22. Indicate the number of times you have been hospitalized during this pregnancy? (Indicate number here)……..

E. Maternal knowledge and attitude towards EID

23. Do you have any knowledge on how to reduce the chances of HIV transmission to your infant?

    a) Yes [ ]

    b) No [ ]

    If No go to question 25, If yes continue with question 24

24. You can reduce the chances of HIV transmission to your infant by? (Tick appropriately)

    a) Appropriate feeding practices [ ]

    b) Prophylaxis for the infant immediately after birth [ ]

    c) ART for the mother during pregnancy and thereafter [ ]

    d) Early HIV diagnosis for the mother [ ]

    e) Appropriate mode of hospital deliver [ ]

    f) None of the above [ ]

    g) Other (Indicate) ……..

25. Would you be willing to bring your infant for HIV testing using PCR to determine their HIV status at 4-6 weeks, 6 months and 12 months and any other prescribed time thereafter?

    a) Yes [ ]

    b) No [ ]

    If No, indicate reason(s)……

26. Would you be willing to give your child ARVs for PMTCT of HIV for the prescribed duration every day without fail?

    a) Yes [ ]

    b) No [ ]

    If No, indicate reason(s)……

27. If your baby tests HIV positive by PCR, would you be willing to ensure that your baby takes ART for the rest of his/her life?

    a) Yes [ ]

    b) No [ ]

    If No, Indicate reason(s)……

F. Maternal knowledge of infant feeding practices

28. Do you know the available feeding options for your infant?

    a) Yes [ ]

    b) No [ ]

29. Have you been educated on the available feeding options for your infant?

    a) Yes [ ]

    b) No [ ]

    If No go to question 31, if yes continue with question 30

30. What was the source of your information on feeding practices for your infant?

    a) ANC Clinics [ ]

    b) Other departments in the healthcare facility [ ]

    c) Spouse [ ]

    d) Extended family members [ ]

    e) Friends [ ]

    f) Same as how I fed my other infants [ ]

    g) Others (Indicate)……...

31. What feeding option will you settle for your infant in the first 6 months of life?

a) Exclusive breastfeeding for the first 6 months [ ]
b) Mixed feeding for instance breastfeeding and other substitutes such as water, or boiled cow's milk from birth [ ]
c) Formula feeding from birth without giving breast milk [ ]
d) Breastfeeding and formula feeding from birth [ ]
e) Boiled animal milk from birth without breastfeeding [ ]
f) Heat-treated breast milk for first 6 months [ ]
g) Other (Explain)……

G: Infant feeding practices

32. What was the <u>first milk</u> that you gave (or someone else gave) to your infant after birth? (Select only one response)

a) Breast milk [ ]
b) Formula milk [ ]
c) Animal milk (goat, cow, camel) [ ]

33. How soon after delivery was this milk given to your baby?

a) Less than one hour [ ]
b) 1-4 hours [ ]
c) 4-12 hours [ ]
d) More than 12 hours [ ]
e) I cannot recall [ ]

34. Is (name) currently breastfeeding?

a) Yes [ ]
b) No [ ]

If yes continue with question 35, If No skip to question 36

35. Is (name) breastfeeding exclusively?

a) Yes [ ]
b) No [ ]

If Yes, continue with question 36, If No skip to question 37

36. What age did you introduce the foods?

a) Immediately after birth [ ]
b) When baby was < 6 months old [ ]
c) Only before my breasts started producing milk [ ]
d) Other (Indicate)…….

37. What kind of foods are you giving to your baby? Tick all that apply.

a) Plain water [ ]
b) Infant formula milk [ ]
c) Animal milk (Cow's/goat/camel milk) [ ]
d) Thin porridge [ ]
e) Mashed Fruits [ ]
f) Mashed potatoes [ ]
g) Others (Specify)……

38. How did you make the above decision? (Select only One response)

a) By yourself- no discussion with anyone [ ]
b) After discussion with someone else [ ]
c) Your family or extended family members told you [ ]
d) Healthcare provider told you [ ]
e) Same as previous child [ ]
f) Other (Indicate)……

H: Initiation into care and treatment

39. Briefly describe in your understanding, the services that will be offered to you and your infant as you go through the EID process…….……

……..……

40. Is there any reason as to why you would not want your infant to be initiated into care and/or treatment with ARVs and cotrimoxazole? .....……

……

41. At what age was your infant initiated into the EID program? (Confirm response from MCH booklet)

a) At birth [ ]
b) 1 day to 4 weeks [ ]
c) Between 4-6 weeks [ ]
d) >6 weeks but <10 weeks [ ]
e) >10 weeks but <6months [ ]
f) >6months but <12 months [ ]

42. At what age did your infant receive the first PCR results? (If no PCR results **End questionnaire**)

a) At birth [ ]
b) Between 4-6 weeks [ ]
c) >6 weeks but <10 weeks [ ]
d) >10 weeks but <6months [ ]
e) >6months but <12 months [ ]
f) No PCR results received (If no PCR results **End questionnaire**) [ ]

43. What were the results of the PCR test offered to your infant?

a) Positive [ ]
b) Negative [ ]
c) No PCR results given [ ]

44. Is your infant initiated on ART Therapy?

a) Yes [ ]
b) No [ ]

If No End the interview here, If yes continue with question 45

45. At what age was your infant initiated on ART?

g) At birth [ ]
h) Between 4-6 weeks [ ]
i) >6 weeks but <10 weeks [ ]
j) >10 weeks but <6month [ ]
k) >6months but <12 months [ ]

END OF QUESTIONNAIRE. THANK YOU FOR YOUR PARTICIPATION!

Appendix III: Infant Follow-Up 6weeks, 10weeks, 14weeks, 6months, and 12 months.

A: Child characteristics (Confirm from MCH booklet)

(A) Basic information

Questionnaire Serial Number			
Research assistant name			
Date of interview	Day	Month	Year
Mothers CCC number			
Infant HEI number Infant MBP number			

POSITIVE PCR INFANT			**NEGATIVE PCR INFANT**		
Indicator	Status	Date taken	Indicator	Status	Date taken
Sex of infant			Sex of infant		
Age of infant (weeks)			Age of infant (weeks)		
Birth Weight(Kg)			Birth Weight(Kg)		
Progressive (Kg)			Progressive (Kg)		
Height (cm)			Height (cm)		
Head circumference			Head circumference		
(MUAC) in (cm)			(MUAC) in (cm)		
PCR status			PCR status		
CD4 % (cells/mm^3)			-		
Viral load count (IU/mL)			-		
Co-infections			-		
ART			ART prophylaxis (up to 12 weeks)		
CTX			CTX		
Other medication			Other medication		
Hospitalization(s)			Hospitalization(s)		
Other illnesses			Other illnesses		
Feeding practice			Feeding practice		
PCR result at 6 weeks	Date recieved:		PCR result at 6 weeks	Date received:	

(B) Infant Feeding practices follow-up

1. Have you started feeding your baby on other foods other than breast milk?
   a) Yes [ ]
   b) No [ ]

   If **No**, **SKIP** to question 5 if **yes** continue with question 2

2. What age did you introduce the foods?
   e) Immediately after birth [ ]
   f) When baby was < 6 months old [ ]
   g) Only before my breasts started producing milk [ ]
   h) When baby was > 6 months old [ ]
3. What kind of foods are you giving to your baby?
   h) Plain water [ ]
   i) Infant formula milk [ ]
   j) Animal milk (Cow's/goat/camel milk) [ ]
   k) Thin porridge [ ]
   l) Mashed Fruits [ ]
   m) Mashed potatoes [ ]
   n) Others (Specify)……
4. How did you make this decision? (Select only one response)
   g) By yourself- no discussion with anyone [ ]
   h) After discussion with someone else [ ]
   i) Your family or extended family members told you [ ]
   j) Healthcare providers told you [ ]
   k) Same as previous child [ ]
   l) Other (Indicate)……
5. What benefits do you think you will get from enrolling your infant in the EID program? ……

   ……

6. What are some of the challenges you have encountered as you seek EID services for your infant?

……
……
……

7. What can be done to improve your infant's and your experience as you go through the EID process?

……
……

Appendix IV: Data abstraction tool for maternal follow-up at 6 and 12 months

(A) Basic information

Questionnaire Serial Number			
Researchers initials			
Date of interview	Day	Month	Year
Mothers CCC number			
Infant HEI number Infant MBP number			

(B) Follow-up of the mother at 6 months and 12 months

Check from mother's CCC file and update

INDICATOR	STATUS	DATE TAKEN
Weight (Kgs)		
Height (centimeters)		
BMI (Kg/M^2)		
CD4 Count ($cells/mm^3$)		
Viral Load (IU/mL)		
HB Level (g/dl)		
HIV staging		
Mother's adherence to the last clinic given		
Presence of opportunistic infections		
Presence of co-infections		
ART mother is taking		

Note: Ensure to administer the Morisky Medication ART Adherence Scale (MMAS-8) to confirm ART adherence.

Appendix V: Focus group discussion guide

Preliminaries

- Ensure that you had already asked for consent form each participant before beginning the FGD.
- Introduce self and the note-taker
- Explain the background of the study
- Complete confidentiality-to obtain unbiased responses
- Rules for the discussion: One person at a time, no side conversations, sound projection

1. Study background information

The objectives of this group discussion will be to explore:

1) The maternal factors influencing health outcomes among infants enrolled for EID services in selected hospitals in Nairobi County. More specifically
    i. Perceived susceptibility of EID
    ii. Perceived severity of EID
    iii. Perceived benefits of EID
    iv. Perceived barriers of EID
    v. Cues to action
    vi. Self-efficacy
    vii. Maternal understanding/knowledge of services that will be offered to her and her infant during the EID program.
    viii. Maternal attitude towards the EID program

2. Focus Group Discussions target respondent

- Women aged 18 to 44 years

3. Introduction

- Welcome the respondents and introduce self, introduce Research and the purpose of the research
- Encourage the respondents to decide on the language to be used: English/ Kiswahili
- Explain this is a free discussion and there are no right or wrong answers
- Explain that you need to record the discussion for report writing purposes
- Assure the respondents of confidentiality on the discussion
- Encourage everyone to participate and offer their very honest opinions
- Ask participants to speak clearly, one at a time during the discussion
- Give directions on the location of restrooms
- Request respondents to switch off mobile phones to avoid interruptions
- Explain the session length as 30 to 45 minutes

4. Ice breaker

- Let us start by introducing ourselves, please tell us your: name, age, level of education, number of children, marital status and what you are currently doing for a living

5. Assessing perceived susceptibility of EID

Probe for:

a) Perceived heightened risk of HIV transmission to the infant based on personal traits or behaviors
b) Perceived low perceived risk of HIV transmission to the infant based on personal traits or behaviors

6. Assessing the perceived severity of EID

Probe for:

a) Perceived consequences to the infant by virtue of the mother being HIV positive

7. Assessing the perceived benefits of EID

Probe for:

a) Perceived positive effects or benefits to be expected following the EID program initiation and completion. Benefits to the mother and benefits to the infant.

8. Assessing the perceived barriers of EID

Probe for:

a) Perceived barriers as the mother-infant pair as they go through the EID program

9. Assessing cues to action

Probe for:

a) Perceived solutions to the challenges that the mothers felt were affecting them
b) Possible recommendations that could improve their experience as the mother-infant pair go through the EID program

10. Assessing self-efficacy

Probe for:

a) The mother's confidence in her ability to reduce the chances of MTCT and possible actions to she can implement to reduce the chances of MTCT.

11. Exploring knowledge gaps on maternal understanding/knowledge of services that will be offered to her and her infant during the EID program

Probe for :

a) Services offered during EID to the infant
b) Services offered during EID to the mother
c) Importance of EID services
d) Knowledge on how to reduce MTCT
e) Knowledge of feeding practices
f) Knowledge on infant prophylaxis, (drug type, dosing, side effects, and benefits)
g) Knowledge on maternal ART (drug type, dosing, side effects, and benefits)

12. Exploring maternal attitude towards the EID program

Probe for :

a) Willingness to bring your infant for the EID program for 18 months at every clinic
b) If your baby has a PCR negative result at the first test willingness to continue with the EID program for 18 months
c) If baby turns PCR positive at any point, willingness to continue with the EID program for 18 months
d) Attitude towards service delivery (PCR Test results, Viral load test results, waiting time for consultation and receiving of drugs)
e) Attitude towards elathcare providers (interpersonal relationship with the healthcare providers)
f) Taboos or cultures that would prevent uptake of EID services

13. Knowledge on feeding practices

Probe for :

a) Feeding practice immediately after birth
b) Feeding practice up to 6 months
c) Feeding practice during weaning
d) Cessation of breastfeeding time and procedure

14. Knowledge on infant prophylaxis, (drug type, dosing, side effects, and benefits)

Probe for :

a) Infant age for each mother
b) Infant prophylaxis drug type
c) Infant prophylaxis dosing
d) Infant prophylaxis side effects

Moderator to probe for all challenges and benefits

a) Infant prophylaxis benefits
b) Infant prophylaxis adherence challenges

15. Knowledge in maternal ART (drug type, dosing, side effects, and benefits)

Probe for :

a) Maternal prophylaxis and ART drug type
b) Maternal dosing
c) Maternal ART side effects

16. Conclusion

- What more would you like to know in regards to EID services?
- Is there anything you would like to add in regards to what we have discussed?

THANK RESPONDENTS AND END DISCUSSION

Appendix VI: Healthcare providers key informant interview guide

Facility-level factors associated with EID in selected hospitals in Nairobi County, Kenya.

1. Facility name ……2. Job designation……

3. Please indicate your gender

   Male [ ] Female [ ]

4. Please indicate your age bracket

   Below 25 years [ ] 25-35 years [ ] 36-45 years [ ]

   46-55 years [ ] Above 55years [ ]

5. Please indicate your highest academic qualifications

   Certificate [ ] Diploma [ ] Higher Diploma [ ] Degree [ ]

   Masters [ ] PhD [ ]

6. Are you attached to this section on a full-time basis

   Yes [ ] No [ ]

7. Kindly circle appropriately.

Years of service in the **EID PROGRAM**	**TOTAL** years of service
a) 1-2 b) 3-5 c) 6-10 d) >10 years	a) 1-5 b) 6-10 c) 11-15 d) 16-20 e) 21-25 f) >26

A: Knowledge and training

1. Have you undergone any training specifically on EID? If yes kindly elaborate the key areas that you were trained
   on……...……
   ……
2. The knowledge that you have on EID was gained from;
   a) Formal classroom education
   b) On-job training
   c) Informal set-up
3. Others, explain……
4. What key areas on EID would you want to receive training on?
   .....……
   ……..
5. Do you have guidelines on EID in this department? If yes, kindly indicate the title and year of publication of the
   guidelines……..……
   ……
6. How would you rate your knowledge on undertaking EID practices? Tick only once.

Novice (new to, or inexperienced)	Intermediate	Experienced user

B: Service organization (Tick appropriately)

Item	Highly adequate (3)	Adequate (2)	Present but not adequate (1)	Not adequate at all (0)
1. Availability of clinical staff permanently allocated to EID service delivery (nurse, doctors, and clinical officer)				
2. Availability of non-clinical staff permanently allocated to EID service delivery (counselors and others)				
3. Clinic days (appropriateness of clinic days)				
4. Service delivery space				
5. Privacy in the consultation room				
6. Sample Turn-Around Time (TAT) -within 14 days of sample removal				
7. Patient referral systems				
8. Availability of manuals and or guidelines on EID				
9. You aware of the contents of the EID manuals provided by the MoH				

1. What challenges do you face while offering EID services in this facility?.....……
   ……
2. What do you feel can best improve EID service utilization within the catchment population of the facility? ……

THE END

Appendix VII: observation chart

Facility-level factors associated with EID in selected hospitals in Nairobi County, Kenya

Item	Highly adequate (3)	Adequate (2)	Present but not adequate (1)	Not adequate at all (0)
Manuals/guidelines on EID				
Healthcare providers allocated to EID service delivery				
CD4 Machine				
Viral load machine				
Consultation room space				
Privacy in the counselling room				
Availability of ARVs (adult)				
Availability of CTX (adult)				
Availability of ARVs (pediatrics)				
Availability of CTX (pediatrics)				
Availability of EID forms/registers				
Integration of nutritional services with EID services				
PCR sample turn-around-time (TAT)				
Infant records (163 records) at 6 weeks	No. of samples with TAT <14 days.		No. of samples with TAT ≥ 14 days.	

Key: Interpretation of the observation chart scores

0-Not adequate at all: Meaning non-existent or not present at all

1-Present but not adequate: Meaning is existent but not functional or not in use

2- Adequate: Meaning is existent, may have occasional stock-outs, functional and in use however not always or to the required standards, and resources to enforce fully may not be adequate.

3- Highly adequate: Systems are fully functional and producing optimal results. Commodities are always available. No stock-outs at any time

THE END

Appendix VIII: Ethical review clearance certificate

KENYA MEDICAL RESEARCH INSTITUTE

P.O. Box 54840-00200, NAIROBI, Kenya
Tel: (254) (020) 2722541, 2713349, 0722-205901, 0733-400003, Fax: (254) (020) 2720030
E-mail: director@kemri.org, info@kemri.org, Website. www.kemri.org

KEMRI/RES/7/3/1 **November 20, 2017**

TO: **ELIZABETH MUEKE KIILU,**
PRINCIPAL INVESTIGATOR.

THROUGH: **DIRECTOR, CPHR,**
NAIROBI

Dear Madam,

RE: **KEMRI/SERU/CPHR/002/3525 *(RESUBMISSION II OF INITIAL SUBMISSION)*: DETERMINANTS OF HEALTH OUTCOMES AMONG INFANTS ATTENDING EARLY INFANT DIAGOSIS PROGRAM FOR HIV IN SELECTED HOSPITALS IN NAIROBI COUNTY KENYA.**

Reference is made to your letter dated November 6, 2017. The KEMRI Scientific and Ethics Review Unit (SERU) acknowledges receipt of the revised study documents on November 9, 2017.

This is to inform you that the committee has reviewed your responses and finds that the following issues raised during the 266th Joint Committee A, B, C and ERC meeting of the KEMRI Scientific and Ethics Review Unit (SERU) held on **August 31, 2017** are adequately addressed

Consequently, the study is **granted approval** for implementation effective this day, **November 16, 2017** for a period of one year. Please note that authorization to conduct this study will automatically expire on **November 15, 2018.** If you plan to continue data collection or analysis beyond this date, please submit an application for continuation approval to SERU by **October 4, 2018**.

You are required to submit any proposed changes to this study to SERU for review and the changes should not be initiated until written approval from SERU is received. Please note that any unanticipated problems resulting from the implementation of this study should be brought to the attention of SERU and you should advise SERU when the study is completed or discontinued.

You may embark on the study.

Yours faithfully,

DR. MERCY KARIMI NJERU,
ACTING HEAD,
KEMRI/SCIENTIFIC AND ETHICS REVIEW UNIT

In Search of Better Health

Appendix IX: County approvals

NAIROBI CITY COUNTY

Telegrams: "PRO-MINHEALTH", Nairobi
Telephone: Nairobi 217131/313481
Fax: 217148
E-mail: pmonairobi@yahoo.com

When replying please quote

Ref. No. CMO/NRB/OPR/VOL.1/2018/12

COUNTY HEALTH OFFICE
NAIROBI
NYAYO HOUSE
P.O. Box 34349-00100
NAIROBI

COUNTY HEALTH SERVICES

5th February, 2017

Elizabeth Mueke Kiilu
Principal Investigator

RE: RESEARCH AUTHORIZATION

This is to inform you that the Nairobi City County Operational Technical Working Team reviewed the documents on the study titled, "**Determinants of Health Outcomes Among Infants Attending Early Infant Diagnosis Program for HIV in Selected Hospitals in Nairobi County".**

I am pleased to inform you that you have been authorized to undertake the study in **St. Mary's Mission Hospital, Mathare North H/C, Mbagathi Hospital and MSF Kibera H/C, Nairobi County**.

On completion of the study, you will submit **one hard copy and one copy in PDF** of the research findings to our operational research technical working group.

FOR: COUNTY DIRECTOR
HEALTH SERVICES
NAIROBI COUNTY

R. K. MULI
FOR: COUNTY DIRECTOR OF HEALTH SERVICES

Cc: All SCMOHs
All Medical Superintendents

NAIROBI CITY COUNTY

LANGATA SUB COUNTY
HEALTH C OFFICE
P.O.BOX 30108 -NAIROBI

Email Address
nairobiwestmoh@gmail.com

COUNTY HEALTH SERVICES
LANGATA SUB COUNTY

REF. NO: SCMOH/LANG/GEN/2/2018

12TH MARCH, 2018

OFFICER INCHARGE
ST.MARY'S MISSION HOSPITAL
KIBERA SOUTH HEALTH CENTRE

RE: RESEARCH AUTHORIZATION – ELIZABETH MUEKE KIILU

The above named student from Institute OF Tropical Medicine and Infectious (ITROMID) has been authorized to carry out her research on **" Determinants of Health Outcomes Among Infants Attending Early Infant Diagnosis Program for HIV in Selected Hospitals" in Nairobi County .**

This is therefore to request you to accord her the necessary assistance during her research in your respective health facility.

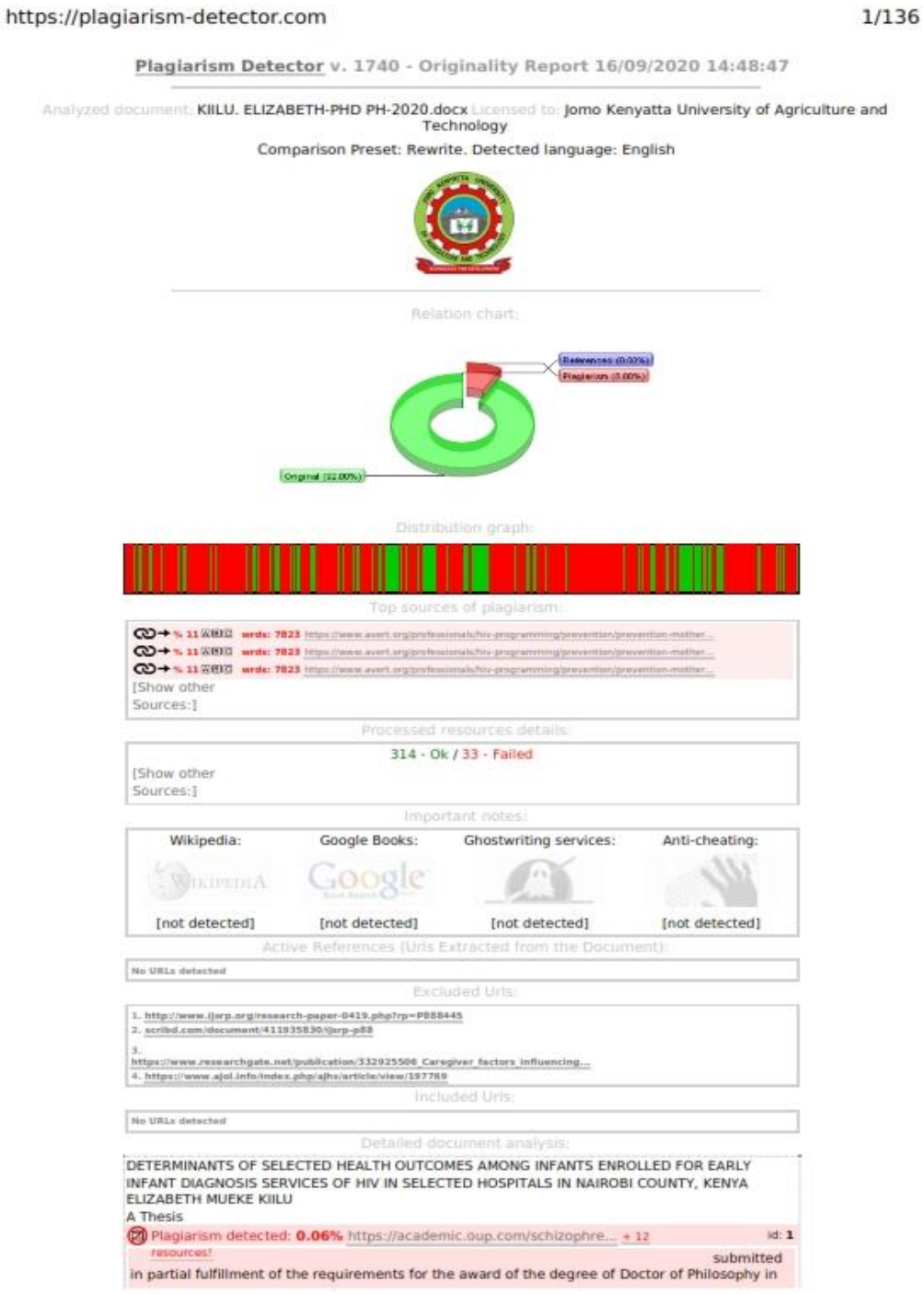
DISTRICT HEALTH ADMINISTRATIVE OFFICER

Date:.....

M.W. THUKU
FOR: SUB COUNTY MEDICAL OFFICER OF HEALTH
LANGATA SUB COUNTY

c.c. Elizabeth M. Kiilu

Appendix X: Plagiarism report



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ELIZABETH MUEKE KIILU
A Thesis
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resources!
submitted
in partial fulfillment of the requirements for the award of the degree of Doctor of Philosophy in

Public Health of the Jomo Kenyatta University of Agriculture and Technology
2020
DECLARATION
This thesis is my original work and has not been presented

for a degree in any other university or institution.
Signature
.....Date.....Elizabeth Mueke Kiilu
TM410-0442/2016 DECLARATION BY SUPERVISORS

This thesis has been submitted for examination with our approval as University

Supervisors.
Signature
.....Date.....Prof. Simon

resources!

Karanja
School of Public Health,
J
omo Kenyatta University of Science and Technology.Signature
.....Date.....Prof. Gideon Kikuvi
School of Public Health,

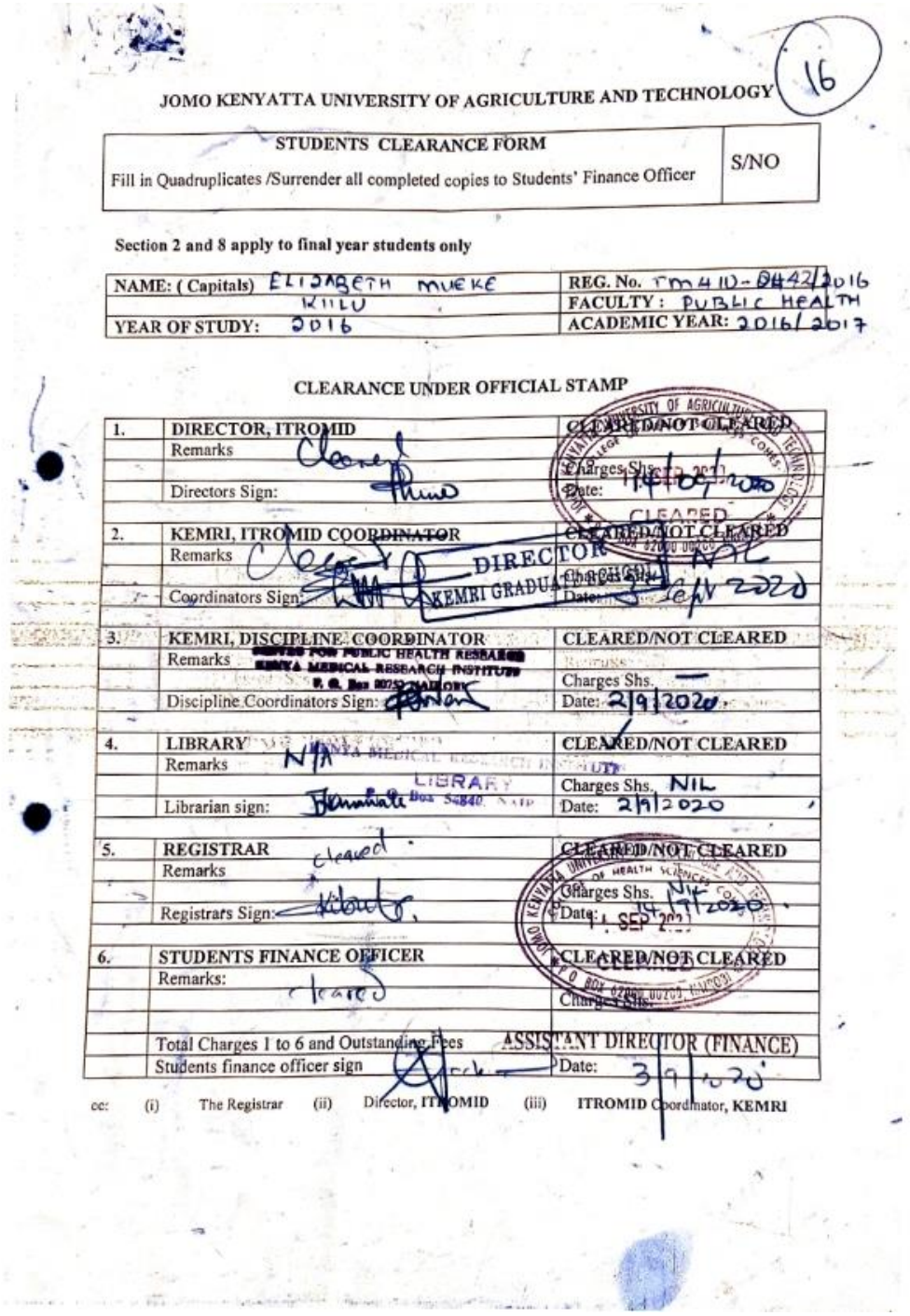
J
omo Kenyatta University of Science and Technology.Signature
.....Date.....Dr. Peter Wanzala
Center for Public Health Research,
K
enya Medical Research Institute.DEDICATION
This work is dedicated to my dear parents Mr. and Mrs. James P. Kiilu, my loving husband Paul and, my beloved son Adrian for the spiritual, moral, financial, and emotional support that you have all accorded to me during the period of my studies. ACKNOWLEDGMENT
I
wish to express my most heartfelt and sincere gratitude to the almighty God for the good health, protection, and care that He has granted unto me. To my supervisors, Prof. Karanja, Prof. Kikuvi, and Dr. Wanzala, I truly appreciate your support and patience throughout this thesis development. My sincere gratitude goes out to all the healthcare facility in-charges and the study participants for their support and cooperation, and to all those who assisted in any way during the data collection and analysis period. Special appreciation goes to Prof. Achia (CDC, KEMRI) and Samuel Mutua (JKUAT). I also wish to extend my gratitude to the National Research Fund (NRF)

resources!

and Jomo
Kenyatta University of Science and Tec

hnology (JKUAT) for funding this study. TABLE OF CONTENTS

Appendix XI: Clearance forms



JOMO KENYATTA UNIVERSITY OF AGRICULTURE AND TECHNOLOGY

16

STUDENTS CLEARANCE FORM Fill in Quadruplicates /Surrender all completed copies to Students' Finance Officer	S/NO

Section 2 and 8 apply to final year students only

NAME: (Capitals) ELIJABETH MUEKE KILU	REG. No. PM410-0442/2016
YEAR OF STUDY: 2016	FACULTY: PUBLIC HEALTH ACADEMIC YEAR: 2016/2017

CLEARANCE UNDER OFFICIAL STAMP

1.	**DIRECTOR, ITROMID** Remarks Cleared Directors Sign:	**CLEARED/NOT CLEARED** Charges Shs. NIL Date: 14/09/2020
2.	**KEMRI, ITROMID COORDINATOR** Remarks Cleared Coordinators Sign:	**CLEARED/NOT CLEARED** Charges Shs. NIL Date: 16/9/2020
3.	**KEMRI, DISCIPLINE COORDINATOR** Remarks Discipline Coordinators Sign:	**CLEARED/NOT CLEARED** Charges Shs. — Date: 2/9/2020
4.	**LIBRARY** Remarks N/A Librarian sign:	**CLEARED/NOT CLEARED** Charges Shs. NIL Date: 2/9/2020
5.	**REGISTRAR** Remarks cleared Registrars Sign:	**CLEARED/NOT CLEARED** Charges Shs. Nil Date: 14/9/2020
6.	**STUDENTS FINANCE OFFICER** Remarks: cleared Total Charges 1 to 6 and Outstanding Fees Students finance officer sign	**CLEARED/NOT CLEARED** Charges Shs. ASSISTANT DIRECTOR (FINANCE) Date: 3/9/20

cc: (i) The Registrar (ii) Director, ITROMID (iii) ITROMID Coordinator, KEMRI

POSTGRADUATE STUDENTS' CLEARANCE FORM

Fill in quadruplicate and surrender all completed copies to Board of Postgraduate Studies. Make sure that you obtain official stamp at every stage of clearance.

NAME: (Capitals) ELIJABETH MUERE KULO		REG. NO. I56/10-0442/2016
FACULTY: Public Health	YR OF ADMISSION: 2016	YR OF COMPLETION: 2020

	OBTAIN OFFICE STAMP ON CLEARANCE AT EVERY STAGE	
1.	DIRECTOR, BOARD OF POSTGRADUATE STUDIES	CLEARED/~~NOT CLEARED~~
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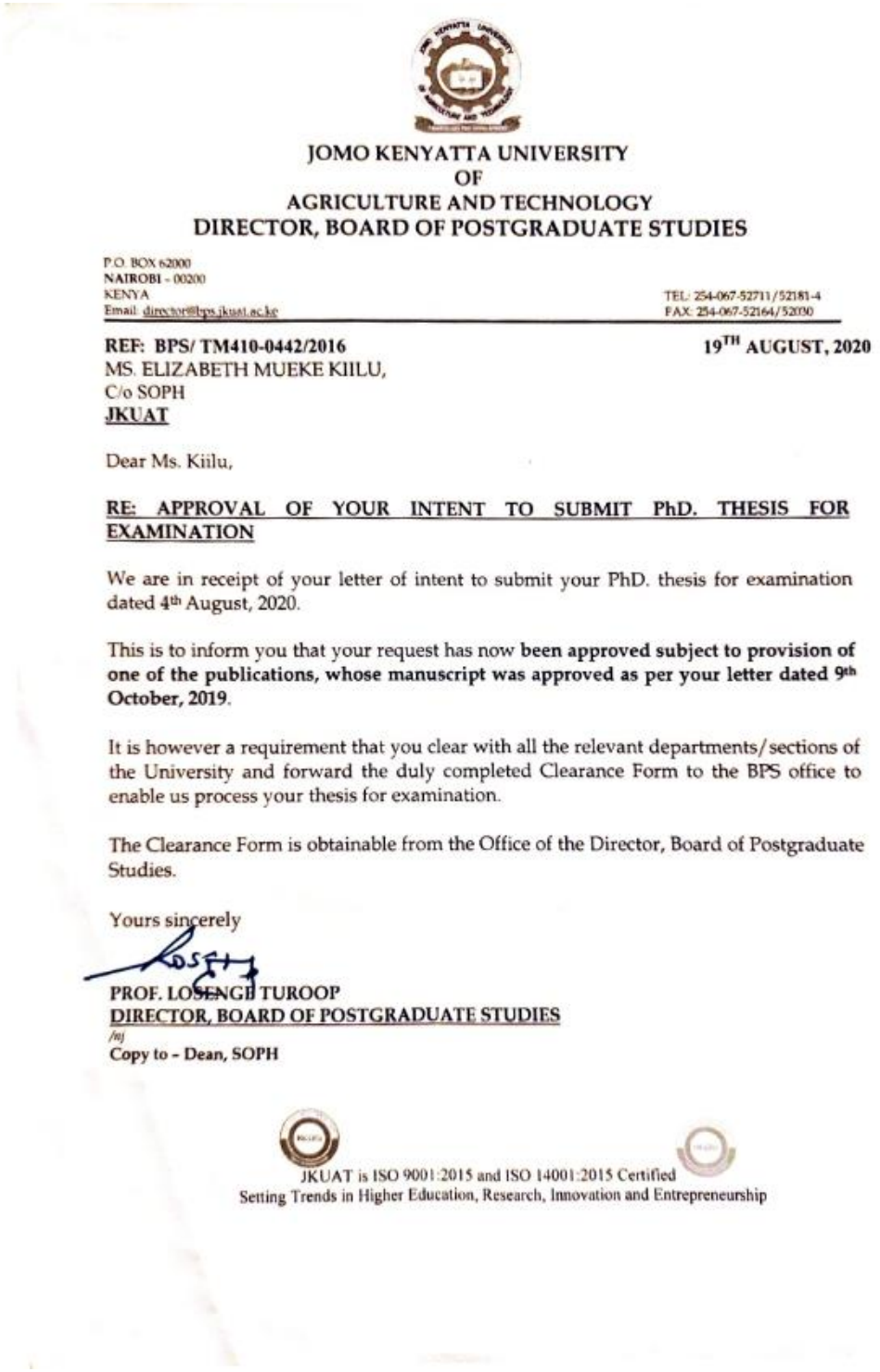
	Remarks:	Charges in Kshs.
	Total charges 2-7 and any outstanding fees	Charges in Kshs.
	Students' Finance Officer's signatare:	Date:

Copy to: (i) Dean of Faculty (ii) Chairperson of Department (iii) Student

Note: For students hosted by KEMRI, items 5 to 8 do not apply.

Appendix XII: Approval letter to submit thesis for examination



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REF: BPS/ TM410-0442/2016 **19TH AUGUST, 2020**

MS. ELIZABETH MUEKE KIILU,
C/o SOPH
JKUAT

Dear Ms. Kiilu,

RE: APPROVAL OF YOUR INTENT TO SUBMIT PhD. THESIS FOR EXAMINATION

We are in receipt of your letter of intent to submit your PhD. thesis for examination dated 4th August, 2020.

This is to inform you that your request has now **been approved subject to provision of one of the publications, whose manuscript was approved as per your letter dated 9th October, 2019**.

It is however a requirement that you clear with all the relevant departments/sections of the University and forward the duly completed Clearance Form to the BPS office to enable us process your thesis for examination.

The Clearance Form is obtainable from the Office of the Director, Board of Postgraduate Studies.

Yours sincerely

PROF. LOSENGE TUROOP
DIRECTOR, BOARD OF POSTGRADUATE STUDIES
/mj
Copy to - Dean, SOPH

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Setting Trends in Higher Education, Research, Innovation and Entrepreneurship

Appendix XIII: Publications

Caregiver factors

influencing seeking of Early Infant Diagnosis (EID) of HIV services in selected hospitals in Nairobi County, Kenya: A qualitative Study

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Abstract – Early Infant Diagnosis (EID) is the practice of testing babies for the HIV virus within the first 4–6 weeks of life or at the earliest opportunity thereafter. In order to correctly inform caregivers the HIV status of their infants, and link HIV-infected infants to care and treatment, a 'cascade' of events must successfully occur. This cascade of events involves early detection, and retention into care and treatment protocols.

The current study aimed at assessing maternal factors influencing seeking of EID of HIV services in selected hospitals in Nairobi County. More specifically, caregiver-level factors were assessed to establish maternal perceptions towards EID service delivery, knowledge, attitudes and practices. The study was conducted at Mathare North Health Center, Mbagathi District Hospital and Kibera South Health Center in Nairobi County, which serve the catchment area of Kibera, Kawangware and Mathare slums. Qualitative data was collected using Focused Group Discussions (FGDs) guide.

Six FGDs were conducted with women of different age-groups, two FGDs in each of the 3 selected facilities. Trained local facilitators were used to conduct the FGDs in Swahili. All FGDs were audio-taped, transcribed, translated and stored safely in a computer. FGDs were discussed and interpreted using the Health Belief Model (Tarkang & Zotor, 2015) and presented according to the emerging themes. The findings of the study were used to inform ways of improving infant health outcomes as they go through the EID program.

Some of the key findings of the study were that: mothers appreciated having the EID program as it ensured that their infants got ART prophylaxis. Additionally, the mothers got counselling services from the providers on how to reduce MTCT. Some of the challenges the mothers cited included; stigma and discrimination from their partners, family members and neighbors, long waiting times while seeking EID services,

difficulty in disclosure of status to their significant others and lack of funds to cater for transport costs to the healthcare facilities to attend their scheduled clinics. Gaps in knowledge were also identified from the focus groups such as lack of adequate knowledge in prophylaxis dosing for their infants and feeding methods.

Recommendations given by the mothers during the focus groups included; improved counselling for partners to reduce stigma and discrimination, provider assisted disclosure and provision of funds to cater for transport costs. We recommend that maternal education to be heightened during PMTCT and EID through rigorous educational packages for HIV positive mothers and their partners to reduce stigma and discrimination. Additionally, telephone reminders and home visits would enhance adherence improving infant health outcomes

Use of qualitative methods are a critical component to better understand why ART eligible mothers choose not to initiate their infants into the EID program on time or continue with treatment to achieve desirable infant health outcomes.

Index terms: Early Infant Diagnosis, Caregiver factors, HIV, health outcomes, qualitative.

Introduction

HIV infection continues to be a global public health concern with an estimated global prevalence of 36.7 million people living with the HIV virus at the end of 2015 (UNAIDS, 2016). In spite of being a preventable disease if effective prevention interventions are not put in place, it will continue to cause morbidity and mortality amongst populations.

In Kenya the prevalence of HIV is estimated at 6% with 1.6 million People Living With HIV/AIDS (PLWHA), of whom 179,894 are children aged 0-14 years. MTCT rates remain high

in Kenya with estimates of 14% and 10,390 HIV infant deaths in

2013 (Government of Kenya, 2014). In the absence of timely

HIV testing and timely ART initiation, one third of infants living with HIV die before their first birthday, and more than half die before the age of 2 years. Thus, EID is a key driver for the implementation of early initiation of infant ART and is associated with lower mortality and morbidity of HIV infected/exposed infants (Tejiokem, et al., 2011).

Prevention strategies that are effective in reducing disease burden among infants include PMTCT (Prevention of Mother to Child Transmission) and EID (Early Infant Diagnosis). An estimated 430,000 new HIV infections occurred in children of which 90% were as a result of Mother To Child Transmission (MTCT) of HIV and 90% of these children were found in Africa (WHO, 2013).

The EID cascade includes the offer and acceptance of EID testing among HIV-exposed infants, including those for whom HIV exposure was unknown, accurate specimen collection, transport, and laboratory processing, relay of results to both healthcare providers and infants' families/caregivers and linkage to care, cotrimoxazole prophylaxis, and ART for infants identified as HIV infected (NASCOP, 2014).

Without any interventions, between 15 % and 45 % of infants born to these women will acquire HIV with 5–10 % during pregnancy, 10–20 % during labor and delivery, and 5–20 % through breastfeeding of their infants (De Cock, et al., 2000). Encouraging progress has been made in scaling up and improving the quality of programs. In 2012, approximately

900,000 pregnant women living with HIV in low and middle income countries received ARVs to prevent MTCT. ART primarily for their own health or the most efficacious antiretroviral prophylaxis (UNAIDS, 2013). This represents one third more than the number who received it in 2009.

Care-givers are at the center of the EID program since the infants are totally dependent on the care-giver for the attendance and completion of the EID cascade. HIV positive women face a number of challenges that affect their health and ultimately the health of their infants. Health systems need to respond well to the needs of women to ensure comprehensive service delivery that caters for their different requirements (Vancouver/Richmond Health Board, 2001). Some of the barriers that were identified that led to poor uptake and retention of infants in the EID program as reported by the care-givers included; stigma and discrimination i.e. In a study conducted by Boender, et al (2012), a care-giver reported that she had not disclosed to her mother about her HIV status since she feared that her mother would disclose her status to everyone and she would end up being stigmatized and discriminated;

"I never got married and feared to tell my mother. She is harsh and will tell everybody to stigmatize me. Nobody knows about

my and my daughter's HIV status. They discriminate you,

even at work".

Onono et al, (2015) also demonstrated that stigma and discrimination played a big role in determining whether the caregivers would bring their infants to the EID program. Most mothers in this study experienced at least an episode of stigma or discrimination due to their HIV status and they hence reported that it was a great barrier to seeking services.

Partner disclosure was also reported as a barrier to the completion of EID cascade of care i.e. Males in the African community are still visualized to be the key decision makers in the households and therefore male involvement has been seen to improve ANC (Antenatal Clinic) which increases PMTCT uptake and is associated with reduced MTCT and infant mortality (Boender, et al, 2012). Other caregiver level barriers that were identified and deemed to undermine the EID program included; knowledge of PMTCT, maternal adherence to ART, food insecurity, cultural factors, lack of accurate health information and social support and overcrowded health systems that caused long waiting times (Murrey et al., 2009).

Methods

A qualitative study was conducted in three facilities: Mbagathi District Hospital, Mathare

North Health Center and Kibera South Health Center in October 2018. The study was undertaken using a semi-structured Focused Group Discussion (FGD) Guide. For analysis, the authors were interested in HIV positive women who had infants less than one year old enrolled into the EID program, so as to get a description of the women's perceived susceptibility, severity, benefits, barriers and cues to action towards the EID program of HIV. Hence, the data included in this paper were only from Focus Group Discussions that were conducted in the three selected facilities. The findings of this study will be used to inform policy on the key things that affect caregivers as they seek EID services and increase women's knowledge on how to reduce HIV transmission to their infants, this will also encourage increased access to EID services.

The first author trained three women in FGD facilitation, so that they could assist in conducting the FGDs, which were conducted by the first author and the trained women. The three women were selected because of their roles as facility mentor mothers and their influence in the community of the selected study areas. During the training, we reviewed written informed consent in both Swahili and English, went through the research ethics and practiced note taking. We also practiced facilitation of the FGD with the use of a tape-recorder to ensure that the three women were well prepared to assist in undertaking the FGD.

We conducted a pre-test of the FGD in Kibera Health center for practice of facilitation with the trained women. The focus groups in the three facilities were divided into two sessions, session one was for women below 18 years to 24 years and mothers between

25 years to 49 years. The inclusion criteria for the younger women was that they were able to give consent, and those less

than 18 years had next of kin to give consent after the accent was

obtained from the mother. The other inclusion criteria that applied across to all the women was that they all attended their CCC clinic in the selected hospitals.

The exclusion criteria was mothers who were "on transit" in the selected hospitals and mothers who were not caregivers to the infants. Other demographic data were not collected for the purpose of the FGD.

The participants were selected by the facility mentor mothers within the selected hospitals. All the participants were read an informed consent in both English and Swahili, depending on their preference, and written informed consent was obtained from all the participants. If a participant could not read or write, the consent form was read to her and an X on her form marked her consent, along with a signature of a witness. All focus groups had 4-6 participants each. Participants were given a snack after their participation and reimbursed transport costs as well. Ethical approval was sought from Kenya Medical Research Institute (KEMRI) Scientific Ethics Review Unit (SERU). Clearance to carry out the study was given by Board of Postgraduate Studies (BPS) of Jomo Kenyatta University of Agriculture, Science and technology (JKUAT). Permission also sought from Nairobi City

Council and the Medical Superintendent of the facilities where the study was undertaken.

The FGD guides covered the following areas: Exploring maternal knowledge and understanding of; services that will be offered to her and her infant during the EID program, feeding practices, Infant ART and prophylaxis, reduction of MTCT, Attitudes towards the EID program, Perceived benefits of the EID program, Perceived Challenges of the EID program and finally, ways to improve EID services offered to the mother infant pair so as to meet their various needs and expectations. The focus groups were translated to Swahili and focus group participants were given a choice of whether to participate in English or Swahili. All focus groups were recorded and transcribed, note taking was also done concurrently. The first author listened to all the recordings and read all focus group transcripts and transcribed them according to the emerging themes.

The Health Belief Model by Tarkang & Zotor (2015) was used to cluster the mothers' responses thematically. The model is outlined in the table shown below;

Table 1: Health Belief Model by Tarkang & Zotor (2015)

Concept	Definition	Application
Perceived susceptibility	Mothers' opinion on chances of getting a condition or passing on the condition to the	Perceived heightened risk or low perceived risk of HIV transmission to the infant,
Perceived severity	Mothers' opinion of how serious a condition and	Perceived consequences to
Perceived benefits	Mothers' belief in the efficacy of the advised	Perceived positive effects or benefits to be expected
Perceived barriers	The mothers' opinion of the tangible and	Identify and reduce barriers through reassurance, incentives and assistance
Cues to Action	Strategies to activate readiness	Perceived solutions to the challenges that the mothers felt were affecting them and possible ways that could
Self-Efficacy	Confidence in one's ability to take action	Provide training, guidance in performing action.

The other authors read the transcribed content and gave their input. All focus group participants were asked the same questions, and emerging themes noted. The representative of what was said about the particular theme, unless otherwise noted.

The unit of analysis was the focus group. The frequencies of the emerging themes were entered and noted in an excel spreadsheets.

Results

Perceived susceptibility

All mothers were aware that their infants were at a risk of HIV infection due to the HIV positive status. Some of the respondents reported as follows;

P1: "If I have cracked nipples I will not breastfeed my child because the baby might get infected if he suckles from my cracked nipple"

P2: "Taking my ARVs well is important so that I can keep the amount of virus in my body low, so as to not pass the HIV virus to my infant".

(FGD1)

The mothers were all very determined to ensure that they do not pass the virus to their infants and were willing to do what it takes to ensure that they have healthy HIV free infants, P4: "I will do wherever the healthcare providers tell me to do so that I do not pass on the virus to my infant".

(FGD5)

Perceived severity

All the mothers were aware of the severity of their illness the consequence of the disease to themselves, their infants and their partners as well. None of the mothers wanted their infants or HIV negative partner to acquire the disease due to the burden associate with living with HIV. Some of their sentiments were as follows;

P1: "HIV is not an easy disease to live with because you have to take ARVs every day to keep you alive"

P2: "If I don't take my ARVs well, my viral load will become high and I risk passing on the virus to my infant when he is breastfeeding"

(FGD2)

P1: "My partner and is HIV negative, so we have to use condoms so that I don't pass on the virus to him. Sometimes he however refuses to wear a condom, I become very worried when this happen because I don't want him to become sick too, if we both die, who will take care of our children?"

(FGD3)

Perceived benefits

Benefits to the mother

Some of mothers indicated that some of the many benefits that they got from attending the EID program was that they able to easily and

quickly access ART and prophylaxis for their infants, and that they were encouraged by the healthcare providers to stick to the EID program even though they did not want to keep the pregnancies

P3: "I had lost all hope as I did not even want this pregnancy in the first place, but the providers gave me a lot of hope and encouraged me, I was able to continue with the EID program well thereafter".

P4: "I had even stopped taking my ARVs but when I started this program, the health workers gave me courage and hope to restart my ARVS, now am well with my infant".

The mothers were also walked through the EID journey by the health workers through constant encouragement and follow up to ensure that they adhered to the treatment program.

(FGD6)

Mothers also reported on benefitting from education about appropriate feeding practices to avoid passing the HIV infection to their infants.

P2: "We are given education on giving prophylaxis, appropriate feeding practices and PMTCT infections".

Another mother reported that meeting other HIV infected women during the EID process in the clinic gave her an opportunity to share her experience with the other mothers and in so doing, encourage each other.

P3: "When we come to the clinic we meet other HIV positive mothers and we encourage each other, we give each other hope and the mentor mothers also encourage us"

(FGD3)

All mothers reported that at the very least, they were able to get their ART and education about PMTCT.

Benefits to the infant

The mothers reported to have gained knowledge on appropriate feeding practices for their infants to avoid spreading of the virus especially during the breastfeeding period. One of the mothers reported that she had actually seen a great difference between the other children that she had given birth to and not enrolled into the EID program, and the current baby that is enrolled into the EID program.

P1: "My other babies were always sick with either diarrhea or influenza, but this baby has never been sick since we started this clinic because we are given good education on raising the baby well, and close baby monitoring has also helped".

P2: "We are taught on good infant feeding practices by the healthcare providers" reported another mother.

(FGD4)

P3: "I did not have a lot of milk and I almost wanted to do mixed feeding a few weeks after delivery, this is because my baby was crying a lot and my relatives and friends were pressurizing me to give the baby food but I refused. The healthcare providers encouraged me to keep breastfeeding to increase milk supply".

(FGD1)

Pressure to mix feed infants from relatives is usually a big barrier towards the achievement of excusive breastfeeding for 6 months, more so for out HIV exposed infants who stand a risk of getting infected with HIV if appropriate feeding practices are not enforced.

Perceived barriers

The mothers had a number of challenges that were affecting them and their infants. The researcher identified the key emerging challenges as reported by the mothers. One of the greatest challenges that the mothers were facing was cost of transport to attend their scheduled infant and mother clinics.

P3: "Sometimes getting bus fare is a big challenge, I am forced to borrow 100 KsH from friends so as to be able to attend my scheduled clinics"

(FGD2)

On average the mothers reported that 200 Ksh is what they would need to cater for transport associated costs. The mothers reported that they would keep borrowing since they cannot ask the healthcare facility to provide for them transport. This is because they would only be advised to transfer to the nearest healthcare facility, which was not an option for them due to fear of stigma and discrimination.

The facilitator probed the mothers further and asked them if there was a healthcare facility that offered EID services near where they lived so that they do not have to incur transport charges. Majority of the mothers reported there were nearby healthcare facilities that offered EID services but that was not an option for them due to fear of stigma and discrimination from the community.

P3: "Transport money to the facility is a big challenge and when we discuss this with the healthcare providers they advise us to go to the nearest facility to reduce transport costs. This is not an option for me because in the nearby facility my neighbors might see me going to CCC and the services are better here anyway"

(FGD3)

Stigma and discrimination was also cited as a great concern by most of the mothers in the FGD. Stigma was originating from various sources such as the mothers partners, neighbors and other relatives. It was seen as a major barrier to adherence and accessing EID services, since it hindered some mothers from attending their scheduled clinics. All the mothers reported to have at least one or more incidents of stigma and discrimination

P4: "My partner is HIV negative and is aware of my positive HIV status, he agreed to marry me despite him knowing my status. He sometimes stigmatizes me by blaming me for my HIV status which really hurts me. He accuses me of being unfaithful to him especially when I am coming for my CCC appointments."

In response to this statement one of the mothers advised the other mothers that the only way to earn respect from their spouses and reduce stigma and discrimination is to be economically empowered.

P5: "I want to encourage women to look for ways to generate income and be self-sustaining this way your husband will respect you and you will not have to keep borrowing money every time you want to attend your clinic" (FGD4)

Some partners did not support the mothers financially especially to come for their appointments.

P3: "My husband will not give me a coin to come for my appointments despite the fact that I am unemployed. I am forced to save from the little money he leaves for food. Sometimes I call the healthcare providers in EID in advance and tell them that they will have to give me transport back home since I only have money for one way trip. They usually help but you cannot borrow each time"

P2: "Some neighbors know my HIV status so whenever I leave the house they start gossiping me, one neighbor even insulted me pertaining my status and I felt very bad because I did not ask for this disease".

(FGD5)

Another mother also had fear of stigma and discrimination from the neighbors due to the close proximity of the houses which were semi-permanent and had very little privacy.

P1: "Our houses are connected wall to wall so whenever I want to swallow my drugs, I cover myself with blankets to reduce the noise the medicines make in the tins so that they don't know that I am taking medicine"

On the same breath, another mother conveyed the same concerns;

P2: "Those ARV containers make a lot of noise, so whenever I come to pick the medicine I must roll them in a sweater to reduce the noise made by the tablets in the plastic containers and put the medicine in at least 3 bags to reduce the noise they make so that when I am walking people will not hear that I am carrying ARVs in my bag"

(FGD4)

Another mother reported how stigma and discrimination had affected her life and adherence to ART

P4: "I was really discriminated and stigmatized by my nuclear family when I disclosed my HIV status to them. I defaulted on

my treatment for a long time and this caused treatment failure on first line, am now on second line treatment and very keen to take my drugs not to have treatment failure again"

(FGD1)

Another challenge reported by the mothers was that sometimes getting food or at least one meal that is balanced was a problem. Adequate nutrition is a key factor in the management of HIV clients. It is important for the mothers to have an adequate and balance diet so that this can boost their immune system, as well as ensure sufficient nourishment for their children from breast milk.

P1:"My husband ensures that the baby food is available but doesn't bother to ensure that I get a balanced meal. Sometimes the money left behind is too little so I buy food for my infant and sacrifice myself."

Another mother reported that she doesn't care much about her own food as long as her baby gets food. She went further to explain that lack of adequate food sometimes made her not adhere to her drugs due to the effects of taking the ARVs on an empty stomach.

P2:"My husband gives me very little money for food so I mostly buy for my baby food and eat whatever else is available". "I sometimes don't get enough food for myself and my child. I can sometimes only take porridge only the whole day. This is usually very bad because the night ARVs give you a lot of dizziness if you take them on an empty stomach"

(FGD2)

Disclosure of HIV status was another big challenge to majority of the mothers. Mothers feared the consequences of disclosing their status to their spouses or other close relatives and friends. Disclosure is a great barrier to drug and clinic adherence both to the mother and the infant. Provider assisted disclosure improves adherence

P2: "I am married as a second wife, my husband's other wife and I have never met. I have not disclosed my status to my husband, and he does not know my status either. I find it difficult to disclose to him my status, with time I will. He gives me very little financial support and at times I go hungry with my other children"

P3: "I do not visit my rural home because I have not disclosed my status to anyone and I will not be able to explain why I am taking medicine every night and why child is also taking medicine every day. I don't want them to stigmatize me".

P4: "Long ago when I used to visit my rural home, since I have not disclosed my status to anyone, I used to remove my tablets from the medicine bottle and but in a paper and hide under my mattress, my viral load went very high and I had to disclose to the healthcare workers that I was removing my medicine from the dispensing bottle. I was discouraged from doing this, now I don't go to my rural home anymore"

(FGD4)

P1: "I have not disclosed my status to anyone else other than my husband, I would like help in disclosing to my sister as well, she is very sensitive and might get blood pressure and we are very close"

P2: "I disclosed my status to my nuclear family members and they were very supportive, they even remind me to take my medicine"

P3: "I am a student in college and I sometimes delay to take my medicine because I get delayed in school. I have not disclosed my status to any person in school so I cannot carry my medicine to school"

(FGD2)

Partner support was yet another challenge that affected majority of the mothers which

ultimately undermined care and treatment efforts for both mother and child.

P1: “My partner is HIV positive and he says that he was infected by someone and has vowed to keep spreading the disease. I am aware he has multiple partners and he refuses to use a condom. I have to pick for him his ARVS and remind him to take the medicine otherwise he will not take the medicine.”

P2: “My husband had refused to take medicine and attend his CCC clinics, I had to come to pick the medicine for him and even then, sometimes he would refuse to take the medicine. One day he just changed and stated taking his medicine and attending clinics.”

P3: “My husband knew his HIV status after I disclosed to him my HIV status. He refused to go for testing until he was very sick and admitted to hospital and tested positive then and started on ARVs. He defaulted on his medication for a while and would only take medicine if I went and picked them for him. He also refused to use condoms. My problem is that my husband has turned me into his drug mule, he can never come for his medication or come for clinics, if I don’t pick his medication for him, he will not take his medicine. I have talked to the healthcare providers and they advised me to bring his card and telephone number then they will talk to him”

P4: “My husband will only take medicine if I bring them myself, he refuses to come for his own medicine, I have no problem picking the drugs for him as long as he swallows them”

(FGD4)

Of great concern was that some partners had behaviors that could increase the mother’s viral load and put her infant at risk as well. For instance one mother reported that;

P3: “Since I told my husband my HIV status he has been very supportive, he even calls from work to remind me to take medicine, he also gives me money to come to hospitals for my appointments. The only challenge is that my partner has refused

to come for testing, the mentor mothers who support us in the treatment program have attempted to call him on several occasions to come to the hospital, but he has never agreed to come. I don’t know his HIV status and he doesn’t take ARVs”.

P4: “My husband’s medicine was changed to the new type of ARVs, since then my husband has refused to take these medicines and instead takes mine which are the same as the ones he used to take”

(FGD2)

Another partner behavior that increased the risk to the mother and infant as reported by some of the mothers was refusal to use condoms during coitus.

P5: “My partner has completely refused to use condoms, every time I pick them they expire in the house. He says he will not use condoms with his wife since he is not having sex with any other person outside their union. If I insist that we will not have sex, he says that he will go and seek sex elsewhere”

P6: “I knew my HIV status with this current pregnancy, with the other pregnancies I was HIV negative. When I disclosed my status to my husband he was very cross with me and he said not to bring up the topic again. We do not use condoms because he refuses, I am aware that he is adding me his virus but there is nothing I can do about it, he gets very angry when I speak about my HIV status”

(FGD4)

Long waiting times as the mother-infant pair sought for services was yet another challenge reported by the mothers. Long waiting times reduce adherence to scheduled CCC and EID clinics.

P1: “The healthcare workers take very long health breaks delaying our treatment and increase waiting times. So I don’t come early, I finish my work first in the house then come at noon so that I don’t stay for too long in the hospital”

P2: “Often the consultation room services begin very late, some doctors come in late in the morning which makes us stay in the hospital for very long. I wish the services

would start on time so that we can be attended to quickly and so that we can go back to our other issues at home"

(FGD6)

P4: "The delays in the general CCC could be a contributory factor to our men refusing to come for their own drugs. My husband initially used to come to pick his own drugs, but the long waiting time in the general CCC made him to stop coming for the drugs because he said that he is wasting too much time in the CCC and this could make him get fired from his workplace. I don't mind getting him the drugs, because at least he is agreeing to swallow the drugs"

(FGD3)

Most of the mothers also reported that they experienced some side effects due to swallowing the ARVs such as dizziness, abdominal discomfort, diarrhea, nausea and vomiting when they were first put on ARVs. However they also reported that the symptoms disappeared after some time. These side effects did not stop them from continuing their treatment all the same

P1: "Initially the ARV drugs gave me a lot of dizziness and with time the effects disappeared"

(FGD5)

All the mothers reported that that they had not experienced ARVs stock outs but had to buy medication for cor-morbidites and other opportunistic infections as these drugs were often out of stock.

P2: "There has never been a stock out of ART, however if you have co-morbidities you will not get any medication, you have to purchase in the chemist"

(FGD6)

None of the mothers reported challenges in prophylaxis administration to their infants.

Cues to Action

Cues to action were the perceived solutions to the challenges that the mothers felt were affecting them and possible ways that could improve their experience as the mother-infant pair go through the EID program. The cues to action were reported as perceived by the mothers as follows.

1. Reduction of waiting times in the consultation rooms and in the laboratory;

"Patients should be seen in the order they have come and not skipping other patients."

"Start clinics on time so that mothers can leave on time as well"

"There are too many processes before one is seen and you can enter up to 5 rooms a day before you are done with the final process the services should all be offered under the same room"

"Separating drug dispensing points for HIV patients and the general population to reduce waiting times"

2. To ease the cost of transport;

"If we can be given a little money to come for clinic appointments, this would go a long way in ensuring that we do not miss our scheduled appointments due to lack of bus fare"

"Giving long appointment dates such as three months or six months can reduce the cost of coming to the hospital by reducing the number of hospital visits"

3. To improve partner support;

"Invite our partners to come for counselling in order to understand more so our negative partners, this will reduce stigma and discrimination"

4. To improve adherence;

Economic empowerment so that the mothers can be independent and not rely so much on their spouses, relatives and friends "If you hear of any casual work kindly let me know so that I can generate my own money"

"Telephone reminders two or three days before the appointment days would go a long way in ensuring we keep our scheduled appointments"

Self-Efficacy

All mothers were aware of how to take their ARVs and were confident that they would not pass on the virus to their infants if they adhered to the education and instructions given to them by the healthcare providers. Some mothers however felt that in addition to the routine hospital education they received, additional take away materials to read at home would increase their awareness on PMTCT.

In addition to use of the Health Belief Model by Tarkang & Zotor (2015) maternal Knowledge, knowledge gaps, Attitudes and Practices (KAPs) were also explored. The findings were as indicated below:

1) Exploring knowledge on how to reduce Mother To Child

Transmission (MTCT)

All mothers knew at least one way of preventing MTC infections during the antenatal, delivery and breastfeeding periods

Prevention during pregnancy/antenatal clinic

Mothers reported the following ways of reducing chances of infection to their unborn infants: maternal ART adherence, infant prophylaxis, condom use, starting ANC early enough by 3 months. One of the mothers reported that:

P1: "In early pregnancy I was vomiting a lot and by the time my pregnancy was 7 months, I had a very high viral load. The doctors told me that it was because I was vomiting my ARVs, something that could have been prevented. I however was put on good medicine and my viral load went down"

(FGD3)

All mothers reported that they were given prophylaxis drugs for infant before birth and given instructions on how to take the drugs. Some mothers however reported that they did not know why they were giving the prophylaxis especially the septrin:

P3: "I was given 3 types of drugs which I cannot recall the names while I was pregnant, and instructed on how to give the baby, I however was not told why I was giving my baby these drugs."

P4: Another mother reported that "septrin is given to my baby to prevent HIV infection just like Nevirapine and another ARV drug that I cannot recall the name"

(FGD2)

From the above sentiments it was clear that some mothers did not know the use of the medication given to them during pregnancy. They all however reported to administer the medicines given to them to their infants immediately after birth.

Prevention during delivery

All mothers' reported to have been given prophylaxis for their infants immediately after birth, and all were hospital deliveries. The mothers reported as follows;

P1: "I was given prophylaxis for my infant during pregnancy, after delivery I not sure of how to give the medicine so my husband explained to me that I should give the baby the medicine first before breastfeeding"

(FGD1)

P4: "When I was admitted in labor, I called the nurse and told her that I was HIV positive and that I had carried my infant prophylaxis drugs with me. The nurse was very happy and assured me that immediately after birth my baby would be weighed and given the drugs".

(FGD2)

P5:"I need to ensure I deliver in the hospital for safe delivery of my infant"

(FGD5)

"I ensure that I take my ARVs very well to reduce chances of infection to my baby and

also give my baby prophylaxis on time every day"

(FGD4)

From the above sentiments, mothers were well knowledgeable on how to ensure they do not transmit the virus to their infants during the delivery period. They all reported to have gained this knowledge primarily from the healthcare facilities during the antenatal care clinic visits.

Prevention after delivery and during breastfeeding period

Some of the ways that mothers thought could reduce transmission of HIV during the breastfeeding period included;

P5: "One should avoid rubbing children gums with traditional medicine to relieve teething pain as this could pass on the virus if the baby has bleeding gums"

P6: "To prevent infection to my baby during breastfeeding, I check to ensure I have no wounds in my breast, and seek medical attention if I see breast wounds"

(FGD4)

All mothers also knew the various ways of reducing HIV transmission to their infants during the breast feeding period. On further probing by the facilitator, all the mothers also knew that maternal ART adherence reduced their viral load reducing transmission during the breast feeding period.

2) Exploring Knowledge on infant prophylaxis, (drug type, dosing, side effects and benefits)

Most of the mothers knew the infant prophylaxis types and benefits of the drugs however there was a knowledge gap on drug dosing and drug side effects as reported by some mothers:

P1: "I only know that I give my baby septrin, I don't know the names of the ARV Prophylaxis I am giving my infant"

P2: "I can't remember the names of the drugs that I give to my infant, but I know the dosing since I am given instructions for use in the hospital"

(FGD2)

One thing of great concern was that Majority of the mothers did not know the correct dosing for the infant prophylaxis and were not aware of when they should stop the drugs

P4: "I do not know when I should stop the drugs for my infant but I will continue to give my baby prophylaxis drugs until the healthcare worker tells me to stop"

(FGD5)

It is imperative for the mothers to be able to recognize drug side effects and dosing to avoid adverse drug reactions to the infant.

3) Knowledge on maternal ART (drug type, dosing, side effects and benefits)

Only one mother knew the ARV types she was taking. All the other mothers did not know the names or the potential side effects of the ARVs they were taking. They however were aware of the dosing schedule. All mothers were aware of septrin and dosage of the same.

"I don't know the type of drugs I take nor the side effects but I am aware of my dosing schedule which is one tab in the morning and one tab in the evening"

"I can't remember the names of my ARVs, I only remember septrin as one of the drugs that I take"

(FGD3)

4) Knowledge on feeding practices

All mothers practiced exclusive breast feeding up to six months and introduced other foods at 6 months. A few mothers however had no knowledge on when they should stop breastfeeding.

"I practiced exclusive breastfeeding for 6 months and introduced other feeds at 6 months,

I however don't know for how long I should continue breast feeding my infant perhaps you could tell me"

(FGD6)

5) Exploring maternal attitude towards the EID Service delivery

All mothers were willing to bring their infants for the 18 months period EID program irrespective of the infant HIV status. There were no reported cultural barriers hindering the mothers from bringing their infants for care.

The mothers reported that the services offered to them were generally good other than long waiting hours to see the clinicians. They also reported good interpersonal relationships with the healthcare providers:

P1: "I am happy with the services and attitudes of the health workers in the EID program. I wish we could be retained here and not discharged back to the main CCC clinic after the 18 months"

(FGD3)

All the mothers expressed dissatisfaction with services offered in the general CCC because of long waiting times: P3: "In the general CCC you have to wake up at 5am so that at least by 12 pm you have been discharged"

(FGD1)

However the mothers expressed dissatisfaction with lab services offered to them. They reported that they had to queue for long periods of time to get their blood drawn for viral load counts and PCR testing for their infants. This made their infants to become distressed and delayed them from going back to their duties back at home. They also reported delays in the receipt of their infants PCR results as well as their viral load counts. The mothers' reports were as follows:

P5: "You have to wait in the queue like any other patient and it takes a very long time"

(FGD3)

The mothers requested to have alternative lab/testing area for their infants and themselves as well as their infants. P4: "We request to have our own lab/bleeding area specifically for HIV exposed infants, this would reduce on waiting times"

(FGD3)

Long Turn-around time from collection of the sample to receipt of the same to the caregiver was also reported as a challenge by the mothers. Most mothers reported an average waiting time of two to three months:

P1: "I received my 6 weeks PCR results when my baby was four and a half months. They say that the results take some time these days"

P3: "I waited for about two months and decided to enquire about my baby's results during one of my normal hospital visits."

(FGD6)

There were also reports that the lab results would get misplaced and you would be required to repeat the test:

"Sometimes the results get misplaced and you are force to repeat the test"

(FGD4)

However, mothers in one of the facilities reported that they were removed lab samples in the service delivery rooms and did not have to go and queue in the lab for sample removal. In the same facility, mothers got their infants PCR results in the next visit which was scheduled between one or two months.

All the mothers were very satisfied with the counselling services offered to them as reported below:

P4: "Counselling is done very well such that even if you had decided not to take medicine, you will be counselled to start"

P5: "I had defaulted on my PMTCT visit and the mentor mothers looked for me in my house and restarted me on ART. My

husband and I had separated and the counsellors looked for him and reconciled us."

(FGD3).

Discussion

The success of the EID program is pegged on ensuring that the caregivers understand the benefits of timely initiation of their infants into care. High maternal knowledge was attributed to improved EID attendance, in a study conducted by Makau, Okwara, & Oyore (2015), this also lead to improved health seeking behavior in the mothers and good infant health outcomes. A study by Adeniyi et al., (2015) demonstrated that nearly all the study participants were not aware of how soon or the right time for ARVs to be initiated to their infant with HIV infection. This could lead to delay in initiation into care with consequent poor infant outcomes.

Stigma and discrimination also undermine the efforts of PMTCT strategies, Adeniyi et al., (2015) point out that Stigma resulting from their own disclosure to others reduced their likelihood of recommending other members of their community into the EID program. Similarly, a study by Hassan et al., (2011) cited that lack of appropriate social support structures to facilitate disclosure and handle possible stigma and discrimination. One of the caregivers stated the following concerning disclosure: "…you might tell one who ends up taking you to the chief… you might be jailed and asked to pay a lot of money; you cannot tell anyone about this illness, people are taken to court… you cannot tell anyone, it is your secret". Inappropriate social support structures for disclosure were seen to be a contributing factor to general drop-out of caregivers from the EID program.

A study with similar findings by Hlarlaithe, et al., (2014) demonstrated that non-disclosure to partners and other persons in the caregivers lives had many different complex dimensions where the fear of disclosure was very real and put the mother and infants life at great risk especially due to poor adherence.

Makau, Okwara, & Oyore (2015), study demonstrated that mothers stated the following factors that negatively influenced EID uptake; inaccessibility of health services due to long distances to the hospitals, long waiting times at the service delivery points and lack of transport to attend their scheduled clinic.

Although no direct costs were incurred by the caregivers while seeking EID services, indirect costs were mentioned by the caregivers in our study such as cost of transport as they come for EID services and cost of buying non-ART drugs for opportunistic infections.

These findings were similar to those of Hassan et al., (2011) where the authors stated that caregivers complained of cost implications of travel to the healthcare facilities and long waiting times to get services. The caregivers recommended longer appointment schedules to reduce the number of hospital visits. Transport costs was also cited as a perceived barrier by Hlarlaithe et al., (2014), where caregivers pointed out that it was a great barrier to accessing services to them. These authors also found out that stigma and discrimination, lack of or inadequate male partner support and the influence of men and other women living in the household of the caregiver influence her ability to seek EID healthcare services or not. These factors therefore needed to be explored further to assess the impact they had on maternal health seeking behavior as they go through EID.

Our study had limitations found in most qualitative studies where findings of the research were not tested to discover whether the findings were statistically significant or due to chance. Further, no attempt was made to assign frequencies to the linguistic features which were identified in the data. Despite these limitations, the study was able to learn from the participants the EID process the *way* the mothers experience it, their perceptions and interpretation of EID concepts in real time. Central themes were able to be identified and emerging issues documented for future action and recommendations.

Conclusion

Despite the good knowledge of mothers about infant HIV infection and the availability of treatment, inadequate knowledge on appropriate feeding practices, ART therapy and prophylaxis for both mother and child undermine PTMCT efforts. Additionally, stigma and discrimination as well

as fear of disclosure reduce adherence to care and treatment. These challenges need to be addressed through urgently through community education, partner counselling and assisted disclosure as part of the PMTCT package in our country so as to improve adherence and ultimately improve infant health outcomes.

Competing interests

The authors declare no competing interests.

Authors' contributions

Elizabeth Mueke Kiilu development of the concept and manuscript, Simon Karanja and Gideon Kikuvi critically reviewing of the document from its conception, up to manuscript submission and the final approval. All authors read and agreed to the final version of this manuscript and equally contributed to its contents and to the management of the case.

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.Determinants of HIV positive status at first PCR test among infants seeking Early Infant Diagnosis (EID) services in selected hospitals in Nairobi County, Kenya

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Summary

Introduction

Globally, Mother To Child Transmission (MTCT) rates accounted for 8.9% of all HIV infections by the end of 2015, with Sub-Saharan Africa accounting for 12% of these infections. In Kenya, MTCT rates were 14% (2015), accounting for 7% of all new infant infections globally by the end of 2015. Early Infant Diagnosis (EID) is the practice of testing infants for HIV within the first 4–6 weeks of life or at the earliest opportunity thereafter to promptly link HIV-infected infants to care and treatment. In the absence of timely HIV testing and Antiretroviral Therapy (ART) initiation, one-third of infants living with HIV die before their first birthday, and more than half die before 2 years. The objective of this study was to establish the determinants of HIV positive status at first PCR test among infants seeking EID services in the selected hospitals in Nairobi County, Kenya.

Materials and Methods

A longitudinal cohort study employing a mixed-method approach was used. Quantitative data were collected from 163 mother-infant pairs using interviewer administered, pre-tested, semi-structured questionnaires while qualitative data was collected using a Focus Group Discussions (FGDs) guides. Data was coded, cleaned and analyzed using STATA Version 14. Quantitative data was analyzed using Fisher's

exact test (p=0.05) and Poisson Regression (p= 0.05) at bivariate and multivariable levels respectively and, thematic analysis undertaken for qualitative data.

Results

The findings from the adjusted parsimonious model revealed that that three variables most influenced the infant HIV status at first PCR test. The study participants who had been administered with ART during pregnancy had a lower risk (RR= 0.06) of getting HIV positive infants relative to those who hadn't received ARVs during pregnancy (95% CI 0.014, 0.213 p= 0.000). Mothers who had been initiated on ART during the first trimester had lower risk (RR= 0.1) of getting a HIV positive infant than mothers who had been administered with ARVs in the third trimester (95% CI 0.014, 0.021, p= 0.001). Similarly, mothers who were on first-line regimen were found to have a lower risk (RR= 0.04) of getting HIV infected infants compared to participants who were on the second line regimen (95% CI 0.012, 0.114, p= 0.000), suggesting that all these three significant variables were protective factors.

Conclusion

The findings of this study suggests that first line ART regimen administered before pregnancy or during the first trimester of pregnancy is effective in lowering the risk of getting a HIV positive infant.

Keywords: *Early Infant Diagnosis, Pediatric, HIV, Maternal*

Introduction

Globally, HIV/AIDS infection continues to be a public health concern with an estimated 36.7 million [31.1-43.9 million] people living with HIV globally at the end of 2015 [1]. In spite of being a preventable disease, it continues to cause morbidity and mortality amongst populations. Prevention strategies that are effective in reducing disease burden among infants include Prevention of Mother to Child Transmission (PMTCT) and EID. EID is the practice of testing infants for HIV within the first 4–6 weeks of life or at the earliest opportunity thereafter [2].

Without proper and prompt interventions half of the infants infected with HIV will die before their second birthday. MTCT of HIV accounted for 8.9% of all HIV infections globally by the end of 2015 [4] of which Sub-Saharan Africa

accounted for 12% MTCT, while Kenya accounted for 7% of all new infant HIV infections globally, with 13,000 new infant infections occurring annually [3].

A HIV-positive mother can transmit the virus to her child during pregnancy, labor, delivery, or during the breastfeeding period. In the absence of any intervention, transmission rates range from 15% to 45%. This rate can be reduced to below 5% with effective interventions during the periods of pregnancy, labor, delivery, and breastfeeding [4].

Although there has been a reduction of MTCT transmission rates in Kenya from 17% in 2010 to 14% by the end of 2015, MTCT rates of HIV in Kenya remain higher than the global target which was to reduce MTCT rates to 5% or less among breastfeeding women and to less than 2% or less among non-breastfeeding women by the end of 2015 [5].

Further, a low number of infants are retained throughout the EID program due to a high rate of Loss-To-Follow-Up (LTFU) of up to 54% by the end of the EID program [6]. These factors have greatly undermined the efforts to reduce the MTCT rates that stood at 14% in Kenya by the end of 2014 [6,7].

This study was focused on assessing the determinants of HIV positive status at first PCR (Polymerase Chain Reaction) test among infants seeking EID services. This would in-turn help in informing ways to strengthen EID services ultimately reducing pediatric HIV infection in Kenya.

Methods

Study design:

A longitudinal cohort study employing mixed-methods approach was used where both qualitative and quantitative data were collected and analyzed.

Study site: This study was carried out in Mathare North Health Center, Mbagathi District Hospital and Kibera South Health Center in Nairobi County within the catchment area of Kibra and Mathare informal settlements.

Study population: The study participants were mother-infant pairs recruited at 4-6 weeks of age, attending the Comprehensive Care Clinic (CCC) at the selected healthcare facilities. Mothers not willing to participate in the study, or were too sick to respond to the questions and were not the biological mothers to the infants were excluded from the study.

Sampling and sample size determination: The sample size was determined using Conchran's (Cochran, 1977) method and a sample size of 166 respondents was selected with 163 (98.2%) respondents participating in the study. Simple random sampling technique was used to select the study participants. A total of Six FGDs with 5-6 participants were conducted to attain saturation used. Participants were selected and grouped based on age categories of ≤21, 22-35 and 36-49 years.

Data collection tools: Pre-tested semi-structured interviewer administered questionnaires, Focus Group Discussion (FGD) guide and a data abstraction tool was used to collect health information (from Maternal and Child Health (MCH) booklets and mothers' CCC follow-up file). In addition, anthropometry instruments (for measuring weight and height) and laboratory equipment (for carrying out Polymerase Chain Reaction (PCR) tests and determining Viral Load counts) were also used. A Key Informant Interview (KII) guide was also used to collect information from the key healthcare workers delivering EID services in each of the selected facilities.

Data analysis: Data entry, cleaning, coding, and analysis were done using STATA Version 14. Descriptive statistics were used to summarize the data. Fisher's exact test and Poisson were used to analyze the data at bivariable and multivariable levels respectively.

This study outcome was to determine the HIV positive status of the infants at first PCR test which is usually done at 6 weeks. This was undertaken by categorizing the infants into two groups i.e. HIV positive or HIV negative infants. The overall HIV positivity rate

in the infants was (4.3%) and since this proportion was very small, the outcome was assumed to represent a count of the number of cases in the group. To relate the count of the cases to predictors (socio-demographic and maternal factors), a Poison regression model was assumed in the form:

$$E\ \frac{y}{n} = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_k X_K \quad \ldots (1)$$

Where, the term on the left of the equation was the log of the expected value of counts of HIV positive status which was modeled as a linear combination of the predictors (on the right of the equal sign). The model related the log of the expected value of counts of HIV positive infants and a linear combination of predictors in the bivariable analysis at a significance level of $P \leq 0.1$. The model was subsequently extended to control for other predictors by including all significant variables at the bivariable step in the multivariable analyses at a significance level of $P<0.05$ as follows:

$$E\ \frac{y}{n} = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_K \beta_K \quad \ldots. (2)$$

Where, k was the number of predictors.

Multivariable modeling was carried out using a backward elimination strategy and involved checking for confounding and relevant interaction terms. During modeling, the statistical significance of the contribution of individual predictors (in bivariable analyses) or groups of predictors (in multivariable analyses) to the model was tested using the likelihood ratio test and the Bayesian predictors of best model selection.

The models were assessed for overall fit using $\chi 2$ goodness-of-fit tests computed as the sum of the squared deviance or Pearson residuals. The values of the two test statistics were compared to assess a lack of fit. As with all overall goodness-of-fit statistics, a $P>0.05$ (non-significant) indicates that the model fits the data well.

Qualitative data was entered using the NVIVO software which was then presented thematically by describing emerging themes obtained from the HIV positive mothers.

Ethics statement: The researcher sought ethical approval to conduct the study from the Kenya Medical Research Institute (KEMRI) Scientific Ethics Review Unit (SERU) KEMRI/SERU/CPHR/002/3525. Permission was also sought from Nairobi County Ministry of Health and the Medical Superintendent of the facilities where the study was conducted. Risks, benefits, confidentiality, and voluntary participation were clearly explained and written, and informed consent was obtained and duly signed by the study participants.

Results

Socio-demographic and socio-economic characteristics of the study participants

The median age of participants was 29.6 years.

Approximately, (55.8%) of the participants had utmost primary level of education. Majority of the participants were married (85.28%). Approximately seventy (73.01%) of the participants had 2-5 persons living in their households and close to two thirds (65.64%) had informal employment. In this study majority (57.67%) earned between 6,001-12,000.00 Kenya Shillings (Ksh.) per month (Table 1).

Table 1: Maternal socio-demographic and socio-economic characteristics

Characteristics of the study participants	Frequency (n=163)	Percentage (%)
Age in years		
≤21	32	19.6
22-35	75	46.0
36-49	56	34.4
Highest Level of Education		
≤Primary	91	55.8
≥Secondary	72	44.2
Number of persons living in the household		
2-5	119	73.0
6-8	44	27.0
Respondent marital status		
Single	24	14.7
Married	139	85.3
Employment status		
Formal	27	16.6
Informal	107	65.6
Unemployed	29	17.8
House-hold income (Ksh)		
≤6000	32	19.6
6001-12000	94	57.7
≥ 12001	37	22.7

Prevalence of HIV at recruitment among infants seeking Early Infant Diagnosis (EID) services

The overall HIV prevalence of the infants at recruitment was (4.3%) of the 163 infants that were included in the study. The HIV prevalence of the infants as per the maternal socio-economic and socio-demographic factors of the mothers' was as shown in Table 2 below:

Table 2: Prevalence of infant HIV status at recruitment

Characteristics (n=163)	HIV status among infants at first PCR test	
	HIV Negative n (%)	HIV Positive n (%)
Age in years		
≤21	29 (90.6)	3 (9.4)
22-35	72 (96.0)	3(4.0)
36-49	55 (98.2)	1 (1.8)
Highest Level of Education		
≤Primary	86 (94.5)	5 (5.5)
≥Secondary	70 (97.2)	2 (2.8)
Number of persons living in the household		
2-5	114 (95.8)	5 (4.2)
6-8	42 (95.4)	2 (4.6)
Respondent marital status		
Single	23 (95.8)	1 (4.2)
Married	113 (95.7)	6 (4.3)
Employment status		
Formal	26 (96.3)	1 (3.7)
Informal	106 (99.1)	1 (0.9)
Unemployed	24 (82.8)	5 (17.2)
Monthly house-hold income (Ksh)		
≤6000	27 (84.4)	5 (15.6)
6001-12000	93 (98.9)	1 (1.1)
≥ 12001	36 (97.3)	1 (2.7)

Socio-demographic and socio-economic factors associated with infant HIV positive status

Employment status (p= 0.002) and household income (p= 0.004) were significantly associated with infant HIV status. Most (17.2%) of HIV

positive infants were from unemployed mothers and with the lowest household income (15.6%) (Table 3 below).

Table 3 Socio-demographic and socio-economic factors associated with infant HIV positive status

Characteristics (n=163)	HIV negative infants n (%)	HIV positive infants n (%)	Fishers Exact Test P-value
Age in years			0.224
≤21	29 (90.6)	3 (9.4)	
22-35	72 (96.0)	3 (4.0)	
36-49	55 (98.2)	1 (1.8)	
Highest Level Education			0.466
≤Primary	86 (94.5)	5 (5.5)	
≥Secondary	70 (97.2)	2 (2.8)	
Number of persons living in the household			1.000
2-5	114 (95.8)	5 (4.2)	
6-8	42 (95.5)	2 (4.5)	
Respondent marital status			1.000
Single	23 (95.8)	1 (4.2)	
Married	133 (95.7)	6 (4.3)	
Employment status			0.002
Formal	26 (96.3)	1 (3.7)	
Informal	106 (99)	1 (1)	
Unemployed	24 (82.8)	5 (17.2)	
Monthly household income			0.004
≤6000	27 (84.4)	5 (15.6)	
6001-12000	93 (98.9)	1 (1.2)	
≥12001	36 (97.3)	1 (2.7)	

Maternal characteristics during PMTCT associated with infant HIV positive status More infant HIV positivity (10.3%) was observed in mothers that had ≤ two years HIV diagnosis from the study inception than in mothers that had more than two years of HIV diagnosis, since the study inception. The mothers that had not been initiated on ART during pregnancy and the mothers that had delayed ART initiation (i.e. given ART in the third trimester) also experienced highest infant positivity at (27.3%) and (50.0) respectively (Table 4).

Table 4: Association between infant HIV positive status and maternal characteristics during PMTCT

Characteristics (n=163)	HIV Negative infants' n (%)	HIV Positive infant's n (%)	Fishers Exact P-value
Year Confirmed Positive			0.009
1997-2015(> 2years prior to study)	104 (99.0)	1 (1.0)	
2016-2017(≤ 2years prior to study)	52 (89.7)	6 (10.3)	
Mode of Delivery			0.587
CS	18 (94.7)	1 (5.3)	
SVD	138 (95.8)	6 (4.2)	
Given any ART			0.009
No	2 (50.0)	2 (50.0)	
Yes	154 (96.9)	5 (3.1)	
Stage ARTs administered during pregnancy			0.002
First Trimester	124 (98.4)	2 (1.6)	
Second Trimester	24 (92.3)	2 (7.7)	
Third Trimester	8 (72.3)	3 (27.3)	
Gestation of pregnancy at 1st PMTCT/ANC visit for this pregnancy			0.881
First Trimester	29 (96.7)	1 (3.3)	
Second Trimester	75 (96.2)	3 (3.8)	
Third Trimester	52 (94.6)	3 (4.6)	
No of PMTCT Visits			0.000
<=1	10 (90.9)	1 (9.1)	

2	15 (75.0)	5 (25.0)
>=3	131 (99.2)	1 (0.8)

Association between infant HIV positive status and Partner Disclosure of HIV status Mothers who had not disclosed their HIV status to their partners and neither knew their partner's HIV status experienced more HIV positivity in their infants (13.3%) and (10%) respectively (Table 5 below).

Characteristics (n=163)	**HIV Negative infants n (%)**	**HIV Positive infants n (%)**	**Fishers p-value**
ART adherence -(Morisky Score)			0.001
Good	95 (99.0)	1 (1.0)	
Inadequate	50 (96.2)	2 (3.8)	
Poor	11 (73.3)	4 (26.7)	
Maternal HIV Staging			0.020
I	131 (97.8)	3 (2.2)	
II	25 (86.2)	4 (13.8)	
ART Regimen			0.000
First Line	150 (98.7)	2 (1.3)	
Second Line	6 (54.6)	5 (45.4)	
Viral Load			0.000
Undetectable Viral Load	119 (99.2)	1 (0.8)	
Low Viral Load	19 (95.0)	1 (5.0)	
High Viral Load	18 (78.3)	5 (21.7)	
Maternal BMI			0.376
Underweight	8 (88.9)	1 (11.1)	
Normal	83 (95.4)	4 (4.6)	
Overweight	49 (98.0)	1 (2.0)	
Obese	16 (94.1)	1 (5.9)	

Table 5: Association between infant HIV status and Partner Disclosure of HIV positive status

Table 6: Association between infant HIV status and maternal characteristics at Recruitment

Characteristics (n=163)	HIV Negative infants n (%)	HIV Positive infants n (%)	Fishers p-value
Have a partner			0.545
No	16 (94.1)	1 (5.9)	
Yes	140 (95.9)	6 (4.1)	
Disclosed your HIV Status			0.116
No	13 (86.7)	2 (13.3)	
Yes	127 (97.0)	4 (3.0)	
Know Partner HIV status			0.048
No	36 (90.0)	4 (10.0)	
Yes	104 (98.1)	2 (1.9)	
Spouse HIV Status			1.00
Negative	42 (97.7)	1 (2.3)	
Positive	62 (98.4)	1 (1.6)	

Association between infant HIV positive status and maternal characteristics at Recruitment

Mother who had poor ART adherence and high viral loads experienced more HIV positivity in their infants (26.7%) and (21.7%) respectively. Similarly, mothers who were on the second line regimen and in stage II of HIV infection also experienced highest HIV positivity in their infants (45.4%) and (13.8%) respectively (Table 6 below).

Significant variables in the multivariable (P <0.05) Model assessing the relationship between the log of expected counts of HIV positive infants and the associated risk factors

In the overall parsimonious model, (p= 0.000) which was arrived at in a backward stepwise method, three variables discussed below best explained and most influenced the infant HIV positive status at first PCR test.

ART being given during pregnancy was a protective factor whereby participants who had been administered with ART during pregnancy had a lower risk (RR=0.06) of getting HIV positive infants relative to those who had not received ART during pregnancy (95% CI 0.014, 0.213 p= 0.000). Additionally, mothers who had been initiated on ART in the first trimester experienced lower risk (RR=0.1) of getting a HIV positive infant than mothers who had been administered with ARVs in the third trimester (95% CI 0.014, 0.021, p= 0.001).

Therefore, administering ARV as early as in the first trimester or sooner was a protective measure in reducing the risk of HIV transmission to the infant. Similarly, mothers who were on first-line regimen experienced a lower risk (RR= 0.04) of getting HIV infected infants compared to participants who were on the second line regimen (95% CI 0.012, 0.114, p = 0.000) (Table 7 below).

Table 7: Parsimonious multivariable (P <0.05) model for the log of expected counts of HIV positive infants

Infant HIV status at Recruitment	ARR	Robust Std. Err.	z	P>z	95% C.I Lower	95% C.I Upper	LR Chi2(4)	Prob > Chi2
Given ART during pregnancy							47.55	0.000
No *(Reference)*	1.00							
Yes	0.06	0.04	-4.18	0.000	0.014	0.213		
Stage ART first administered in Pregnancy								
Third Trimester *(Reference)*	1.00							
First Trimester	0.10	0.10	-2.22	0.026	0.012	0.760		
Second Trimester	0.69	0.43	0.60	0.549	0.201	2.352		
ART regimen								
Second-line *(Reference)*	1.00							
First-line	0.04	0.02	-5.81	0.000	0.012	0.114		
_cons	18.37	11.59	4.62	0.003	5.34	63.23		

Table 8: Model Summary

Model	Deviance G.O.F	Persons G.O.F	Log-Likelihood	AIC	BIC
	13.805 (1.000)	28.873 (1.000)	-13.902	37.805	53.274

Spearman test of correlation

Test of Ho: Giving ARVs during pregnancy, Stage ARVs were administered in pregnancy and Mothers ARV regimens are correlated hence we reject the null hypothesis (Table 9 below). Therefore, the variables in the model shown in (Table 7 above) are not correlated hence, a good model to explain the outcome variable of infant HIV status.

Table 9: Spearman correlation coefficient test

Explanatory variables	Given ARVs during pregnancy	Stage ARVs were administered in pregnancy	Mothers ARV regimen
Given ARVs during pregnancy	1.000		
Stage ARVs were administered in pregnancy	-0.0236	1.000	
Mothers ARV regimen	-0.1154	0.098	1.000

Discussion

This study provided a detailed quantitative and qualitative assessment of factors that influence infant HIV positive status at first PCR test. The mean HIV positivity rate at 6 weeks for the infants was 4.3% (CI 1.149 - 7.440) similar to findings in four government hospitals among infants in Kenya by [8]. This figure of 4.3% was way below the national MTCT rates that stood at 14.3% [9] and also met the national and global target of reducing the MTCT rates to below 5%, and was also comparable to findings in Malawi that had a prevalence of (4.1%) [10]. The low prevalence rate in Malawi was achieved through vigorous PMTCT interventions to enhance adherence and retention throughout the cascade of care [10].

Approximately, (52.7%) of the infants had a PCR test before 6 weeks of age and were regarded as having timely initiation into EID, this was much higher than what was seen in a study conducted in Ethiopia by [11] where the initiation rate was (41%). At bivariable level, timely initiation into EID was positively associated with infant HIV status at 6weeks (p=0.03) however at multivariable level it was not significantly associated with infant HIV status at first PCR test (p= 0.08). In the Libyan study, infants had a timelier PCR testing with 73% of the infants being recruited between 4-6

weeks. This high rate of timely PCR testing was attributed to mothers knowing their HIV status before pregnancy and good maternal ART adherence post-partum [12].

Demographic characteristics that influenced infant HIV status at recruitment included household income (p=0.002) and maternal employment status (p= 0.004) findings which were consistent with a study conducted in Kenya [2]. At multivariable level mothers who had informal employment had a lower risk of getting HIV positive infants relative to mothers who were unemployed. Similarly, mothers with higher income levels had lower risk of getting a HIV positive infant relative to mothers that had very little income of less or equal to 6000KsH. Improvement of household economic status through income-generating activities could reduce sero-positivity in infants by eliminating other competing priority interests. This is further supported by FGDs that were conducted where the mothers indicated that economic constraints were a big challenge towards access of service delivery: P3: "My husband will not give me a coin to come for my appointments despite the fact that I am unemployed. I am forced to save from the little money he leaves for food. Sometimes I call the healthcare providers in EID in advance and tell them that they will have to give me transport back home since I only have money for one way trip. They usually help but you cannot borrow each time"(FGD5).

P3: "Sometimes getting bus fare is a big challenge, I am forced to borrow 100 KsH from friends so as to be able to attend my scheduled clinics, you cannot borrow every time it is a big challenge" (FGD2)

A Key Informant Interview (KII) also conducted on health workers managing the EID clinic also revealed economic challenges as a barrier to access to service delivery which could lead to poor ART adherence and increase the risk of HIV transmission to the infants: "Sometimes clients miss their appointments and when we call them as part of defaulter tracing they indicate that they did not have transport money to attend the clinic, and that they will

come once they get money. This is dangerous since the mother may not have enough drugs and may end up with poor drug adherence" (Nurse, KII 2)

The maternal level of education did not influence the infant HIV status despite most of the participants having a primary level of education and below. These findings were similar to those of Zambia [13, 3, and [11]. Mothers who did not receive ART during pregnancy all had HIV positive infants which denoting a high rate of vertical transmission rate in these infants. Similar findings were observed in the [14, 8] studies. This denoted a great need to increase ART coverage during PMTCT to reduce the chances of vertical transmission.

Gestation at first PMTCT visit did not influence infant HIV status a finding similar to that of [8] however, mothers who attended more ANC visits(>=3) had a lesser risk (0.03) of getting HIV infected infants relative to mothers who had attended lesser clinics, with similar observations in another study conducted in Kenya [11]. ANC attendance improves maternal knowledge on importance of PMTCT attendance and consequently improves ART adherence and maternal health which cascades to improve HIV exposed infant health outcomes [13].

Partner disclosure is pertinent in ensuring maternal adherence to PMTCT clinics and provides a facilitated environment for HIV testing where issues of blame, discordance, and future care options are explained [12]. Mothers who fail to disclose to their partners due to fear, stigma or denial are much more likely to default care putting their infants at more risk of HIV infection [15]. This study showed a significant association between partner disclosure and infant HIV status at the bivariate level however, at multivariate level partner disclosure status was found not to be significant. However, in the FGD conducted by the researcher, mothers cited disclosure as a barrier to proper ART adherence:

P2: "I am married as a second wife, my husband's other wife and I have never met. I have not disclosed my status to my husband, and he does not know my

status either. I find it difficult to disclose to him my status, with time I will. He gives me very little financial support and at times I go hungry with my other children"

P4: "Long ago when I used to visit my rural home, since I have not disclosed my status to anyone, I used to remove my tablets from the medicine bottle and but in a paper and hide under my mattress, my viral load went very high and I had to disclose to the healthcare workers that I was removing my medicine from the dispensing bottle. I was discouraged from doing this, now I don't go to my rural home anymore" (FGD4).

Disclosure was seen as an enabler of good adherence if proper disclosure strategies were put in place:

P2: "I disclosed my status to my nuclear family members and they were very supportive, they even remind me to take my medicine, the nurse assisted in the disclosure"(FGD2).

Disclosure status in this study was high (89.8%) among HIV positive mothers a finding similar to that of [12] in a Zambian study. A pooled estimate study in sub-Saharan among post-partum and pregnant women by [16] however showed much lower levels of disclosure (63.9% CI 56.7% - 71.1%). Majority of the participants had partners with (59.81%) of the partners being concordant and (40.19%) being discordant partners. The sero-concordant status findings were similar to those of HIV positive mothers in a Zambian study [12] but the discordance status differed where the authors found only 28% serodiscordant among the participants partners. Interventions to encourage and support women in safely disclosing their status were seen to be an urgent area to be addressed to enhance maternal adherence.

Approximately (58.9%) participants had good ART adherence post-partum a finding that differed with a study in Libya where mothers reported very high adherence of (81%) [12] however, only 56% of the participants were on lifelong ART in the Libyan study whereas in the current study all nearly all the participants were on lifelong ART (97.6%). Good ART adherence is key in ensuring viral suppression and

ensuring that vertical transmission rates are kept below 5% in breastfeeding mothers and below 2% in non-breastfeeding mothers [4]. A systematic review [17] study also highlighted that maternal ART adherence reduced the odds of HIV infection to the infants.

Routine viral load monitoring is carried out at 6 months, 12 months for newly diagnosed HIV positive patients then thereafter every 12 months if the patient is virologically suppressed i.e. viral load count of <100 copies [4]. An undetectable viral load was a potective factor and was associated with a lower risk (RR 0.04) of infant HIV transmission in comparison to mothers that had high viral load counts . Viral load is used to detect treatment failure and decision if to change ART regimen or enhance adherence counseling. This pointed to a re-evaluation of the mothers in the high viral load category for enhanced adherence counseling or change of regimen to reduce the risk of HIV infection to the infant. This is especially important, in order to also initiate the HIV exposed infants on the optimal prophylaxis in the case of mothers with high viral load and are breastfeeding [18]. In the United Kingdom, the link between MTCT is well established whereby the risk of transmission from a pregnant mother on antiretroviral treatment and has achieved viral suppression (undetectable viral load) to her infant is 0.1%. Although the risk of MTCT is greatest for pregnant mothers with high viral loads, the transmission may still occur even when maternal viral loads are very low (<50 copies) or even undetectable [19].

Proper PMTCT strategies ensure that mothers do not progress from the first stage to the second stage of HIV infection by ensuring the viral load is suppressed through proper ART adherence. In the current study, mothers who were in the second stage of HIV infection experienced more positivity in their infants (2.45%) compared to the mothers in the first stage of HIV who experienced (1.8%) infant HIV positivity at bivariate level.

In the multivariate level, mothers in stage two of HIV infection had a higer risk (RR= 6.2) of getting HIV positive

infants compared to mothers in the first stage of HIV infection. Most HIV patients are usually switched to second-line regimen due to treatment failure caused by several reasons such as poor drug adherence and drug resistance, which are the two leading reasons why HIV positive mothers are usually switched on second-line regimen. Treatment failure leads to an increase in maternal vial load which can, in turn, increase the risk of HIV transmission to the infant [14]. There is usually a period of high viremia (due to treatment failure or poor adherence) between being switched from first to second line regimens which puts the infants at a very high risk of HIV transmission. This also explains why most infant HIV positivity was observed in mothers on the second line regimen of ART.

This study had several limitations. Exposure history was from the mother's self-report and not all the history given could be corroborated from the maternal CCC file, IMCI booklet and appointment booklets. Where it was not possible to corroborate the mothers self-report, the questionnaires were structured to counter-check the responses asked in a different format within the same questionnaire. Secondly, given the phrasing of the questionnaire, it was difficult to determine if the mothers were adherent to ARVs throughout the pregnancy period i.e. periods of cessation and non-adherence. Adherence, however, was also determined by observation of participant serial viral loads from pregnancy up to one year post-partum. Due to the small sample size selected, the MTCT rates of 4.3% obtained in the study may have been an underestimation of the true MTCT rates.

Conclusion

Contrary to adults' HIV infection, pediatric HIV infection disease progression is quite rapid and without prompt treatment, half of the infants will not survive their second birthday. This then necessitates rigorous interventions to ensure that infants are identified on time and retained in the EID cascade of care to ensure optimal infant health outcomes. This study, therefore, identified three main factors that promote optimal infant health

outcomes as they go through the EID process and these included ensuring mothers are initiated on ARVs on or before the first trimester of pregnancy and ensuring proper ART adherence so that the mother remains in the first-line regimen of care for as long as possible.

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Competing interests

The authors declare no competing interests.

Authors' contributions

Elizabeth Mueke Kiilu development of the concept and manuscript, Prof. Simon Karanja, Prof. Gideon Kikuvi and Dr. Peter Wanzala critically reviewing of the document from its conception, up to manuscript submission and the final approval and Dr. John Gachohi, data analysis and review. All authors read and agreed to the final version of this manuscript and equally contributed to its contents and the management of the case.

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