ACCESSIBILITY OF HIV DIAGNOSTIC SERVICES BY EXPOSED UNDER FIVE-YEAR CHILDREN IN MUHEZA DISTRICT IN NORTH-EAST TANZANIA

By

Veneranda Masatu Bwana

A Thesis submitted to the University of Zambia in partial fulfillment of the requirements for the Doctor of Philosophy in Public Health

The University of Zambia
Lusaka
2019
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DECLARATION

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Signature: ……………………… Date: ………………………
# APPROVAL

This PhD thesis of Veneranda Masatu Bwana is approved in partial fulfillment of the requirements for the award of the Doctor of Philosophy in Public Health by the University of Zambia.

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PHILOSOPHICAL QUOTES

‘Children are our most valuable natural resource.’

- Herbert Hoover (2008)

‘Children are the future generation of a nation and as such they should have the privilege of access to a happy life, a life without necessarily being afflicted with disease.’

- Veneranda Masatu Bwana (2014)
ABSTRACT

Introduction: Early diagnosis of HIV (Human Immunodeficiency Virus) among exposed infants gives an opportunity for early access to HIV care and treatment with potential for increased survival. Despite global efforts to scale up early infant diagnosis (EID) services, in resource-limited, high HIV burden countries including Tanzania, the coverage is still lower than the recommended levels. The study was carried out to determine HIV prevalence and factors associated with accessibility of EID among HIV exposed under five-year children in Muheza district, Tanzania.

Methods: A concurrent mixed methods design comprising of cross sectional survey, health facility survey and case study design was conducted among mother/guardian-child pairs of HIV exposed child and health care providers at Muheza health facilities between June 2015 to June 2016. Information on HIV status, socio-demographic and other relevant data was collected using structured questionnaires, interview guides and health facility checklist. Multiple regression analyses were done by using STATA version 13.0 to examine the factors associated with accessibility to EID. Thematic generation and analysis were done using Nvivo version 10.

Results: A total of 576 HIV exposed children with their respective mothers/guardians were recruited. Of the 576 mothers/guardians, 549 (95.3%) were the biological mothers with a median age of 34 years (inter-quartile range (IQR):30 to 38 years). The median age of the 576 children was 15 months (IQR: 8.5 to 38.0 months). A total of 251 (43.6%) children were born to mothers with unknown HIV status at conception. Only 329 (57.1%) children accessed EID between four and six weeks of age. In the district, EID testing sites were only available in 61% of health facilities. Children born to mothers with unknown HIV status at conception (AOR=0.6, 95% CI 0.4-0.8) and those with ages 13-59 months (AOR=0.4, 95% CI 0.2-0.6) were the significant factors of missed opportunity to access EID. Children born to mothers with unknown HIV status at conception (AOR=0.6, 95% CI 0.4-0.8) and those with ages 13-59 months (AOR=0.4, 95% CI 0.2-0.6) were the significant factors of missed opportunity to access EID. Children living with the head of household with at least a high education level had higher odds of accessing EID (AOR= 1.8, 95% CI 1.1-3.3). Their likelihood of accessing EID services was three-fold higher among mothers/guardians with good knowledge of HIV infection prevention of mother to child transmission (PMTCT) (AOR=3.2, 95% CI 2.0-5.2) than those with poor knowledge. Mothers/guardians living in rural areas had poorer knowledge of PMTCT (AOR=0.6, 95% CI 0.4-0.9) than those living in urban areas. According to qualitative interviews, barriers identified to influence EID access at individual level included inadequate
knowledge regarding EID and PMTCT, lack of transport cost to go to health facility, poverty, HIV stigma, culture, traditional and religious beliefs, geographical relocation, lack of psychosocial support, lack of paternal permission, poor patient-health care provider interaction and low satisfaction with health care services. Laboratory materials out of stock, weak health care infrastructures, lack of skilled health care providers, inadequate health care providers and delay of HIV results were an additional challenges to health care system that affect access to EID services. In addition, health care providers were not satisfied with their job due to high workload, lack of motivation, communication and transport allowances. Furthermore, the HIV prevalence among 576 under five children was 10.6% (95% CI 8.1-13.1%). The burden of HIV infection was observed among older children aged 25-59 months (AOR= 5.6, 95% CI 1.6-19.1) and those born to mothers with unknown HIV status at conception (AOR=3.9, 95%CI 1.6-9.3). The odds of HIV infection was higher among children who were delivered at home (AOR=2.6, 95% CI 1.0-6.6), received mixed feeding (AOR=2.4, 95% CI 1.1-4.9), and those living far from health facility (AOR 2.5, 95% CI 1.1-5.4). The odds of HIV infection was low among children with head of household who had at least attained high education level (AOR= 0.3, 95% CI 0.1-0.9).

**Conclusion:** Accessibility of EID services among HIV exposed under five-year children in Muheza district is low and the HIV prevalence among this population is high. This does not show just limitations in testing efforts in the past, but it suggests a reshaping of current HIV testing for women and men so that pre-pregnancy HIV knowledge of status is prioritized. Further, these findings stress the need for continued HIV education and outreach services, particularly in rural areas in order to target reaching out to hard to reach and predominantly poor mothers and their children. Noting that there still exists many gaps in the EID system, creating a functioning surveillance system with strategy to generate context specific information for programming, should also be prioritized for improved PMTCT and EID programming.
LIST OF ORIGINAL PAPERS


DEDICATION

I dedicate this work to my beloved husband John Henry Kwingwa for his devotion, enthusiasm and encouragement throughout the period of my PhD training and to our lovely daughters Joven, Joan and Joylin for their constant love and patience throughout the period of when I was away from home.
ACKNOWLEDGEMENTS

I am grateful to everyone who has helped me to make this work a reality. First and foremost, I would like to thank Almighty God for His guidance and strength throughout my studies and by His grace for my having accomplished my studies successfully. Secondly, I wish to express my deepest gratitude to all mothers/guardians-child pairs and health care workers for their consent to participate in the study.

I would like to acknowledge the Education, Audio-visual and Culture Executive Agency Project of the European Commission for funding my study through Intra-ACP (Africa, Caribbean & Pacific) Scholarship. I would also like to acknowledge the Medical Research Coordinating Committee of the National Institute for Medical Research (NIMR) in Tanzania and the University of Zambia Biomedical Research Committee (UNZABREC) in Zambia for granting ethical approval to conduct the study. My sincere gratitude also goes to the University of Zambia for providing a very conducive learning environment throughout my study period.

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Matibwa Dr. Susan Rumisha, Fagason Mduma, Dr. Elizabeth Shayo, Grades Stanley and Evord Kimario, sincere gratitude for your invaluable support all the times. Many thanks to Josephine Mhina, Irene Lazaro, Veronica Msingwa, Diana Kwetukia, Sharifa Ngwatu, Batuli Shangalawe, Mohamed Seif, Ruth Mzava, Majaliwa Msiyani, Arno Mkina, John Fundi, Lawrence Malata and Kassimu Bawazir for their assistance during data collection. Thanks to Dr. Juma Mfanga (District Medical Officer), Dorothy Lema (Regional Reproductive and Child Health Coordinator), Angelina Sengwaji (District Reproductive and Child Health Coordinator), Paulo Muhusa (District laboratory technologist), Herieth Nyangasa (Council HIV/AIDS coordinator-CHAC of Muheza), Dr. Baltazar Nyombi (Head KCMC Clinical Laboratory) and health care providers of the Muheza Designated District Hospital and health centers and dispensaries for their extended cooperation during data collection.

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<th>Description</th>
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<tr>
<td>3TC</td>
<td>Lamivudine</td>
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<td>ABC</td>
<td>Abacavir</td>
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<td>AIDS</td>
<td>Acquired immunodeficiency syndrome</td>
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<td>ANC</td>
<td>Antenatal Clinic</td>
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<td>ARIs</td>
<td>Acute Respiratory Tract Infections</td>
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<td>ART</td>
<td>Antiretroviral Therapy</td>
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<tr>
<td>ARV</td>
<td>Antiretroviral</td>
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<tr>
<td>CBOs</td>
<td>Community based Organizations</td>
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<td>CD4</td>
<td>Cluster of differentiation 4</td>
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<td>CRS</td>
<td>Catholic Relief Services</td>
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<td>CTC</td>
<td>Care and Treatment Clinic</td>
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<td>CTX</td>
<td>Co-trimoxazole</td>
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<td>DBS</td>
<td>Dried Blood Spot</td>
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<td>DNA</td>
<td>Deoxyribonucleic acid</td>
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<td>EFV</td>
<td>Efavirenz</td>
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<td>EIA</td>
<td>Enzyme Immunoassays</td>
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<tr>
<td>EID</td>
<td>Early Infant Diagnosis</td>
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<td>EMS</td>
<td>Expedited Mail Service</td>
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<td>EMTCT</td>
<td>Elimination of mother-to-child transmission of HIV</td>
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<td>FGDs</td>
<td>Focus group discussions</td>
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<td>FTC</td>
<td>Emtricitabine</td>
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<td>HAART</td>
<td>Highly Active Antiretroviral Therapy</td>
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<td>HIV</td>
<td>Human immunodeficiency virus</td>
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<td>IDIs</td>
<td>In-depth interviews</td>
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<td>IMCI</td>
<td>Integrated Management of Childhood illnesses</td>
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<td>KCMC</td>
<td>Kilimanjaro Christian Medical Center</td>
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<td>MAIG</td>
<td>Muheza AIDS Intervention Group</td>
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<td>MOHCDGEC</td>
<td>Ministry of Health, Community, Development, Gender, Elderly and Children</td>
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<td>MoHSW</td>
<td>Ministry of Health and Social Welfare</td>
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<td>MTCT</td>
<td>Mother to Child Transmission</td>
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<tr>
<td>Acronym</td>
<td>Description</td>
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<tr>
<td>NACP</td>
<td>National AIDS Control Program</td>
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<td>NGOs</td>
<td>Non Governmental Organizations</td>
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<td>NVP</td>
<td>Nevirapine</td>
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<td>PCR</td>
<td>Polymerase chain reaction</td>
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<td>PEPFAR</td>
<td>President's Emergency Plan For AIDS Relief</td>
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<td>PLHIV</td>
<td>People living with HIV</td>
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<td>PMTCT</td>
<td>Prevention of Mother to Child Transmission</td>
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<td>PSU</td>
<td>Primary sampling units</td>
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<td>RCH</td>
<td>Reproductive and child health</td>
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<td>RNA</td>
<td>Ribonucleic acid</td>
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<td>SDG</td>
<td>Sustainable Development Goals</td>
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<td>SHDEPHA</td>
<td>Service Health and Development for the people living with HIV/AIDS</td>
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<tr>
<td>STIs</td>
<td>Sexually Transmitted Infections</td>
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<td>SWAAT</td>
<td>Society for women and AIDS in Africa Tanzania</td>
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<td>TACAIDS</td>
<td>Tanzania Commission for AIDS</td>
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<td>TasP</td>
<td>Treatment as prevention</td>
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<td>TAWG</td>
<td>AIDS Working Group</td>
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<tr>
<td>TDF</td>
<td>Tenofovir disoproxil fumarate</td>
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<tr>
<td>TLE</td>
<td>Tenofovir, Lamivudinie and Efeverens</td>
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<tr>
<td>UNAIDS</td>
<td>Joint United Nations Programme on HIV/AIDS</td>
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<td>UNICEF</td>
<td>United Nations Children's Fund</td>
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<tr>
<td>VCT</td>
<td>Voluntary Counselling and Testing</td>
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<td>WHO</td>
<td>World Health Organisation</td>
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### DEFINITIONS OF TERMS

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<th>Term</th>
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<tr>
<td>Access to health services:</td>
<td>Timely utilization of services according to need</td>
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<td>Early infant diagnosis (EID):</td>
<td>Early diagnosis of HIV among HIV exposed infants at the age of four-six weeks</td>
</tr>
<tr>
<td>Early infant testing:</td>
<td>HIV testing at age of four-six weeks among HIV exposed infants</td>
</tr>
<tr>
<td>Exclusive breastfeeding (EBF):</td>
<td>Is defined as giving the baby only breast milk for the first six months as feed. Prescribed medicines, vitamins, supplements or oral vaccines were allowed in the definition of exclusive breastfeeding</td>
</tr>
<tr>
<td>Guardian:</td>
<td>Defined as the child’s main primary caregiver living with the child in the same household and this included either the parent, grandparent, sister, brother, aunt or uncle</td>
</tr>
<tr>
<td>Infant:</td>
<td>A child aged below twelve months</td>
</tr>
<tr>
<td>Mixed Feeding (MF):</td>
<td>Is giving the baby under the age of six months both milk and other liquids (such as water, tea, formula, animal milk) or solid foods (such as porridge, potatoes or rice)</td>
</tr>
<tr>
<td>Replacement Feeding (RF):</td>
<td>Is defined as giving the baby something other than breast milk which meet all the infant’s nutrition requirement. During the first six months of life, the only replacement feed that meets an infant’s nutritional requirements is commercial infant formula</td>
</tr>
<tr>
<td>Under five-year children:</td>
<td>All children aged less than five years</td>
</tr>
<tr>
<td>Loss to follow up:</td>
<td>Refer to children who at one point in time were actively participating in a continuum of care at the health facility, but have become lost (either not seen at scheduled clinic visits or by being unreachable) at the point of follow-up in a routine care.</td>
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CHAPTER 1: INTRODUCTION

1.1 General Overview of HIV/AIDS

More than 35 years have elapsed since the occurrence of first cases which were diagnosed with a new disease known as Acquired Human Immunodeficiency Syndrome (AIDS) during early 1980s. The disease was present among previously healthy young homosexual men who presented with an unusual syndrome characterized by generalized lymphadenopathy, *Pneumocystis carinii* pneumonia, candida mucosal infection, variety of viral infections and unusual cancers such as Kaposi’s sarcoma (Gottlieb et al., 1981). In early 1983, the human immunodeficiency virus (HIV) was isolated. In 1984 HIV was identified as a possible cause of AIDS (Gallo, 2005). The virus exists in two types, the HIV-1 and HIV-2, but HIV-1 causes most of HIV infections worldwide (McCutchan, 2006). Infection with HIV-1 progresses faster than HIV-2 (Burgard et al., 2010). Infection with HIV-1 is widely distributed and HIV-2 mainly occurs in West Africa (Bock and Markowitz, 2001, Sharp et al., 2001). In Tanzania, infection with HIV is only caused by HIV-1 subtype and infection with HIV-2 has not been reported yet. The common HIV-1 subtypes in Tanzania are A, C, D and their recombinants (Renjifo et al., 1998).

The virus directly infects and kills CD4+ T lymphocyte cells that are critical for effective immune responses (Zunich and Lane, 1990). The decline in CD4+ T lymphocyte count results into a decline of cellular immunity making the human body more susceptible to opportunistic infections and other secondary infections (UNAIDS, 2010). In adults and children aged more than 18 months of age, the HIV infection is detected by the presence of HIV antibodies in serum or plasma and in children below 18 months of age, by the presence of the virus by nucleic acid detection using polymerase chain reaction (PCR) or p24 antigen testing (Barletta et al., 2004, WHO, 2010c).

The subsequent global AIDS pandemic has stimulated an extraordinary biomedical research effort with successive major expansion of knowledge in many aspects of HIV infection. The main transmission modes of HIV are through sexual contact, exposure to infected blood products, needle sharing and from mother-to-child (MTC), vertically (Gouws et al., 2006). Preventive strategies with multiple options for diverse populations are
underway in most countries with generalized epidemics addressing these modes of transmission (Auvert et al., 2005, De Cock et al., 2000, Dei Jnr, 2016, Gregson et al., 2006). As a consequence of heterosexual transmission has resulted into a remarkable surge of paediatric cases which is the expectation of life in most regions. The introduction of safe and cost effective Prevention of mother to child transmission (PMTCT) interventions have shown a substantial progress in the reductions of new paediatric cases in most low and middle income countries (UNAIDS, 2015).

Globally, infectious disease due to HIV is considered as one of the most important public health problem afflicting children. Every year, estimated 110 000 children become newly infected with HIV in high HIV burden countries in sub-Saharan Africa (UNAIDS, 2016a). In 2016, about 400 new paediatric HIV infections occurred every day and about 64 percent of them were from sub Saharan Africa including Tanzania. In the same year, an estimated 120 000 AIDS-related deaths occurred among children aged less than 15 years (UNAIDS, 2017b). Majority of infected infants and children die from HIV-related causes without being tested of the infection. Without access to early HIV diagnosis, antiretroviral therapy (ART) and supportive care, about half of HIV-infected infants in developing countries progress to death within two years of age (Newell et al., 2004). Previous studies have demonstrated a substantial increase in survival rate if HIV-infected children have access to early HIV diagnosis and treatment (Violari et al., 2008). Nevertheless, early infant diagnosis (EID) systems in resource limited, high HIV burden countries including Tanzania are still challenged at multiple levels of the cascade that influence health outcome among children (Jani and De Schacht, 2019, Manumbu et al., 2015a, Sutcliffe et al., 2014).

1.2 Early Infant Diagnostic Accessibility Project

1.2.1 Statement of problem

EID services have been integrated into PMTCT programme since 2006 in most sub Saharan Africa including Tanzania whereby, HIV testing by DNA PCR is routinely performed to all HIV exposed infants at the age of four to six weeks (Buchanan et al., 2014, Nkenfou et al., 2012, MoHSW, 2012, UNAIDS, 2016a). Despite this, the number of
infants who are brought for early HIV testing at the recommended age are still low, as a result there is no sufficient information regarding the burden of HIV in infants and young children.

Most children died in some parts of the developing countries from preventable and treatable causes due to delay in getting basic health services including early diagnosis and prompt treatment. Early diagnosis of HIV for HIV exposed infants gives an opportunity for early access to HIV care and treatment with potential for increase survival. However, late diagnosis of paediatric HIV infections and persistence of vertical transmission continues to be the major challenge despite the introduction of PMTCT services in most sub Saharan Africa including Tanzania (UNAIDS, 2015). In 2014, only 49 percent of all HIV exposed infants in resource-poor, high HIV burden countries access EID services within two months of life (compared to 40 percent in 2013) (UNAIDS, 2015). However, there was wide variation between countries on EID coverage. Among the seven out of 21 priority countries, the coverage of EID access within two months of life were 50 percent or more, it ranged from 51 percent in Uganda and 95 percent in Namibia. While in the remaining priority countries, it ranged from four percent in Chad, 43 percent in Tanzania and 45 percent in Zimbabwe, the coverage which is still far below the 80 percent EID coverage recommended by WHO (UNAIDS, 2015, WHO, 2007a).

Studies conducted in sub Saharan Africa, majority of HIV exposed infants access EID at older ages. For example, in Mozambique about a quarter of HIV exposed infants received the first HIV test at a median age of 5.0 months (Cook et al., 2011) while in Zambia nearly three quarters received the test at a median age of 8.1 months (Sutcliffe et al., 2014). Accordingly, the median age at first HIV test was 5.0 months in Uganda (Mugambi et al., 2013) while in Cameroon it ranged from 1.5 to 4.0 months (Noubiap et al., 2013, Tejiokem et al., 2011). In contrast, in Nigeria, the median age was 13 weeks (range = 4.0–72 weeks) (Anoje et al., 2012) while studies in Tanzania reported the median age of 5.6–16.0 weeks at first HIV test (Buchanan et al., 2014, Chiduo et al., 2013, Nuwagaba-Biribonwoha et al., 2010). Overall, these studies suggest the existence of some variability at the age of first HIV test among children within the African region (Bwana et al., 2016). Probably, the
observed late HIV testing at older ages may be due to symptoms that brought them at the health facility for diagnostic testing.

EID services are still challenging in resource limited countries including Tanzania due to weak health systems where only a few HIV exposed infants are tested (UNAIDS, 2015). Majority of HIV-exposed and HIV-infected children remain unidentified due to inaccessibility and insufficient utilization of these services (Chilongozi et al., 2008). EID implementation in resource limited countries is challenged by weak health care system, inadequate skilled health care providers, difficulties in specimen transport, long turnaround time between specimen collection and receipt of results, and limitations in supply chain management (Cherutich et al., 2008, Coulibaly et al., 2014, Jani and De Schacht, 2019, Sutcliffe et al., 2014). At individual levels, poor knowledge on PMTCT and EID, poor compliance to PMTCT and EID, low maternal education level, poverty, long distance to health facility, HIV stigma, lack of social support were identified barriers for missed opportunity to access EID services (Adeniyi et al., 2015, Hassan et al., 2012a, Nkenfou et al., 2012, Woldesenbet et al., 2015). However, effective implementation requires more evidence on the reasons of low testing rates of HIV among exposed under five-five children. Urgent measures need to be taken in order to improve uptake and implementation of EID services in resource limited settings.

Therefore, the main gaps concerning EID services are low coverage and timely testing at first HIV test as compared to 80 percent coverage and testing at the age of four to six weeks, respectively, as recommended by WHO (WHO, 2007a). As a consequences of low EID coverage, there is a dearth in information regarding the burden of HIV infection in infants and young in children (WHO, 2010b). This study investigated factors associated with uptake and delivery of EID services for children aged under five years exposed to HIV infection in Muheza district, Tanzania. In addition, knowledge, attitudes and perceptions among mothers/guardians and health care providers regarding EID services in Muheza district were also explored. Continuous epidemiological surveys are highly needed in order to ascertain the factors associated with low testing rates among HIV exposed children, hence the need to conduct this study in Muheza district, Tanzania.
1.2.2 Study justification

Tanzania is among the 22 countries which is in line with the Global plan for eMTCT of HIV (TACAIDS, 2012a, UNAIDS, 2015). Monitoring of the preventive programmes to ensure that they reach the global targets for HIV elimination is crucial especially in sub Saharan Africa with limited resources. MTCT continues to be a major concern especially in sub Saharan Africa including Tanzania and is denying children the opportunity of HIV-free generation. Through PMTCT interventions, the country has made significant progress in reducing the number of new HIV infections among children but still, MTCT rate is eight percent and the Global target for eMTCT has not yet been achieved (UNAIDS, 2017b). The rate of MTCT of HIV can be reduced by prompt access to EID services and adherence to PMTCT interventions. Identification of HIV infected children is the main stay for establishing the burden of HIV infection among children and hence makes this study necessary to be conducted. Factors that hinder identification of early HIV infection among infants needs to be addressed in order to monitor the progress and effectiveness of PMTCT to reach the dream of an HIV-free generation. If we do not understand these factors that hinder uptake of infant HIV testing, as a consequence, no data will be generated, due to lack of data, we had no right to speak about the magnitude of HIV in infants and young children and the health care system will not know how it is progressing regarding effectiveness of PMTCT interventions.

For Tanzania to achieve the eMTCT, the identification of the implementation gaps that limit effective EID is crucial. Continuous ongoing epidemiological studies are important in order to determine the pace of available interventions. In addition knowing the burden of HIV infection in children and understanding the factors associated with low testing rate is crucial due to following reasons: 1) it will help to focus on interventions more effectively 2) it will bring more researchers and academicians to perform more researches for better understanding of HIV epidemiology, care, treatment and social support of HIV exposed children together with their families and 3) policy will be informed for more effective action and implementation.

Therefore without knowing the factors associated with low test rates and burden of HIV among HIV exposed children, the policy will not be informed and as a consequence
interventions will not be focused effectively, and hence this study. This thesis focuses on identification of possible barriers into two perspectives including health service delivery (i.e. the supply side) (human resources, infrastructures, medicines, lab supplies) and uptake (i.e. the demand side) (user barriers: social, economic, cultural and knowledge gaps) that limit access to EID services in Muheza district, Tanzania. It is envisaged that the study has highlighted some of the factors that are hampering the progress despite investment of EID services and possible recommendations of improving the services in resource-limited, high HIV burden countries like Tanzania.

1.2.3 Objectives

1.2.3.1 Main objective

To determine factors affecting accessibility of early infant HIV diagnosis among under five-year children in Muheza district, Tanzania

1.2.3.2 Specific objectives

1. To investigate factors associated with accessibility of early infant HIV diagnosis among under five-year children.
2. To explore knowledge, attitudes and perceptions of mothers/guardians and health care providers regarding EID services.
3. To assess structural environments that support delivery and uptake of EID services.
4. To determine HIV prevalence among under five-year children.
5. To find out what socio-demographic characteristics associated with HIV infection among under five-year children

1.2.4 Research question

What is the prevalence and factors affecting accessibility of HIV diagnosis among under five-year children in Muheza district, Tanzania?
CHAPTER 2: BACKGROUND

2.1 Global epidemiology of HIV and AIDS

Worldwide in 2016, approximately 2.1 million children less than 15 years old globally were living with HIV, and more than 90 percent were in sub-Saharan Africa (UNAIDS, 2017b). There was an eight percent reduction in new infections among children aged less than 15 years between 2015 and 2016, with an estimated 160,000 acquiring HIV in 2016 (UNAIDS, 2017b). The number of children aged less than 15 years who died from AIDS-related illness has decreased from 210,000 in 2010 to 120,000 in 2016 (UNAIDS, 2017b). This notable decline is due to increased access to paediatric antiretroviral therapy (ART) and reduction in new HIV infections among children (UNAIDS, 2017b).

In sub-Saharan Africa, less than 60 percent of children aged less than 15 years are newly infected with HIV annually in 2015. In the same year, 1.2 million new HIV infection among children aged less than 15 years were averted since 2009 (UNAIDS, 2016a). From 2009 to 2015, the reduction in new HIV infections in children aged below 15 years varied from 69 percent (Tanzania), 69 percent (Zambia), 71 percent (Malawi), 80 percent (Swaziland) and 86 percent (Uganda). There were 62 percent reduction in the number of children aged 0-4 years who died from AIDS-related illness in sub-Saharan Africa, a decrease from 129,000 in 2009 to 49,000 in 2015 (UNAIDS, 2016a).

Paediatric HIV infection has evolved because of rapid expansion of HIV epidemic worldwide among heterosexual population (Gouws et al., 2006). In 2014 the Joint United Nations Programme on HIV/AIDS (UNAIDS) stated the new targets for ending the global HIV/AIDS epidemic by 2030 (UNAIDS, 2016a). This target focused on closing the access gap to HIV treatment and prevention which is stated as a set of ‘90-90-90’ target to be achieved by 2020. The target clearly stresses that 90 percent of people living with HIV should know their HIV status, 90 percent of people who know their status should access HIV treatment and 90 percent of people on HIV treatment should have achieved viral suppression (UNAIDS, 2016a). These 90–90–90 targets apply to all populations including children and women and even higher levels need to be achieved among pregnant women. It is anticipated that as access to viral load testing and ARV therapy coverage expands, and
routine monitoring systems are strengthened, the 90–90–90 targets will improve with subsequent reduction in new paediatric HIV infections (UNAIDS, 2017a).

2.2 Tanzania epidemiology of HIV and AIDS

Since the first three AIDS cases reported in Kagera Region, Tanzania in 1983, the HIV epidemic has continued to be the major public health concern and has affected all sectors in Tanzanian population (TACAIDS, 2014). By 1986, all regions in Tanzania had reported AIDS cases. The HIV epidemic in the country is heterogeneous with geographical and population variability. In 2012, HIV prevalence ranged from 1.5 percent in Manyara, 2.4 percent in Tanga to as high as 14.8 percent in Njombe (THMIS, 2012). The HIV epidemic in the country is mostly attributable to heterosexual transmission which accounts for 80 percent, followed by MTCT (18 percent) and blood-borne infections (1.8 percent) of all HIV infections (TACAIDS, 2014).

Furthermore, in Tanzania, nearly half (45 percent) of the total population consists of young children aged less than 15 years (National Population (Census, 2013). This is a big concern since they are the future generation that will enter a reproductive age group (15-49) that can raise the economy of Tanzania. HIV infection continues to claim over thousands of lives of HIV exposed infants and children yearly in the country (UNAIDS, 2015). In 2013, there were 300 000 children aged less than 15 years living with HIV which account for 28 percent of all people living with HIV (PLHIV) in the country (Nuwagab-Biribonwoha, 2015, TACAIDS, 2014). In 2016, there were 1.4 million PLHIV in the country. In the same year, of the 55 000 total new HIV infections, 10 000 were children aged less than 15 years (UNAIDS, 2017b). The HIV prevalence among adults aged 15-64 years was five percent (6.5 percent among females and 3.5 percent among males) and it was less than one percent among children aged less than 15 years. The HIV prevalence varies geographically across Tanzania. In 2016, the HIV prevalence ranged from less than one percent in Lindi, five percent in Tanga to as high as 11.4 percent in Njombe (THIS, 2016-2017). HIV prevalence also varied between urban (6.0 percent) and rural (4.2 percent) areas. Furthermore, according to THIS 2016-17, there were higher estimated number of PLHIV in Kagera, Iringa, Tanga, Dodoma, and Mwanza compared to the 2016-17 Spectrum data. In Kagera, there was a 122 percent increase (approximately from 54 000 to 120 000), while in Tanga
there was 129 percentage increase (approximately from 24,000 to 55,000) in the estimated number of PLHIV (THIS, 2016-2017).

During the past decades, access to ART was very limited in Tanzania. Scaling-up access to ART has minimized the impact of the epidemic, such that, between 2004 to 2016 the HIV prevalence in Tanzania has declined from seven to five percent respectively (TACAIDS, 2014, THIS, 2016-2017). Furthermore, in 2016, Tanzania has achieved a 69 percent reduction in new paediatric HIV infections since 2009, and MTCT rate at the end of breastfeeding has gone down to eight percent (UNAIDS, 2016b). The number of new paediatric infections in 2016 has reduced to nearly half since 2010 (UNAIDS, 2017b, WHO, 2017a). In addition, between 2010 and 2016, there were reductions in AIDS-related deaths in the country from 71,000 to 33,000 which translate into a 53 percent reduction in AIDS-related deaths. These achievements can be attributed to effective PMTCT interventions and increased access to lifelong ART among PLHIV including pregnant women (UNAIDS, 2017b).

Currently, Tanzania has made considerable progress towards achieving the 90-90-90 targets. Recent statistics by THIS 2016-2017 reported that, only 52 percent of PLHIV knew their status and of these 91 percent had initiated ART. In addition, among PLHIV who self-report current use of ART, 88 percent are virally suppressed (THIS, 2016-2017). While, statistic for children are rarely available, but it was reported that, only 18 percent of children aged less than 15 years living with HIV are virally suppressed (THIS, 2016-2017). Thus, additional efforts are required to improve targeted HIV testing among men and women in order to achieve the 90-90-90 targets with ambition to end the HIV epidemic in Tanzania by 2030 (UNAIDS, 2014).

### 2.3 HIV diagnosis in infants and children

Diagnosis of HIV infection in children aged >18 months (including adults) usually is made by detection of HIV antibodies by enzyme-linked immunosorbent assays (ELISA), or rapid antibody test in whole blood, serum or plasma (WHO, 2010c). For national guidelines in Tanzania, the detection of HIV antibodies is done by using Determine® or Bioline® rapid
tests for the first test and using Uni-Gold® rapid test for the second test. HIV infection is tested and confirmed based on concordance of the results of these two HIV rapid tests (MoHSW, 2008a).

Diagnosis of HIV in children below 18 months is complicated by persistence of maternal HIV antibodies, rendered HIV antibody test unreliable (WHO, 2010c). Laboratory diagnosis of HIV infection in infants and children aged ≤18 months is done by detection of viral nucleic acid ribonucleic acid (RNA) or pro-viral deoxy ribonucleic acid (DNA) using polymerase chain reaction (PCR) or viral antigens (p24) testing (WHO, 2010c, MoHSW, 2008a). In infants and children under going virological testing, the following assays (with respective specimen types) are strongly recommended for use: HIV DNA on whole blood specimen or dried blood spot (DBS); HIV RNA on plasma or DBS; Ultrasensitive p24 Antigen on plasma or DBS (WHO, 2010c). It is strongly recommended that HIV virological testing be used to confirm HIV infection in infants and children ≤18 months of age (WHO, 2018). WHO recommends that all HIV exposed infants have virological testing at four to six weeks of age. The detection of HIV DNA on DBS has been shown to be more feasible in rural settings and samples can be stored for a long time and easily transported to Zonal/Central Laboratories (Nuwagaba-Biribonwoha et al., 2010).

2.4 Prevention of HIV

Paediatric HIV infection is a consequence of heterosexual transmission and HIV sero-positivity in pregnant women (Gouws et al., 2006). Therefore, prevention of heterosexual transmission in young adults and adolescents would also reduce paediatric HIV infection (UNAIDS, 2017a). If the 90-90-90 targets are met, which fast track the reduction in new adult HIV infections to 200 000 in 2030; this will translate into the reduction of HIV infected new born and the reality of an HIV-free generation will be achieved (UNAIDS, 2014). Since there is no cure to HIV, these targets can be achieved by combining the already established HIV prevention methods with provision of ART to prevent HIV infections. Methods of HIV prevention include behavioural, biomedical and structural
interventions that mainly focus on the major routes of HIV transmission (De Cock et al., 2000, Medley et al., 2009, WHO, 2016a).

Behavioral interventions focus on provision of health education in the community to address risk behavior reduction measures (Medley et al., 2009). These interventions include promoting safe sex behavior, safe sexual partner, reduce number of sexual partners, delay the age of first sex and improving sexual and reproductive health services education (Fishbein, 2000, Gray et al., 2007, Medley et al., 2009).

Structural interventions focus on opportunities that enhance availability, acceptability and accessibility of services that promote safe behaviours practices (Blankenship et al., 2000). Strengthening health care system for prompt access of services (including PMTCT and EID) and harmonizing enabling environment for linkage to several interventions that have an impact on resilience and vulnerability to HIV (Abdul-Quader and Collins, 2011). Harm reduction interventions such as needle and syringe programmes in intravenous drug users are among the structural interventions available in reducing spread of HIV (WHO, 2016a).

Biomedical interventions such as male and female condoms, voluntary medical male circumcision, pre-exposure prophylaxis and HIV treatment as prevention (also known as TasP) are major important strategies toward HIV prevention (Cohen et al., 2012, WHO, 2016a). On top of all, PMTCT intervention remain to be the major important strategy in preventing the risk of acquiring HIV in children. The rate of MTCT of HIV can be reduced by prompt access to EID services and adherence to PMTCT interventions (UNAIDS, 2015).

2.5 Treatment of HIV

Since, a cure for HIV or an effective HIV vaccine does not yet exist, the advent of potent combination ART effectively suppress HIV replication in infected patients and controlling the AIDS epidemic (WHO, 2016a). In additional to reducing plasma viral load, ART also improve immunological status and hence reduce the severity of HIV infection among PLHIV (WHO, 2016a). Antiretroviral drugs are grouped into classes, that specifically
target steps of the viral replication in the host cell. The usual ART regimen combines at least two different drugs from different classes. These classes include nucleoside reverse transcriptase inhibitors, non-nucleoside reverse transcriptase inhibitors, protease inhibitors, fusion inhibitors, entry inhibitors and integrase strand transfer inhibitors (FDA(US), 2018).

The WHO recommends generic drug formulations for use in low and middle income countries. An approach of ‘test and treat all’ has been implemented in most countries to fast track the 90-90-90 targets. The WHO recommends to initiate ART as soon as possible to all PLHIV after a confirmed diagnosis is reached (WHO, 2016b). A fixed dose combination of tenofovir disoproxil fumarate (TDF) + lamivudine (3TC) (or emtricitabine (FTC) + efavirenz (EFV) as the preferred first-line ART regimen for adults (including pregnant women) and children aged more than 10 years have been recommended. For children aged three to less than 10 years, the recommended first line ART regimen include a combination of Abacavir (ABC) + 3TC + EFV. The recommended first line ART regimen for children younger than 3 years include a combination of ABC or Zidovudine (AZT)+ 3TC+ Lopinavir/ritonavir (LPV/r) (WHO, 2016a). Early initiation of ART has been shown to reduce the risk of death and increase survival in children born to HIV infected mothers (Violari et al., 2008).

Transmission of HIV infection to the child depends on the infectiousness of the mother. The infectiousness of the host has a more detrimental effect in increasing the risk of transmitting the HIV infection to another individual. The virus rapidly multiplies in the body when an individual stops taking ART treatment. The more the viral load, the more the infectiousness of the host, the more the mutations that occur that may lead to drug resistance. Furthermore, an individual can be co-infected with more than one different HIV subtypes, so protection is important even if the individual is infected (MoHSW, 2014, Taylor et al., 2008). The uses of ART have been shown to decrease the risk of transmitting HIV infection from one individual to another as well as from the mother to child. In Tanzania mainland, it has been reported that about 68 percent and 71 percent of HIV positive pregnant women receive ART to prevent MTCT in 2010 and 2012, respectively (TACAIDS, 2012b). Maintaining adherence to ART is the most important factor for success of ART treatment.
2.6 Mother to child transmission of HIV

2.6.1 Vital information in MTCT of HIV

Mother to child transmission or vertical transmission, is the most predominant source of HIV infection in young children. To set good ground for issues concerning HIV in children it is important to understand that HIV transmission from mother to child can occur during pregnancy, delivery and through breastfeeding (UNAIDS, 2015). MTCT is directly associated with high maternal viral load and advanced stage of maternal HIV infection. High maternal plasma viral load reflects the high rate of viral replication which is a powerful indicator of HIV transmission. Maternal immunological status with CD4 cell count less than 200 cell per mm$^3$ near delivery and those who have been diagnosed with severe clinical disease are more likely to transmit the virus than those who are less severely affected by HIV infection (Leroy et al., 2002, Mock et al., 1999). The risk has been shown to be higher during vaginal deliveries, prolonged rupture of membranes during labour due to direct contact between infant and HIV infected maternal body fluid (blood, vagina and cervical secretions) (Kovacs et al., 2001, Newell, 2001). The risk of MTCT of HIV is greatest if there is concomitant presence of sexually transmitted infections (STIs), especially if genital ulceration is present (John et al., 2001). There are evidences that mothers presenting with malaria during pregnancy have an increased risk of MTCT (Mwapasa et al., 2004, Uneke, 2007). Prematurity, multiple pregnancy, breast feeding combined with other food before six months of age, cracked nipple or oral disease in the infant while breast feeding have been considered to increase the risk of MTCT (Newell, 2001).

MTCT accounts for more than 90 percent of HIV infections in children (WHO, 2007a). In the absence of any intervention, about 15-45 percent of HIV-infected mothers will transmit infection to their children, that is, 5-10 percent during pregnancy, 10-15 percent during labour and delivery and 5-20 percent during breastfeeding (De Cock et al., 2000). However, PMTCT strategy is an essential part of maternal, new born and child health service package and have been considered as the most safe and cost effective way to avert HIV infection and increase survival in children. However, to avert HIV infection among
children can only be possible by timely access to EID services and adherence to PMTCT services (UNAIDS, 2015).

In addition, increasing the level of general knowledge of MTCT of HIV and reducing the risk of transmission using ARV drugs is important in reducing transmission of HIV during pregnancy, childbirth, and breastfeeding (MoHSW, 2014). A study conducted in Kenya showed that caretakers and health service providers were aware of vertical transmission from mother to child which is through birth and breastfeeding but they had inadequate training and knowledge of EID services (Hassan et al., 2012b). As it was reported that, despite having undergone PMTCT counseling, nine out of ten of the caregivers said that “they had not heard of early infant testing before their children were enrolled for EID care”. However, none of the health service providers reported having attended a formal training specifically on EID (Hassan et al., 2012b).

2.6.2 Prevention of Mother to Child transmission of HIV globally

PMTCT is an intervention initiated by World Health Organization (WHO) aiming to ensure that no child is born with HIV globally (WHO, 2010b). PMTCT programmes have been widely implemented globally in most countries including sub-Saharan Africa since 2000. By the end of 2004 most countries in sub-Saharan Africa had established PMTCT programmes (Anoje et al., 2012, Braun et al., 2011, Nkenfou et al., 2012, Torpey et al., 2012). The PMTCT programmes focus on: (i) primary prevention of HIV infection in women of reproductive age (ii) prevent unintended pregnancies in women living with HIV, (iii) prevent HIV transmission from women to their infants and (iv) provide care, treatment and support to HIV infected mothers, their infants and families (WHO, 2010b). These approaches provides a continuum of interventions and care for women, children and their families. Thus, PMTCT is in line with sustainable development goal (SDG) number three, that requires countries to ensure healthy lives and promote well-being for all at all ages and to end the AIDS epidemic by 2030 (WHO, 2015). Furthermore, in 2006, the WHO decided to expand the initiatives of HIV care and treatment to include EID into PMTCT services (WHO, 2007a). PMTCT interventions, has undergone enormous development based on
scientific evidence from various researches aiming to reduce MTCT (Horvath et al., 2009, WHO, 2004).

Over the past decades, several regimens have been in use to reduce MTCT recommended by WHO. In 2010, the WHO recommended the regimen termed as option A. The regimen involved the use of AZT from 14 weeks of pregnancy until seven days post delivery and infant NVP from birth until one week after cessation of breast feeding (WHO, 2010a). Later on, guidelines were updated which encouraged long duration of triple ART during pregnancy from 14 weeks of pregnancy until end of breastfeeding and infant NVP daily from birth to age four to six weeks, this regimen was termed as option B. This regimen was further modified to initiate a lifelong triple ART during pregnancy irrespective of clinical stage of disease or CD4 count and infant NVP up to the age of four to six weeks. This regimen was termed as option B+ which was highly recommended by WHO (WHO, 2010a).

Since the introduction of potent regimes, good progress has been made on reduction of MTCT globally. However, more priority was given among the 22 Global priority countries that accounted for more than 90 percent of pregnant women living with HIV worldwide (UNAIDS, 2015). In 2009, only 37 percent of pregnant women living with HIV in 21 global priority countries (data from India was not available, so it was dropped) access antiretroviral drugs compared to 77 percent in 2014 and MTCT rate were reduced by half from 28 percent to 14 percent (UNAIDS, 2015). By 2016, more than 1.4 million pregnant women were living with HIV globally and only 76 percent access lifelong ART and approximately 160 000 new HIV infections occurred among children (UNAIDS, 2017b). Thus, more efforts are needed in order to increase access to lifelong ART among pregnant women, to ensure retention into continuum of care and adherence to ART throughout pregnancy and breastfeeding, if we are to reach the ambitious of eMTCT by 2030 (UNAIDS, 2014).

Furthermore, EID services have been integrated into PMTCT programme throughout sub Saharan Africa including Tanzania since 2006 (Buchanan et al., 2014, Nkenfou et al., 2012, Ong’ech et al., 2012, Wiegert et al., 2014). Nevertheless, service integration has a number
of challenges since it require strengthening the capacity of health care providers, improve infrastructures and strengthening health system to ensure universal access to HIV testing, prevention and treatment (WHO, 2010b, WHO, 2007a). Integration usually also requires retraining (health care providers need additional skills to perform multiple new tasks) and can raise questions around suitable remuneration due to increased workload (Chirdan et al., 2009).

In addition, loss to follow up has been shown to be an additional challenge in effective implementation of PMTCT programme. In some studies in Tanzania and South Africa, more than 30 percent of HIV infected infants did not report to HIV Care and Treatment Clinics (CTCs) for ART despite the fact that they were referred for ART (Chiduo et al., 2013, Jones et al., 2005, Mwendo et al., 2014). Studies in South Africa and Tanzania have showed that, more than 60 percent of infants born to HIV-positive mothers who were registered for care were lost to follow-up at different ages from six weeks to 12 months old (Chiduo et al., 2013, Jones et al., 2005). More than three quarters of infants born to HIV infected mothers who register for care, drop out before six months of age and up to 85 percent by the 12 months of follow up (Sherman et al., 2005, Patton et al., 2007). Loss to follow up needs to be addressed in all EID services early enough before initiation of ART in order to safeguard the life of those infants and children who are confirmed to be HIV positive.

2.6.3 PMTCT situation in Tanzania

Tanzania is among the 22 priority countries of the Global Plan targeted for elimination of new HIV infections among children and keeping their mothers alive. These countries including Tanzania, account for more 90 percent of the global number of pregnant women living with HIV who were in need of services to prevent mother-to-child transmission (UNAIDS, 2015). In 2000, Tanzania Ministry of Health and Social Welfare (MoHSW) in collaboration with United Nations Children's Fund (UNICEF) established a pilot programme at five tertiary hospitals located in Dar es Salaam, Kilimanjaro, Mwanza, Mbeya and Kagera. The initiative was aimed at assessing the feasibility of integrating PMTCT services into routine maternal and Child Health services (MoHSW, 2012). In 2004
the PMTCT services were integrated into routine ANC, delivery and Post natal care services. The integrated PMTCT/ANC/post natal care services were scaled up nationally to involve all regions in Tanzania. By 2011, 96 percent of RCH facilities had integrated PMTCT in routine ANC, delivery and post natal care services; about 64 percent of HIV infected pregnant women and 56 percent of HIV exposed infants received ARVs for PMTCT and 19 percent of pregnant women with advanced HIV infection were started on lifelong ART (MoHSW, 2012). The national PMTCT guidelines were available for use which were adapted from WHO PMTCT guidelines. Several updated revisions were subsequently available based on WHO updates (MoHSW, 2013a). In 2007, EID services with DNA PCR was introduced into ANC/PMTCT services which were subsequently scaled up in all regions of Tanzania (MoHSW, 2012).

In Tanzania, all pregnant women are recommended to attend at least four focused ANC visits which is in line with WHO recommendations (Kearns et al., 2014). Several visits to health care facility provide maximum benefits among pregnant women to receive integrated package of services which are related to their own health and to their new born babies. The services include education on all HIV related issues, HIV testing and counseling, EID testing, family planning, immunization, nutritional support and counselling, Vitamin A supplementation and other services that are essential for improving health outcomes. At every ANC visit, all particulars of every pregnant women are usually recorded in appropriate registers for documentation. HIV infected pregnant women were recorded in PMTCT care registers. After birth, HIV exposed infants were recorded in the EID registers (child follow up registers) and followed up to 18 months. But currently the new “cohort mother-child” register is in use in some health facilities in Tanzania during 2016 which record both HIV infected pregnant women since first ANC visit up to delivery + HIV exposed infant up to 18 months.

Since 2013, Tanzania is implementing an Option B+ strategy as its national policy for preventing new HIV infections among children and keeping their mothers alive (UNAIDS, 2015, MoHSW, 2013a). More than 90 percent of Reproductive and Child Health clinic (RCH) are providing ANC and PMTCT services and approximately 98 percent of pregnant women attend ANC at least once during pregnancy (TDHS-MIS, 2015-16). The coverage
of pregnant women accessing antiretroviral medicines has increased from 75 percent to 84 percent during 2010 and 2016 respectively (UNAIDS, 2017b). In 2016, the country, had made a significant progress towards eMTCT as it had achieved a 69 percent MTCT reduction since 2009, but not yet reached the Global Plan target for eMTCT of 90 percent reduction that was set by 2015 (UNAIDS, 2017b). Furthermore, the rate of MTCT of HIV in the country has gone down to eight percent but not yet to the Global Plan target level of less than five percent (UNAIDS, 2017b). The number of children born with HIV had reduced from 11,000 in 2010 to 10,000 in 2016 (UNAIDS, 2017b, WHO, 2017a). These achievements so far can be attributed to the use of effective PMTCT regimens including Option B+ and also increased access to ART by pregnant women living with HIV and access to NVP among new born babies (UNAIDS, 2017b).

2.6.4 Early infant diagnosis of HIV globally

EID of HIV infection is part of maternal, newborn and child health service package that has been integrated into PMTCT in most countries since 2007 in sub Saharan Africa including Tanzania (Buchanan et al., 2014, Nkenfou et al., 2012, Ong’ech et al., 2012, UNAIDS, 2015). Despite the investments in PMTCT interventions in most sub Saharan Africa, the coverage of HIV interventions in infants and children remains unacceptably low (Cook et al., 2011, Coulibaly et al., 2014, TACAIDS, 2012a, WHO, 2010b). In 2014, there was a significant progress in paediatric HIV diagnosis, whereby, only 49 percent received a virologic HIV test within the first two months of life among the 21 priority countries (compared to 40 percent in 2013) (UNAIDS, 2015). However, there is wide variation between countries on EID coverage. Only seven of the 21 priority countries were providing timely virological diagnosis to 50 percent or more among HIV exposed children in 2014, these are Namibia (>95 percent), South Africa (94 percent), Zambia (94 percent), Swaziland (81 percent), Kenya (72 percent), Lesotho (55 percent) and Uganda (51 percent). While in the remaining countries, the EID coverage were less than 50 percent , that ranged from four percent in Chad, 43 percent in Tanzania and 45 percent in Zimbabwe (UNAIDS, 2015).

Furthermore, in 2015, of the 1.4 million children aged less than 15 years born to mothers living with HIV in 21 priority countries, only 51 percent were tested within two months of
age and, of those, only 50 percent received results, with a median time between 30-90 days from sample collection to return of results to caregivers (Manumbu et al., 2015a, Sutcliffe et al., 2014, UNICEF, 2015). Of those children who received their results and were confirmed to be HIV positive, only half access ART (Bourne et al., 2009, Innes et al., 2014, UNAIDS, 2016a). Moreover, in 2014, only 31 percent of children less than 15 years who were living with HIV in 21 priority countries received ART, compared to 27 percent in 2013 and 10 percent in 2009 (UNAIDS, 2015). These statistics suggest that urgent measure needs to be taken in order to improve the quality and survival among children. Without early diagnosis and treatment, about one third of HIV-infected infants will die before the age of one year, half by their second birthday and 80 percent by their fifth birthday (Newell et al., 2004, Bourne et al., 2009).

The major contributing factors to the low ART coverage in infants and children might be due to limited capacity of most health facilities to conduct virological testing for EID (Ciaranello et al., 2011). The inability to diagnose HIV infection as early as possible in infants and young children severely limits access to ART and its timely initiation in most settings including Tanzania (Ciaranello et al., 2011, Cook et al., 2011, Coulibaly et al., 2014). WHO recommends that HIV exposed infants to be tested at the first postnatal visit at the age of four to six weeks or at the earliest opportunity thereafter, and those found infected to start ART immediately (WHO, 2013). However about half of HIV exposed infants still do not receive an HIV test as recommended (UNAIDS, 2015). Thus it is critically important to strengthen health systems to ensure the uptake and continuity of migration through the EID cascade and monitoring the implementation of PMTCT programme in order to move towards eMTCT (UNAIDS, 2015). Prompt access to EID services should be emphasized at optimal levels in order to maximize an opportunity for follow up of HIV exposed children for early detection of infection and timely access to ART (WHO, 2013).

Several important factors hampering access to EID services were reported from studies conducted in sub Saharan Africa which stem from individuals/community and health system perspectives. Individual factors include; low maternal education level, long distance from health facility, poverty and lack of social support reported in Kenya to affect EID
services (Hassan et al., 2012a). Other reported factors to affect EID services include, affordability to cater for transport cost in Malawi (Braun et al., 2011), lack of paternal support/permission in Malawi and Zambia (Dube et al., 2012, Kankasa et al., 2009) and larger household size in Mozambique (Cook et al., 2011). However, poor compliance to PMTCT/EID among women in Cameroon (Nkenfou et al., 2012) and poor knowledge on PMTCT and EID among mothers in South Africa (Woldesenbet et al., 2015) were among the barriers to access to EID and PMTCT services. HIV related stigma have been reported as one of the major factors leading to poor return of follow up to HIV clinic among mother-child pairs. In South Africa, maternal fear of infant HIV results, feeling of shame or guilty to raise infant when found to be HIV positive were identified as barriers to access EID services (Adeniyi et al., 2015).

Health facility factors including supplies out of stock in Kenya and Burkina Faso (Hassan et al., 2012a, Coulibaly et al., 2014), limited capacity to perform PCR analysis in sub Saharan Africa (Ciaranello et al., 2011) were among the barriers to access EID services. In Kenya, unavailability of algorithm for EID and lack of training on DBS sample collection among health care providers were found to affect EID services (Cherutich et al., 2008). In addition understaffing and poor health care infrastructure in Burkinafaso (Coulibaly et al., 2014), long time of return of HIV results in Zambia, Uganda, Cameroon and Zimbabwe (Sutcliffe et al., 2014, Mugambi et al., 2013, Tejiokem et al., 2011, Wiegert et al., 2014) were among the factors that affect access EID services. Poor communication between ANC and postnatal facilities, poor documentation of HIV status on infant register and lack of provider-initiated testing and counseling (PITC) for unknown HIV exposed infants were reported to affect access of EID in South Africa (Woldesenbet et al., 2015). Thus it is critically important to strengthen health systems to ensure uptake and increase EID services coverage and timely testing at the age of four to six weeks as recommended by WHO.

EID is very crucial because it reduces the costs of infant follow-up and lowers morbidity and mortality rates through timely getting HIV-infected children into appropriate care and treatment programmes (Ciaranello et al., 2011, WHO, 2010b). Other benefits of EID include reductions in antibiotic prophylaxis for HIV-uninfected infants, a reduction in maternal anxiety, and the ability to monitor the effectiveness of PMTCT programmes.
(Creek et al., 2008). Therefore, it is important to identify barriers that affect accessibility to EID services in order to strengthen the programme.

2.6.5 EID in Tanzania

Tanzania Ministry of Health established a pilot EID programme at a tertiary hospital located in Mwanza during October 2006 to March 2007. During this period, 510 HIV-exposed infants were identified from the four health facilities. Of these, 441 (87 percent) infants had an HIV DNA PCR test at a median age of four months (IQR: 1 to 8 months) and 75 (17 percent) were PCR positive (Nuwagaba-Biribonwoha et al., 2010). The Ministry of Health in collaboration with development partners, as part of scaling up services, developed guidelines on EID, including new guidelines for early initiation of ART for infected infants. Four zonal Laboratories located within tertiary hospitals (Kilimanjaro Christian Medical Centre (KCMC), Muhimbili National Hospital, Mbeya Referral Hospital and Bugando Medical Centre) were equipped to perform EID using DNA-PCR testing. By June 2009, Dec 2010 and December 2016 there were 509, 1,520 and 4,737 sites providing EID services through collection of DBS (Dried Blood Spots) and transporting to the reference laboratories for testing in the Tanzania mainland (MoHCDGEC, 2017b, MoHSW, 2012). In all districts of Tanzania including Muheza district, EID cascade is a well programmatic service as part of maternal and child health care services (Figure 2.1). The entry points to access EID at the health facility include ANC, PMTCT, RCH, labour ward, postnatal clinic, paediatric inpatient ward and immunization clinic. HIV exposed infants can be identified at any entry point of care at the health care facility and tested at the age four-six weeks as recommended by WHO. All DBS samples from all health facilities are transported to the nearby reference laboratory and when results were out are usually sent back to respective health facilities either by SMS (short message service) or postal mail. However, for hospital that have reference laboratory in situ, the transportation time of DBS sample to the lab is usually minimized compared from other health facilities, whereby the DBS specimen have to be sent to central point (district hospital/regional hospital) before they were channeled to reference laboratory.
Figure 2.1: The EID cascade

Source: MoHSW (2013)

2.6.6 Improving effectiveness of EID implementation

More effort to identify children living with HIV are growing in many countries. Turnaround time and the actual return of test results to health care providers and caregiver of the HIV exposed infant are critical bottlenecks to early initiation of ART. However, the advent of point of care (POC) EID technologies is a breakthrough that creates opportunity to increase coverage of EID testing (UNAIDS, 2018, WHO, 2017b). A number of countries are currently implementing POC early infant diagnostics for HIV. There is strong evidence that POC EID technology significantly increases the timely diagnosis of infants living with
HIV, improves their access to ART, saves lives and is cost-effective (Jani et al., 2018, Francke et al., 2016). For instance, studies conducted in Malawi and Mozambique, infants who had been diagnosed with HIV using POC EID technology were more likely to start ART immediately than infants whose test samples had to be sent to central laboratories (Jani et al., 2018, Mwenda et al., 2018). POC EID makes it possible to test infants on-site, provides the opportunity to reduce test turnaround times, limit patient loss along the HIV testing cascade, reduce infant mortality, and allow for task shifting to lower cadres of health care providers at decentralized health care facilities (WHO, 2016a). However, the higher cost of POC tests may discourage scale-up, in Zimbabwe it was found that POC EID improved infant survival by 6.8 percent and was cost-effective compared to conventional EID because of much greater proportion of infants living with HIV who successfully initiate ART faster after a POC test (Bailey and Peter, 2018).

The HIV Infant Tracking System (HITSystem) has been found to be effective and feasible to implement in low-resource settings. A tracking and notification system tested in Kenya, sends automatic text messages to health care service providers of EID, laboratory technicians, and mothers of HIV exposed infants at specified intervals in the service cascade. Infants enrolled in the HITSystem were significantly more likely to receive complete EID compared with those assigned to standard of care. This significantly reduced the turnaround time for receiving test results and notifying mothers of the results. HIV positive infants also started ART more quickly after diagnosis than their counterparts in the control arms of the study (Finocchario-Kessler et al., 2018). In addition, the use of mobile phone-text message alerts for mothers also has been shown to increase EID access, entry and retention of HIV-exposed infants in care (Finocchario-Kessler et al., 2014).

In Tanzania, integrated ANC/PMTCT services had substantially improved coverage of EID services in recent years (UNAIDS, 2015). However, the success and benefits of this integrated services are dependent on effective implementation, which can be hampered by weak health system factors (WHO, 2007b). Provision of a set of interventions at a single point to a targeted group had been shown to increase their coverage (TDHS-MIS, 2015-16). Failure to deliver integrated health services jointly with other complementary programmes
provided to a target group has been found as a barrier to access other health care services. For example, overlooking the opportunity to check and update HIV status or vaccination status, when a child is brought to the health care facility for other services (MoHSW, 2012).

In addition, routine HIV testing to all infants presented at vaccination clinics and hospitalized children in Tanzania and Zambia have been found to identify large number of HIV exposed infants and children (Goodson et al., 2013, Kankasa et al., 2009). In South Africa, identifying HIV-exposed infants presented at their six week immunization visit and inform mothers during ANC about infant testing has been shown to increase access to EID (Woldesenbet et al., 2015). It is also important to ensure that all adults in HIV care are explicitly offered testing for their children, and to offer testing for young children who present for immunization, malnutrition services and tuberculosis treatment, as well as those who present with illnesses at outpatient or in paediatric wards.

Improving PMTCT services will automatically improve implementation of EID services. Poor compliance to PMTCT services among pregnant women living with HIV has shown to affect access and uptake of EID services (Nkenfou et al., 2012). This could be due to social or behavioural factors, such as HIV-related stigma, lack of partner support/permission or negative attitudes to health care providers (Adeniyi et al., 2015, Dube et al., 2012). Social intervention to support these mothers, such as the involvement of male partners, use of peer support group (mother to mother, mentor mothers), and CHWs has shown to improve compliance, and retention in PMTCT services, and the uptake of early infant HIV testing (Ambia and Mandala, 2016). Likewise, behavioural intervention, such as the use of customized messages alert through mobile phones, that can easily inform mother of important clinic visits, has also shown to increase uptake of EID services (Ambia and Mandala, 2016). Furthermore, structural interventions, such as conditional cash transfer, training of health care providers, improved referrals and linkages, strengthening laboratories infrastructures and integration of PMTCT into routine maternal and child health care services has shown to increase uptake of infant HIV testing and ultimately improving EID coverage (Ambia and Mandala, 2016). More efforts are needed to
strengthen integrated ANC/PMTC/EID services into existing health care system in order to improve effectiveness and implementation of EID services.

Access to EID services among HIV exposed under five-year children continue to be among the major problem in Tanzania health care system. Nearly half of HIV exposed infants accessing EID services in 2014 in Tanzania. Infants and young children are the most vulnerable population and they progress to severe fatal diseases than elderly if they are diagnosed late with HIV infection (Pananghat et al., 2016). In addition, without early treatment, infants infected in utero or during labour and delivery have poor prognosis compared with those infected during breastfeeding period (UNAIDS, 2016a). Hence, this study aims to identify factors that hinder accessibility to EID services among under five-year children exposed to HIV infection in Muheza district, Tanzania in order to improve EID services.

### 2.7 Tanzania Health Care System

This section provides an overview of the health care system in Tanzania and its general organization, as a context in which to view the implementation of PMTCT and EID services within existing health care system.

The Tanzania health sector is guided by the National Health Policy (2007) which provides Government’s vision on long-term developments in the health sector (MoHSW, 2008b). The vision of the Health Policy in Tanzania is to improve the health and wellbeing of all Tanzanians with a focus on those most at risk, and to encourage the health system to be more responsive to the needs of the people. The policy mission is to facilitate the provision of equitable, accessible, good quality, affordable and sustainable basic health services, which are gender sensitive and sustainable, delivered for the achievement of improved health status (TDHS-MIS, 2015-16). The implementation of the National Health Policy-2007 has been in line with implementations of the National Development Vision 2025, the Millennium Development Goals (MDGs), the National Strategies for Growth and Reduction of Poverty (popularly known by its Kiswahili acronym, ‘MKUKUTA’).
programmes and other development efforts (MoHCDGEC, 2017a). In line with WHO recommendations, Tanzania Ministry of health foster to strengthen the health care system in all the six health system building blocks. These include service delivery, governance, health workforce, health information system, access to essential medicines and medical supplies, health care financing.

2.7.1 Service provision

Health services in Tanzania are provided by public and private health facilities. The health care system has been structured into levels starting from village health post and dispensaries at lower levels to consultant/specialized hospitals at the top levels (Figure 2.2) (MoHSW, 2013c). Health services provided at the dispensaries, health centers and district hospitals represent the primary health care services where most of ANC, PMTCT and EID services are provided. At the lower levels, healthcare is initiated at the household level where by in most cases care is sought from either traditional, natural therapist or conventional health facilities, most often, when homecare has failed (MoHSW, 2013c). The next level, we have village health post whereby a village health worker also known as CHW provides basic preventive health services within the community after a short training before they provide the services. Clients often start at village health services go upward, and may be referred to dispensary services, health centre services, district hospitals, and regional hospitals (MoHSW, 2013c).
2.7.2 Health service delivery

In Tanzania, geographical inequalities in the distribution of health care facilities among urban and rural areas do exist and this limits health service access and utilization. More than 80 percent of the total population has access to health services and over 90 percent of the population lives within 10 km from a health facility (TDHS, 2010). In the year 2010, about 82.4 percent of urban women delivered at a health care facility compared to only 41.9 percent of rural women (Kearns et al., 2014). In addition, in the same year only 15.1 percent of pregnant women attended their first ANC visit during their first trimester of pregnancy and less than half of women receive the recommended minimum number of ANC visits. Poor utilization of health services is a challenge especially among pregnant women which has great impact on child health outcome (Kearns et al., 2014). Therefore, the Tanzania health care system should make more efforts to follow and support pregnant women living with HIV and their upcoming HIV exposed children to adhere to PMTCT and EID services.
2.7.3 Governance
In Tanzania, the Ministry of Health, Community Development, Gender, Elderly and Children (MoHCDGEC) and the President’s Office Regional Administration and Local Government (PMORALG) are jointly responsible for the delivery of public health care services (MoHSW, 2013c). The Tanzanian health System is based on decentralized services to Local Government Authority (LGA) in line with decentralization by devolution principle. The Ministry of Health is responsible for policy formulation and the development of guidelines. The central government provides leadership and stewardship in the health sector (MoHSW, 2013c). At the regional level, the Regional Health Management Teams (RHMTs) interpret these policies and supervise their implementation in all public and private health care facilities in the districts. Each RHMTs are headed by a Regional Medical Officer. Regional Medical officers report through the Regional Administration Secretary to the MOHCDGEC on issues related to technical management and to the PMORALG on issues related to health administration and management of health services. At the district level, the Council Health Management Teams (CHMTs) is responsible for council health services including dispensaries, health centers and district hospital. Each CHMT is headed by a District Medical Officer, who is in charge of all district health services and is answerable to the LGA (MoHSW, 2013c).

The MOHCDGEC also oversees autonomous agencies with health-related responsibilities, including the Tanzania Food and Drugs Authority, the Medical Stores Department, the Chief Government Chemist, Tanzania Food AND Nutrition Centre and the National Institute for Medical Research (MoHCDGEC, 2017b). The MOHCDGEC collaborates with donors and non-governmental organizations on the implementation of public health programmes such as the Expanded Programme on Immunisation, Reproductive and Child Health Services, the National AIDS Control Programme, the National Malaria Control Programme and the National Tuberculosis and Leprosy Programme (MoHCDGEC, 2017b).

2.7.4 Health workforce
Tanzania’s health sector, like most countries in sub-Saharan Africa is facing a big shortage of human resources for health at all levels, which indirect affect negatively the delivery of health care services to the Tanzanian people (MoHSW, 2013c). PMTCT and EID services
as part of maternal, child and newborn health has been a priority component of Tanzania national health policy since 2006. However, little improvement has been observed on maternal and child health indicators (National Population (Census, 2013, TDHS, 2010) in recent years due to weak health system that is compounded with low quality of health services and inadequacy of skilled health care providers (MoHSW, 2013c).

2.7.5 Health information system
For many years, the Tanzania MOHCDGEC implemented routine Health Management Information system (HMIS) for reporting health related data from health care facilities. Data from each health facility were summarised manually and then sent to district hospital. These were then sent to regional and subsequently to national level either manually or electronically (MoHSW, 2013c). This system was associated with a number of challenges characterized by incompleteness, inconsistency, poor quality and limited utilization of data. Poor linkage of hospital data, especially linkage of mother-infant pairs data in PMTCT was an additional challenge (MoHSW, 2013c). Currently, HMIS has been replaced by open source software known as the District Health Information Software two which requires health facilities to procure computers and data entered electronically. The system uses mobile phones from the facility direct to a central database and has been scaled up to involve all health care facilities in Tanzania (MoHSW, 2013c).

2.7.6 Access to essential medicines and medical supplies
The government aims to ensure the availability of drugs, reagents, diagnostic resources, medical supplies and infrastructures. The Medical Store Department (MSD) is responsible for ordering and distributing all the medical supplies and equipments used in public health care facilities (http://www.msd.go.tz). However, public and private health care facilities procurer medicines and medical supplies from MSD, private pharmacies or directly from manufactures (http://www.msd.go.tz). Weakness in supply chain management has been identified as a challenge to health sector that limits adequate supply of medical supplies. Poor forecasting, long supply lead times required for ordering medical supplies and inefficiencies in procurement were most identified challenges in supply chain (Wales et al., 2014). Medical supplies out of stock have been a threat to most health care interventions such as HIV/AIDS programme including PMTCT and maternal and child health services.
However, the quality of PMTCT and EID services have been reported to be poor and this was mainly due to supplies out of stock like HIV kits, ART, medical supplies for infection prevention that support PMTCT and ANC services (An et al., 2015).

2.7.7 Health care financing

Tanzania uses a mix of financing sources to support its health care system. It depends heavily on development partner (donor funding) which contributes up to 40 percent of total health expenditure. Other financial sources include, out-of-pocket payments (households), taxation and prepayment insurance schemes (MOHSW, 2013d, Dutta, 2015). The proportion of the total government expenditure going to the health sector in 2015/16 was 11.3 percent (Lee et al., 2015). The health budget for the year 2017/2018 was approximately seven percent of the total government of Tanzania budget (PEPFAR, 2018).

Tanzania national HIV program including PMTCT and EID is largely donor dependent through President's Emergency Plan For AIDS Relief (PEPFAR) which contribute about 98.9 percent of public financing for HIV and AIDS. PEPFAR cater for the total country needs for ART, rapid HIV test kits, EID, and viral load commodities by providing them to the central medical stores for distribution (PEPFAR, 2018).

2.8 Conceptual Framework

A proximate determinant conceptual framework was used to assess factors associated with accessibility to EID services (Figure 2.3). The framework has been adapted from earlier works (Davis and Blake, 1956, Bongaarts, 1978). In this framework the underlying factors including individual factors (demand-side determinants) and proximate factors including health facility factors (supply-side determinants) interact with community factors and influence each other to bring public health outcome which can be favorable or unfavorable. In the context of this study the main primary outcome (dependent variable) of interest is EID access. The demand-side determinants are factors influencing the ability to use health services at individual, household or community level, while supply-side determinants are aspects intrinsic to the health system that hinder service uptake by individuals, households or the community(Jacobs et al., 2011). In modifying one or more of these factors in this
proximate determinant framework could provide evidence in favour of improving EID services and hence improved quality of life of HIV exposed infants and young children.

Figure 2.3: Conceptual framework showing factors associated with accessibility to early HIV testing
CHAPTER 3: METHODS

3.1 Study area

The study was conducted in Muheza District in Tanga Region, north-eastern Tanzania (4°, 45’S; 39°00’E) (Figure 3.1). The district covers an area of 1,974 square kilometers with estimated population of about 230,366 (MDC, 2017). The district has 37 wards and 135 villages. About 90 percent of the people live in the rural areas (National Population Census, 2013). The majority (about 80 percent) of the population walk five to 10 km to the nearest health care facility (MDC, 2017).

The average annual rainfall range from 1000-1500 mm and average temperatures range from 26-32°C. The district has three main climatic belts namely Coastal belt, Lowland plains belt and Mountainous belt. Muheza District has four Divisions, 33 Wards and 135 registered Villages. The infrastructures of the district are fairly built, the road network sums up to more than 586 km of which 421 km connect to the periphery. During rainy season, some of the roads are partially or completely impassable which hinder communication to some health facilities (MDC, 2017).

The prevalence of HIV in the district in 2013 was estimated to be 3.9 percent. The HIV prevalence among male and females aged above five years in 2013 was estimated to be 3.3 percent and 4.6 percent respectively (MDC, 2013). However, there were no reported data on HIV prevalence of children below five years. In 2015, the HIV prevalence among pregnant women in Muheza district was four percent. The prevalence in other districts ranged from 1.4 - 3.7 percent (Lushoto 1.4 percent, Kilindi 1.7 percent, Korogwe 3.3 percent, Handeni 2.1 percent, Mkinga 2.9 percent and Pangani 3.9 percent). The prevalence was 3.7 percent and 5.5 percent in Korogwe and Tanga Town councils respectively (Azoumah et al., 2017, TDHS-MIS, 2015-16). Key health indicators of Tanzania and of Muheza District are presented in table 3.1.

The district is served by only one district-level general hospital which is called Saint Augustine Muheza Designated District Hospital (SAMDDH), also known as Teule Hospital. The Hospital is owned by the Anglican Church Diocese of Tanga. The district has
a total of 46 health facilities (one hospital, four health centers and 41 dispensaries) and were all included in the study. These include, district hospital; Kididima, Bulwa, Mkuzi, Ubwari (health centers); Bwembwera, Kibaoni, Kicheba, Kwafungo, Longuza, Magila, Magoda, Misozwe, Mkanyageni, Nkumba, Potwe, Songa, Tongwe, Pangani falls, Ngarani, Mhamba, Misalai, Monga, Zirai, Mgambbo, Ngua, Derema, Amani, Kisiwani, Mambara, Mtindiro, Kwabada, Kilulu, Muheza medicare, Muheza, Kwatango, Kambai, Kigumba, Machewa, Kigongo (dispensaries).

Table 3.1: Health indicators for Tanzania and Muheza district

<table>
<thead>
<tr>
<th>Description</th>
<th>Tanzania Figure/percent</th>
<th>Muheza Figure/percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population proportion (%) under 15 years</td>
<td>45.2</td>
<td>33.7</td>
</tr>
<tr>
<td>Population proportion (%) under five years</td>
<td>-</td>
<td>8.1</td>
</tr>
<tr>
<td>Population proportion (%) under one year</td>
<td>-</td>
<td>3.1</td>
</tr>
<tr>
<td>Population of women(%) aged 15-49 years</td>
<td>24.3</td>
<td>24.8</td>
</tr>
<tr>
<td>Antenatal coverage 1st visits (%)</td>
<td>-</td>
<td>11</td>
</tr>
<tr>
<td>Antenatal coverage ≥ 4 visits (%)</td>
<td>-</td>
<td>38</td>
</tr>
<tr>
<td>Postnatal care coverage within 7 days after delivery (%)</td>
<td>-</td>
<td>29</td>
</tr>
<tr>
<td>Total fertility rate(number of children per woman)</td>
<td>5.2</td>
<td>-</td>
</tr>
<tr>
<td>Births delivered at health facility (%)</td>
<td>63</td>
<td>85</td>
</tr>
<tr>
<td>Children (12-23) months received all basic vaccinations (%)</td>
<td>75</td>
<td>-</td>
</tr>
<tr>
<td>Children under five(%) who are stunted(moderate or severe)</td>
<td>34</td>
<td>0.4</td>
</tr>
<tr>
<td>Neonatal mortality (per 1 000 live births)</td>
<td>25</td>
<td>30</td>
</tr>
<tr>
<td>Infant mortality (per 1 000 live births)</td>
<td>43</td>
<td>25</td>
</tr>
<tr>
<td>Under 5 mortality (per 1 000 live births)</td>
<td>67</td>
<td>30</td>
</tr>
<tr>
<td>Maternal mortality ratio (per 100 000 live births)</td>
<td>398</td>
<td>-</td>
</tr>
<tr>
<td>Literacy rate among adults aged 15 years and above (%)</td>
<td>73</td>
<td>-</td>
</tr>
<tr>
<td>Life expectancy at birth (years), M=Male, F=Female</td>
<td>62 (F=64; M=60)</td>
<td>-</td>
</tr>
</tbody>
</table>


3.1.1 Care and Treatment Clinics in Muheza

In the district, Care and Treatment Clinics (CTCs) services that provide HIV care and treatment services are offered in nine health facilities. The PMTCT services are available in 36 health facilities and are offered in almost five days per week. The EID services are
available in 28 health facilities and are usually offered twice per week or in any day when they receive the patients. HIV is the most important leading infectious disease in Muheza District. In 2013, the proportion of patients on ART according to age is described as follows: Among under five-year children, the proportion of male and female was two percent (138) and 2.1 percent (148) respectively. Among individuals aged five to 15 years, the proportion of male and female was 2.8 percent (201) and 3.1 percent (218) respectively. Among individuals aged >15 years, the proportion of male and female was 27.4 percent (1935) and 62.7 percent (4429) respectively. The total proportion of HIV positive male and female who are on ART by 2013 were 32 percent (2274) and 68 percent (4795) respectively (MDC, 2013).

Figure 3.1 Map of Tanzania showing study site
3.1.2 EID cascade in Muheza

The entry points to access EID at the health facility in Muheza district include ANC, PMTCT, RCH, postnatal clinic, paediatric inpatient ward and immunization clinic whereby an HIV exposed infants can be identified at these points of care. All DBS samples from dispensaries and health centers are transported to the central point at Muheza district hospital (Teule Hospital) at irregular time intervals depending on the amount of DBS collected at particular health facility (Figure 2.1). In Muheza district, transportation of DBS sample from peripheral health facilities to Muheza district hospital is by foot or public transport such as bus and motorcycle, and rarely by hospital vehicle. Due to problem of transport, most often health care providers from remote health facilities have to wait at least a number of DBS samples have been collected (often times at least five or more) before they decide to send to district hospital, so these create a lot of unnecessary delays. Since some facilities can collect two or three DBS samples per one week. At the district hospital, again they have to wait at least to receive a minimum number of 10 to 20 DBS sample before they ship to reference Laboratory. This creates another delay. All DBS samples collected at district hospital are then transported to KCMC Clinical Laboratory for PCR analysis by EMS. After receiving for DBS samples in the lab, they are processed and results are usually sent back to district hospital. In the past the results were usually sent by both SMS printer and EMS (Expedited Mail Service). But during the period of study the results were received by EMS only because SMS printer was out of order since March 2014. Getting the HIV result is a challenge in Muheza district. It can take weeks for the results to come back to the respective dispensary or health centre and it is worse in remote health facilities due to problem of transport. Then, at the health facility the health care provider needs to contact the mother for follow-up. Then, those who tested positive are refereed to CTC for ART care, and negative ones are followed up (MoHSW, 2013a, MoHSW, 2013b). The long turnaround times from DBS sample collection to result receipt at the health facility, and even longer time for results return to caregivers, contributes to high loss-to-follow-up of HIV exposed infants (Chiduo et al., 2013, Manumbu et al., 2015b).
3.2 Study population

These included all under five-year children born to HIV positive mothers who were not breast feeding; mothers/guardians who have HIV exposed under five-year child and health care providers involved or working with people living with HIV/AIDS (PLHIV) in Muheza district.

3.3 Study design

Study design was a concurrent mixed methods comprising of cross sectional survey, health facility survey and case study designs were conducted from June 2015 to June 2016 (Table 3.2). Results obtained during cross sectional survey and health facility and case study including from both methods (qualitative and quantitative) were triangulated for interpretation. Mixed methods and triangulation of qualitative data gave credibility to the findings from the study. Though mixed methods design provide an in depth to investigation of the questions under the study but it is more labour intensive and require greater resources and time. However this was minimized by collecting data employing all methods at one point per each site visited in that particular day. That means data was collected concurrently throughout the study period. However, the quality of data collected in mixed methods might have been presented at suboptimal level, but each methods adhered to its own standard procedures during data collection, management and analysis. In addition, case study was done to explore mothers/guardians’ views, perceptions and provide insight into complex relations which are critical in order to understand what are the factors affecting access to EID among under five-year children.
### Table 3.2: General summary of the Methods

<table>
<thead>
<tr>
<th>Study design</th>
<th>Data collection</th>
<th>Study population</th>
<th>Main outcome</th>
<th>Main analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cross sectional survey</td>
<td>Structured interviews.</td>
<td>Mothers/guardians each with HIV exposed child enrolled from 18 facilities in Muheza district</td>
<td>EID coverage, barriers to access EID, HIV prevalence and factors associated with HIV infection among under five children</td>
<td>Descriptive statistics and Multiple variable logistic regression analysis</td>
</tr>
<tr>
<td>(quantitative)</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Health facility survey</td>
<td>Structured interviews.</td>
<td>Health care providers working with PLHIV enrolled from 18 facilities in Muheza district</td>
<td>Knowledge and training on EID</td>
<td>Descriptive statistics analysis</td>
</tr>
<tr>
<td>(quantitative)</td>
<td></td>
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</tr>
<tr>
<td>Health facility survey</td>
<td>Checklist. Observations and documentary reviews from 46 facilities in Muheza district</td>
<td>Number of facilities providing EID services, infrastructures and supplies for EID</td>
<td>Descriptive statistics analysis</td>
<td></td>
</tr>
<tr>
<td>(qualitative)</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Case study</td>
<td>Interviews guides.</td>
<td>IDIs for health care providers and FGDs for mothers/guardians conducted from three facilities in Muheza district</td>
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<td>Thematic analysis</td>
</tr>
<tr>
<td>(qualitative)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### 3.3.1 Cross sectional study

The first and second specific objectives were accomplished by cross sectional study design.

#### 3.3.1.1 Selection and sampling

**i. Selection of study area**

The district has been chosen purposively for the entire study as being among the leading District with high HIV prevalence among pregnant women in Tanga Region. Tanga is among the Region in Tanzania with high number of PLHIV (TDHS-MIS, 2015-16).
ii. Inclusion and exclusion criteria for selecting population
Study population were selected based on the following inclusion criteria: 1) Mother or guardian agreed to participate and aged ≥16 years with HIV exposed child; 2) For a mother/guardian aged between 16 -18 years, assent was sought together with the consent from the guardian/next of kin who is ≥ 18 years; 3) All under five-year children born to HIV positive mother and who had stopped breast feeding (≥ six weeks post breast feeding). The window period for HIV DNA PCR test is typically six weeks after last exposure, hence children who had stopped breast feeding at six weeks or more were enrolled, in order to determine HIV transmission at the end of breastfeeding in this study. All under five-year exposed children who were not permanent residents of Muheza district were excluded.

iii. Sample selection criteria
The participants for cross sectional survey were selected by using multistage sampling. The decision was just made to select at least more than half of the health facilities that are providing EID testing, hence decide to include 18 health facilities purposively, and these serve as Primary sampling units (PSUs). The following stages were followed to obtain 18 health facilities (also these are clusters).

iv. Multistage sampling
Stage 1: The district chosen purposively.
Stage 2: Health facilities were randomly selected. Health facility (defined as PSUs). A list of PSUs was obtained according to their geographical location from Muheza District Council. All health facilities were listed by name and numbered from 1 to N (the total number of PSUs); therefore N=46.
Stage 3: A total of 18 health facilities were randomly selected, therefore n=18. Then calculated sampling interval \((k)=N/n\); \(k=46/18=3\). Then, first element out of the three was selected randomly from the first k units, number two out of the three was randomly selected (using “lottery” system). Then the selected PSU was included in the list of PSU in the survey. After that health facilities were selected that occupying positions 2, 2+2=4, 4+2=6, 6+2=8, 8+2=10,…etc., this continues until 18 health facilities (clusters) were obtained. Those health facilities that were selected and found to have no EID services the next on the list were chosen and the process continues. At each health facility a list of HIV
exposed under five-year were obtained from various sources prior the initiation of the study. Therefore, the study population included all selected mothers/guardians with children below five years born to HIV positive mothers (who were not breast feeding for ≥ six weeks) from each PSU.

v. Sample size determination

The sample size was calculated based on the formula that accounted for simple random sampling and the design effect which account for between and within cluster variation (Gorstein et al., 2007).

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

Where,

- \( n \) = estimated sample size
- \( z \) = 1.96 (at 95% Confidence interval)
- \( p \) = estimate of the expected proportion which was 43% (EID coverage in Tanzania in 2014)
- \( d \) = desired level of absolute precision which was taken at 5%
- \( DEFF = 1 + \delta (n - 1) \), where \( DEFF \) is the design effect, \( \delta \) is the intraclass correlation for the statistic in question, and \( n \) is the average size of the cluster. It was assumed that EID coverage differ from one cluster to another, that is, not the same within clusters. The average size for each cluster was estimated at 20 mother/guardian-child pairs and intraclass correction was estimated at 0.05 taken from previous survey in Kenya (Finocchario-Kessler et al., 2015). Therefore, \( DEFF = 1+0.05 \times (20-1) = 1.95 \), which was estimated at a factor of two.

In 2014, the estimated EID coverage in Tanzania was 43 percent. Based on this statistics and a response rate of 90 percent and thus the estimated sample size was 753 + 75 = 828. The study was confined within HIV exposed under five-year children, hence calculated sample size was corrected for this finite population of 828 children. The estimated annual number of HIV exposed under five children in Muheza district is around 400 children. The correction was done through the relation,

\[ n^* = \frac{n}{1 + \frac{n - 1}{N}} \]

Whereby: \( N \) = finite population, \( n \) = is the corrected sample size. Therefore,
\[ n^* = \frac{400}{1 + (400-1)/828} = 270 \]. Hence the estimated sample size was 270. Initially the minimum and maximum number of mother/guardian-child pairs in each cluster was set at 20 to 50. But, the proportion to size was set at five percent if the facility has an estimated total number of HIV exposed under fives below 500, and at 20 percent if it was more than 500 children. The selection was mainly based on availability of EID services at particular health facility. In this study a total of 576 mother/guardian-child pairs were enrolled.

### 3.3.1.2. Variables studied

Dependent variables include EID access, HIV status and knowledge on HIV prevention and transmission. Primary outcome variable: EID, was categorized into ‘yes’ as obtain the test or ‘no’ not obtained the test at the age four to six weeks. Secondary outcomes variables: HIV status was categorized into HIV negative or positive, Knowledge on HIV transmission and prevention was categorized into good or poor knowledge.

Independent variables include education, age, sex, occupation, monthly earning (income), size of the household, distance to health facility (estimated by time taken to reach the facility by foot), ART and cotrimoxazole of mother, birth weight, delivery place, delivery mode, feeding mode at birth, child prophylaxis at birth, maternal use of ART, cotrimoxazole, maternal HIV status prior to conception and unplanned pregnancy of the index child.

### 3.3.1.3. Data collection

Four nurse counsellors were trained on how to conduct interviews using a pre-tested questionnaire. Most of the questions were closed with an open option, and some were open-ended. Information on HIV status, socio-demographic characteristics and other relevant family and health status were collected. For the child, age, sex, HIV status, obtained/did not obtain the first HIV test at age of four-six weeks, mode of feeding opted at birth (EBF, RF, MF), NVP at birth (given or not given), immunization status by age (completed/not completed) were collected. Guardian’s age, sex, religion, residence, income, highest education level, marital status, occupation, knowledge on HIV
transmission and prevention and time period when the child’s first HIV test ought to be performed. Further information collected included size of the household (number of people living in the same household with the child) and distance to the nearest health facility (which was defined by time taken in minutes to reach the facility on foot). Maternal information included whether the index pregnancy was planned or not, HIV status prior to conception, level of CD4 count during pregnancy as well as cotrimoxazole during pregnancy. Head of household’s sex, age, relation to the child and highest education level was also collected.

Mothers/guardians’ satisfaction on services at health facility was assessed based on five key questions which were in a Likert’s scale form (Garwood, 2006). These questions are suitable for measuring a respondent’s opinion or attitude towards a given question, thus capturing the intensity of the respondent’s feelings for a given item. The Likert’s scales allow the respondent to specify their degree of preferences or opinion including a neutral option without restricting them to a simple ‘yes/no’ answer. However, there is a potential risk that mothers/guardians did not dare to be too negative about health care services (including EID, PMTCT) provided at the health care facility. These questions were mainly addressing issues related to health care services such as HIV testing, treatment, advice, nutritional and social support received at the health facility. Each question had five options of pre-coded responses with a neutral point being “neither satisfied nor dissatisfied”, “neither poor nor good” or “moderately”. The scale ranged from 1 to 5 such as very dissatisfied as 1; dissatisfied as 2; neither satisfied nor dissatisfied as 3; satisfied as 4 and very satisfied as 5); very poor as 1; poor as 2, neither poor nor good as 3; good as 4 and very good as 5; not at all as 1; slightly as 2; moderately as 3; very much as 4 and extremely as 5. Moreover, the general quality of all health services was assessed on how low or high they were satisfied with the overall quality of health care services provided at a particular health facility. This included services as a whole, reception by Health care providers , comfortability with the environment of care, freedom to interact with health personnel (asking questions for clarification), family planning, adequate medicines and diagnostic services. Mother/guardian’s willingness to receive the HIV testing and diagnosis for their children was also assessed.
Mother/guardian’s knowledge on HIV transmission including PMTCT and MTCT was also assessed based on four key questions. These questions were mainly addressing general MTCT knowledge, prevention on the risk of MTCT, timing of post exposure prophylaxis to HIV exposed infant and factors affecting HIV transmission. General knowledge of MTCT of HIV were assessed based on these responses, coded as yes/no in each response; 1) In utero to unborn child; 2) During delivery; 3) During breast feeding. Prevention on the risk of MTCT was assessed based on these responses, by selecting one most effective drug; 1) Sulphamethotrexate Pyrimethamine (SP) drug; 2) Folic + ferrous tablets; 3) ARV drugs; 4) Traditional medicines; 5) I don’t know. Timing of post exposure prophylaxis to HIV exposed infant was assessed on these responses; 1) Within 6-12 hours post delivery; 2) Five days after birth; 3) One week after birth 4) Other, specify. Factors affecting HIV transmission from mother to the child were assessed on these responses, coded as yes/no in each response; 1) Sexual transmitted diseases (e.g. syphilis); 2) Unplanned pregnancy; 3) Mastitis/cracked nipples; 4) I don’t know. In addition, general beliefs regarding HIV transmission were assessed based on these responses, coded as yes/no in each response; 1) HIV/AIDS can be transmitted by mosquito bites; 2) By evils spirit/bewitched; 3) A person can be infected by sharing food with a person who has AIDS.

Mothers/guardians whose children received an HIV test late (i.e. testing at ≥ seven weeks of age) were asked to state the reasons for the delay. Multiple responses regarding the factors associated with missed opportunity to receive the first HIV test for their children at the age between four to six weeks were assessed. During recruitment, more data on children and their mothers were extracted from registers, child card and hospital case files to supplement the collected primary data. In the context of this study, a guardian was defined as the child’s main primary caregiver living with the child in the same household and this included either the parent, grandparent, sister, brother, aunt or uncle.

i. Laboratory tests

a) HIV exposed children aged < 18 months

The HIV DNA PCR testing was used to confirm HIV infection in all HIV exposed children less than 18 months of age according to national guidelines. DBS samples were routinely collected from HIV exposed children at the first encounter to the health facility. For
infants, using a heel prick, five circles were filled with blood on a specific Whatman filter paper card and air dried for ≥ four hours on a drying rack. After drying, the cards were placed in a gas-impermeable zip locked bag with desiccant sachets and stored in a safe location. All DBS samples from peripheral health centers and dispensaries were transported to the district hospital and then were mailed to the Kilimanjaro Biotechnology Clinical Laboratory at KCMC (Kilimanjaro Christian Medical Center) in Moshi, Tanzania (which is located about six hours drive from Muheza).

In the laboratory, the DBS were tested for HIV DNA using version two of the COBAS AmpliPrep/COBAS TaqMan 48 system. One DBS circle was used to run a DNA-PCR test and if positive, a second circle was analysed to confirm the first result. A test result was considered positive if both PCR assays were positive. All DBS results are then sent back to the District Hospital using EMS. From the District Hospital results are then transported to peripheral health centers. Every DBS card was labeled with the child’s name and a unique identification. This identifier was unique from each health facility to each individual child which was also recorded in the EID and PMTCT Mother-Child Follow-up Register that remains at the health facility. The similar identification was also commonly recorded on the child’s under five card. Other information recorded in the registry included: child sex, date of birth, date sample taken, results and date of first DBS, PMTCT regimen (ARV/ART) used by the mother, infant regimen (ARV prophylaxis), infant feeding option, and initiation of co-trimoxazole prophylactic therapy. A total of selected 18 health facilities that provide PMTCT, EID and pediatric HIV care and treatment services in the District were visited. All guardian-child pairs visited the 18 selected health facilities were all enrolled according to inclusion and exclusion criteria. Those who were already confirmed to be HIV positive below 18 months age, their positive DBS PCR results that were recorded at the health facility registries/DBS book were cross-checked by retrieving original records from KCMC. Also other different sources were used to validate the HIV results. These include mother and/or pediatric hospital case files, child’s under five-year cards, PMTCT registers, DBS results counter books/exercise books, EID hard copies laboratory results. Both SMS message (using SMS printer) and hard copies of results were sent to District Hospital since 2010 to March 2014.
b) HIV exposed children aged > 18 months

The Rapid HIV antibody test was done in all HIV exposed children aged more than 18 months using Determine®/Bioline® rapid tests for the first test. If the first test was positive, the second test was performed using Uni-Gold® rapid test. HIV diagnosis was confirmed based on concordance of the results of these two HIV rapid tests. Furthermore, the sample turnaround time (TAT) which was defined as time between DBS sample collection and return of HIV DNA PCR results to the facility, for the first HIV DNA PCR test was assessed.

ii. Recruitment

HIV exposed children were recruited at selected health facilities. At health facility the Principal investigator and four Research assistants who have experience in HIV Counseling and testing were situated in one/two stations where counseling and data collection took place. All children followed standard Maternal and Child Health services as per Health Services’ IMCI (Integrated Management of Childhood illness) guidelines. This includes having all baseline investigations and appropriate interventions done at any point in time. As part of routine care participants were treated as per national guidelines.

iii. Participant tracing

HIV exposed children born to HIV positive women aged ≥16 years were traced at the Labour ward registries, CTC database, RCH, PMTCT clinics of particular health facility. When a couple/individual confirmed to be HIV positive, they were immediately linked to Community Health care providers (CHWs) to the locality where they are living. They were more open and free to talk with CHWs in any matter concerning their health. CHWs were trained to adhere to ethical principles to protect the rights and confidentiality of their patients. CHWs were also employed during the process of identifying all HIV exposed children who missed the opportunity of early HIV testing and also save the source for obtaining the mothers/guardians for focus group discussion.

iv. Community/household tracking system

All under five-year HIV exposed children were recruited at the respective health care facility with their respective mothers/guardians. Those who missed at the health facility,
were traced by CHWs to their locality in the Community up to household level. Confidentiality was strictly maintained during the tracking process in the community. Not more than two visits were done at each house to declare missing. Majority were traced during just single visit at the household level.

v. Data management

All completed questionnaires were stored in a secure place at National Institute for Medical Research (NIMR), Amani center, Muheza, Tanzania. All questionnaires were counted and checked against errors i.e. legibility, range of values, inconsistency, missing identification number. If anything was wrong in any questionnaire, it was returned by the Researcher to the field site to be rectified. All collected questionnaires were double entered into the database by two separate data clerks using Epi Data software. Data checks and cleaning of the database was done by Principal investigator.

3.3.1.4 Data analysis

To facilitate data entry, responses provided in open-ended questions were re-coded into themes which were developed to respond to study objectives. All data were double entered in Epi Data database version 3.1 (http://www.epidata.dk/). Data were compared directly at entry with a previous entry of the same data. After finishing data entry, data were validated in Epidata, and any discrepancy observed was clarified by editing the data and comparing with original data forms and redo the validation. The amount of discrepancy allowed was 2 percent. The validation process continued until all data were compared. After validation of data had finished, data were exported to STATA version 13 statistical package (Stata Corp, College Station, Texas, USA) for analysis.

Continuous variables were described using median and inter quartile range (IQR) because they were not normally distributed. Categorical variables were described using frequencies and percentages. The accessibility to HIV test by the child was categorized into a binary variable, “yes” as obtained or “no” as not obtained the test at the age of four to six weeks.
Mothers/guardians’ perceptions to health care services based on five options of pre-coded responses with a neutral point being neither satisfied nor dissatisfied, or neither poor nor good were described by using percentages.

Binary logistic regression was done and all factors with p-values of ≤ 0.2 including priori factors were considered for multiple variable logistic regression analysis. Multiple logistic regression analyses were used to examine the associations between various factors and service accessibility by the child at the age of four to six weeks. A manual backward stepwise selection was employed by removing non-significant variables (one at a time starting with those with the highest p-value). Goodness of fit of the final model was tested using likelihood ratio test. The final model consisted of variables that were significant at p-value of ≤ 0.05 including those with epidemiological importance. Adjusted odds ratios with their corresponding 95 percent confidence intervals were estimated and presented. Three individual multiple regression models were fitted for 1) the child and maternal variables, 2) guardian variables, and 3) the head of household variables. Subsequently, two combined models were fitted: 1) a model that contains the three set variables; and 2), a model that includes only significant variables which was used in the final interpretation. Furthermore, a separate model to assess the mother/guardian’s knowledge of HIV (including MTCT and PMTCT) was also fitted. In this study, ‘accessibility of first HIV test by the child at the age of four to six weeks’ was defined as the time when the child was obtaining HIV test at the age of four to six weeks. In addition, another model to assess predictors associated with HIV infection among under five children was also fitted.

i. Developing Composite Indicator Variable for Knowledge level on HIV

A composite variable on knowledge on HIV transmission including PMTCT and MTCT of the mother/guardian was generated based on the four key questions as described above. The knowledge level was categorized into a binary variable ‘good’ or ‘poor’. The following were steps that were followed during the development of the composite variable of knowledge of HIV by use of recode and compute commands.

**Step 1:** All key questions/indicators for knowledge of HIV were recorded as yes=1, no=0
The key indicators were: 1) general MTCT knowledge, 2) drug to prevent risk of MTCT, 3) timing of post exposure prophylaxis to HIV exposed infant (timing of infant NVP), 4) factors affecting HIV transmission.

**Step 2:** I decided on the most sensitive variable (in this case it was ‘knowledge MTCT of HIV’). Then, I recode general knowledge of MTCT in what may be desirable and undesirable outcomes. Desirable outcome was labeled as 1 and undesirable as 0. In this case, 1=good knowledge and 0=poor knowledge.

**Step 3:** To build first composite variable.

a. I recode using the recode command the second most sensitive variable into different codes from those of the first one in this case it was ‘drug to prevent MTCT’, I recode this variable as, 1=3 and 0 = 9

b. After recoding, I compute the first composite variable by adding the first sensitive indicator variable (general knowledge on MTCT) and second sensitive indicator variable (drug to prevent MTCT) using the compute command, the most sensitive indicator should always be on top, that is, ‘general knowledge of MTCT’

c. Then, I test the first composite variable by running a frequency of the variable (‘knowledge of MTCT’ and ‘drug used to prevent MTCT’), from these, I decided on whether to put them in the desirable or undesirable outcome variables, see illustration below.

d. After running the frequency, I recode the first composite variable using the recode command into 0 and 1. Hence, the first composite variable was successfully created.

<table>
<thead>
<tr>
<th>Knowledge on MTCT</th>
<th>Drug to prevent MTCT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1(desirable)</td>
<td>0 (undesirable)</td>
</tr>
<tr>
<td>4 *</td>
<td>3 *</td>
</tr>
<tr>
<td>10 †</td>
<td>9 †</td>
</tr>
</tbody>
</table>

4=1+3; 3=0+3; similarly for cells with †; 10=1+9; 9=0+9.

e. The first composite variable was recoded into 1 and 0 from 3, 4, 9, and 10. At this point care should be taken during formation of composite variable into 1 and 0, for example: 1 may contain 4+10+3 or 1 may contain 4+10 depending on the subject matter that is studied.
Step 4: To create the second composite variable
   a. I recode the third most sensitive variable which is ‘timing of infant NVP’ by using the recode command into different codes from those of the first composite variable, as 1=3, and 0=9
   b. After recoding third variable, I compute the second composite variable by adding the first composite indicator variable (knowledge of MTCT and drug for PMTCT) and third sensitive indicator variable (timing of infant NVP) using the compute command.
   c. Then, I test the second composite variable by running a frequency of the variable.
   d. After running the frequency, I recode the second composite variable using the recode command into 0 and 1. When this is done, the second composite variable was successfully created.
   e. The second composite variable was recoded into 1 and 0 from 3, 4, 9, and 10.

Step 5: To create the third composite variable
   a. I recode the fourth most sensitive variable which is ‘factors affecting HIV transmission’ by using the recode command into different codes from those of the second composite variable, as 1=3, and 0=9
   b. After recoding fourth variable, I compute the third composite variable by adding the second composite indicator variable (knowledge of MTCT, drug for PMTCT and infant NVP) and fourth sensitive indicator variable (factors affecting HIV transmission) using the compute command.
   c. Then, I test the third composite variable by running a frequency of the variable.
   d. After running the frequency, I recode the third composite variable using the recode command into 0 and 1. When this was done, the third composite variable was successfully created.
   e. The third composite variable was recoded into 1 and 0 from 3, 4, 9, and 10.
   f. This was the end of the composite variable of the knowledge of HIV, categorized into 1=desirable (good) and 0=undesirable(poor).

3.3.2 Health facility survey

Part of specific objective three and part of objective four were accomplished during health facility surveys.
3.3.2.1. Selection and sampling

i. Inclusion and exclusion criteria
Inclusion criteria included, health care providers involved with PLHIV and all PMTCT, EID documents from 2007-2015 at 46 health facilities were reviewed. All health care providers who are not working in Muheza district were excluded.

ii. Sample selection criteria
Health care providers in 18 selected clusters (health facilities) were enrolled into the study.

3.3.2.2 Variables studied
Age, sex, education, qualification, knowledge and training on EID, number of facilities providing EID in the district, infrastructures and supplies for EID services.

3.3.2.3 Data collection

i. Health facility readiness
An assessment of the health facility readiness in 18 health facilities was also done. A separate questionnaire was administered among health service providers involved with PLHIV to identify healthcare service factors that influence accessibility to EID services. These included availability of EID algorithm and PMTCT guidelines, and training in EID among health care providers, number of health workers with their qualification, documentation of HIV status on infant booklet/Road to Health card and knowledge on timing of first HIV test ought to be performed to HIV exposed infants. General knowledge and beliefs regarding HIV transmission were assessed based on these responses, coded as yes/no in each response; 1) HIV/AIDS can be transmitted by mosquito bites; 2) By evils spirit/bewitched; 3) In utero to unborn child; 4) During delivery; 5) During breast feeding; 6) A person can be infected by sharing food with a person who has AIDS. In addition, knowledge on the timing of post exposure prophylaxis to HIV exposed infant among health service providers was also assessed on these responses;1) Within 6-12 hours post delivery; 2) Five days after birth; 3) One week after birth; 4) I don’t know. Timing of the first HIV
test ought to be performed to HIV exposed child was assessed based on these responses; 1) Four-six weeks of age; 2) Two months of age; 3) Other, specify; 4) I don’t know. They were also asked to specify the timing of the second HIV test ought to be performed to HIV exposed child who opted exclusive breast feeding.

Health care providers’ satisfaction with their job was assessed based on six key questions which were in the form of Likert’s scale. This was an appropriate way to capture the opinions of health care providers regarding satisfaction with their job. The problem with these types of questions is that respondents may avoid extreme responses for fear of negative repercussion. The questions were mainly addressing the health care providers’ satisfaction regarding provision of health services to their patients, quality of the services at the facility, working environment at the facility, availability of supplies at the facility and assistance obtained from their head of departments related to their daily duties at the facility and trustworthiness to their patients if they understood health service provider’s advices regarding care, nutritional and social support. Each question had five options of pre-coded responses with a neutral point being “neither satisfied nor dissatisfied”, “neither poor nor good” or “moderately”. The scale ranged from 1 to 5 such as very dissatisfied as 1; dissatisfied as 2; neither satisfied nor dissatisfied as 3; satisfied as 4 and very satisfied as 5); very poor as 1; poor as 2, neither poor nor good as 3; good as 4 and very good as 5; not at all as 1; slightly as 2; moderately as 3; very much as 4 and extremely as 5.

In addition, non-participatory observations at all 46 health facilities were conducted by guided checklist to assess the capacity of the health facility to conduct on site EID and PMTCT services in Muheza district. Availability of equipments, supplies and medication that support PMTCT and EID services were assessed. Since DBS samples from Muheza are sent by EMS to KCMC Clinical laboratory. Unable to account the EMS service on handling, reliability and accountability and transportation of DBS samples. Unable to account on the supplies chain of commodities used for EID services.

**ii. Document review**

A guided checklist was used to review EID and PMTCT registries records in all 46 health facilities in order to assess the demographic patterns that influence HIV infection and early
HIV testing among under five HIV exposed children in Muheza district. These included, number of:- births, women counselled on PMTCT, pregnant women tested HIV positive, pregnant women on ARV prophylaxis, pregnant women on ART, HIV exposed infants (HEI), HEI registered, HEI started ARV prophylaxis after delivery, HEI started cotrimoxazole, HEI tested for HIV DNA PCR, HIV positive infants confirmed by PCR, HIV negative infants confirmed by PCR.

3.3.2.4 Data analysis

Data were entered into Epi Data database, and data analysis was done using STATA version 13.0 (statcorp, Texas, USA). Continuous variables were described using median and IQR. Categorical variables were described using frequencies and percentages. Health care providers’ perceptions to health care services based on five options of pre-coded responses with a neutral point being neither satisfied nor dissatisfied, or neither poor nor good were described by using percentages. The reviewed records from all 46 health facilities were presented in numbers, proportions and figures.

3.3.3 Case study design

The specific objectives three and four were accomplished by case study design. This design was done in order to triangulate data obtained from cross sectional and health facility surveys.

3.3.3.1 Selection and sampling

i. Inclusion and exclusion criteria

Study population were selected based on the following inclusion criteria: 1) Health care providers involved with PLHIV, (2) Mother/guardian aged ≥ 16 years; 3) Mother/guardian with HIV exposed under five-year child who obtained HIV test at the age of four to six weeks; 4) Mother/guardian with HIV exposed under five-year child who did not obtained HIV test at the age of four to six weeks. Health care providers who were not working in
Muheza district and mothers/guardians who were not living in Muheza district were excluded.

ii. Sample selection criteria
A purposive sample of three health facilities (out of 18 selected health facilities) were selected based on optimal EID delivery services in order to identify and recruit eligible mothers/guardians and health care providers to be involved for focus group discussions (FGDs) and key informants-in depth interviews (IDIs) respectively. A number of participants involved in cross sectional and health facility surveys were also involved during FGDs and IDIs. Participants for FGDs were to be purposively selected and allocated in FGDs based on these criteria: 1) Participants representing a wide variety of views, perceptions and experiences; 2) Matching presence of people with different views in each group; 3) Geographical equity using the selected health facilities as catchment; 4) Balancing participants HIV exposure (mothers/guardians who had HIV exposed under five-year children) including whose children who had obtained HIV test at the age of four-six weeks and those who did not obtained the HIV test at the age of four to six weeks.

iii. Sample size
In each of the three selected health facilities, participants were randomly selected, one health worker in charge at PMTCT, one in charge at RCH clinic and one Clinician were enrolled. In total nine key informants for IDs were obtained for IDIs. Two FGDs from each health facility were conducted. Each FGD comprised of eight to 13 mothers/guardians. In total six FGDs were conducted for the three selected health facilities.

3.3.3.2 Variables studied
Themes covered during interviews include knowledge of EID,MTCT and PMTCT; late HIV test of the child; geographical access/access to health facility; cultural, traditions and religious beliefs; psychological factors; psychosocial support; HIV stigma and disclosure; autonomy, gender dynamics and decision making process, patients-health care providers interaction; health facility resources, supplies and infrastructures and service satisfactory perspectives among patients and health care workers. Socio demographic variables such as
age, sex, occupation, marital status were included. District demographic characteristics such as number of births; number of women counseled on PMTCT, number of pregnant women confirmed of HIV positive; number of women on lifelong ART; number of HIV exposed infant given ARV prophylaxis; number of exposed infants who underwent EID test at four-six weeks by DNA PCR, overall number of infants who underwent EID test by DNA PCR; number of HIV positive confirmed infants and number of HIV negative confirmed infants were also included.

3.3.3.3 Data collection

i. In-depth Interviews and Focus Group Discussion
Data collection was done by FGDs (for mothers/guardians) and IDIs (for Health care providers) and data were collected by three sociologists. The IDI and FGD semi structured interview guides were used. An in-depth interview took a form of open-ended, discovery-oriented interrogative method to elicit information from participants. For IDIs only one individual(key informant) was used as a respondent. Each FGDs comprised of eight to 12 mothers/guardians. Each interview session lasted around forty five minutes to an hour.

ii. Recording IDIs and FGDs
The IDIs and FGDs were conducted in an environment which was conversant to the participant by using either Kiswahili or English depending on the participant’s preference. Every health care provider was free to choose any location/ room at the health facility for IDI. All FGDs participants preferred to conduct interviews at the health facility. FGDs were conducted in a conference room located far at the periphery of the District hospital whereby there were no any interference with outside environment and confidentiality was strictly maintained. The IDIs and FGDs were recorded by using a digital voice recorder and by writing after obtained consent from the participants. Also some other important non-verbal communication were noted down by hand in the notebook. One of the main themes were reasons for late HIV test among under five-year children. Challenges faced by health care providers before and after introduction of new advances in technology to perform EID were also explored. Also barriers and challenges associated with delivery and uptake of HIV test were explored. At the end of each interviews, the main points from respondents
were summarized and agreement checked and they were asked if there was anything more to add.

iii. **Validity of recorded data**

Each record were validated every morning by the Principal investigator. The recorded raw data were downloaded to the computer and transcribed. Later on, the Expert from Department of Linguistic at the University of Dar es Salaam validated the transcripts.

iv. **Location of health care facilities in Muheza district**

Mapping of the geographical location of all health facilities was done by using Geographical Position system (GPS). The GPS receiver used was Garmin Etrex 10. Map was constructed using Geographical information system (GIS). GIS software used to make map of health facilities was ArcGIS 10.1. The availability health facilities that provide onsite EID services (such as DBS sample collection) was observed, documented and mapped for all 46 health facilities in Muheza district.

3.3.3.4 **Data analysis**

Data analysis was done by using Nvivo statistical software (QSR Nvivo 10). The recorded interviews were transcribed verbatim and translated from Kiswahili to English by three independent qualitative researchers. Notes were then compared to ensure truthfulness of transcription and translation. Field notes were reviewed for additional information. After review all the interviews for a number of times, the texts were transferred to Nvivo software for qualitative processing of the text. All the concepts emerged from the participant’s responses (transcribed interviews) were coded. Then a number of themes were identified from participants’ responses that provided the basis for further processing of data. This was done by reading every interview, thoroughly taking sentences one be one in order to subdivided the contents into themes. The interviews were constantly reviewed and compared which made it possible to subdivide the themes into subthemes. Although predefined themes were developed based on literature review before the interviews, but some other themes emerged during data processing. As the process continued, new themes were created, others were integrated into the existing ones. The process continued until
fewer and fewer revisions were made and all relevant information were grouped and coded appropriately. During analysis, more than 90 percent of the themes were discovered within four FGDs, and six IDIs. Then, participants’ quotations from interviews were searched that expressed relationships of any kind that supported the developed themes. The notes were cross checked to ensure appropriate responses of participants. Results obtained during cross sectional survey and health facility surveys and case study including from both methods (qualitative and quantitative) were triangulated for interpretation.

Experienced qualitative researcher, independently reviewed a random sample of four interviews (including audiotapes, field notes and coding of themes) and provided feedback on the overall trustworthiness of the data and the analysis.

3.4 Ethical considerations

Ethical principles were adhered to throughout the study in accordance with Helsinki declaration on ethical principles for medical research involving the human subject. The study ensured that the rights, integrity and confidentiality of study participants were protected. Participants were enrolled after the study protocol and consent forms were approved by relevant ethics committee. The privacy and confidentiality of all data and information collected was strictly maintained for study participants. No names that were used to identify participants during data collection, report or publication of study findings. All data and information collected from participant were kept in a secure place and accessibility was restricted to authorized research team.

3.4.1 Benefits and risk to the study participants

The study involved HIV testing to all HIV exposed children and their HIV status was determined for effective appropriate care and management. All confirmed HIV positive children were referred to CTC for initiation of ART according to Tanzania guidelines on the management of HIV and AIDS. About two to three drops of blood was taken from each child for HIV testing. Minimal pain at the puncture site was expected. About two to three attempts was done to obtain blood sample. There was a very small risk of continuing
bleeding after pricking at the puncture site. Standard operating procedures were followed to avoid entry of infection at the puncture site. There was minimal risk for mothers/guardians and Health care providers to be involved in the study. Some refreshments like drinking water were provided to the study participants whenever available.

3.4.2 Informed consent

Informed consent was obtained from health care providers and mothers/guardians by using the language conversant to them (preferably Kiswahili and English were used), and a written consent form was signed by both parties and a copy was given to the participant and another copy remained with the Researcher. Assent was also obtained from mothers/guardians aged less than 18 years of age. Counselling of the mothers/guardians of HIV-exposed children before and after the HIV test was performed in accordance with standard testing and counselling guidelines. Pre test counseling was performed to consent for testing for their exposed children. Post test counseling was performed after results came out in accordance with standard testing and counseling guidelines. During data collection the Researcher was part and parcel of the ongoing PMTCT program.

3.4.3 Institutional review committee

Ethical approval was obtained from Medical Research Coordinating Committee of the National Institute for Medical Research, Tanzania and University of Zambia Biomedical Research Ethics Committee, with reference numbers NIMR/HQ/R.8a/Vol. IX/1978 and 001-01-15 respectively. Permission to conduct this study was given by Muheza District Council, Tanzania.

3.4.4 Risk identification and mitigation strategy

Stigma was anticipated in this study. There was no breach of conduct of the ethical principles regarding conduct of research involving human beings. The presence of the research team in the study area for a period of one year might to some degree change the
behaviour pattern of the residents and even the responses obtained during the interviews. The research team informed the community at individual and family level early enough before initiation of the study. Familiarization period was allowed during which the behaviour and practices of the participants returned to normal state before initiation of the study.
4.1 Characteristics of study participants

4.1.1 Mother/guardian-child pairs

Of the total 1043 mothers HIV positive mothers with HIV exposed under five-year children were recorded from labour ward, PMTCT and CTC registers, 378 had missing information; leaving only 665 mother/guardian-child pairs. Of these, 61 were still breast feeding, so were excluded, 28 mothers refuse to participate and the remaining 576 mother/guardian child pairs were enrolled as *de facto* sample size. The median age of the mothers/guardians was 34 years (IQR: 30-38 years) and the median age of under five-year children was 15 months (IQR: 8.5-38) (Table 4.1). A total of 528 (91.7 percent) children were delivered at health facility and, 329 (57.1%) received the first HIV test at the age of six weeks of age and there were no child who receive the test at the age of four weeks. The overall median age at the time of first HIV test for 576 HIV exposed under five children was six weeks (IQR: 6-20 weeks). In addition, 88.5 percent (n=510) children received the first HIV DNA PCR test with different time periods from six weeks to nine months.

In addition, 43.6 percent (251) were born to mothers with unknown HIV status at conception, suggesting that, a number of these mothers did not know their HIV status before being pregnant and were labeled as “unknown HIV status at conception. Most (75.1%) of the children received exclusive breast feeding, 22.6 percent (n=130) received mixed feeding and only 2.3 percent (n=13) received replacement feeding. A total of 83 (14.4%) children did not receive NVP prophylaxis at birth and the period there after.

The turnaround time of the DBS sample, the time taken between DBS sample collection to the receipt of DBS results at the health facility was also determined. Only 413 records had complete data on the date of sample collection and the date of arrival of the DNA PCR results to the health facility. The date of arrival of PCR results to health facility was not recorded in 97 records. The sample turnaround time for first HIV DNA test for the 413 records examined has median of six weeks (IQR: 5-10 weeks).
### Table 4.1: Demographic distribution of the study participants

#### Children

<table>
<thead>
<tr>
<th>Age category (months)</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤12</td>
<td>224 (38.9)</td>
</tr>
<tr>
<td>13-24</td>
<td>155 (26.9)</td>
</tr>
<tr>
<td>25-59</td>
<td>197 (34.2)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sex</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>281 (48.8)</td>
</tr>
<tr>
<td>Female</td>
<td>295 (51.2)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Residence</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rural</td>
<td>445 (77.3)</td>
</tr>
<tr>
<td>Urban</td>
<td>131 (22.7)</td>
</tr>
</tbody>
</table>

#### Guardians

<table>
<thead>
<tr>
<th>Age category (years)</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>15-34</td>
<td>302 (52.5)</td>
</tr>
<tr>
<td>35-70</td>
<td>274 (47.6)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sex</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>7 (1.2)</td>
</tr>
<tr>
<td>Female</td>
<td>569 (98.8)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Education</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>No education</td>
<td>78 (13.5)</td>
</tr>
<tr>
<td>Primary complete</td>
<td>451 (78.3)</td>
</tr>
<tr>
<td>Secondary/high school and above</td>
<td>47 (8.2)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Marital status</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Married/living together</td>
<td>519 (90.1)</td>
</tr>
<tr>
<td>Single/divorced/widow</td>
<td>57 (9.9)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Occupation</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trading</td>
<td>97 (16.8)</td>
</tr>
<tr>
<td>Formal employment</td>
<td>15 (2.6)</td>
</tr>
<tr>
<td>Subsistence farmer</td>
<td>464 (80.6)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Income</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low (≤34 US Dollar)</td>
<td>531 (92.2)</td>
</tr>
<tr>
<td>High (&gt;34 US Dollar)</td>
<td>45 (7.8)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Relation to the child</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mother</td>
<td>549 (95.3)</td>
</tr>
<tr>
<td>Father</td>
<td>7 (1.2)</td>
</tr>
<tr>
<td>Grandmother</td>
<td>13 (2.3)</td>
</tr>
<tr>
<td>Aunt</td>
<td>7 (1.2)</td>
</tr>
</tbody>
</table>

#### Heads of household

<table>
<thead>
<tr>
<th>Age category (years)</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>15-34</td>
<td>95 (16.5)</td>
</tr>
<tr>
<td>35-85</td>
<td>481 (83.5)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sex</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>404 (70.1)</td>
</tr>
<tr>
<td>Female</td>
<td>172 (29.9)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Education</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>No education</td>
<td>58 (10.0)</td>
</tr>
<tr>
<td>Primary complete</td>
<td>44 (8.0)</td>
</tr>
<tr>
<td>Secondary/high school and above</td>
<td>474 (82.0)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Relation to the child</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mother</td>
<td>65 (11.3)</td>
</tr>
<tr>
<td>Father</td>
<td>355 (61.6)</td>
</tr>
<tr>
<td>Grandmother/grandfather</td>
<td>131 (22.7)</td>
</tr>
<tr>
<td>Other relatives ‡</td>
<td>25 (4.4)</td>
</tr>
</tbody>
</table>

**Notes:**
(a) Total sample size, N = 576
(b) Guardian in this study was the main primary caregiver of the child living in the same household
(c) ‡ Other relatives included were the sister, brother, aunt and uncle
In addition, a total of 247 (out of 576) mothers/guardians, whose children missed the first HIV test between four and six weeks of age were also interviewed to assess barriers associated with EID services. Furthermore, a total of 59 mothers/guardians were involved in FGDs. Three (five percent) and 56 (95 percent) mothers/guardians were in the age group of 15-24 and 25-70 years respectively. A total of 49 (83.0 percent) mothers/guardians were subsistence farmers and 10 (17.0 percent) were involved with trading. Single mothers/guardians were 20 (33.9 percent), married were 31(52.5 percent), widow were four(6.8%) and separated were four (6.8%).

### 4.1.2 Health care providers

Of the total of 112 health care providers (median age, 40 years; IQR 28-51), 26.8% were male and female were 73.2%. Their overall median years of service working with PLHIV was 4 years (Table 4.2). Only 17.0 percent received PMTCT training and only 33.9% had been trained on EID services 12 months prior the study. For further details, refer to Table 4.3.

#### Table 4.2: Qualifications of health care providers involved in in-depth interviews

<table>
<thead>
<tr>
<th>Variable</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>30 (26.8)</td>
</tr>
<tr>
<td>Female</td>
<td>82 (73.2)</td>
</tr>
<tr>
<td>Highest education</td>
<td></td>
</tr>
<tr>
<td>Primary</td>
<td>6 (5.4)</td>
</tr>
<tr>
<td>Secondary</td>
<td>18 (16.1)</td>
</tr>
<tr>
<td>College and University</td>
<td>88 (78.6)</td>
</tr>
<tr>
<td>Qualification</td>
<td></td>
</tr>
<tr>
<td>Medical doctor</td>
<td>2 (1.8)</td>
</tr>
<tr>
<td>Clinical officer</td>
<td>21 (18.8)</td>
</tr>
<tr>
<td>Assistant Medical officer</td>
<td>1 (0.9)</td>
</tr>
<tr>
<td>Nursing staff</td>
<td>48 (42.9)</td>
</tr>
<tr>
<td>Medical attendant</td>
<td>31 (27.7)</td>
</tr>
<tr>
<td>Home based care volunteers</td>
<td>4 (3.6)</td>
</tr>
<tr>
<td>Medical social worker</td>
<td>1 (0.9)</td>
</tr>
<tr>
<td>Assistant Pharmacist</td>
<td>1 (0.9)</td>
</tr>
<tr>
<td>Laboratory assistant</td>
<td>2 (1.8)</td>
</tr>
<tr>
<td>Laboratory technologist</td>
<td>1 (0.9)</td>
</tr>
</tbody>
</table>

*Notes:* (a) Total sample size, N= 112
Table 4.3: Demographic characteristics of health care providers involved in in-depth interviews

<table>
<thead>
<tr>
<th>Qualification</th>
<th>Age (years)</th>
<th>Sex</th>
<th>Position in hospital</th>
<th>Highest education</th>
<th>Health facility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clinical officer</td>
<td>27</td>
<td>F</td>
<td>CTC clinician</td>
<td>Diploma</td>
<td>Mkuzi</td>
</tr>
<tr>
<td>Registered nurse</td>
<td>30</td>
<td>F</td>
<td>PMTCT in charge</td>
<td>Diploma</td>
<td>Mkuzi</td>
</tr>
<tr>
<td>Registered Nurse</td>
<td>28</td>
<td>F</td>
<td>RCH in charge</td>
<td>Diploma</td>
<td>Mkuzi</td>
</tr>
<tr>
<td>Nurse assistant</td>
<td>36</td>
<td>F</td>
<td>CTC in charge</td>
<td>Certificate</td>
<td>Mkanyageni</td>
</tr>
<tr>
<td>Clinical officer</td>
<td>47</td>
<td>M</td>
<td>CTC clinician</td>
<td>Diploma</td>
<td>Mkanyageni</td>
</tr>
<tr>
<td>Enrolled nurse</td>
<td>50</td>
<td>F</td>
<td>RCH in charge</td>
<td>Diploma</td>
<td>Mkanyageni</td>
</tr>
<tr>
<td>Nurse midwife</td>
<td>54</td>
<td>F</td>
<td>PMTCT in charge</td>
<td>Certificate</td>
<td>Teule</td>
</tr>
<tr>
<td>Nursing officer</td>
<td>59</td>
<td>F</td>
<td>RCH in charge</td>
<td>Degree</td>
<td>Teule</td>
</tr>
<tr>
<td>Registered nurse</td>
<td>40</td>
<td>F</td>
<td>OPD in charge</td>
<td>Degree</td>
<td>Teule</td>
</tr>
</tbody>
</table>

Notes: (a) Total sample size, N= 9 (b) CTC= Care and Treatment Clinic (c) RCH= Reproductive and Child Health (d) PMTCT= Prevention of mother to child transmission (e) OPD= Outpatient Department

4.2 Factors influencing access to EID services in Muheza district

This section answers objective one, three and four.

The themes emerged from mothers/guardians and health care providers interviews were shown in Table 4.4. Barriers regarding with missed opportunity to access EID at the age of four to six weeks among under five-year children exposed to HIV infection in Muheza was reported by 247 mothers/guardian as shown in Table 4.5.
<table>
<thead>
<tr>
<th>Main theme</th>
<th>Individual factors</th>
<th>Sub themes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knowledge of EID, MTCT and PMTCT</td>
<td>HIV transmission/PMTCT/EID Accessibility</td>
<td>Use of PMTCT interventions</td>
</tr>
<tr>
<td>Geographical access/access to health facility</td>
<td>Poverty, poor economic conditions, affordability to cater for transport cost, distance from health facility, geographical relocation, geographical position</td>
<td></td>
</tr>
<tr>
<td>Cultural, traditions and religious beliefs</td>
<td>Child looks healthier, child is still young for HIV test</td>
<td>Traditional beliefs/traditional healers, religious beliefs and practices</td>
</tr>
<tr>
<td>Psychological factors</td>
<td>Fear of raising HIV infected child, fear to take the blood sample from young child</td>
<td>Denial/shock (after pregnant woman received HIV+ results)</td>
</tr>
<tr>
<td>Psychosocial support</td>
<td>Paternal/family/community support</td>
<td></td>
</tr>
<tr>
<td>HIV Stigma and disclosure</td>
<td>Stigma and discrimination within community and family members, HIV disclosure</td>
<td></td>
</tr>
<tr>
<td>Autonomy, gender dynamics and decision making process</td>
<td>Paternal permission, or household decisions made from male partner/husband, from guardian’s parents or grandparents</td>
<td></td>
</tr>
<tr>
<td><strong>Institutional (Health system) factors</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Patients-health care providers interaction</td>
<td>Patients’ attitudes to health care providers, fear of health care providers</td>
<td></td>
</tr>
<tr>
<td>Health system resources structure, supplies and infrastructures</td>
<td>Health care providers attitudes to patients</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Shortages of health care providers, number of qualified staff</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Trained health care providers</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Poor techniques in DBS sample collection</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Long waiting time</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Medical supplies out of stock</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Poor documentation of HIV status on infant’s booklet</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Weak infrastructures</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Delay of HIV results</td>
<td></td>
</tr>
</tbody>
</table>
Table 4.5: Barriers influencing access to EID services in Muheza district, Tanzania

<table>
<thead>
<tr>
<th>Individual factors</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Culture issues⁵</td>
<td>11 (4.5)</td>
</tr>
<tr>
<td>Children appeared in good health</td>
<td>34 (13.8)</td>
</tr>
<tr>
<td>Inadequate knowledge</td>
<td>42 (17.0)</td>
</tr>
<tr>
<td>Unawareness of EID services</td>
<td>21 (8.5)</td>
</tr>
<tr>
<td>Long distance to the health facility</td>
<td>9 (3.6)</td>
</tr>
<tr>
<td>Lack of money for transport to go to the health facility</td>
<td>13 (5.3)</td>
</tr>
<tr>
<td>Lack of paternal permission/support to access EID services</td>
<td>31 (12.6)</td>
</tr>
<tr>
<td>Guardian was uninformed if the child was born to HIV+ mother</td>
<td>13 (5.3)</td>
</tr>
<tr>
<td>Guardian-child pairs relocated to a residence far away from the facility with EID service</td>
<td>9 (3.6)</td>
</tr>
<tr>
<td>Their mothers disbelieve their HIV+ results and were not on ARV during pregnancy†</td>
<td>7 (2.8)</td>
</tr>
<tr>
<td>Mothers feared that their HIV+ status will be known by health workers*</td>
<td>14 (5.7)</td>
</tr>
<tr>
<td>Mothers feared if their children would be found to be HIV+*</td>
<td>11 (4.5)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Health facility factors</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Long waiting time to get services at the facility</td>
<td>6 (2.4)</td>
</tr>
<tr>
<td>Health workers did not know the correct age to perform child’s first HIV test</td>
<td>11 (4.5)</td>
</tr>
<tr>
<td>Mothers not registered at the health facility, so the child was not tested</td>
<td>6 (2.4)</td>
</tr>
<tr>
<td>The child’s clinic card did not have facility number, so he was not tested</td>
<td>10 (4.0)</td>
</tr>
<tr>
<td>Unavailability of trained health workers</td>
<td>5 (2.0)</td>
</tr>
<tr>
<td>DBS kits out of stock</td>
<td>16 (6.5)</td>
</tr>
<tr>
<td>Improper collection of DBS specimen</td>
<td>7 (2.8)</td>
</tr>
<tr>
<td>The first HIV test results lost</td>
<td>4 (1.6)</td>
</tr>
</tbody>
</table>

Notes: (a) Total sample size, N= 112 (b) ⁵The culture does not allow to send back the young child to the health facility, the cultural does not allow the young child to be carried by everyone and should be kept inside the house (c) † Three mothers believe in Almighty God who will cure them from HIV infection through prayers and refuse to take ARV (d) *HIV related stigma experienced by 17 mothers has directly affect access to EID services

4.2.1 Mother/guardian-child pairs factors

4.2.1.1 Logistic regression of factors associated with accessibility

In multiple logistic regression models for individual characteristics, it was found that mothers/guardians with good knowledge on HIV, had significantly higher odds ratio for the mother/guardian-child pairs accessing EID (AOR=2.8, 95% CI 1.7-4.7) compared to those with poor knowledge. For every mother/guardian who was married/living together with their spouses, the odds ratio of mother/guardian-child pairs accessing EID was higher (AOR=2.3, 95% CI 1.1-4.4) compared to those who were single/divorced/widow. Those
with the head of household as the father (AOR=2.2, 95% CI 1.3-6-3.8) and who has attained secondary or high school education (AOR= 1.9, 95% CI 1.1-3.3), had significantly higher odds for mother/guardian-child pairs accessing EID (Table 4). In contrast, having a child in the age groups of 13-24 months (AOR=0.4, 95% CI 0.2-0.6) or 25-59 months (AOR=0.3, 95% CI 0.2-0.5), were associated with lower odds of accessing EID. Similarly, lower odds of accessing EID were observed among children being found HIV positive (AOR=0.2, 95% CI 0.1-0.4). Likewise, lower odds to access EID were observed among children born to mothers with unplanned pregnancies (AOR=0.7, 95% CI 0.5-0.9) and those born to mothers with unknown HIV status at conception (AOR=0.6, 95% CI 0.4-0.8). In addition, lower odds to access EID were also observed among children with mothers/guardians who did not know the age when the first HIV test of the child ought to be performed (AOR=0.2, 95% CI 0.1-0.3); and those who lived in areas located far away from a health facility (AOR=0.5, 95% CI 0.3-0.7) (Table 4.6,4.7 and 4.8).

However, in a separate multiple variable analysis that combined three set variables, we found that children with mothers/guardians who were married/living together with their spouses (AOR=2.3, 95% CI 1.2-4.6), having general good knowledge on HIV (AOR=2.4, 95% CI 1.4-4.0) remained independently associated with increased likelihood of accessing EID services. Having a child in the age group of 13-59 months (AOR=0.4, 95% CI 0.2-0.7), a child being found HIV positive (AOR=0.3, 95% CI 0.1-0.6), living far away from the health facility (AOR=0.6, 95% CI 0.4-0.9) and mothers/guardians who did not know the age when the first HIV test of the child ought to be performed (AOR=0.2, 95% CI 0.1-0.4) remained independently associated with lower odds to access EID services (Table 4.9).
Table 4.6: Logistic regression of factors associated with child’s HIV testing at six weeks old by child and maternal characteristics

<table>
<thead>
<tr>
<th>Variables</th>
<th>Proportion (%)</th>
<th>COR (95% CI)</th>
<th>P value$$</th>
<th>AOR (95% CI)</th>
<th>P value*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age in months</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≤12</td>
<td>38.9</td>
<td>1</td>
<td>&lt;0.001</td>
<td>0.4 (0.2-0.6)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>13-24</td>
<td>26.9</td>
<td>0.4 (0.2-0.5)</td>
<td>&lt;0.001</td>
<td>0.3 (0.2-0.5)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>25-59</td>
<td>34.2</td>
<td>0.2 (0.2-0.4)</td>
<td>&lt;0.001</td>
<td>0.3 (0.2-0.5)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Sex</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>51.2</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>48.8</td>
<td>1.1 (0.8-1.5)</td>
<td>0.7</td>
<td>1.0 (0.7-1.5)</td>
<td>0.9</td>
</tr>
<tr>
<td>Residence</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Urban</td>
<td>22.7</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rural</td>
<td>77.3</td>
<td>0.7 (0.5-1.0)</td>
<td>0.07</td>
<td>1.1 (0.7-1.8)</td>
<td>0.6</td>
</tr>
<tr>
<td>Place of delivery</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Health facility</td>
<td>91.7</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Home</td>
<td>8.3</td>
<td>0.5 (0.3-0.8)</td>
<td>0.01</td>
<td>0.6 (0.3-1.2)</td>
<td>0.1</td>
</tr>
<tr>
<td>HIV status</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Negative</td>
<td>89.4</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Positive</td>
<td>10.6</td>
<td>0.1 (0.1-0.2)</td>
<td>&lt;0.001</td>
<td>0.2 (0.1-0.4)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Maternal HIV status at conception</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Known</td>
<td>56.4</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unknown</td>
<td>43.6</td>
<td>0.4 (0.3-0.6)</td>
<td>&lt;0.001</td>
<td>0.6 (0.4-0.8)</td>
<td>0.002</td>
</tr>
<tr>
<td>Maternal planned index pregnancy</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>52.1</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>45.1</td>
<td>0.7 (0.5-1.0)</td>
<td>0.06</td>
<td>0.7 (0.5-0.9)</td>
<td>0.04</td>
</tr>
<tr>
<td>Unknown</td>
<td>2.8</td>
<td>0.2 (0.1-0.7)</td>
<td>0.01</td>
<td>0.4 (0.1-1.3)</td>
<td>0.1</td>
</tr>
</tbody>
</table>

Notes: (a) $^*$P values of AOR, $^\$P values of COR (b) COR=Crude odd ratio, AOR=Adjusted odd ratio, CI=Confidence interval (c)Odd ratio of; < 1 - the factor under the study have reduced odds to access the test; 1 - the factor under the study is not associated with access to test; > 1- the factor under the study have increased odds to access the test
Table 4.7: Logistic regression of factors associated with child’s HIV testing at six weeks old by guardian characteristics

<table>
<thead>
<tr>
<th>Variables</th>
<th>(%)</th>
<th>COR (95%CI)</th>
<th>$^\text{P}$ value</th>
<th>AOR (95%CI)</th>
<th>$^\text{P}$ value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age in years</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>35-70</td>
<td>47.6</td>
<td>1</td>
<td></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>15-34</td>
<td>52.4</td>
<td>1.6 (1.2-2.2)</td>
<td>0.01</td>
<td>1.4 (0.9-2.1)</td>
<td>0.1</td>
</tr>
<tr>
<td><strong>Education</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No education</td>
<td>13.5</td>
<td>1</td>
<td></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Primary complete</td>
<td>78.3</td>
<td>1.1 (0.7-1.8)</td>
<td>0.7</td>
<td>0.7 (0.4-1.3)</td>
<td>0.3</td>
</tr>
<tr>
<td>Secondary/high school and above</td>
<td>8.2</td>
<td>0.9 (0.5-1.9)</td>
<td>0.8</td>
<td>0.9 (0.4-2.5)</td>
<td>0.9</td>
</tr>
<tr>
<td><strong>Marital status</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Single/divorced/widow</td>
<td>9.9</td>
<td>1</td>
<td></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Married/living together</td>
<td>90.1</td>
<td>2.3 (1.3-4.0)</td>
<td>0.004</td>
<td>2.3 (1.1-4.4)</td>
<td>0.02</td>
</tr>
<tr>
<td><strong>Reported age to perform first test</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 - 6 weeks</td>
<td>67.2</td>
<td>1</td>
<td></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>≤1 week, 2 - 240 weeks</td>
<td>22.2</td>
<td>0.07 (0.04-0.12)</td>
<td>&lt;0.001</td>
<td>0.08 (0.04-0.13)$^\dagger$</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>I don’t know</td>
<td>10.6</td>
<td>0.1 (0.1-0.2)</td>
<td>&lt;0.001</td>
<td>0.2 (0.1-0.3)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td><strong>Knowledge on HIV</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Poor</td>
<td>25.4</td>
<td>1</td>
<td></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Good</td>
<td>74.6</td>
<td>5.7 (3.7-8.6)</td>
<td>&lt;0.001</td>
<td>2.8 (1.7-4.7)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td><strong>Monthly income</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High (&gt;34 US Dollar)</td>
<td>7.8</td>
<td>1</td>
<td></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Low (≤34 US Dollar)</td>
<td>92.2</td>
<td>2.9 (1.5-5.5)</td>
<td>0.001</td>
<td>1.6 (0.7-3.6)</td>
<td>0.3</td>
</tr>
<tr>
<td><strong>Size of the household</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≤7 people</td>
<td>90.1</td>
<td>1</td>
<td></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>&gt;7 people</td>
<td>9.9</td>
<td>0.5 (0.3-0.8)</td>
<td>0.01</td>
<td>0.5 (0.3-1.0)</td>
<td>0.05</td>
</tr>
<tr>
<td><strong>Distance to health facility</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Near (≤30 minutes)</td>
<td>46.4</td>
<td>1</td>
<td></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Far (&gt;30 minutes)</td>
<td>53.6</td>
<td>0.5 (0.4-0.8)</td>
<td>&lt;0.001</td>
<td>0.5 (0.3-0.7)</td>
<td>0.001</td>
</tr>
</tbody>
</table>

Notes: (a) $^\text{P}$ values of AOR, (b) $^\text{P}$ values of COR (c) COR=Crude odd ratio, AOR=Adjusted odd ratio, CI=Confidence interval (d) $^\dagger$ Unable to round off (c) Odd ratio of; < 1 - the factor under the study have reduced odds to access the test; 1 - the factor under the study is not associated with access to test; > 1 - the factor under the study have increased odds to access the test
Table 4.8: Logistic regression of factors associated with child’s HIV testing at six weeks old by head of household characteristics

<table>
<thead>
<tr>
<th>Variables</th>
<th>Proportion (%)</th>
<th>COR (95%CI)</th>
<th>P value§</th>
<th>AOR (95% CI)</th>
<th>P value*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age category (years)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>35-85</td>
<td>83.5</td>
<td>1</td>
<td></td>
<td>1.3 (0.8-2.1)</td>
<td>0.3</td>
</tr>
<tr>
<td>15-34</td>
<td>16.5</td>
<td>1.4 (0.9-2.1)</td>
<td>0.19</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Education</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No education</td>
<td>10.0</td>
<td>1</td>
<td></td>
<td>1.3 (0.8-2.1)</td>
<td>0.3</td>
</tr>
<tr>
<td>Primary complete</td>
<td>8.0</td>
<td>2.0 (0.9-4.4)</td>
<td>0.1</td>
<td>1.6 (0.7-3.6)</td>
<td>0.3</td>
</tr>
<tr>
<td>Secondary/high school and above</td>
<td>82.0</td>
<td>2.2 (1.3-3.9)</td>
<td>0.01</td>
<td>1.9 (1.1-3.3)</td>
<td>0.04</td>
</tr>
<tr>
<td>Relation to the child</td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mother</td>
<td>11.3</td>
<td>1</td>
<td></td>
<td>1.3 (0.8-2.1)</td>
<td>0.3</td>
</tr>
<tr>
<td>Father</td>
<td>61.6</td>
<td>2.2 (1.3-3.8)</td>
<td>0.003</td>
<td>2.2 (1.3-3.8)</td>
<td>0.01</td>
</tr>
<tr>
<td>Grandmother/grandfather</td>
<td>22.7</td>
<td>1.0 (0.5-1.8)</td>
<td>0.9</td>
<td>1.1 (0.6-2.0)</td>
<td>0.8</td>
</tr>
<tr>
<td>Other relatives‡</td>
<td>4.4</td>
<td>1.6 (0.6-4.0)</td>
<td>0.3</td>
<td>1.5 (0.6-3.8)</td>
<td>0.4</td>
</tr>
</tbody>
</table>

Notes: (a) *P values of AOR, §P values of COR (b)COR=Crude odd ratio, AOR=Adjusted odd ratio, CI=Confidence interval (c) Odd ratio of; < 1 - the factor under the study have reduced odds to access EID; 1 - the factor under the study is not associated with access to EID; > 1 - the factor under the study have increased odds to access EID

Table 4.9: Logistic regression of factors associated with child’s HIV testing at six weeks old by all participants characteristics

<table>
<thead>
<tr>
<th>Children</th>
<th>Proportion (%)</th>
<th>AOR (95%CI)</th>
<th>P value*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age category(months)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≤12</td>
<td>38.9</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>13-24</td>
<td>26.9</td>
<td>0.4 (0.2-0.7)</td>
<td>0.001</td>
</tr>
<tr>
<td>25-59</td>
<td>34.2</td>
<td>0.4 (0.2-0.7)</td>
<td>0.001</td>
</tr>
<tr>
<td>HIV status</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Negative</td>
<td>89.4</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Positive</td>
<td>10.6</td>
<td>0.3 (0.1-0.6)</td>
<td>0.002</td>
</tr>
<tr>
<td>Marital status</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Single/separated/widow</td>
<td>9.9</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Married/living together</td>
<td>90.1</td>
<td>2.3 (1.2-4.6)</td>
<td>0.02</td>
</tr>
<tr>
<td>Reported age to perform first test</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4-6 weeks</td>
<td>67.2</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>≤1 week, 2-240 weeks</td>
<td>22.2</td>
<td>0.08 (0.04-0.14)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>I don’t know</td>
<td>10.6</td>
<td>0.2 (0.1-0.4)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Knowledge on HIV</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Poor</td>
<td>25.4</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Good</td>
<td>74.6</td>
<td>2.4 (1.4-4.0)</td>
<td>0.001</td>
</tr>
<tr>
<td>Distance to health facility</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Near (≤30 minutes)</td>
<td>46.4</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Far (&gt;30 minutes)</td>
<td>53.6</td>
<td>0.6 (0.4-0.9)</td>
<td>0.01</td>
</tr>
</tbody>
</table>

Notes: (a) *P values of AOR (b) AOR=Adjusted odd ratio, CI=Confidence interval (c) Unable to round off (d) Odd ratio of; < 1 - the factor under the study have reduced odds to
In a multiple logistic regression model for mother/guardians characteristics, mothers/guardians who were married or living together with their spouses (AOR=2.7, 95% CI 1.5-4.8) and with a primary education level (AOR=1.9, 95% CI 1.1-3.3) had good knowledge on HIV (including MTCT, PMTCT and EID). Mothers/guardians living in rural areas had poor knowledge on HIV (including MTCT and PMTCT) (AOR = 0.6, 95% CI 0.4-0.9) (Table 4.10).

### Table 4. 10: Guardian characteristics associated with general good knowledge on MTCT and PMTCT

<table>
<thead>
<tr>
<th>Guardians</th>
<th>Proportion (%)</th>
<th>COR (95% CI)</th>
<th>$^\text{§}$P value</th>
<th>AOR (95% CI)</th>
<th>$^\text{*}$P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age in years</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>35-70</td>
<td>47.6</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>15-34</td>
<td>52.4</td>
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<td>1.5 (1.0-2.2)</td>
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<td>0.3 (0.1-1.2)</td>
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<td>&lt;0.001</td>
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Notes: (a) $^\text{*}$P values of AOR, $^\text{§}$P values of COR (b) COR=Crude odd ratio, AOR=Adjusted odd ratio, CI=Confidence interval (c) Odd ratio of; < 1 - the factor under the study have poor knowledge on HIV; 1 - the factor under the study is not associated with knowledge on HIV; > 1 - the factor under the study have good knowledge on HIV
**Knowledge on EID:** Inadequate knowledge of EID was reported by some mothers/guardians as among the barriers to access EID. They did not know the specific time of when an HIV test is ought to be performed to an HIV exposed child, as some of the respondents from focus group interviews had these to say, ‘*The first test for the child had to be taken at the age of six months..’* (1FGD, HIV positive mother#3). Another respondent had these to add, ‘*I did not know the age when my child needs to be tested’* (6 FGD, HIV positive mother#1). Furthermore the health care workers continue to provide conflicting information regarding infant HIV testing, as by one respondent: ‘*The nurse told me that the first HIV test will be done when my child stop breastfeeding.’* (2 FGD, HIV positive mother#7).

**Knowledge and beliefs of HIV transmission:** Out of 576 mothers/guardians, more than 60 were aware that MTCT of HIV can occur in utero, during delivery and through breast feeding. Despite the fact that majority have good knowledge on MTCT but, some of them have some misconceptions about HIV transmission. Some still believe in witchcraft, mosquito bites or sharing food with the person who has AIDS as a cause of acquiring HIV infection to a person (Figures 4.1). Some (42 percent) mothers/guardians also reported that MTCT of HIV could be transmitted through sharing of tooth brush, sharps tools, razor blades, spoon, biting when breast feeding, biting food and give it to the child, not using ARV and low CD4 count during pregnancy and blood transfusion from mother to the child.

![Figure 4.1](image_url)  

*Figure 4.1: Proportion of mothers/guardians on the knowledge and beliefs of HIV transmission*
Use of ART to prevent MTCT: Out of 576 mothers/guardians, 79 percent were aware that the risk of HIV transmission to unborn baby can be prevented by taking ARV during pregnancy (Figure 4.2). About 13 percent they did not know the most effective drug used to prevent the risk of MTCT of HIV and even they don’t know the name of drugs. ‘I do not know the name of the medicine I am using…I just take it one pill every day.’ (2 FGD, HIV positive mother#9).

![Figure 4. 2: Proportion of mothers/guardians on the knowledge of the most effective drug to prevent MTCT](image)

Infant feeding practices: Majority of mothers were conscious about breastfeeding in the context of HIV prevention. However, there is a lot of confusion among them regarding breast feeding guidelines in the context of HIV prevention. Most mothers did not strictly adhere to PMTCT guidelines like EBF for six months. Majority of mothers fear to breastfeed their children, and others prefer not to breast feed at all. Others prefer to breast feed for three months, other six months, others continue up to one year and others one year and six months. Early weaning below six months was also reported among mothers which is contrary to guidelines. ‘..I was afraid and worried to transmit infection to my child because I had HIV..so I started giving cow milk, later on porridge mixed with “Blue Band” when she was five months old...’ (3 FGD, HIV positive mother#8). Poor knowledge regarding breastfeeding in the context of preventing MTCT makes mother to listen to health care providers’ advise since they know nothing, as expressed by one respondent: ‘..when my child was six months old.. our nurse...she told me that “is it true that you will not give the child any other food varieties from six months until he reaches one year and
two months?, so you had to stop breast feeding your child because we are in research’...’ (5 FGD, HIV positive mother#1).

**Lack of PMTCT and EID training during ANC visits:** Out of 576 mothers/guardians, 47 percent reported to receive training specifically on EID services during attendance to ANC and PMTCT clinic. Hence this may explain partly the observed inadequate knowledge on EID and PMTCT among mothers/guardians that influence access to EID and PMTCT services.

### 4.2.1.3 Economic, psychosocial, stigma and cultural factors

#### i) Geographical access/access to health facility

**Poverty and transport cost.** Lack of money for transport to health facility was reported by some mothers as among the barriers to access EID services, as some of the respondents had these to say: ‘honestly speaking, the natives are economically poor, the economy is the main challenge... once it happened someone did not attend, if you ask, she will tell you that is due to lack of fare’ (Mkuzi, Registered nurseIDI#1). Another respondent had these to add: ‘..you wish to check up your child health but you can’t, your income is low and you depend on farming, you have planted maize and got finished..' (1 FGD, HIV positive mother#6). Due to poor economic conditions, some mothers/guardians would wish to be assisted with bus fare and some food stuffs for their children and for themselves in order to sustain their living. ‘We request to be given services especially milk to we women living with HIV because we cannot stop to breast feed our babies due to hard life we have, therefore we found ourselves to infect our children because of long duration of breast feeding but all this is due to our poverty, we thought if I stop to breast feed my child what can I offer him?’ (FGD, HIV positive mother#). Women empowerment was among the most widely discussed issues mentioned during qualitative interviews. They would wish to be given some funds to run small business in order not to depend on their parents, male partner/spouse or other relatives. ‘On the side of economy, we had economic hardship, ...honestly our economic status is very poor we need to be supported economically in order to sustain our living and maintain our treatment...because it comes the time you work so
hard in order to get your needs, therefore if there is a possibility of being supported
economically let us be supported...(1 FGD, HIV positive mother#11).

**Distance to the health facility:** Distance from the health care facility was a widely
discussed challenge reported in most mothers/guardians’ focus group interviews to affect
access to EID services, as illustrated by some respondents: ‘From where am living to the
health center is far, but I don’t know the exact kilometers...’ (2 FGD, Guardian#3).
Another respondent had these to add: ‘...poverty can be an obstacle,...for example people
from ‘Kilapura’ and ‘Machemba’, many of them are our customers and without three
thousands and five hundred Tanzanian shilling they cannot afford to come here because it
is very far...’(Mkanyageni- Clinical officerIDI#5).

**Geographical relocation:** In this study, some mother/guardian-child pairs reported to shift
to another residence where the facility with EID services was far away from them. Their
children did not access EID services at recommended age. Stigma surrounding their
community could be one of the contributing factors to move away from their former
residence. Others tend to shift from one health facility to another or from one district to
another with no clear referral arrangements. This brought problems in terms of data
reporting and management. These patients will be recorded as lost to follow up if nothing
had been reported about their whereabouts at their original health facility. These would
result into over reporting of data, due to re-registering of the same patient more than once
and hence would impair health care provider’s working performance, as narrated by one
respondent: ‘The effect can be because of the environment due to traditions and customs,
the government had allowed the free provisions of services and are available in different
areas. So because we do not have procedures like Kenya and Zanzibar, in Zanzibar if you
get pregnancy you have to remain in the same area until you give birth, the same applied to
Kenya you have to remain in the same area so that you can receive good services with
good progress and they want to know their results but it is difficult here. But the PMTCT
had been measured depending on the patients or children who can be found there in the
surrounding environment because those who start attending in between with no history it is
difficult to know where they had started..’ (Teule, Registered nurseIDI#7).
In addition, some of the patients they used to register as new patients when shifting to other health care facilities and hence they will be recorded as lost to follow up, as narrated by one respondent: ‘...There is a lot of issues that can be a reason of not attending to clinic, first can be lack of follow up and women had no permanent station. For example a mother coming from Dar es Salaam to give birth here (Muheza) and DBS test being taken in Dar es Salaam as a result we lose the data, also a mother from here (Muheza) will go to give birth at Tanga and took DBS there in Tanga and start taking medicine there. So these are the issues that make difficult in data management.’ (IDI, Registered nurse#7).

**Geographical position:** Some parts of Muheza are impassable during rainy seasons which led to most of the patients not to access the services in timely manner, as illustrated by one respondent: ‘Sometimes it is a geographical position, we had experienced people from Machemba where during the rainy season a river become full of water, they fail to cross a river and it reaches the time where there is no connection so we had to wait as a result a child can come with two years and six month old.’ (Mkanyageni, Nurse assistantIDI#2).

**ii) Cultural, traditions and religious beliefs**

**Cultural beliefs:** Some of the mothers/guardians never thought of bringing their young babies to the clinic for first HIV test, these has been expressed as the baby looks apparently healthy, so the guardians/mothers felt there were no need to access the services. However, this could be due to rational decision at individual level not to access the services, and presumed that it was not important to send a healthy child to hospital to access the services, unless the child has an acute illness is when she will decide to send the child. Eleven mothers reported that their cultural does not allow to send back the young child to the health facility for HIV test. In addition some mothers reported that the culture also does not allow the young child to be carried by everyone and should be kept inside the house, as narrated by some respondents: ‘The child was born premature at home according to our culture it is not advisable for the baby to be carried by everyone, so I kept the baby at home.’ (1 FGD, HIV positive mother#6). Another respondent had these to add: ‘The child appeared in good health at that time.’ (3 FGD, HIV positive mother#4).

**Traditional beliefs:** Mothers/guardians were reported to attend to traditional healers first for the use of traditional medicines to cure illness. These circumstances continue to delay
management if the child is found to be HIV infected. In addition their beliefs that the child possess different disease that is incurable by modern medicine continue to complicate the situation, as one respondent had these to say: ‘...for instance my grandson was in a very bad situation ...I also attended to traditional healer and they gave me different varieties of herbal medicines and I spent some money...I had to boil then I gave him to drink...a traditional healer discovered that the child had ‘mamboleo’ disease and honestly I spent a lot of money but my grandson had not changed but after coming to Teule hospital and being tested and start using the dose the child had recovered...’ (6 FGD, Guardian#4).

Some pregnant women’s perceptions is that they have been bewitched by a close relative, so they found no need of taking ARV drugs during pregnancy. These mothers tend to consult traditional healers for cure if her child falls sick, as illustrated by some respondents: ‘...at the beginning my child had enlarged lymph node and I went even to traditional healers but my father decided to sent a child to Teule Hospital...’ (2 FGD, HIV positive mother#3). Another respondent had these to add: ‘...After a month she came back with a tin full of medicine(ARV), and she said “I had stopped using this medicine because I do not have HIV, it is my father who bewitches me”...she delivered at Teule...she came to us while the child had six months... her card did not show anything if she is taking medicine (ARV), I took DBS for her child while six months old .. ’ (Mkanyageni, Nurse assistantIDI#2).

**Religious beliefs:** Religious beliefs were reported to affect access to EID. Very few mothers, reported to attend for prayers for cure of HIV and ignore continuing taking ARV drugs during pregnancy for the safety of themselves as well as their children. They believe in Almighty God who will cure them from HIV infection through prayers and refuse to take ART, as expressed by one respondent: ‘...she is not using medicine..because that mother said that “I will go for prayers and I will be cured... I have been bewitched...”...So if she went to take TB drugs for her three months old child who is also HIV positive, she continuing insist telling the nurse that she still attending prayers...it is like that, because we used to talk with her but she did not understand.’ (Teule, Nurse midwiferyIDI#8).These attitudes and beliefs prevent women from seeking health care services during pregnancy which led to poor compliance and adherence to PMTCT and poor access to infant HIV testing.
iii) Autonomy, gender dynamics and decision to send the child to clinic

*Lack of paternal permission.* Lack of paternal permission were reported by some mothers as among the barriers to send the child to access HIV testing. However, as a lack of gender autonomy at household level, this may limit the probability that women would identify it as barrier to access EID services, especially if they were viewed to be socially submissive and polite. Gender inequality resulting in lack of autonomy may limit participation in EID and PMTCT programmes. Traditional gender roles and cultural beliefs may influence access to health care services by a given community that are culturally adhered to their norms which affect health care seeking behaviours. Some mothers said their husband/partner or their parents made major decisions in the household, however, some mothers did not feel that their husband/partner/parents would refuse to allow them to seek care for themselves or their children. In some few cases, male partner/husband make decisions determining women participation in HIV testing for themselves as well as for their children, as narrated by one respondent: ‘*My husband knows that he was infected, and he did not allow me and my child to go to hospital to check our health status*’ (3 FGD, HIV positive mother#7).

Most mothers said their husband/male partner made major decisions in their families, and rarely by the mother, as one respondent had these to say: ‘*My partner is the one who made the decision to test a child to know if the child also had HIV infection.*’ (2 FGD, HIV positive mother#1). Few mothers reported to decide on their own, to send the child to clinic to access EID services, as illustrated by one respondent: ‘*I decided on my own, I told my husband that due to these swellings I need to go to Teule hospital to test the health of the child.*’ (2 FGD, HIV positive mother#5). Few mothers said their mother or father made decision to send the child to clinic to access EID. ‘*It is my mother who decided for testing her grandchild.*’ (2 FGD, HIV positive mother#6).

iv) Psychological factors

Women fear to receive HIV test results for their children was found as a barrier to send back their children to access early infant HIV testing. Some mothers feared if their HIV exposed children would be found to be HIV positive, so they did not send them back to health facility to access EID. These mothers may not understand the importance of EID or see the need to have their apparently healthy children tested. In addition, they may want to protect their children from a stigmatizing diagnosis if found to be HIV positive. Other
factors include apparent denial by mothers, mostly if the child is found by EID to be infected, and concerns about taking blood sample on a child’s heel, as it may be perceived as the tests being painful to the children. Also most mothers did not refer directly to themselves during interviews but describe what ‘some of them’ perceived sending of their children to health facility for HIV test. ‘Some of them fear to attend if they will be told that their children are infected, because they think they are using medicine and their children will also taking medicine until grown up without ending,... “how will I give medicine to my child!”...this is the only thing that make women not to bring back their children to clinic....since she felt that it is better not to send the child for testing, she does not want to know her HIV status that’s why she does not want to test her child.’ (3 FGD, HIV positive mother#7).

Fear for the young child to be taken the blood sample were reported by mothers as among the barriers to send their children to clinic to access the first HIV test. These mothers might perceive the test to be traumatic and painful and also might distort a child's heel, as one respondent had these to say: ‘...others fear their children to be taken blood on a heel.’ (Mkanyageni, Nurse assistant IDI#2). Other mothers felt it is better to die, as they said that it is impossible to take care of an HIV positive child because he will be on lifelong ART, which they found to be unmanageable. Others were crying after being told that their children were infected and it was very hard to accept the situation, as expressed by one respondent: ‘My first born was born safely but the second born had infection, once I conceived my husband hide his HIV status... after being told that I had infection I was shocked..I used to cry all the time till my friend came to comfort me and told me that even her aunt had infection, so I had to accept... ’ (4 FGD, HIV positive mother#3).

Most mothers were aware that their HIV exposed children were given ARV prophylaxis in order to prevent them from infection. However, worry and anxiety still persist among these women as they confess that, even if the child was not found with HIV now, he may have it in the future, as one respondent had these to say: ‘You might have initiated giving drugs (ARV prophylaxis) early but then you might be surprised when he is three years old you come to realize that the child is having HIV, this is a big challenge’ (4 FGD, HIV positive mother#5).
However, some mothers were blaming themselves and felt guilty that they have transmitted the HIV infection to their children by not accepting their HIV positive results during pregnancy. Others felt it is their negligence of not having regular HIV testing even before conception or stayed for a long time without understanding their health status. In addition, some mothers were blaming the health care providers after they received the HIV positive results of their children. They blamed the health care provider that they did not tell them in advance that they were infected so that they could be enrolled into PMTCT program to reduce MTCT, as narrated by one respondent: ‘...My third child I gave birth here at Teule hospital and they did not tell me early may be I would not had transmitted the infection to my child, as I returned home with my child after delivery and breast feed him for one year, I fell sick and my young sister escorted me to hospital and after testing I was found to be infected. So it was very painful to me and asking myself why they did not tell me early I would not had been transmitted the infection to my child.’ (4 FGD, HIV positive mother#7).

Furthermore, some mothers, do not believe their own HIV positive results and were not on ARV during pregnancy. Failure to accept HIV positive results among pregnant mothers would cause negative effect on health outcomes of their children. These mothers will not send back their children to clinic to access EID as themselves are uncertain of their own HIV status. ‘...one of them disagreed with her results until today... she is in Dar es Salaam and she knew her status since long time.. she was brought with her friends nurses as they know her so that at least a child can be tested, after taking a test and the results came back and was positive, we gave her a call to come to take the results, but she was silent...' (Teule, Nurse midwiferyIDI#8).

v) Psychosocial support

Lack of paternal/family/community support. Some mothers who were living with HIV, reported to receive very little psychosocial support resulting into social isolation and sadness. They articulated their beliefs that lack of social support and the stress of illness directly contributed to poor adherence and poor access to PMTCT and EID services. Some mothers reported that lack of paternal support during pregnancy and child delivery contributed to poor access to EID. ‘ Most men contributed because when they impregnated the women they abandon them and no provision of care anymore... ’ (1 FGD, HIV positive
However, only a few report lack of appropriate social support structures to facilitate disclosure of their HIV status and handle stigma as a contributing factor to poor access to EID services. Some of the mothers who were widow or separated by their husbands whether died or ran away, they tend to have poor access to PMTCT and EID compared to mothers in a formal relationship because of limited financial or social support. Some even lack the bus fare to send their children to clinic for the first HIV test, as illustrated by one respondent: ‘Sometimes you wish to come to clinic but you don’t have bus fair, men as men after being impregnated you, they escaped, now you are left with no help (1 FGD, HIV positive mother#6). The situation become more worse if there is no support from their family members and most often due to stigma and discrimination, as expressed by one respondent: ‘...others you may find husband has died, now relatives discriminate and stigmatized... relatives do not care for you therefore it becomes a problem.’(1 FGD, HIV positive mother#5).

vi) HIV stigma and disclosure

**HIV related stigma:** HIV related stigma was a most widely discussed challenge. Poor compliance to PMTCT and EID services have been reported to be highly contributed by stigma in the community. This has been reported by both health care providers and mothers/guardians to be one of the barriers to access these interventions at the health care facility, as one respondent had these to say: ‘Every month when they come to the clinic to enter in the PMTCT room become so difficult, so we used to enter with them in the family planning room when we are giving them PMTCT services, they fear because that room is well known that it concerned with people living with HIV.’ (Mkuzi, Registered nurseIDI#9).

In addition stigma against PLHIV at health care facilities was an additional challenge addressed by mothers/guardians, as illustrated by one respondent: ‘...in our Misozwe Hospital after being tested by the nurse and found to be HIV positive, the nurse went out and start telling people pointing to me, and said, run away from her...our nurses at Misozwe..they had no confidentiality... ’ (2 FGD, HIV positive mother#2).

Some patients are more clever, they used to hide their ANC or CTC cards (patient-held cards which records important health information including HIV status) and get another one with different name and place of residence. Others, may travel to another health facility.
and being registered as new patient without showing their previous ANC/CTC cards. In addition, they don’t like identification codes of their HIV status that has been written on their ANC cards, as illustrated by some respondents: ‘...due to stigma...one can come from Dar es Salaam and told you that she had never attended clinic so we register her as new patient...and others are coming while in labour with no antenatal card and told you that I forgot it in Dar es salaam or she can hide it...so we had to counsel her, test while she is in labour before giving birth....we test and we cover her if is infected (i.e. giving ARV)...’ (Mkanyageni, Nurse assistantIDI#2). Another respondent had these to add: ‘..My sister who died due to HIV was living here at home where I am living now and my mother was the one who was taking care for her. Therefore my mother told me that I have to leave away at our home place. Also my mother and my young sisters and brothers stigmatized me with my child, when my child got flue or sweating they told me to send the child to hospital for testing’ (6 FGD, HIV positive mother#4).

Undisclosure of HIV status: Women fear disclosing their HIV status to partner/husband and other family members. This has affected access to PMTCT and EID services. In most cases these women may fear abandonment especially if they depend on their partner for their livelihood. Thirteen children were living with grandmother as their main primary care taker, but they were uninformed if anyone was born to HIV positive mother. In addition, a child born to HIV positive mother has high risk to receive mixed feeding (MF) if disclosure has not been done to other family members when exclusive breast feeding (EBF) had been opted, as one respondents had these to say: ‘She is stigmatized herself because she said even her husband new nothing about her status...’ (Teule, Nurse midwiferyIDI#8). Nearly all women had disclosed to at one or more family members, most often their mothers. ‘I do not like HBC(Home based care) to come to visit at my home place, I have disclosed my HIV status to my mother only I do not like other people to know my status’ (2 FGD, HIV positive mother#8). Although mothers acknowledged that attitudes about HIV has changed as ART became more widely available, because people are no longer dying, but social isolation and HIV stigma still persists. However, disclosure of HIV status to partner or family members, may initially be accepted and supportive but later could become more distant and rejecting, as one of the respondent had these to say ‘..after having received counseling, I disclosed my status to my family, but later on, there were some people from
my family whom we are of the same blood, they started to isolate and stigmatized me...I had not allowed to touch their utensils, their children not to play with my children and I had to get out from their homes...' (FGD2 HIV positive mother #9).

4.2.1.4 Mothers/guardians’ satisfaction on health care services

i) Satisfaction levels to health care services
A total of 576 guardians were asked about their satisfaction with the quality of services offered at health facilities. About 402 (69.8%) mothers/guardians were satisfied with the level of care at the facility in terms of space, confidentiality and attention. Most of them (85.5%, n=492) were satisfied with EID services provided to their children (Figure 4.3). Generally, low satisfaction with the overall quality of services at the facility was reported by 306 (53.1%) mothers/guardians. However, 559 (97.1%) mothers/guardians were willing to receive EID services for their children.
Figure 4.3: Mothers/guardians’ satisfaction by health care services in Muheza district.
Schematic presentation showing mother/guardian’s perceptions regarding receiving services at the health facility such as level of care, HIV testing, treatment and advice. The horizontal axis shows satisfaction levels as a rating scale of five options. The vertical axis shows proportion of respondents (mothers/guardians) corresponding to the five options on each column (A) Level of satisfaction with the reception given by health care workers. (B) Level of satisfaction of care at the facility (space, confidentiality with patient information, promptness of attention). (C) Level of satisfaction with EID services provided to their children. (D) Trustworthiness on health care workers’ information (care, nutritional, social support). (E) Level of overall quality of health care services at the facility.
ii) Attitudes of mothers/guardians towards Health care providers

**Patient-health care provider interaction:** Mothers/guardians in this study perceived the quality of health care provider-patient interaction to be good. This was reflected in their ratings of nearly 75 percent in the following characteristics of the health care providers: reception, promptness of attention, confidentiality with patient information and trustworthiness on health care workers' information (Figure 4.3). One of the respondent had these to say: ‘There is no any problem, they give us good services with good reception.’ (2 FGD, HIV positive mother#7). However, the quality of interpersonal care and attitudes between health care providers and patients was reported by some mothers/guardian as contributing factors to poor access to EID and PMCTC services. Interaction of patients and health care service providers, characterized by good communication and patient-centered care, is necessary for a positive influence on patient satisfaction and retention into continuum of care and adherence to PMTCT and EID services.

**Poor communication skills:** However, several mothers/guardians related negative experiences with health care providers, in most cases with nursing provider. Some mothers/guardians felt the nurses to be harsh, impolite and others even tend to disclose their HIV status to other patients attending at the facility or in the community. Also some clinicians appeared to be angry and impolite to guardians when a sick child is sent late to health facility, as one respondent said ‘...When my first born was seven month age, I got another pregnant,...I came at Teule hospital, the first thing to be told by the nurse is that I will die, and I was totally lose hope, and I did not go back again, I went back again during delivery due to that shock of being told like that. But the third pregnancy I swear that I will never go back to the clinic until delivery...she shouted to me harshly at the office and finally I cried.’ (1 FGD, HIV positive mother#1).

**Confidentiality at the health care facility:** Lack of confidentiality had been shown to affect access to EID services among mothers with their HIV exposed children, as narrated by one respondent: ‘At Mkuzi health center there is no confidentiality because children are being tested on the same area with those(PLHIV) who attend clinic, so once you enter everyone see you.’ (2 FGD, Guardian#2).
Fear of health care providers: During the period of this survey it was reported that fear of health care providers was one of the reasons of not sending their children to clinic to access first HIV test. This has been reported by 14 mothers that they feared the health care providers because they knew their HIV positive status. ‘The other one can tell you that “I can’t go there because the nurse who is there knows me”, but you told her that I will not be around in the other day and she will be the one who will be around, she will just tell you that “If she will be around I will not come and it is better to miss medicine because she knows me and she will spread my information there”, even if you told her that there is no such kind of behavior but she said... “aaaah no way she will go and spread my information there!..’Teule, Nurse midwiferyIDI#8).

4.2.2 Health system factors

4.2.2.1 Health care providers’ knowledge and beliefs

Knowledge on EID: Only 76 (67.9 percent) out of 112 of the interviewed health care providers from 18 health facilities, know the correct age of when the first HIV test is ought to be performed to HIV exposed infant, that is between four to six weeks age. Only 5 (4.5 percent) of them know the timing of the second HIV test ought to be performed to HIV exposed infant/child, that is from six weeks after the end of breast feeding. This was also transpired in some mothers/guardians, being given contradicting information by health care providers regarding the age to access the first HIV test for HIV exposed child, such as; ‘at the end of breast feeding, at six months old, at nine months old or after two years old’.

Knowledge and beliefs on HIV transmission: More than 60 percent of the 112 health care providers were aware that MTCT of HIV can occur in utero, during delivery and through breast feeding. Despite the fact that majority of health care workers have good knowledge on MTCT but, some of them have some misconceptions about HIV transmission. Some still believe in witchcraft, mosquito bites or sharing food with the person who has AIDS as a cause of acquiring HIV infection to a person (Figures 4.4).
Use of ARV to prevent MTCT: All health care providers knew that MTCT can be prevented by taking ARV during pregnancy. Most health care workers were aware of the use of infant ARV prophylaxis and choice of safe infant breast feeding practices, none of them reported the use of elective caesarean method as one of other modes of interventions to prevent MTCT. Seventy (62.5 percent) out of 112 health care worker, know the timing of post-exposure prophylaxis (infant NVP) to be give to HIV exposed infant that is from birth up to six weeks. Some clinicians appeared to lack some knowledge of the timing of NVP prophylaxis that should be given to HIV exposed children than the nursing staff, as some of the respondents had these to say: ‘I am not sure.. what I know..after a week or two weeks you can give NVP prophylaxis till the DBS results were brought back.’ (Mkuzi, Clinical OfficerID#4). Another respondent had these to add: ‘...am not sure in which age had to start using medicine (NVP) as prophylaxis...’ (Mkanyageni, Assistant Medical OfficerID#3).

Infant feeding practices: Most health care providers were not conversant with the clear guidelines for infant feeding practices in the context of preventing the risk of MTCT of HIV. Most of them reported EBF as the only preferred practice, others reported EBF together with MF practices. Some reported avoidance of breast feeding practices in the
context of preventing the risk of MTCT of HIV. Health care workers’ worries and perceived risk regarding HIV transmission through breast feeding continue to persist despite the available recommended breast feeding guidelines, as expressed by one responded: ‘...it is a danger because the child had to start eating food after six months as a normal child born to HIV negative mother, so there is a problem...’ (Teule, Nurse midwiferyIDI#8). Some health care providers advise mothers to exclusively breastfeed their children for six months only and to stop breast feeding if they can afford the feeding formula. Others advise them to exclusively breastfeed only for six months and start introducing other food varieties after six months and continue breast feeding up to 12 months, 14 months or 18 months. Mothers were often given conflicting advice from health care providers regarding the issue of infant feeding practices. Due to this context most mothers were somehow confused and hence the majority did not adhere to these breast feeding guidelines.

4.2.2.2 Health facility resources and infrastructures

i) Shortage of health care providers

Generally there was a health care providers shortage, in almost every health facility in Muheza, particularly with regard to skilled health care providers. Most health facilities have clinical officers, few fully qualified medical doctors (MD) and all are working in almost every specialty including working with PLHIV, and there were no clinicians specialized as pediatricians in Muheza district. One health care provider can work in more than one position in order to serve the purposes of their patients. A nurse can attend more than 60 patients in a day and can work as a doctor for outpatients, dispensing drugs, vaccination, family planning, ANC services for pregnant women, monitoring growth during under five-year child clinic, CTC services and collection of DBS samples and other RCH activities. ‘...another challenge is the shortage of workers... you may find you have 60 patients waiting for you and you are supposed to check blood pressure, weight, make follow up so it is very difficult job as a result some of duties you have to do very fast due to the number of people and the extent of work.’ (Mkanyageni, Nurse assistantIDI#2).
Due to their limited number, health care providers had to cope up with the environment and the number of patients attending in a particular day so that every patient has to be served. Some of the respondents had these to say: “I am working at CTC, RCH, PMTCT and sometimes I act as a doctor if a doctor is in leave so I used to prescribe and dispense medicine in the OPD.” (Mkanyageni- Enrolled nurseIDI#5). Another respondent had these to add: ‘.I was working in the doctor’s office once a doctor was out of the office...but after being transferred at this facility...I work in RCH which is combined with PMTCT, in pharmacy and out patient also am a CTC in charge.’ (Mkanyageni, Nurse assistantIDI#2).

ii) Untrained health care providers

*Lack of PMTCT and EID training:* Out of 112 health care providers, only 37(34 percent) and 19 (17 percent) received formal EID and PMTCT training respectively during 12 months prior the study. These training also included the use of PCR testing for DBS. Almost all health care providers felt EID knowledge was insufficiently covered during informal ANC and PMTCT training (mainly at health facility presentation). Exactly half (50 percent) of the health care providers did not receive formal training specifically on EID, as expressed by one of the respondent: ‘...I think we test the child from three or six months after delivery...I did not receive DBS training but my nurses are those who attended this training.’ (IDI, Clinical officer#4). Another respondent had these to add: ‘For example, breast feeding of children for one year, not all knew that as even me I was told that breast feeding is for six months but those who attended the second training they had been told that a child had to be breast fed for one year’ (Teule, Nurse MidwiferyIDI#8). All health care providers were recommended to receive more training on regular basis on EID and PMTCT for themselves, As well as for all mothers during ANC and PMTCT clinic visits, as narrated by some respondents: ‘..we had to get refreshers courses...also we had to be motivated...if they give us refreshers courses at least one per week, we will be energetic in our working environment...’(Mkuzi, Enrolled nurseIDI#6). Another respondent had these to add: ‘We need to increase education....because if we give her an appointment to come another day, some of them they did not come back.’ (Teule, Nurse midwiferyIDI#8).

In addition, five mothers/guardians reported that health care provider supposed to collect DBS sample was not around during their appointment visit at the age of six weeks of the child.
Most health care providers were not conversant with the available registers provided by the Ministry of Health instead they prefer to use other counter books/exercise books (improvised registers) for record keeping. ‘The other one is how to record these books as we have been given new register (“MTUHA”, “cohort mother-child register”), because we used to interchange duties so it is better every one can understand.’ (IDI, Nurse midwifery#8). During health facility survey, this was evident as some PMTCT registers were half filled with no documentation as to whereabouts of the child of whether the child has died or lost to follow up. The improvised registers only captured the socio demographic characteristics of the mother-child pairs as well as particulars of the first and the second DBS testing. Health care providers should to receive training at least every six months on PMTCT and EID services as well as on how to fill the registers, as narrated by one respondent: ‘We are supposed to be updated, because since I attended training in 2010 about DBS we had not received another training... I think it should be after every six months because things are changing so we have to cope with the time.’ (Teule, Nurse midwiferyIDI#8). They also suggest that training should involve all health care providers in the institution so that they can have the knowledge on prevention of MTCT. ‘..I never received training about DBS....I got experience after being taught with my workmate and also my workmate was taught by the one who was present here(Mkuzi).’(Mkuzi, Registered nurseIDI#1).

iii) Poor techniques in DBS sample collection

Lack of training in DBS sample collection among health care provider was reported to affect delivery of EID services. Some health care providers reported to have experienced difficulties in DBS sample collection from HIV exposed infants. Improper collection of DBS sample was reported by seven mothers/guardians as one of the major causes of late access to EID. Since these poor DBS samples were rejected on arrival at the lab, hence another sample was retaken but it was late. Lack of training has negative effect on work performance whereby to some extent impairs staff confidence when serving their patients, as expressed by one respondent: ‘..I can be taking DBS.. but different with someone who attended the training because she can be more familiar and knowing the reason why the DBS is taken on the heel after reaching one month and two weeks, therefore am doing only due to the experience that I was given by my workmate, therefore, if I would had attended
the training, I could be more competent and understanding well.’ (Mkuzi, Registered nurseIDI#1).

Lack of frequent training among health care providers has been reported to affect the delivery of EID services among under five-year children. Mothers were complaining that they spend long time at the facility due to difficulties encountered by health care providers while taking blood samples from infants for DBS testing. More than one DBS sample test should be repeated until a proper one is collected. ‘If you are going for the first time to test your child/children, you consume a lot of time because taking sample to children somehow is difficult, you can reach at hospital at 09:00 am and left at 15:00 pm. The first sample can be retaken more than two because of being improperly taken, so we are spending a lot of time.’ (4 FGD, HIV positive mother#6).

Improper collection of DBS sample has been found to affect EID, as most of the samples which does not fulfill the standard criteria were always rejected on arrival at the Laboratory. The challenge to health care providers is to trace the child again to be taken another DBS sample. This makes the whole issue to be complicated, as narrated by some respondents: ‘The challenge for Muheza, is that, they are not coming themselves, they just use EMS to send the DBS sample to the Laboratory, so if the sample is rejected it may take long for the child to be taken again the sample.’ (KCMC Lab service provider). Another respondent had these to add: ‘...there is a tendency of taking DBS, someone can take the first DBS but it was returned, took the second one again was returned, meaning that they were improperly taken thus why on arrival at KCMC lab they were returned back...because to take DBS sample you need to receive training. Initially I was not able to take good DBS samples, if contaminated samples are sent to KCMC lab, they were returned back to the facility and then we had to take another (DBS samples)’ (Teule, Nurse OfficerIDI#9).

iv) Long waiting time at the health care facility
Most mothers/guardians usually complain due to long waiting time at the facility before they have to be attended. But this is only due to limited number of health care providers. The problem of long waiting time has been observed in more than 60 percent of health
facilities in Muheza. ‘These services for maternal and child health should be improved, to increase the number of health workers because you are going to health facility early in the morning but due to low number of health workers, we reached home late and we are not being provided with any food at the health facility’ (4 FGD, HIV positive mother#7).

v) Medical supplies out of stock
Lack of supplies for DBS kits at the health facilities has been reported by health care workers as the main problem that affect service provision to their users. The issue of ART drugs being out of stock most of the times has been reported also to be the main problem at some health facilities. Some medical supplies especially HIV kits and ARV drugs do not reach on time and health care providers have to go to district hospital to collect the medical supplies and some of them have to use their own money for transport cost, as some of the respondents had these to say: ‘..in HIV testing services we need supplies to be brought to our facility and we should not make follow up using our own fare because sometimes you are not having some money ..others used to say “aaah...I cannot use my money to make follow up, this is not my hospital”...but for us whom we get allowances we used to make follow up at district hospital, but others who are not involved in DBS sample collection, if you tell them to send DBS at district hospital, cannot agree (Mkanyageni, Enrolled Nurse IDI5). Another respondent had these to add: ‘..we always make follow up but did not reach on time..it is not DBS kits only but also drugs like ARV because we had to make follow up from the main CTC.’(Mkanyageni, Clinical officer#IDI5). Mothers/guardians recommended that the services should be improved and all supplies should be available in each health care facility in the district. ‘DBS kits were out of stock, therefore I had to travel to the health facility that was far, therefore my child delayed to be tested on time.’ (1 FGD, HIV positive mother#7). In addition 16 mothers/guardians also reported lack of DBS kits during their appointment visits at the health care facility as among the barrier to access EID services.

vi) Poor documentation of HIV status on infant’s booklet/Road to Health card
Poor documentation of HIV status on infant’s booklet were among the contributing factors for missed opportunity to access EID services as reported by some health care workers. However, most health care workers they are conversant on the use of patient-held Road to
Health card, where by a code on the maternal ANC or child booklet/register is written to indicate the HIV status of the mother as well as infant HIV exposure status respectively. During health facility survey, health care workers were also asked how are they documenting the HIV status on infant booklet/register by asking them this question: “What do you write on under five-year card/infant register/booklet to know their HIV status?”. Of the 112 health care workers, 69 (61.6 percent) said they code with a letter “E” meaning that the child is exposed or “PMTCT-1” meaning the child was born to an HIV positive mother. While, 5 (4.5 percent) of them write nothing and 38 (33.9 percent) did not know what to write.

vii) Weak infrastructures/Health facility infrastructures

Most mothers/guardians and health care providers were generally not satisfied with the environment of care and attention at the facility due to limited space and lack of confidentiality. Patients tend to shift to other health facility due to lack of confidentiality at some health facilities. Most of services are conducted in one room due to limited space which compromises the quality of care they provide to their patients. During the survey in most health facilities, family planning, vaccination, antenatal and postnatal services all were conducted in one room. For example in Mkanyageni dispensary they have one building with partitions for CTC, doctor and RCH rooms. The dressing, injection, dispensing, laboratory and reception areas all has been located at the entrance of the building, as illustrated by some respondents: ‘...the first challenge is lack of confidentiality in our working environment when we provide services to our patients and this is almost similar to all dispensaries.. due to scarcity of buildings all RCH services are concentrated in one room.’ (Mkanyageni, Nurse assistantIDI#2). Another respondent had these to add: ‘Honestly...we have a very small space..the challenge is the building, the space is very small.’ (Teule, Nurse midwifeIDI#8).

In addition, lack of appropriate counseling space, with high patient volumes in one building, and staffing limitations will automatically compromise effectiveness of EID and PMTCT services. In some health facilities in Muheza district, only one or two nurses were available in high burden primary health care facilities (dispensaries and health centres) during the period of survey. Therefore, with current health care worker capacity, and
adding EID/PMTCT responsibilities would be burdensome and unmanageable. However, in 2016, Tanzania has signed a task shifting policy, whereby some duties are shifted to lower cadres of health care providers according to WHO recommendations on task shifting also known as task sharing (PEPFAR, 2018, WHO, 2008). The Tanzania task shifting policy allows trained CHWs to perform rapid HIV testing and it has been implemented since July 2018 (PEPFAR, 2018). These CHWs may also be allowed to perform other duties other than rapid HIV testing without compromising the quality of care. This in turn will automatically reduce workload of health care providers, improve quality of service delivery and also improve patient satisfaction with services (Ikahu et al., 2016).

viii) Delay of HIV results (Long turnaround time)
Late return of DBS results has been reported by majority of mothers/guardians and health care providers. The results can come to health facility after more than one, two or five months. In addition, some mothers/guardians were not satisfied with the receipts of HIV results for their children due to variability in turnaround time. These mothers were wasting their time unnecessarily to return to the health facility and suggest at least the result to be brought back within one week. Some mothers were unhappy and felt tired with the health care system, as expressed by one respondent: ‘In our facility..the problem is the returning of the results...you can make follow ups at the end you give up... since when my child was at the age of one month and now she is ten months and the results are not out...now I gave up and I do not know if my child is infected or not...because when I go there to follow up results, there is no clear answer... ’ (3 FGD, HIV positive mother#3).

Some mothers (12.5 percent, n=72) were discouraged to return to the health facility to collect their children’s results. Three mothers each with HIV exposed child aged six months, nine months and four years, respectively declared that they have never received the first DBS results of their children since birth. Few of them (one percent, n=6) claimed that their results were not seen or found at the clinic. Most health care providers reported this to be a critical problem that affect EID implementation, as narrated by one respondent: ‘..The other thing is delay of results, women are not getting results on time, so we had to make sure that women get results on time so that they can settle, as if the results delays they remain in dilemma with confusion.’ (Teule, Registered nurseIDI#7). However, when
results were received late at the facility, the life saving for these PCR technique might turn into undesirable effect as three children in 2015 in Muheza district had been reported to die before the results came out, as one of the responded had these to say: ‘...The one who died, died three months before the results came out, was admitted here at hospital but also her mother was not using medicine(ARV).’ (Teule, Nurse midwifery IDI#8).

During the survey, the KCMC Clinical Laboratory was visited to identify any challenges encountered for delaying of DBS results to health facilities of Muheza district. To process one DBS sample cost 75 USD, and transport of DBS results for one EMS envelope cost 15,000 Tanzanian Shilling (eight USD) even if it contains two or 20 DBS results. These costs were covered by CRS (Catholic Relief Services) and PEPFAR during the period of study.

Soon after DBS samples are received in the laboratory, they are processed immediately and results are sent within one week. In the past the results were usually sent by both SMS printer and EMS. But currently these SMS printers are out of order since March 2014, because the SMS card need to be filled with money all the time by the health care facility. ‘Currently this SMS printer is out of order due to lack of refill of the cheap inside with money...but KCMC Lab want to install new technique that will allow the nurse at the health facility to receive the SMS instantly on the nurse’s phone and hence to receive the results on the same day.’ (KCMC Laboratory service provider.

Also several problems have been encountered regarding DBS samples by Laboratory service provider due to sample rejection. Sample rejection is usually sent by hard copy with description together with its DBS sample to the health facility. The challenge for Muheza district is, if the sample is rejected on arrival, it takes long time for the child to be taken again the sample because the rejected sample has to be sent back to the facility via EMS. The health care worker need to trace the child again immediately to take another DBS sample. The KCMC Laboratory staff used to undergo on site supervision once per year to health facilities in Muheza district to check if they have any complains or if results are sent very late or any other challenges encountered. ‘There are a lot of problems that lead us to reject the sample; like, no lab request form, inadequately labeled, no date of birth on DBS
sample, DBS not in zip lock bags, no humidity indicator in the envelope, DBS samples not in glassine bags, both desiccants and humidity indicator are inside the glassine bag with the sample, all four DBS samples placed in one glassine bag each must occupy one bag, no DBS sample only request form is seen, insufficient quantity of blood collected, DBS is dirty/contaminated… ’(KCMC Laboratory service provider).

4.2.2.3 Health care providers’ satisfaction on health care services

i) Satisfaction levels to health care services
A total of 112 health care providers were asked about their satisfaction with the quality of services offered at health facilities. About 75 (67%) of them were satisfied with the health care services they provide to their patients. Most of them (71.4%, n=80) rated the level of overall quality of health care services at the facility as satisfactorily good (Figure 4.5). Generally, 51(45.5%) health care providers were satisfied with the availability of supplies at the facility.
Figure 4.5: Health care providers’ satisfaction by health care services in Muheza district.
Schematic presentation showing health care provider’ perceptions regarding health care services they provide to their patients at the health facility such as level of care, working environment and availability of supplies. The horizontal axis shows satisfaction levels as a rating scale of five options. The vertical axis shows proportion of respondents (health care providers) corresponding to the five options on each column. (A) Level of satisfaction with the health care services they provide to their patients. (B) Level of satisfaction of the working environment of care at the facility (space, confidentiality of patient information, promptness of attention).(C) Level of satisfaction with the assistance obtained from their head of departments.(D) Level of satisfaction with the availability of supplies at the facility. (E) Trustworthiness to their patients if they understood health care provider’ advice
regarding care, nutritional and social support. (F) Level of overall quality of health care services at the facility.

**ii) Attitudes of health care providers towards mothers/guardians**

Most health care providers appeared sympathetic and supportive towards mothers/guardians in a sense that more than 60 percent were satisfied with their job (Figure 4.6). But health care providers often expressed frustration as most of the children are brought late to the facility for first HIV testing despite the advice given to the mothers/guardians. In addition their traditional customs, local beliefs, religious beliefs, injudicious beliefs on evil spirits and frequent consultations to traditional healers continue to complicate the success of PMTCT program, as narrated by one responded as: ‘...she came back again and claimed that “the medicine(ARV) aborted my pregnant... so I decided to look the other side”, which she meant to go to traditional healers.. ’ (Mkanyageni, Nurse assistant#IDI2). Health care providers attributed this as to low levels of education, although mothers/guardians mentioned other barriers to access EID services (long waiting time, mother not registered at the facility, child under five card to lack health facility number) that were not mentioned by health care providers. ‘..the second thing is education, you can advice mother to come for DBS test of her child...but she will just ignore... the date can reach but she will not attend at the clinic with the child with no any sound reason that she can tell you... you call them by phone but also they will not come on time..’ (Mkanyageni, Nurse assistant#IDI2).

However, some health care providers pointed out that some mothers usually complained about the issue that lack of under five-year children cards after delivery to be one of the reason for not accessing the EID services, as one responded said: ‘...after delivery, they used to claim that “my child had no card” but I used to tell them that you had to come I will give you the card for the child but because he had no number I will give the number later..’(Teule IDI, Nurse midwifery#8). In contrary, ten mothers testified that the under five-year child’s clinic card did not have health facility number, so he was not tested during appointment visit at the age of six week. In addition, some mothers also testified that their children were not tested at the age of six weeks because their mothers were not registered at that particular health facility as they just went there to access EID for their HIV exposed children.
**Poor follow up of HIV testing and counseling among mothers:** Most health care providers were not happy because of poor ANC attendance among pregnant women. Despite being counseled to access HIV testing on regular basis during pregnancy, but some do not show up for HIV testing as recommended by guidelines. Some HIV exposed under five-year children were born to mothers who had just undergone single HIV test. These mothers were later seroconvert to be HIV positive unknowingly since they did not retest after the first HIV test found to be negative. Since the use of conventional HIV antibody test needs regular testing due to the maximum allowed window period of three months that needs to detect the HIV antibodies. ‘..*there should be an emphasis of testing .. but we used to forget the second test and you can see the four visits had passed but if you check the status of PMTCT had already tested but the second test not yet tested...therefore we as health care providers we are also supposed to insist on the second test because it is very important.’ (Mkanyageni IDI, Nurse assistant#2). In addition, they pointed out that unattendance to regular ANC clinic among mothers has been reported to affect the implementation of PMTCT programmes in Muheza district.

**iii) Health care providers’ aggravation**

Health care providers appear frustrated with the quality of health services in the district. They reported that the HIV prevalence is on the increase in the Muheza district despite a lot of efforts and investments made in the past decades on HIV control and prevention. However, they claimed that the current HIV prevalence reported at National level is lower than the actual HIV prevalence in the district. In the past years, the existence of donor funded projects and community based organizations (CBOs) and Nongovernmental organizations (NGOs) dealing with PLHIV were very active compared to the current situation. Muheza was the only leading district in Tanzania that had a lot of these groups in the community for raising awareness, but to date most of them are dormant.

Currently, among the active CBOs in Muheza are Muheza AIDS Intervention Group (MAIG) and JILINDE. ‘JILINDE’ is a Swahili word which means protect yourself against HIV/AIDS. Also among active NGOs in Muheza are Muheza Hospice, Tanga AIDS Working Group (TAWG), Service Health and Development for the people living with HIV/AIDS (SHDEPHA), Society for women and AIDS in Africa Tanzania (SWAAT) and
TIWAMWE. TIWAMWE is an NGO which deals with women development in Muheza District, ‘TIWAMWE’ means we are together in ‘Bondevi’ tribe which among the tribes in Muheza.

A quote from one registered nurse concerning health care services in Muheza has this to say: ‘There are many groups because the HIV infection here at Muheza is increasing but at national level they said it is dropping down but in our district the HIV prevalence is increasing because of lack of awareness, there is no follow up and the services are not in a proper way as required and at the beginning the projects were helping to awaken people during 2004. In other word I can say that people are being educated but the service are not good. I can confidently say this is the only leading district that have many groups for these people in Muheza District for raising awareness, but due to lack of supervision, the operation of these groups had died.’ (Teule, Registered nurseIDI#7).

iv) Poor motivation and turnover of health care providers
Most health care providers were not satisfied with their job for various reasons including high workload, lack of motivation, lack of communication and transport allowances. Poor motivation due to high workload and lack of incentives which lead to turnover of staff shown to be among the challenge in health care system in Muheza district. ‘...when I wanted to work in Germany, the Dr (name) was very angry, she told them to increase my salary so that I could not leave but I decided to go..so I think motivation to health care providers is very important ...(Teule, Nurse OfficerIDI#9). Working in more than one section/department due to staff shortages has been found to be overwhelmed with many duties as evidenced that sometimes health care providers forget to put records in the hospital registers. With large number of patients, most of the registers were usually incomplete lacking some important information, as expressed by one respondent: ‘We try at our level to keep documents but not in a more proper way, because of working in many departments sometimes we fail to enter some data because of being too busy, so once supervisors are coming they see some gaps in register books.’ (Teule, Registered nurseIDI#7).
4.2.3 Structural environments that support delivery and uptake

4.2.3.1 Availability of PMTCT, Care and Treatment Clinic services

Physical observations were done in 46 health facilities during September-October 2015 to assess availability of supplies, that support PMTCT and EID services in Muheza district. However, before the survey, it was reported that, CTC services were available in nine facilities, PMTCT services were provided in 42 health facilities in Muheza district. During the survey, it was observed that PMTCT services were available in 36 facilities (one hospital, four health centers, 33 dispensaries) and onsite EID services were available in 28 (60.9 percent) health facilities (one hospital, four health centers, 23 dispensaries) (Figure 4.6). Despite being provided with DBS kits, the DBS sample collection were not conducted in six health facilities and used to refer their clients to district hospital for DBS sample collection. Most of health care providers in these facilities declared to have no confidence on DBS sample collection even though they have been trained on how to collect the DBS sample. However, mothers with their HIV exposed under five-year children seen at those sites without EID were referred to sites with EID services, which at times were far away and often times the mother-child pair did not complete the referral due to lack of transport cost. No clear arrangement for follow up of these clients to ensure they reach at the health facility with EID services. In addition, the distribution of PMTCT, CTC and EID services were mapped accordingly as shown in Muheza district map in Figure 4.7.

![Figure 4.6: Numbers of Muheza health facilities with EID, PMTCT and CTC services by September-October 2015](image-url)
4.2.3.2 Muheza health facilities information by September-October 2015

i) PMTCT and EID guidelines

Out of 46 health facilities in Muheza district, the PMTCT guidelines were available in 14 facilities, and in house EID algorithm for HIV was available in 10 facilities. However, a separate interviews among 112 health care providers were done in selected 18 health facilities. In six (33.3 percent) out of 18 health facilities, in house algorithm for EID for HIV was visible and displayed on the table/wall. While in 12 (66.7 percent) health facilities it was neither displayed nor visible but it was reported that they were available,
but they could not be retrieved during the time of survey. However, 79 (70.5 percent) of the 112 interviewed health care providers said that the EID algorithm for HIV was available at their health facilities, 12 (10.7 percent) said it was not available and 21 (18.8 percent) did not know if it was available.

ii) Medical supplies and infrastructures
For HIV test kits, the DBS kits were out of stock from one week to nine months in nine facilities; however Determine/Bioline antibody tests were available in 45 facilities, except in one which had only Unigold test kits; Unigold antibody tests were available in 41 facilities, in five facilities were not available. Generally, 52 percent of health facilities experienced interrupted supply of HIV kits at a certain period within 12 months prior the study. There is no laboratory in health facilities of Muheza district for measuring DNA HIV PCR and in 15/46 (32.6 percent) they have laboratory or a room reserved for basic tests. Although the district hospital provides CD4 counts facility, it was not working at the day of visit due to stock out of reagents. Only three health facilities (Bulwa, Mkuzi and Nkumba) had point of care CD4 machines (portable machines). Most health facilities lacked enough space to accommodate PMTCT and EID services. Most of facilities had just a single building with small partitions, and in most facilities, more than one services (such as vaccination, antenatal clinic, family planning, PMTCT services) were concentrated in one small room. More than 20 percent of health facilities did not have basic drugs for PMTCT, ARV prophylaxis for HIV exposed infants and drugs for other opportunistic infections during the period of survey (Figure 4.8).
Figure 4.8: Muheza health facilities with basic antiretroviral and some opportunistic drugs by September-October 2015

Notes: TLE(Tenofovir, Lamivudine & Efavirenz); Other ARV include single tablets of Zidovudine, Lamivudine, Efavirenz, Nevirapine (NVP), Haematenics tablets = FEFO (Ferrous and Folic acid)/FA(Folic acid)/FESO (Ferrous sulphate)

4.2.3.3 Record review of PMTCT

In Muheza district, PMTCT and EID documents (registries, reports) from all health facilities that provide PMTCT and EID services were reviewed from 2007-2015. But most of the data in 2007 to 2009 were not available and if available were incomplete. Eight facilities they have unfilled registers due to unavailability of PMTCT and EID services. Although from 2011-2014 some registries were incomplete, monthly, quarterly and annual reports were also used in order to supplement the missed data for each year. All data from each health facility were compiled together and presented as shown below (Figure 4.9 and 4.10). The observed irregular pattern is more likely an indication that the PMTCT programs in Muheza in 2011-2014 was lagging; as the number of HIV positive pregnant women receiving ART prophylaxis has decreased and it was later increased in 2014 and 2015. This could also explain the challenge on the implementation of option B+ in Muheza since its adoption in 2013, the time when the country was switching to option B+ (Figure 4.9). The irregular pattern is also observed to HIV exposed infants. Not all HIV exposed infants received ARV prophylaxis and the pattern was more worse in 2014 (Figure 4.10).
However, challenges contributing to these irregular patterns observed could be due to under reporting in PMTCT and EID data, staff workload due to shortages of health care workers, as reported previously that sometimes they forget to record data in registers.

Figure 4. 9: Numbers of pregnant women received PMTCT interventions from 2010 to 2015 in Muheza district

Figure 4. 10: Numbers of HIV exposed infants received EID services from 2010-2015 in Muheza district
4.3 HIV infection and associated factors among under five-year children

This section answers specific objective two.

4.3.1 HIV prevalence

Out of 576 children, 61 were diagnosed to be HIV positive, of which 31 were confirmed by HIV DNA test, and 30 by HIV antibody test. HIV prevalence was 10.6 percent (95% CI: 8.1-13.1%). Majority (75.4%, n = 46) of HIV positive children were diagnosed at ≥ 12 months old. Among 61 HIV positive children, 52 (85.2%) children received the first HIV testing at more than six weeks of age which implies that they missed opportunity to access EID services during their infancy period (Figure 4.11). The median age at diagnosis among those confirmed to be HIV positive was 20 months (IQR: 12.5-35 months). Accordingly, 4 (6.6%), 12 (19.7%) and 45 (73.7%) HIV positive children were in ≤ 11 months, 12-23 months and 24-59 months age group respectively.

Figure 4.11: Proportion of HIV positive under five-year children by age at diagnosis and timing of first HIV testing

4.3.2 Associated factors

In multiple logistic regression model, children who were older, delivered at home, born with low birth weight, received mixed feeding practices, born to mothers with unknown
HIV status at conception, with unknown immunization status, lived far from the health facility were significantly and independently associated with HIV infection (Table 10).

Higher odds of HIV infection was observed among older children aged 13-24 months (AOR=3.5, 95% CI 1.1-12.1) and 25-39 months (AOR= 5.6, 95% CI 1.6-19.3) than in younger children. If a child was delivered at home the risk of HIV infection was 2.6 (AOR=2.6, 95% CI 1.1-6.6) times higher as compared to those delivered at a health facility. Children born with low birth weight of < 2500g had 3.5 (AOR=3.5, 95% CI 1.2-10.0) times higher risk of HIV infection compared to those with ≥ 2500g. Children whose immunization status during infancy period was unknown the risk of HIV infection was 2.2 (AOR=2.2, 95% CI 1.1-4.9) times higher compared to those who had completed all the vaccines. The risk of HIV infection in children was 2.4 (AOR=2.4, 95% CI 1.1-4.9) times higher among those who received mixed feeding compared to exclusive breastfed. If the child was born to mother with unknown HIV status at conception, there was a four-fold (AOR=3.9, 95% CI 1.6-9.3) risk of HIV infection compared to those born to mothers with known status. The risk of HIV infection was three (AOR=2.5 95% CI 1.1-5.4) times higher among those who lived far from a health facility as compared to their counterparts.

The odds of HIV infection in children was lower (AOR= 0.3, 95% CI 0.1-0.9) among those with a head of household who attained at least secondary school or high education as compared to their counterparts. Similarly, the odds of infection was reduced among children who had received NVP after delivery (AOR=0.2 95% CI 0.1-0.5) compared to non-recipient of NVP. The risk of HIV infection was also reduced among children born to mothers with CD4 cell count of ≥ 350 cell/µl (AOR=0.3 95% CI 0.1-0.9) compared to those with low CD4 cell count (Table 4.11).
Table 4.11: Logistic regression of factors associated with HIV infection among under five-year children

<table>
<thead>
<tr>
<th>Child and maternal variables</th>
<th>Proportion (%)</th>
<th>COR (95% CI)</th>
<th>P value§</th>
<th>AOR (95% CI)</th>
<th>P value*</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age category(months)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>≤ 12</td>
<td>38.9</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13 – 24</td>
<td>26.9</td>
<td>5.9 (1.9-18.1)</td>
<td>0.02</td>
<td>3.5 (1.1-12.1)</td>
<td>0.04</td>
</tr>
<tr>
<td>25-59</td>
<td>34.2</td>
<td>14.9 (5.2-42.4)</td>
<td>&lt;0.001</td>
<td>5.6 (1.6-19.3)</td>
<td>0.01</td>
</tr>
<tr>
<td><strong>Place of delivery</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Health facility</td>
<td>91.7</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Home</td>
<td>8.3</td>
<td>3.7 (1.8-7.5)</td>
<td>&lt;0.001</td>
<td>2.6 (1.1-6.6)</td>
<td>0.04</td>
</tr>
<tr>
<td><strong>Birth weight</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≥ 2500</td>
<td>91.2</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>&lt;2500</td>
<td>8.9</td>
<td>1.7 (0.7-3.7)</td>
<td>0.2</td>
<td>3.5 (1.2-10.0)</td>
<td>0.02</td>
</tr>
<tr>
<td><strong>Immunization by age</strong></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Completed</td>
<td>70.1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Not completed</td>
<td>4.7</td>
<td>2.3 (0.6-8.2)</td>
<td>0.2</td>
<td>1.3 (0.3-6.6)</td>
<td>0.7</td>
</tr>
<tr>
<td>Unknown</td>
<td>25.2</td>
<td>6.2 (3.5-11.1)</td>
<td>&lt;0.001</td>
<td>2.2 (1.1-4.9)</td>
<td>0.04</td>
</tr>
<tr>
<td><strong>Mode of feeding</strong></td>
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<td></td>
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<td></td>
</tr>
<tr>
<td>Exclusive breastfeeding</td>
<td>75.2</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Replacement feeding</td>
<td>2.3</td>
<td>4.4 (2.3-8.3)</td>
<td>&lt;0.001</td>
<td>0.6 (0.1-5.2)</td>
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<tr>
<td>Mixed feeding</td>
<td>22.6</td>
<td>10.9 (5.1-23.0)</td>
<td>&lt;0.001</td>
<td>2.4 (1.1-4.9)</td>
<td>0.02</td>
</tr>
<tr>
<td><strong>NVP prophylaxis</strong></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0 day</td>
<td>14.4</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>1-90 days</td>
<td>85.6</td>
<td>0.1 (0.04-0.1)</td>
<td>&lt;0.001</td>
<td>0.2 (0.1-0.5)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td><strong>Maternal CD4 cell count†</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≤ 349 cell/µl</td>
<td>32.8</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≥ 350 cell/µl</td>
<td>37.2</td>
<td>0.3 (0.1-0.6)</td>
<td>0.001</td>
<td>0.3 (0.1-0.9)</td>
<td>0.03</td>
</tr>
<tr>
<td>Unknown</td>
<td>30.0</td>
<td>0.3 (0.7-2.3)</td>
<td>0.4</td>
<td>0.9 (0.4-2.0)</td>
<td>0.8</td>
</tr>
<tr>
<td><strong>Maternal HIV status at conception</strong></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Known</td>
<td>56.4</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unknown</td>
<td>43.6</td>
<td>8.0 (4.0-16.2)</td>
<td>&lt;0.001</td>
<td>3.9 (1.6-9.3)</td>
<td>0.002</td>
</tr>
<tr>
<td><strong>Distance to health facility</strong></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Near (≤30 minutes)</td>
<td>46.4</td>
<td>1</td>
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</tr>
<tr>
<td>Far (&gt;30 minutes)</td>
<td>53.6</td>
<td>3.2 (1.7-6.0)</td>
<td>&lt;0.001</td>
<td>2.5 (1.1-5.4)</td>
<td>0.02</td>
</tr>
<tr>
<td><strong>Head of household variables</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Education</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No education</td>
<td>10.0</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Primary complete</td>
<td>8.0</td>
<td>0.6 (0.2-2.0)</td>
<td>0.4</td>
<td>0.8 (0.2-3.9)</td>
<td>0.8</td>
</tr>
<tr>
<td>Secondary/high school and above</td>
<td>82.0</td>
<td>0.5 (0.2-1.1)</td>
<td>0.08</td>
<td>0.3 (0.1-0.9)</td>
<td>0.03</td>
</tr>
</tbody>
</table>

Notes: (a) *P values of AOR, ‡P values of COR (b) COR=Crude odd ratio, AOR=Adjusted odd ratio, CI=Confidence interval (c) †36 missing values
CHAPTER 5: DISCUSSION

The present study observed that only slightly over half of the children below five years exposed to HIV infection accessed EID services at six weeks of age in Muheza district. Furthermore, in the district, EID services were only available in limited number of health facilities showing that EID services coverage in Muheza is below the 80 percent threshold recommended by WHO (WHO, 2007a). This contrasts to the increased reported Tanzanian coverage and some selected countries in sub Saharan Africa (Braun et al., 2011, Coulibaly et al., 2014, Noubiap et al., 2013, UNAIDS, 2015). Nevertheless, when compared to studies conducted in Kenya, Swaziland, South Africa and Namibia which ranged from 72-95 percent, EID services coverage in Tanzania is considerably lower suggesting that the Muheza findings may be a true reflection of the national picture (Chetty et al., 2012, UNAIDS, 2015).

The main reasons affecting the lower coverage of EID services still remain unclear. However, several factors affecting access to EID including both individual and health facility (institutional) were identified in Muheza district. At the individual level, inadequate maternal knowledge and awareness of EID services, education level of the head of household, marital status, lack of paternal support/permission, lack of social support, larger size of household, cost of transport cost, long distance to health facilities, fear of raising HIV infected child, undisclosure of HIV status to partners/husband/family members and HIV-related stigma were identified as barriers of accessing EID services. At the health facility level, unavailability of trained health care providers, weak infrastructures, inadequate supplies of laboratory materials, late return of HIV test results and poor patient-health care provider interaction were the main constraining factors.

Older children were observed to access EID at ≥ to seven weeks of age in this study. In addition, high HIV prevalence has been observed among older children, thus, it is highly likely that late access to EID increases the risk of HIV transmission among these children. Studies from Ethiopia and Tanzania reported that young infants access HIV testing earlier than older infants and HIV transmission was higher in infants enrolled late than those who presented earlier (Koye and Zeleke, 2013, Mwendo et al., 2014). This implies that accessibility to HIV testing among children at older ages could have been prompted by
manifestation of clinical symptoms that required diagnostic testing. This suggests that the current recommended age to access EID may be evaluated and if feasible to start performing the first HIV test within a few days after delivery. The strategy will create awareness and may increase motivation to bring the child later at the age of six weeks and EID coverage may be increased. This will ensure early enrolment into continuum of care in order to identify early HIV infection for timely access to ARV treatment.

Children born to mothers with unknown HIV status at conception and born to mothers with unplanned pregnancy were significantly associated with poor access to EID services in Muheza. Several studies reported that routine HIV testing to all infants presented at vaccination clinics (Goodson et al., 2013, McCollum et al., 2012, Ong'euch et al., 2012, Rollins et al., 2009, Wiegert et al., 2014) and to all hospitalized children (Kankasa et al., 2009, Ndondoki et al., 2013) have been found to identify large number of HIV exposed infants and children. In Botswana, Uganda and Malawi, EID of HIV is offered even to those infants born to mothers of unknown HIV status (Creek et al., 2008, Wanyenze et al., 2010, Weigel et al., 2009). In contrast, in Mozambique, EID programs target infants born to mothers with known HIV positive status (Cook et al., 2011). These studies indicate that a considerable number of HIV infected children will remain unidentified in the community if EID services are offered only to children born to mothers with known HIV status. Furthermore, many high-HIV burden countries have been linking HIV testing with child immunization services. They also have been offering HIV testing to children admitted in paediatric wards or as part of nutrition support programmes, community child care services and other child health services (Fayorsey et al., 2013). In addition, HIV positive pregnant women with unplanned pregnancy had found to have poor uptake of PMTCT and high rate of MTCT (Ramraj et al., 2018). Thus, unplanned pregnancies predict maternal health behaviours during pregnancy and throughout postpartum period, including late presentation for ANC and reduced adherence to PMTCT and poor access to infant HIV testing (Gipson et al., 2008, Wado et al., 2013).

In the district it was interestingly found out that, the majority of children were born to mothers with unknown HIV status at conception. This suggests that, measures have to be taken among women of reproductive age to know their HIV status before planning to be
pregnant. Unfortunately, some mothers did not know the implication of window period in relation to the risk of MTCT. However, the Tanzania guidelines, recommend HIV testing to all pregnant women at first ANC visit, even if they were previously tested. If the HIV test is negative, it is recommended to repeat HIV testing in the third trimester, in case if the test was conducted during the window period (MoHSW, 2013a). In addition, HIV negative mothers should be encouraged to request re-testing after delivery, at postnatal clinic and throughout breast feeding period in order to identify those that may have seroconverted.

In this study, higher likelihood to access EID services were observed among children whose heads of household had attained high education level. Studies conducted elsewhere reported that parents with low educational status tend to have poor follow up to scheduled clinic visits (Hassan et al., 2012a, Ioannidis et al., 1999, Woldesenbet et al., 2015). In addition, inadequate mother/guardian’s knowledge and awareness of HIV/AIDS observed in our study, have also been shown to affect access to EID in South Africa (Ahoua et al., 2010). Moreover, a number of HIV exposed children in Muheza, were living with grandmothers or other guardians as their main primary care, when the mothers are attending to livelihood activities away from home. A study conducted in South Africa reported that, more than two-thirds of primary care taker of children was the grandmother (Ahoua et al., 2010, Jones et al., 2005). These primary care takers may not know the importance of regular follow up visits especially if they are not informed of the mother’s HIV status. Thus, these children will continue to be unidentified in the community. They may be diagnosed late if presented to health facility with symptomatic disease or may even die undiagnosed in the community. Therefore, increase in the knowledge, awareness and understanding about HIV transmission, prevention and control services in the community is crucial as it may influence the change in health seeking behavior.

In this study, the long distance to the health facility, larger size of the household, affordability to cater for transport costs and paternal permission/support were found to affect access to EID. Indeed, studies in South Africa, Zambia, Malawi, Cote d’Ivoire also revealed that lack of paternal support (Dube et al., 2012, Jones et al., 2005, Kankasa et al., 2009, Ndondoki et al., 2013) and lack of paternal permission in Malawi (Bobrow et al., 2016) have great influence on the mothers’ compliance to bring their infants for follow up
to EID services. In addition, pregnant women living with HIV who were single/widows or divorced were more likely to have poor access to scheduled clinic visits during ANC and poor access to PMTCT and EID services. They may have poor access to health care services because of limited financial or social support compared to women in a formal relationship, which in turn affect access to EID (Simkhada et al., 2008). These findings suggest the need to develop and strengthen the health related funding mechanisms that will improve social networks and support structures in the community and especially among PLHIV. Women empowerment programmes should be strengthened to address issues of affordability.

In addition, HIV-related stigma, such as failure by a maternal spouse to disclose their HIV status to their family, maternal fear of the possibility of their child being found HIV positive were found to affect access to EID services in Muheza District. This results into poor compliance to PMTCT and EID services and may lead to poor attendance of regular clinic visits for their children. These findings were also similar to those reported previously (Adeniyi et al., 2015, Woldesenbet et al., 2015). This suggests the need to engage communities for sensitization, particularly education about PMTCT and HIV infection during pregnancy, in order to reduce stigma and improve disclosure. In addition, stigma and discrimination by health care providers to women living with HIV observed in this study discourage them from using care and treatment services including uptake to early infant HIV testing at health care facilities, similar findings have been reported in Ethiopia (Feyissa et al., 2012). Training and awareness-raising among health care providers is very crucial to reducing discriminatory attitudes and behaviours against their clients at health care facilities.

Health facility factors were also found to affect EID services in this study. The observed poor DBS sample collection techniques, inadequate knowledge of HIV testing guidelines among health care providers, lack of guidelines for early infant HIV testing and diagnosis were among the barriers that affect EID services that has also been reported elsewhere (Cherutich et al., 2008, Coulibaly et al., 2014, Woldesenbet et al., 2015). The shortage of health care providers was the major cited barrier in this study. This lead to increase in workload and health care provider becomes overwhelmed with high patient volume. This
has greatly contributed to the long waiting times among patients. In this study, few health care providers received training on PMTCT and EID services hence contributed to the observed phenomena. In Kenya and Burkina Faso reported understaffing and lack of trained health care providers have been shown to hamper the progress of EID services (Cherutich et al., 2008, Coulibaly et al., 2014). As a result, the delivery of quality of services to patients will be impaired due to brief consultations and counselling sessions received to patients in order to avoid long waiting times. Provision of continuous training especially in PMTCT and EID services to health personnel with first priority being given to those involved in providing paediatric care is highly needed.

Furthermore, the long turnaround time of PCR results have been shown to affect access to EID services in our study. The finding is consistent with those reported from other studies (Hassan et al., 2012a, Mugambi et al., 2013, Rollins et al., 2009, Sutcliffe et al., 2014, Tejiokem et al., 2011). The long turnaround time definitely leads to delay in making early diagnosis for early initiation of ART for HIV infected children, whilst continuing with routine care for HIV uninfected children.

Inadequate supply of laboratory materials like DBS kits was also a barrier to access EID services in the district. Similar findings have been documented in other studies (Cherutich et al., 2008, Coulibaly et al., 2014, Hassan et al., 2012a, Woldesenbet et al., 2015). Most facilities in Muheza have inadequate or cramped premises that do not suffice the optimal delivery of services to their patients, similar findings have been reported in Togo (Azoumah et al., 2017). In Kenya and Burkina Faso, stock outs and interrupted supplies of materials like DBS kits and weak health facility infrastructures were critical factors affecting access to EID services (Coulibaly et al., 2014, Hassan et al., 2012a). Availability of supplies and improving health facility infrastructures should be considered as mandatory for a well functioning PMTCT and EID services, this must be taken as a critical issue. In addition, measures aimed at increasing the availability of advanced laboratory that perform PCR techniques will improve the outcomes of EID services in most sub Saharan Africa including Tanzania (Bwana et al., 2016).
In addition, limited capacity to perform PCR analysis is one of the main challenges as there is no single laboratory that performs PCR analysis for HIV DNA in health facilities of Muheza district. Similar problems have also been observed in most health facilities in sub-Saharan Africa (Ciaranello et al., 2011, Cook et al., 2011, Dube et al., 2012). Some children in this study never received their test results and others their results were not found at the clinic. The transportation of DBS samples over very long distances for PCR analysis is a challenge in Muheza district that needs attention. The samples have a high chance of being lost, damaged and causes delays in producing laboratory results. Transportation of DBS results back to health facility is an additional challenge, as the results may also be lost on the way to health facility due to poor handling by service providers or weak transportation system. This is a big challenge in health care system in terms of wasted reagents, wasted human resources time and loss to follow up of HIV exposed infants. This creates additional challenge, of unnecessary repeat of HIV testing and the health care providers had to trace the child to be retaken another sample and often times they will not be found.

Interaction between patients and health care providers have been shown to influence uptake of EID and PMTCT services. Break of code of conduct of ethics regarding confidentiality and protection of patients’ rights has been revealed, which has been translated to be a poor relationship between patients and health care providers. Most mothers/guardians perceived nurses to be less friendly and helpful than clinicians and this was not apparent from interviews with nurses. This has contributed greatly to poor compliance of mothers/guardians to access PMTCT and EID services. Similar findings have been reported elsewhere that identify the existence of poor patient-health care provider relationship to have influenced poor retention of HIV-positive mothers and their children in continuum of care (Bwana et al., 2016, Gourlay et al., 2014, Oetzel et al., 2015). Good patient-health care provider interaction characterized with good communication and patient-centered care, has a positive influence on patient satisfaction and motivate patient/patient retention into PMTCT and EID of HIV programs (Batbaatar et al., 2017, Lyatuu et al., 2008). This suggests the need to strengthen service delivery component of the health care system, in the form of achieving high quality patient-provider interaction that foster uptake and adherence to EID services.
However, health care providers dissatisfaction with their job, lack of motivation with shortcomings within resource-limited health system like Tanzania, may have an impact in meeting the needs of their patients if their own needs are not met (Dansereau et al., 2015). Despite the fact that the country already struggles with a severe shortage of human resources for health mechanisms that promote health care providers’ job satisfaction are urgently needed to scale up and sustain high-quality EID and PMTCT services in the country (MoHSW, 2013c). in addition, a lack of trust by users in health care providers observed in this study is an additional challenge found to affect access to EID services, making people reluctant to use the respective services (Ozawa and Walker, 2009).

Moreover, because most barriers to access health care services cannot be overcome by the health sector acting alone, hence inter-sectoral collaboration should be considered to mitigate these barriers (Braveman and Gruskin, 2003, Ensor and Cooper, 2004) . Innovation community based interventions by the use of CHWs have proven successfully in overcoming access barriers, since community participation in addressing these interventions reduces the substantial gaps between the population and health care systems, also it reduces disparities in accessing HIV/AIDS interventions in the community (Ahmed et al., 2013, Kim et al., 2012).

MTCT of HIV remains an important public health problem in most sub-Saharan Africa including Tanzania (Cook et al., 2011, Mwendo et al., 2014, Noubiap et al., 2013). The results from this concurrent study indicate that nearly three quarters of children diagnosed with HIV infection in Muheza were diagnosed at more than one year of age. Majority of HIV positive children were in the age group between 13-59 months and also accessed the first HIV testing at more than six weeks of age. Studies from Ethiopia and Tanzania reported that HIV transmission was higher in infants enrolled late than those who presented earlier (Koye and Zeleke, 2013, Mwendo et al., 2014). This suggest that late HIV testing at older ages may be due to symptoms that brought them at the health facility for diagnostic testing.

Furthermore, the likelihood of HIV infection in children was lower among those children with the head of household who had attained secondary education or more. Higher
educated individuals were more likely to adopt preventive strategies and possibly due many years spent in school that have been exposed to regular prevention messages on HIV transmission (Michelo et al., 2006). The assumption that effects of educational attainment of the head of household on risk of HIV infection in children is likely to be exerted through mediator factors such as the power of decision to send the child to clinic to access interventions (Boerma and Weir, 2005, Hargreaves and Glynn, 2002). In addition, the likelihood of HIV infection in children was observed to be high among those children with unknown immunization status. Most of these under five-year children presented with cards but the date of vaccination was not recorded and even the guardian did not know if the child had received them. These findings suggest that most of these children did not access these interventions during their infancy that exposed them to risk of acquiring infection. Studies in Tanzania, Kenya, Malawi, South Africa and Zimbabwe reported that routine HIV testing to all infants presented at vaccination clinics has been found to identify a large number of HIV exposed infants and was reported to be more feasible and acceptable (Goodson et al., 2013, Rollins et al., 2009, McCollum et al., 2012, Ong'ech et al., 2012, Wiegert et al., 2014).

It has been reported that, majority of HIV infection in children is due to MTCT (UNAIDS, 2016a). Moreover, the risk of MTCT of HIV is higher among women who are not on ART, and is particularly high among newly infected women who are not yet diagnosed and not on treatment, due to the high levels of viraemia (UNAIDS, 2016a). Children born to mothers with unknown HIV status at conception were more at risk than those born to mothers with known HIV status. Study in Mozambique reported that EID programs target infants born to mothers with known HIV positive status (Cook et al., 2011). This implies that, most of HIV infected children would be left unidentified if EID services are offered only to children born to mothers with known HIV status. In this study, vertical transmission of HIV has been considered to be higher among children delivered at home and in those who received mixed feeding, similar findings have been reported in other studies (Becquet et al., 2009, Koye and Zeleke, 2013). However, children born from rural mothers are more prone to mixed feeding, the choices that commonly practiced throughout Africa (de Paoli et al., 2001, Piwoz and Humphrey, 2005). In this study, place of residence was not significant after adjustment with other variables on the risk of HIV infection in
children. Recent studies in Tanzania, Rwanda and Ethiopia reported less HIV transmission among urban children than rural ones (Koye and Zeleke, 2013, Mwendo et al., 2014, Ruton et al., 2012). This could be due to inefficient PMTCT services or inaccessible of health facilities in rural compared to urban areas. Most women in low income countries do not have access to antenatal services and present late with symptoms at the health facility which could have an effect to health outcomes to both mother and the child (Graham and Newell, 1999). As it has been reported in Angola that, mother-child pairs accessing PMTCT services since delivery to the full 18 months have been reported to have better outcomes in terms of vertical transmission and child survival (Lussiana et al., 2012).

In this study, children who received NVP prophylaxis have been found to have a reduced risk of acquiring HIV infection as it has been reported in a study in Zimbabwe (Ngwende et al., 2013). Children born to HIV positive mothers who did not take co-trimoxazole during pregnancy had increased risk of vertical transmission in this study. A study in Ethiopia and Tanzania also found that lack of maternal PMTCT interventions was significantly associated with MTCT of HIV (Buchanan et al., 2014, Koye and Zeleke, 2013). Even despite the use of maternal antiretroviral treatment, the risk of HIV transmission from mother to child was observed at CD4 cell count of less than 200/mm³ (Dorenbaum et al., 2002). It was observed in this study that children born to mothers with a high CD4 cell count of more than 350 cells/μl were at reduced risk of being infected. This implies that, a low CD4 count is an indicator of high viral load which is associated with higher risk of vertical transmission. HIV transmission from mother to child has been reported among mothers with lower CD4 counts in several studies (Iliff et al., 2005, Shetty and Maldonado, 2001, Semba et al., 1999, Ngwende et al., 2013). Likewise in this study, low birth weight has been associated with advanced maternal HIV status in a study conducted elsewhere in Tanzania (Dreyfuss et al., 2001).

The strength of this study relies on the fact that, the mixed method design that consisted of cross sectional, health facility surveys and triangulation of qualitative data gave credibility to the findings from the study. This study had limitations, including the potential for reporting bias of the date of first HIV test and what transpired during the pregnancy of their index children. Of note, reporting bias was observed in those children.
who had received the first HIV test before initiation of our study. But this was minimized through verification using the children’s under five-year or antenatal cards, the antenatal care (ANC) records, PMTCT records and laboratory DBS forms. The records were compared to the responses given by the respondents. Selection bias, as only those who have attended at the health facility got higher chance to be selected. These patients may differ from those who were left to be unidentified in the community. Stratified random selection could have been the best approach in this study, but this would have entailed enrollment of more facilities per stratum, and considering the limited resources we opted not to stratify. Also cross sectional studies do not establish temporal or causal relationships but only depict associations. A total of 28 mothers/guardians with HIV exposed children below five years refused to participate in the study. These mothers/guardians-child pairs may have different characteristics compared to those who participated in the study. However, while factors included in multiple variables logistic model were each potentially important factor associated with accessibility to EID services, it is difficult to eliminate the probability that the results were manipulated by unmeasured confounders. In addition, IDIs and FGDs were conducted to triangulate the observed quantitative information to enhance credibility. Although, the quality of data collected in mixed methods might have been presented at suboptimal level, but each method adhered to its own standard procedures during data collection, management and analysis. Interviews were conducted in Kiswahili and then translated to English; it is acknowledged that some of the meanings of the interviewee might have been lost through the translation process. However, three sociologists with Swahili language as their mother tongue were involved in translation process. The information obtained from the interviews, cannot eliminate the possibility that some of the participants’ views during interviews might have not been captured. Information bias is anticipated, because the same participants involved in quantitative survey were also involved in qualitative survey. The findings from qualitative study cannot be generalized to a wider community, however, a rich, complex, deep understanding of factors associated with EID services in Muheza have been gained from the viewpoint of the participants.
CHAPTER 6: CONCLUSION AND RECOMMENDATIONS

6.1 Conclusion

Accessibility to HIV testing and diagnostic services among under five-year children exposed to HIV infection in Muheza district is low despite the investment made in the past decades. This could be partly due to poor knowledge of PMTCT and EID among mothers or guardians. Other factors include lack of transport cost to go to health facility, HIV stigma, culture, traditional and religious beliefs, lack of psychosocial support, lack of paternal permission, poor patient-health care provider interaction and low satisfaction among clients with health care services. Laboratory materials out of stock out, weak health care infrastructures, inadequate health care providers, delay of HIV results and low satisfaction to health services among health care providers were an additional challenges to health care system. Barriers to access EID should be better identified and addressed in order to improve the services. A complex interplay of psychosocial, cultural, economic and health system factors create barriers among mother/guardian-child pairs to access EID in Muheza district. Barriers to access EID should be better understood and addressed in a culturally sensitive manner in order to improve the service. Improving health care providers job satisfaction coupled with efforts to address human resources shortages, infrastructure weaknesses, laboratory supplies are critically important in order to increase uptake of EID services.

In addition, the prevalence of HIV among children aged below five years in Muheza district is higher among older children and also they had poor access to EID. The rate of MTCT of HIV can be reduced by prompt access to EID services and adherence to PMTCT interventions. Moreover, it is important to strengthen prevention efforts to reduce the incidence of HIV among women of childbearing age and to identify new HIV infections among women, which may occur at different points of pregnancy and breastfeeding. It is also important to emphasize women and their male partner to know HIV status before pregnancy. The findings from this study underscore the need to focus on effective implementation of PMTCT programs in order to improve EID services in similar settings. There are still many gaps that exist in EID system, suggesting a need for further studies to identify specific reasons for poor uptake of EID and subsequently addressed in order to
improve access to EID services. The findings from this study had provide strong evidence-based information to identify targeting interventions that will improve PMTCT and EID services towards elimination of MTCT in similar settings.

6.2 Recommendations

The findings from this study have earmarked several barriers that hamper the progress of EID services. Mechanisms that will be able to address barriers at different levels are likely to be the most effective mechanisms. Mechanism which involve educational strategies at community and at health facility level are likely to be most effective in order to address these barriers. In addition the identified barriers on both perspectives (demand-side and supply-side) must be addressed concurrently to have the biggest effect. The following are earmarked recommendations.

6.2.1. Institutional/health facility level

1. A fully functioning EID and PMTCT program is highly recommended including uninterrupted supply of working tools (HIV test kits and drugs), conducive working environment and empower health care providers with adequate knowledge and understanding of EID services in order to improve EID services. Guidelines for PMTCT and EID are changing with time in line with development of research. Provision of continuous training and education among health care providers in order to avoid inconsistence and to catch up with the changing guidelines for deliverance.

2. To increase number of health care providers especially in peripheral health facilities.

3. To ensure satisfaction of patients and optimal delivery of PMTCT and EID services that foster good patient-health care provider interaction during clinic visits. Improving interaction between mothers/guardians and health care providers through training. Health care providers to be trained on how to adhere to medical ethics and how to live with patients.
4. There is a need to increase the number of facilities with EID services to be near to the community in order to improve accessibility of the services and to overcome transport cost.

5. Strengthen infant tracking system by the use of mobile technology in order to reduce loss to follow and active case finding from all entry points at health facility (such as ANC/PMTCT, RCH, labour ward, paediatric ward and postnatal clinic).

6. To strengthen surveillance system that track and link infant-maternal data in order to monitor progress of PMTCT and EID interventions.

7. To strengthen linkages and referral system between community/household level and health facility level in order to capture all pregnant women living with HIV who lost to follow up.

8. To strengthen continued HIV education and outreach programmes particularly in rural areas to identify all children with unknown HIV status in order to improve maternal and child health services.


10. Improve procurement and supply chain management system and maintain stock control system to avoid interrupted supply of EID supplies.

1.2.2 Community/individual level

1. To strengthen Community based interventions through community health workers to scale up and strengthening home-based HIV testing and counseling for partner and community mobilization.

2. To strengthen community awareness and education of ongoing HIV/AIDS interventions as well as to address barriers related to poor access to health care services (including EID and PMTCT).

3. It is important to intensify preventive health care efforts before pregnancy, pre and post natal period for the mothers and the babies and through improvements in educational level of their parents or guardians in order to reduce the risk of acquiring infection.

4. Community involvement (including PLHIV) through participatory education to overcome the issue of stigma.
5. Provision of Community loan funds as well as to strengthen women empowerment programmes to address issues related to affordability. This will help to overcome the cost of transport to health facility and provide finances for basic needs like food and clothes.

6. There is a need to develop and strengthen health related financing schemes such as provision of transport voucher to those in need to cater for transport costs.

7. HIV testing for women and men should be emphasized in order to know their HIV status before pregnancy.
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born to mothers on the prevention of mother to child transmission programme at Chitungwiza Hospital, Zimbabwe, 2008. *BMC public health*, 13(1), 1181.


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APPENDIXES

Appendix 1  Checklist for Health facility records review on EID and PMTCT

Health facility:________ Village:________ Ward:________ Date:___/____/____

General information

Note: If available for 6 months put √6; twelve months put √12; not available put x

<table>
<thead>
<tr>
<th>Present (✓)</th>
<th>Date started the services</th>
<th>Absent (x)</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Health facility is performing EID services (DBS for PCR)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Health facility is performing CTC services</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Health facility is performing PMTCT services</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Poster displaying EID services</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Poster displaying PMTCT interventions</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Availability of guidelines on their desks (EID &amp; PMTCT)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Antenatal leaflets information addressing HIV testing, treatment and prevention</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Equipment, supplies & medication needed for PMTCT & EID services

Supplies for DBS specimen collection

<table>
<thead>
<tr>
<th>Item</th>
<th>Put √/x</th>
<th>Item</th>
<th>Put √/x</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sterile gauze pads or cotton wool</td>
<td>Glassine paper</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alcohol wipes or disinfectant for skin (70% spirit)</td>
<td>Paperwork supplies</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Supplies for collecting, drying and storing specimens</td>
<td>Sealable plastic bags</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DBS filter paper blood collection card</td>
<td>Sharps container</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sterile lancets (2 mm long)</td>
<td>Drying rack</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DNA-PCR Test Laboratory Requisition Form</td>
<td>Pen</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Specimen Delivery Checklist</td>
<td>Desiccant packs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Humidity indicator cards</td>
<td>Safety supplies</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gloves(powder-free preferred)</td>
<td>Rubbish bin</td>
<td></td>
<td></td>
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<tr>
<td>Permanent marker to label the bag</td>
<td>Large envelope</td>
<td></td>
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</tbody>
</table>

HIV test kits, reagents and supplies and ARV for option B+

<table>
<thead>
<tr>
<th>HIV test kits, reagents and supplies</th>
<th>ARVs for Option B+</th>
<th>Put √/x</th>
</tr>
</thead>
<tbody>
<tr>
<td>Item</td>
<td>Drug</td>
<td>Put √/x</td>
</tr>
<tr>
<td>------</td>
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</tr>
<tr>
<td>Determine HIV 1/HIV 2, kit of 100 tests</td>
<td>NVP suspension</td>
<td></td>
</tr>
<tr>
<td>UNIGOLD, kit of 20 tests</td>
<td>ZDV/3TC Tablets</td>
<td></td>
</tr>
<tr>
<td>Vacutainer tubes (pack of 100)</td>
<td>TDF/3TC/EFV Tablets</td>
<td></td>
</tr>
<tr>
<td>Vacutainer needles (pack of 100)</td>
<td>Efavirenz Tablet</td>
<td></td>
</tr>
<tr>
<td>DBS Kits of 20 tests</td>
<td>NVP Tablets</td>
<td></td>
</tr>
<tr>
<td>PCR reagents</td>
<td>Second line ARVs</td>
<td></td>
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</tbody>
</table>
### Medicines for prevention and treatment of opportunistic and common infections

<table>
<thead>
<tr>
<th>Drug</th>
<th>Put √ / x</th>
<th>Put √ / x</th>
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<tbody>
<tr>
<td>Clotrimazole vaginal pessaries, pack of 6</td>
<td></td>
<td>Nystatin oral suspension</td>
</tr>
<tr>
<td>Clotrimazole cream</td>
<td></td>
<td>Nystatin cream</td>
</tr>
<tr>
<td>Co-trimoxazole syrup (for children)</td>
<td>Daktarin oral jelly</td>
<td></td>
</tr>
<tr>
<td>Co-trimoxazole tablets</td>
<td>Betamethasone cream</td>
<td></td>
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<tr>
<td>Ferrous sulphate</td>
<td>Fluconazole tabs</td>
<td></td>
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<tr>
<td>Folic acid tabs</td>
<td>Multivitamin tablets</td>
<td></td>
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<tr>
<td>Multivitamin syrup</td>
<td>Multivitamin syrup</td>
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### Routine equipment and supplies to support PMTCT

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<th>Put √ / x</th>
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<tbody>
<tr>
<td>Small refrigerator</td>
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<td>Goggles/ Eyeglass shield</td>
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<tr>
<td>Timer</td>
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<td>Apron</td>
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<tr>
<td>Cotton wool rolls</td>
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<td>Boots</td>
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<tr>
<td>Antiseptic, e.g. soaps</td>
<td></td>
<td>DBS pack</td>
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<tr>
<td>Chlorhexidine 0.25%</td>
<td></td>
<td>Syringes</td>
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<tr>
<td>Disinfectant / Lysol, 5 litre can</td>
<td></td>
<td>Lancets</td>
<td></td>
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<tr>
<td>Iodine solution, 250ml-10%</td>
<td></td>
<td>Band aids</td>
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<tr>
<td>Gloves(latex), non-sterile disposable</td>
<td></td>
<td>Methylated spirit</td>
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<tr>
<td>Gloves, surgical sterile size 7.5 &amp; 8</td>
<td></td>
<td>Sodium hypochlorite (e.g. JIK)</td>
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<tr>
<td>Gloves, long-sleeved, surgical sterile size 8</td>
<td></td>
<td>Suction tubes</td>
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<tr>
<td>Hb machines</td>
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### PMTCT record Review:  Health facility: ____________________

**Village: __________________ Ward: ________________

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<td>Number of births</td>
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<td>Number of women counseled on PMTCT</td>
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<tr>
<td>Number of pregnant women confirmed of HIV+</td>
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<tr>
<td>Number of pregnant women on lifelong ART</td>
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<tr>
<td>Number of pregnant women on single/dual ARV drug</td>
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<tr>
<td>Number of HIV exposed infants</td>
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<tr>
<td>Number of HIV exposed infants given prophylaxis</td>
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<tr>
<td>Number of exposed infants received HIV test at 4-6 weeks</td>
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<td>Overall number of infants tested by DNS PCR disregard the age at first test</td>
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<tr>
<td>Number of HIV + confirmed infants</td>
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<tr>
<td>Number of HIV- confirmed infants</td>
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<tr>
<td>Number of HIV + infants on ART</td>
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</table>
Appendix 2  Focus group discussion guide for mothers/guardians

Participant: No. |___| Gender (circle)  Male/Female Participant initials: |___|___|

Moderator Initials |___|___| Note taker initial |___|___|

Place of Interview: ___________________________ Date |___|/|___|/|___|

INTRODUCTION
I am ___________________________ from __________ (Moderator)
I am ___________________________ from __________(Note-taker)

- Describe general purpose and aims of the study as speculated in the information sheet. Ensure confidentiality: No names will be used in transcription, analysis or report writing and all data will be only accessible to research provider and will be kept in secure locations.
- Ask if participant has any questions? Happy to be tape recorded?
- Take written consent using information sheet provided.

Demographic characteristics
Can I ask you a few questions about your occupation?

1. House wife |___|
2. Employed |___|
3. Self employee |___|
4. Other (please specify) |___| ______________________

<table>
<thead>
<tr>
<th>Area of study</th>
<th>Topic and Probes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Participant information</td>
<td>1. I would like to hear a bit about your occupation and your work information (i.e. Housewife, employed, self employed etc.)</td>
</tr>
<tr>
<td></td>
<td>2. Can you tell me more about your daily activities? (Probe on care of People living with HIV(PLHIV especially her own exposed children)</td>
</tr>
<tr>
<td>Accessibility, availability, affordability, acceptability, patient’s satisfactory to</td>
<td>3. Where did you get prophylaxis to prevent HIV transmission and opportunistic infections for your child soon after birth?</td>
</tr>
<tr>
<td></td>
<td>4. What types of medicines for prophylaxis to prevent HIV and opportunistic infections have been given to the child soon after birth and thereafter? (include traditional medicine, faith-based treatment)</td>
</tr>
<tr>
<td>EID services</td>
<td>[On each of these probes emphasize on specific examples, real life scenarios]</td>
</tr>
<tr>
<td>-----------------------------------------------------------------------------</td>
<td>--------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>5. How do you talk about the proximity of health facility when you seek care, early HIV testing, diagnosis and treatment for your child?</td>
<td></td>
</tr>
<tr>
<td>6. What is your opinion on the kind of transport you have to use when accessing care, early HIV testing, diagnosis and treatment services for your child?</td>
<td></td>
</tr>
<tr>
<td>7. What is your opinion on the cost of accessing care when accessing care?</td>
<td></td>
</tr>
<tr>
<td>8. What is your opinion regarding receiving care, early HIV testing, treatment at the health facility for your child?probe on the time used to see the Health care providers. The reception by doctors and other service providers. The environment of care, space, confidentiality, attention etc. Probe on any costs involved e.g. whether the patient has to buy medicines other than what is required (e.g. for prophylaxis etc..). Perceptions on the costs involved.</td>
<td></td>
</tr>
<tr>
<td>9. Do you receive any barriers from your spouse/family member in accessing early HIV testing and diagnosis services for your child?Probe if it is culturally acceptable by the family members to access EID services. Probe social support from partner/family member.</td>
<td></td>
</tr>
<tr>
<td>10. Are you satisfied with the service provided at the health care when you visit? Give examples.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Perceptions, attitudes, beliefs regarding service providers and their EID services</th>
<th>[On each of these probes emphasize on specific examples, real life scenarios]</th>
</tr>
</thead>
<tbody>
<tr>
<td>11. Have you heard about EID services of HIV in any health facility?</td>
<td></td>
</tr>
<tr>
<td>12. What kind of EID services of HIV are, and what are the roles of these health service providers in these EID services?</td>
<td></td>
</tr>
<tr>
<td>13. Mention the services provided by these health service providers regarding EID.</td>
<td></td>
</tr>
<tr>
<td>14. What level of education is needed for these health service providers?</td>
<td></td>
</tr>
<tr>
<td>15. What kind of services that you have mentioned do these health service providers give to you?</td>
<td></td>
</tr>
<tr>
<td>16. What services in EID do you think they should provide but they are not?</td>
<td></td>
</tr>
<tr>
<td>17. Do you believe on the advices given by health service providers regarding the care, nutritional and social support for your child?</td>
<td></td>
</tr>
<tr>
<td>18. How do you perceive early infant HIV testing and diagnosis services provided to your child, is it helpful, or just forced to go to health facility to receive these services without your willingness to do so?</td>
<td></td>
</tr>
</tbody>
</table>

| Knowledge on                                                                 | 19. What measures do you know that can be used to prevent HIV |
| EID services                                                                 | 20. Before getting pregnancy of your index baby, were you aware of your HIV sero status? Why you did not know your HIV status before getting pregnancy?  
|                                                                            | Probe: whether she did not attend ANC during her index pregnancy.  
|                                                                            | Probe: if unknown HIV status during conception how did it affects her emotionally.  
|                                                                            | Probe: how did she cope to bear children with her HIV status then? Whether anxious, worried about her health and that of her child?]  
|                                                                            | 21. A child born to HIV positive mother, at which age the child should start ARV prophylaxis to prevent MTCT?  
|                                                                            | 22. Tell me the names of ARV drugs that you know that are taken by the child after delivery as a prophylaxis to prevent a child to be infected with HIV?  
|                                                                            | 23. Tell me the name of medicine that you know that is taken by the child to prevent opportunistic infection?  
|                                                                            | 24. How many HIV tests are supposed to be done to your infant/child in order to confirm their HIV status through their life? (Probe at which age the first and the second test is performed)  
|                                                                            | 25. Which mode of feeding practice do you think is most feasible and acceptable to be used by the infant born to HIV positive mother soon after birth?  
|                                                                            | 26. What is your opinion on exclusive breast feeding practices for prevention of mother to child transmission (MTC) of HIV?  
|                                                                            | 27. How long shall a baby being breastfed exclusively?  
|                                                                            | 28. What other food are given during exclusive breastfeeding period?  
|                                                                            | 29. In your opinion, what are the most important obstacles/issues that have been affecting the delivery and uptake of early infant HIV testing and diagnosis in your setting?  
|                                                                            | Probe for any support received from the partner/health worker [Give examples.  
|                                                                            | Probe for issues of stigma in the society that hinder the follow up of early infant HIV testing and diagnosis services.  
|                                                                            | Probe problems encountered from the supply side(i.e. from health care workers)  
|                                                                            | 30. During the pregnancy of this index baby have you received any special training regarding early infant HIV testing and diagnosis, ARV prophylaxis?  
|                                                                            | Probe for any formal or informal training and who perform the training.  
|                                                                            | Probe lessons taught on how to care for HIV exposed newborns.  
|                                                                            | If lack of training is mentioned, probe further how did it affect the early diagnosis of her/his exposed child if any?  
|                                                                            | Probe for any training or additional training needs that are required from the mother perspective.  
|                                                                            | List all of them that she thinks are required.  
| Delivery and uptake delivery of EID (To find out why infants are not brought back for early testing) |  
|                                                                            | 29. In your opinion, what are the most important obstacles/issues that have been affecting the delivery and uptake of early infant HIV testing and diagnosis in your setting?  
|                                                                            | Probe for any support received from the partner/health worker [Give examples.  
|                                                                            | Probe for issues of stigma in the society that hinder the follow up of early infant HIV testing and diagnosis services.  
|                                                                            | Probe problems encountered from the supply side(i.e. from health care workers)  
|                                                                            | 30. During the pregnancy of this index baby have you received any special training regarding early infant HIV testing and diagnosis, ARV prophylaxis?  
|                                                                            | Probe for any formal or informal training and who perform the training.  
|                                                                            | Probe lessons taught on how to care for HIV exposed newborns.  
|                                                                            | If lack of training is mentioned, probe further how did it affect the early diagnosis of her/his exposed child if any?  
|                                                                            | Probe for any training or additional training needs that are required from the mother perspective.  
|                                                                            | List all of them that she thinks are required.  
|                                                                            |
### Views, suggestions and recommendations regarding EID

<table>
<thead>
<tr>
<th>Question</th>
</tr>
</thead>
<tbody>
<tr>
<td>31. What are your views and suggestions on how to improve quality of life to the baby born by HIV positive mother?</td>
</tr>
<tr>
<td>32. What are your recommendations on how to improve the quality of life of the child born to HIV positive mother if</td>
</tr>
<tr>
<td>the child is confirmed to be HIV positive?</td>
</tr>
</tbody>
</table>

### Summary and any other questions

<table>
<thead>
<tr>
<th>Question</th>
</tr>
</thead>
<tbody>
<tr>
<td>33. (Summarize the main points of the participant checking their agreement and asking if they have anything more to add).</td>
</tr>
<tr>
<td>34. Are there any points you think I’ve missed, or any other issues you’d like to talk about relating to early infant HIV testing and diagnosis?</td>
</tr>
</tbody>
</table>

Thanks the participant for his/her time and make sure they have a contact telephone number for you or another member of the research team should they have any more questions or concerns about the research process.

### Appendix 3 In-Depth Interview topic guide for health care providers

Participant: No. | | Gender (circle) Male/Female  Participant initials: | | |

Researcher Initials | | | | Place of Interview: | | Date | | | |

### INTRODUCTION

My name__________________ from __________

*Describe general purpose and aims of the study as speculated in the information sheet*

*Confidentiality: No names will be used in transcription, analysis or report writing and all data will be only accessible to research provider and will be kept in secure locations.*

*Ask if participant has any questions? Happy to be tape recorded?*

*Take written consent using information sheet provided.*

### Demographic and Work Information

Can I ask you a few questions about your job?  Job Title: ______________

Place of work (circle all that apply, can be more than one):

<table>
<thead>
<tr>
<th>Place of work</th>
<th>Space</th>
</tr>
</thead>
<tbody>
<tr>
<td>CTC/Health facility</td>
<td></td>
</tr>
<tr>
<td>CHMT</td>
<td></td>
</tr>
<tr>
<td>PMTCT</td>
<td></td>
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<tr>
<td>RCH Clinic</td>
<td></td>
</tr>
<tr>
<td>Other (please specify where)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Area of study</th>
<th>Topic and Probes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Participant information</td>
<td>I would like to hear a bit about your job. Can you tell me what does your job involves? [Probe on HIV and AIDS activities]</td>
</tr>
</tbody>
</table>

What are your experiences in working with PLHIV [Probe for care and...
| Knowledge, altitude and perceptions towards EID services | Do you understand the terminology DBS and PCR? Explain what does DBS mean? Explain what does PCR mean?
What measures do you know that are used to prevent HIV transmission from mother to child? Mention all that you know.
HIV positive pregnant woman who was first confirmed to be HIV positive and has not yet started ART, at which period should be given ARV to prevent HIV transmission to the baby? Can you name those drugs that are taken by pregnant woman? [Probe to know specifically the name of ARV used, if possible allow her/him to write down]
A child born to HIV positive mother, at which age the child should start ARV prophylaxis to prevent MTCT?
When did EID (services that use advanced technology of DBS PCR for early infant HIV testing) started here at your facility/District? [i.e. HIV testing at the age of 4-6 weeks of age-what does this started here?]
At your health facility, when did you normally perform the second HIV test to the child aged below 24 months born to HIV positive mother? [Probe, at which child’s age the second HIV test is performed and what is the name/type of that HIV test? i.e., is it DBS or HIV antibody test?]
Which mode of feeding practice do you think is most feasible and acceptable to the infant born to HIV positive mother?
Are there any community-based HIV interventions organized by the village/government/Health Committee in your surrounding Community?
Please, list them all that you know!
How are these community based HIV interventions are working, how are PLHIV are linked with these interventions? How are they dealing with HIV positive children? |
| --- | --- |
| Accessibility, availability and utilisation of EID services | How many infants are getting access to early HIV diagnosis (services that use advanced technology of DBS PCR for early infant HIV testing) in your setting per year (i.e. health facility level/District level)? [probe one year and then calculate annually]
What do you think are the major obstacles that hinder accessibility of early infant diagnosis among HIV exposed children?
How many HIV exposed children and HIV positive confirmed children were lost to follow up after introduction of EID services (using advanced technology of DBS PCR in your setting?)
Which reasons that you consider have been associated with the loss of follow of up to EID services (services that use advanced technology of DBS PCR for early infant HIV testing) among children born to HIV positive mothers?
What does lost to follow up affect the outcome of PMTCT? |
| Challenges facing Health care service providers in performing EID services and assess | What do you think are the most important challenges facing health care service providers in performing HIV diagnosis in children before introduction of new advanced HIV EID services in your setting? [Probe for any challenges before the arrival of DBS test for PCR]
After introduction of new advanced technology to perform early HIV testing by DBS, how do you explain these achievements for the early diagnosis of HIV in children in your setting? |
| provider service satisfactory perspective | Probe is the number of provider adequate to perform EID services? Probe if the supply of EID services like DBS kit, do they reach on time? Or delay like how many days/months? Probe is it successfully? Did all HIV infants born to HIV positive mothers are enrolled into EID services? Probe for those who lost to follow up, how it is taken care off in their facility!
Since the introduction of care and treatment services to people living with HIV (PLHIV) have you ever received any special training specifically related to EID services in the past two years? If yes, when was the training conducted (which year)? Who perform that training?
Since the introduction of care and treatment services to PLHIV have you ever received any special training specifically related to mother and child health on the issue of PMTCT in the past two years? If yes, when was the training conducted (which year)? Who perform that training?
If lack of training is mentioned how has it hindered the delivery of EID services in your setting? [Probe: for additional training needs required, additional provider]
How important is supervision in Care and Treatment Center (CTC) to your health facility? Is this practiced often? if not, Why? If supervision is conducted how often in the past 12 month? What were the topics covered during each Supervision? Is the Supervision from which institution? Governmental? Or Non Governmental. Can you please name the involved organization? Give reasons if supervision had not been conducted at your CTC in the past 12 month!
Are you satisfied with the service that you are providing to your patients, in terms of quality, reliability? Give examples. |
| --- | --- |
| Factors that affect delivery and uptake of EID services to target population | In your experience, what are the most important issues that have been affecting the delivery and uptake of EID services in your setting? Probe for support from the health system [Give examples]e.g., training. Probe for specific requirement that support smooth delivery of service provided like supplies, number of provider etc. Probe for stories from guardian/parents who have HIV exposed infant/s. Probe for reasons why parents do not bring back their children at the recommended age (4-6 weeks age) for HIV testing
What issues obstacles do you consider that affect uptake of EID among infants? Is it long distance to the health facility? Low income? Etc. |
| Views, suggestions and recommendations regarding EID | What are your views and suggestions on how to improve quality of life to the baby born by HIV positive mother?
What are your recommendations on how to improve the quality of life of the child born to HIV positive mother if the child is confirmed to be HIV positive?
What are your recommendations on how we can improve EID services which has been integrated into PMTCT facility? |
| Summary and any other questions | (Summarize the main points of the participant checking their agreement and asking if they have anything more to add).
Are there any points you think I’ve missed, or any other issues you’d like to talk about relating to early infant HIV testing and diagnosis? |
Thanks the participant for his/her time and make sure they have a contact telephone number for you or another member of the research team should they have any more questions or concerns about the research process.

Appendix 4 Questionnaire for mother-child pair

Date of interview: __ __/__ __/ 20__ __. Name of health facility:__________

Time start: __________

A: CHILD DETAILS

1. Date of Birth: __ __/__ __/20__ __ dd/mm/yyyy
2. Gender: 1. Male 2. Female
3. Birth weight ________ (kg);
4. Weight ________kg
5. Height ________cm;
6. Mid Upper Arm Circumference (MUAC)______cm
7. Village name ___________Ward ________________Hamlet ___________

B: HOUSEHOLD LEVEL INFORMATION

i. Primary Caretaker/guardian information:

8. Initials of primary care taker___ ___ ___
10. How is the primary caretaker/guardian related to the child? (relationship code) |__|

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11. Age of primary care taker_____ (years)
12. Sex of primary care taker: 1. Male 2. Female
13. Highest education attained of primary care taker (Education code) |____|

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<thead>
<tr>
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<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>SO: No education</td>
<td>S4: Standard four</td>
<td>F1: Form 1</td>
<td>U: University/college;</td>
</tr>
<tr>
<td>S1: Standard one</td>
<td>S5: Standard five</td>
<td>F2: Form 2</td>
<td>Others (specify)___</td>
</tr>
<tr>
<td>S2: Standard two</td>
<td>S6: Standard six</td>
<td>F3: Form 3</td>
<td></td>
</tr>
<tr>
<td>S3: Standard three</td>
<td>S7: Standard seven</td>
<td>F4: Form 4</td>
<td></td>
</tr>
</tbody>
</table>

14. Marital status of primary care taker

1. Married
2. Cohabitig/living together
3. Divorced/Separated
4. Widow
5. Single

15. Occupation of primary care taker

16. How much is primary care taker earning per month in average?
   1. Zero, 0
   2. Between Tsh. 1 to 74,999
   3. Between Tsh. 75,000 hadi 149,000
   4. Between Tsh. 150,000 to 299,000
   5. From Tsh.300,000 and above

17. Whom, the primary care taker is dependent on?
   1. Husband (married or living together)
   2. Male sexual partner (not married/living together)
   3. Others(specify)_______________________
   4. Mother/mother guardian of the baby

18. How much is the dependant of the primary care taker earning per month in average?
   1. Zero, 0
   2. Between Tsh. 1 to 74,999
   3. Between Tsh. 75,000 to 149,000
   4. Between Tsh. 150,000 to 299,000
   5. From Tsh.300,000 and above

19. Did primary care taker depend on his/her dependant for all the income in the household?  
   1. Yes  2. No

20. If the answer above is no, how is the source of income of primary care taker depend on?
   1. Maternal source of income (mother of the index baby)
   2. Equal responsibilities by both Spouses
   3. Others ______

21. How many course meals did your household (place where the index child is residing) have in the past 24 hours?
   1. One course meal
   2. Two course meal
   3. Three course meal (breakfast, lunch, dinner)

22. Did the household of the index child have enough food to sustain for the whole year for the family?  
   1. Yes  2. No  3. I don’t know

23. Number of people living in the same household with the child (Total number of elders + number of children, index child inclusive) = __ __

24. No. of people who smoke cigarette living in the same household with the child__

ii. Information of the Head of Household
26. How is the head of the household related to the child? (refer relationship codes above) [____]
27. Age of the head of household ____ (years)
28. Sex of the head of household: 1. Male  2. Female
29. Highest education attained of the head of the household (refer education code above): [____]

iii. Information about biological mother of index baby (from any reliable sources)

30. How many:
   1. Total number of deliveries (including this birth and any still births) [____]
   2. Total number of live births (including this birth) [____]
   3. Total number of live children at present? [____]
31. What is the status of those who died if any:
   1. Abortion at 3 month GA
   2. Intrauterine fetal death at 4-9 month GA, (cause of death______________
   3. Neonatal death at 0 – 31 days age, (cause of death______________
   4. Infant death at 32 days – 12 month, (cause of death______________
   5. Other specify (cause and age at death): ________________
99. Not applicable
32. Did biological mother planned to be pregnant of this index baby?
   1. Yes  2. No  99. Not applicable
33. At which gestation age (GA)/month did biological mother first started to attend Antenatal clinic (ANC) during pregnancy of this index baby?
   1. At 12 weeks GA (3 months)  4. Specify: ________________
   2. At 16 weeks GA (4 months)  5. Never attended ANC
   3. At 20 weeks GA (5 months)  99. Not applicable
34. In total how many ANC visits have you made during pregnancy of this index baby?
   1. One  3. Three  5. Five  99. Not applicable
   2. Two  4. Four  6. Six and above
35. During pregnancy of index baby up to 12 month post delivery did biological mother of index baby suffered from the following conditions?
1. Sexual transmitted infections (e.g., gonorrhea) 4. Mastitis
2. Malaria in pregnancy 5. Other

36. (a) Did the biological mother tested for HIV during pregnancy of her index baby?
   1. Yes 2. No 99. Not applicable
   (b) Results of HIV test: 1. Positive 2. Negative

37. If the above question is no, give reasons:
   1. The mother is known HIV positive before this index pregnancy
   2. The mother did not attend ANC during pregnancy of this index baby
   3. Other, specify: ___________________________

38. Date confirmed HIV status of biological mother __ __/ __/ 20__ __

39. Did the biological mother of the index baby on ARV during pregnancy? 1. Yes 2. No

40. If the above question is yes, write the name of that ARV if known (check CTC card or maternal MCH card if available): __________________________


42. If yes Date started ARV __ __/ __/ 20__ __, ARV combination (list all taken and date started) ________________

43. 1) Status at start of ARV of biological mother: (look at patient’s file notes):
   - Age _WHO clinical stage_CD4 count _cell/µl Functional status _Body weight _
   2) Biological mother history of Co-trimoxazole prophylaxis during pregnancy of this index baby:
      1. Yes 2. No

44. CD4 count of biological mother during pregnancy up to 12 months post delivery (if known): ____________ cell/µl; date __ __/ __/ 20__ __

iv. Knowledge on Mother to child transmission (MTCT) of HIV

39. Do you know that MTCT of HIV can occur? 1. Yes 2. No

40. What factors do you think affect HIV transmission from mother to the child (Do not read answers, circle all that apply) Yes=1/No=2
   1. Sexual transmitted diseases (e.g. syphilis) 2. Unplanned pregnancy

41. Effect of HIV on the unborn baby
   1. Spontaneous abortion 2. Intra uterine death (stillbirth) 3. Prematurity
4. Low birth weight  5. I don’t know

42. Choose the correct response regarding HIV transmission (circle all that apply)
   1. HIV/AIDS can be transmitted by mosquito bites
   2. HIV/AIDS can be transmitted by evils spirit/bewitched
   3. A person can be infected by sharing food with a person who has AIDS
   4. HIV can be transmitted by breast feeding
   5. HIV can be transmitted in utero
   6. HIV can be transmitted during delivery
   7. Others, specify: ______________________________

43. During pregnancy, how can we prevent the risk of HIV transmission to the baby? (One most effective you know)
   1. By taking SP drug  4. By taking traditional medicines
   2. By taking ferrous (iron) tablets  5. Co-trimoxazole
   3. By taking ARV drugs  6. I don’t know

45. A child born to HIV positive mother, at which age the child should start ARV prophylaxis to prevent MTCT?
   1. Within 6-12 hours post delivery  3. One week after birth
   2. Five days after birth  4. Other

46. What is the name/s of ARV drugs that are currently used to be taken by the child after delivery as a prophylaxis to prevent a child to be infected with HIV? (circle all that apply)

47. What is the name/s of drugs taken by the child as a prophylaxis to prevent opportunistic infections? (circle all that apply)
   1. Co-trimoxazole  3. Lamivudine
   2. Nevirapine  4. Other

48. At which age should the first HIV test be performed to a child born to HIV positive mother to know HIV status exposure?
   1. Four - six weeks of age  2. Six month of age  3. Specify  4. I don’t know

49. At which age of the child born to HIV positive mother, shall a second HIV test be conducted to this child who is still breast feeding?
   1. Specify  2. I don’t know
C: SOCIO ECONOMIC

50. Do you cook inside the house used for sleeping?  1. Yes  2. No

51. What is the main fuel used for cooking?
   1. Wood  3. Gas
   2. Charcoal  4. Other (specify) ________________

What is the primary construction material used in the house?

52. Roof:  1. Thatch/Grass  3. Tile  5. Don’t know
   2. Iron sheet  4. Other ________________

   2. Brick/blocks  4. Other ___________

54. Floor:  1. Mud  3. Other ________________
   2. Cement  4. Don’t know

55. How many house rooms (including huts/all surrounding structure) are used for sleeping? ____

56. What is the main source of drinking water in the house?
   1. Piped into the house  5. Purchased bottled from shops/trade vendors
   2. Stand pipe/public tap  6. Collected directly from a lake or other source
   3. Individual well  7. Other (specify) ____________
   4. Community well

57. Which of the following assets does your house have? (more than one response)
   5. Radio

D: HEALTH OF CHILD

i. History of opportunistic/secondary infections present during the time of data collection and past

58. Did the child suffering from any illness in the past 24 hours up to now?  1. Yes  2. No

59. If yes, fill in the box below

<table>
<thead>
<tr>
<th>Symptoms</th>
<th>Diagnosis</th>
<th>Test + results</th>
<th>Medication &amp; dose &amp; start date</th>
</tr>
</thead>
</table>
60. Name other illness/operations that have occurred in the past during the child life time (observe child’s file notes)

<table>
<thead>
<tr>
<th>Illness and operation</th>
<th>Date confirmed</th>
</tr>
</thead>
</table>

61. Number of hospital admission since birth up to now________________
62. Number of blood transfusion since birth up to now __________

ii. Data extracted from MCH card

63. Vaccination (record dates of vaccination)

BCG: Birth ___/___/___ Has returned after 3 months if there is no scar ___/___/___
Polio: Birth ___/___/___ 6 weeks ___/___/___ 10 weeks ___/___/___ 14 weeks ___/___/___
DPT/HIB: 6 weeks ___/___/___ 10 weeks ___/___/___ 14 weeks ___/___/___
PCV: 6 weeks ___/___/___ 10 weeks ___/___/___ 14 weeks ___/___/___
ROTA: 6 weeks ___/___ 10 weeks ___/___/___ 14 weeks ___/___/___
Measles 9 months: ___/___/___

64. Observe: Is there any documentation of HIV exposure status on the infant’s Road to Health chart/booklet?

1. Yes: describe what was written ___________ 2. No

iii. HIV history of the child

Hospital file number: Mother _______ ________, Child: _______ ________

65. CTC DBS number: __________________________

66. When your child was vaccinated for the first DPT/Hib vaccine at the age of 6 week:

(multiple responses)
(a) I also ask the health care provider to offer my child the first HIV test at 6 week old 1. Yes 2. No
(b) The health care provider remind me to send my child for the first HIV test
1. Yes 2. No

67. Does your child ever receive first HIV test at age of 4-6 weeks?

1. Yes 2. No (if no go to question 76)

68. If yes name of first HIV test________ (Bioline, Unigold, Determine rapid HIV1/2 antibody tests, DNA PCR, RNA PCR,…)

69. Date sample taken of first HIV test at 4-6 weeks ___/___/___ 20___

70. HIV test results of the first HIV test at 4-6 weeks:
1. Positive  
2. Negative  
3. Not known yet

71. Date of first HIV results given to the mother/guardian if known _ _/ _ _/ 20_

72. If first HIV DNA PCR (DBS) test was done, it was done when your child was 4-6 weeks old?   1. Yes   2. No

73. If the above answer is No, when did the baby receive the HIV DNA (DBS) test?   
   1. At 6 month age  
   2. At 9 months  
   3. Specify ______  
   4. Not applicable

74. Give reasons why the baby was not tested for HIV DNA (DBS) at the age of 4 - 6 weeks old? (circle more than one responses-interrogate deeply to get responses)   
   1. The child was too young to be taken to health facility according to our cultural beliefs   
   2. My child was in good health, hence no need for these services at that time when the child was at age of 4-6 weeks   
   3. The parent/guardian was not aware if these services are available at health facility   
   4. Parent was not informed/told about these services during pregnancy   
   5. The mother of the baby died soon after delivery, and the child was taken by the guardian who was not aware of these services   
   6. Parent/guardian is living far away from the health facility that provide the services   
   7. During that period the parent did not have money for transport to go to the health facility   
   8. Because of long waiting time at the health facility before you are being attended   
   9. I am worried about Health care providers because they know my HIV status and I feel uncomfortable to go with my child to receive these services   
   10. Others explain ________________________________

75. Does your child ever test the second HIV test?   
   1. Yes   2. No   3. Not applicable

76. What is the name of second HIV test?_________________________
   (Bioline, Unigold Determine rapid HIV1/2 antibody tests, DNA PCR, RNA PCR,..)

77. Date of second sample taken for HIV test   __ __/ __/ 20__ __

82. HIV test results of the second HIV test
1. Positive  
2. Negative  
3. Not known yet

83. Date of second HIV results given to the mother/guardian if known_ _/ _/ 20_ _
84. Date of confirmed of HIV positive results of the child for overall tests:_ _/_ _/20_ _

iii. Care of the HIV exposed child

85. Did the baby receive NVP at birth?
   1. Yes  
   2. No [give reasons why has not received? ________]
86. If NVP was given, write down number of days dispensed _____ days
87. What is the child’s antiretroviral therapy (ART) status currently?
   1. None  
   2. Currently on ARVs: Date last taken: __ ___/ __/20__ __
88. Date started ART of the child:  
   1. __ ___/ __/20__ __  
   2. Not applicable
89. If yes, ARV combination (list all taken and date started) ______________________
90. Status at start of ARV of index child: (look at patient’s file notes):
   Age _WHO stage _CD4 count _cell/µl Functional status __ Body weight __
91. List all CD4 counts of index child before start ARV and period there after (if known):
   ____________ cell/µl; date __ ___/ __/20__ __
92. Co-trimoxazole:  
   1. Yes  
   2. No
93. If yes date started co-trimoxazole _ _/_ _/20_ _ : Date stopped _ _/_ _/20_ _
94. What was the mode of delivery of your child?
   1. Caesarean section  
   2. Vacuum delivery  
   3. Spontaneous vaginal delivery
95. Where did the child been delivered?
   1. At the health facility  
   2. At home by traditional birth attendant
   2. At home assisted by experienced relative  
   4. Other, specify________
96. Breastfeeding opted for your infant/child at birth
   1. Yes  
   2. No – child has stopped breast milk completely (no exposures)
97. Mode of feeding opted for your child at birth
   1. Exclusive breast feeding (EBF)  
   2. Replacement feeding (RF) (Infant formula milk)
   3. Mixed feeding (breast feeding and infant formula milk)
   4. Breast feeding (BF) + additional food (i.e., infant fed by formula milk+ complementary food after 6months)
98. How long are you expected to/have you breastfed your child?
1. Exclusively three months  2. Exclusively six months  3. Specify the duration___

99. Give reasons if you are expected/have breastfed your child less than 6 months:
   1. Mother too ill
   2. Mother feared of transmitting the virus to her infant
   3. Others, Specify:_________________________________

93. How many times that you know should a baby has to be breastfed within 24 hours?
   1. Four times   2. Eight times   3. Specify_______

100. What else are you feeding the child?
   1. Water   5. Vegetable extracts
   2. Fruit/fruit juices   6. Beans/meat/fish
   3. Porridge   7. Eggs
   4. Thick porridge or mashed potatoes/rice   8. Others (specify):_________

99. Not applicable

101. The child was weaned at the age of
   1. Three months   3. Other(specify) _________________
   2. Six months   99. Not applicable

The following questions ask about the quality of life, health and other areas of the child’s life. Kindly circle the number that best that fits how much the mother is concerned about the child’s life, health and other areas over the last two weeks. Please read each question, assess the mother/guardian feelings concerning the child, and circle the most appropriate response that fit the child.

<table>
<thead>
<tr>
<th>Question</th>
<th>Very poor</th>
<th>Poor</th>
<th>Neither poor nor good</th>
<th>Good</th>
<th>Very good</th>
</tr>
</thead>
<tbody>
<tr>
<td>102</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>How would you rate your child’s quality of life?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>103</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>How would you rate the quality of social services available to your child?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>104</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>How much do you worry about the health of your child</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Question</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>---</td>
<td>-------------------------------------------------------------------------</td>
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<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>105</td>
<td>How much do you worry about the child’s pain or discomfort?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>106</td>
<td>To what extent do you feel that (physical) pain prevents your child from doing what she/he needs to do? (e.g. playing)</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>107</td>
<td>Does your child have any difficulties with sleeping?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>108</td>
<td>Does your child have any difficulties with feeding?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>109</td>
<td>How much does your child enjoy social life with her parents and other children?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>110</td>
<td>To what extent does your child have difficulty in performing her/his daily playing activities?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>111</td>
<td>To what extent do you have problems with transport?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>112</td>
<td>How difficult is it for you to handle your child’s pain or discomfort?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>116</td>
<td>How satisfied are you with the quality of life of your child?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>117</td>
<td>In general, how satisfied are you with your child’s life?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>118</td>
<td>How satisfied are you with your child’s health?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>119</td>
<td>How satisfied are you concerning your child’s upkeep with the support you get from your family?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>122</td>
<td>How satisfied are you with your child with the conditions of your living place?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>

**E: PATIENTS’ SERVICE SATISFACTORY PERSPECTIVE**

123. How do you rate the service that you receive at the health facility for HIV diagnosis and other health care services of your child?


In general how do you rate your satisfaction with the overall quality of services at the health facility?

1. High 2. Low

124. How do you talk about the proximity of health facility when you seek health care, HIV testing, diagnosis and treatment for your child? 1. Very far (> 5 km) 2. Near (5 km)

125. What kind of transport used to come to health facility ____________________
126. How much money you usually spent in average for transport from village to the health facility where you receive HIV testing by DBS for PCR for your child/scheduled follow up visits (to & fro) ________________ TShs

127. Travel time from village to health facility where you access HIV testing by DBS for PCR ________ (specify how many: hours: minutes) & estimate by foot and/or by means of transport (as reported by parent/guardian by normal day time)

What is your opinion regarding receiving care, HIV testing, treatment at the health facility for your child?

<table>
<thead>
<tr>
<th></th>
<th>Very dissatisfied</th>
<th>Dissatisfied</th>
<th>Neither satisfied nor dissatisfied</th>
<th>Satisfied</th>
<th>Very satisfied</th>
</tr>
</thead>
<tbody>
<tr>
<td>128</td>
<td>Do you satisfied with the reception given by doctors and other service providers?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>129</td>
<td>Do you satisfied with the environment of care (space, confidentiality, attention)</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>130</td>
<td>How satisfied are you with HIV testing and diagnosis services provided to your child?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Not at all</th>
<th>Slightly</th>
<th>Moderately</th>
<th>Very much</th>
<th>Extremely</th>
</tr>
</thead>
<tbody>
<tr>
<td>131</td>
<td>Do you believe on the advices given by health service providers regarding the care, nutritional and social support for your child?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>132</td>
<td>Do you receive any barriers from your spouse/family member in accessing HIV testing and diagnosis services for your child?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>

133. Elaborate briefly any barriers you receive from your spouse/family member in accessing HIV testing and diagnosis services for your child if any? ________________

134. Mention all the services (including training) provided by health service providers to you when you routinely visit the health facility to access HIV testing and HIV diagnosis of your child ____________________________________________________________________________

135. Before receiving these services of your child, were you willing to receive the HIV testing and diagnosis services for your child? 1. Yes 2. No
136. HIV testing among under five children:
First: DBS number____________  First: DBS results and date: __________________
Second: DBS number__________  Second: DBS results and date: __________________
Results of HIV antibody test and date: ______________________
Researcher name: ____________ Researcher signature: ______ Date:__/__/____
Time end _____
DO YOU HAVE ANY QUESTION?
THANK YOU VERY MUCH FOR YOUR TIME

Appendix 5  Questionnaire for health care provider
Questionnaire number________ Date:___________
Initials of Researcher _______ Name of the health facility ______ Time start ______
A: DEMOGRAPHIC CHARACTERISTICS
Initial of interviewee___________
Age __________
Sex: _______Male/Female)
Highest level of education
  1. Standard seven  5. Form five
  2. Form one  6. Form six
  3. Form Three  7. University/College
  4. Form four  8. Other_______________
Job title ___________________________________
Place of work (can be more than one response)
  1. CTC/Health facility  4. RCH Clinic
  2. CHMT  5. Other (please specify where)_____________
  3. PMTCT

B: KNOWLEDGE OF EID & MTCT of HIV
Choose the correct response regarding HIV transmission (circle all that apply)
  1. HIV/AIDS can be transmitted by mosquito bite
  2. HIV/AIDS can be transmitted by evils spirit
3. A person can be infected by sharing food with a person who has AIDS
4. HIV can be transmitted by breast feeding and risk of MTCT of HIV can be reduced by mother taking ARV drugs during pregnancy
5. HIV positive pregnant woman who was first confirmed to be HIV positive and has not yet started ART, at which period should be given ARV to prevent HIV transmission to the baby? (circle all that apply don’t read response)
6. Soon after delivery she should be given single dose of AZT (Zidovudine)
7. Should start triple ART therapy soon when confirmed to be HIV positive and continue with ART treatment for life
8. Should start AZT at GA of 28 weeks

A child born to HIV positive mother, at which age the child should start ARV prophylaxis to prevent MTCT?

1. Soon after child birth or within 72 hours post delivery
2. Five days after birth
3. One week after birth

At which age should the first HIV test be performed to a child born to HIV positive mother?

1. 4-6 weeks of age  2. 2 months of age  3. 6 month of age  4. Specify ______

When shall a second HIV test be conducted to a child born to HIV positive mother who opted exclusive breast feeding for 6 months for her child? 1.Specify______ 2. don’t know

Explain what does DBS mean? ___________________________________________

Explain what does PCR mean?____________________________________________

At your health facility when did you started performing DBS by PCR to test children born to HIV positive mother? 1. Specify year and month__________ 2. Not yet started

Why is it important to do HIV test to the newborn baby? _________________

How many infants are getting access to early HIV diagnosis in your setting per year (i.e. health facility level/District level)? (probe one year and then calculate annually)_______

Which mode of feeding practice do you think is most feasible and acceptable to the infant born to HIV positive mother?

1. Exclusive BF for 6 months only, and stop BF at 6 months and introduce additional food
2. Exclusive BF for 6 months and continue BF up to 12 months + additional food after 6 months
3. Exclusive BF for 6 months and continue BF up to 24 months + additional food after 6 months

Since the introduction of care and treatment services to people living with HIV (PLHIV) have you ever received any special training specifically related to EID services in the past 2 years?  
1. Yes  
2. No

If yes, when was the training conducted (which year)? ___________________

Who perform that training? _________________________________________

Since the introduction of care and treatment services to PLHIV have you ever received any special training specifically related to mother and child health on the issue of PMTCT in the past 2 years?  
1. Yes  
2. No

If yes, when was the training conducted (which year)? ___________________

Who perform that training? _________________________________________

Before introduction of new advanced technology to perform early HIV testing by DBS, how was it affected the HIV diagnosis in children? ________________________

After introduction of new advanced technology to perform early HIV testing by DBS, how do you explain these achievements for the early diagnosis of HIV in children in your setting?

1. Adequate personnel to perform EID  
2. On time delivery of DBS kits  
3. Other____________________

In average how many children born to HIV positive mothers lost to follow up before 6 and 12 months of age since introduction of HIV diagnosis by DBS in your facility?

1. At 6 month _______________________
2. At 12 months _____________________

Which reasons that you consider have been associated with the loss of follow up to EID services among children born to HIV positive mothers

1________________________
What does lost to follow up affect the outcome of PMTCT?

Are there any community-based HIV interventions organized by the village/government/Health Committee in your surrounding Community?

1. Yes  
2. No  
[If yes, list all that you know ________]

C: PROVIDERS’ SERVICE SATISFACTORY PERSPECTIVE

How do you rate the service that you provide to your patients?

1. Very poor  
2. Poor  
3. Neither poor nor good  
4. Good  
5. Very good

Elaborate briefly for your answer above______________________________

What do you write on the child’s Road to Health booklet (MCH card) for documentation of HIV status? ______ I don’t know

What is your opinion regarding care and services provided among children at your health facility?

<table>
<thead>
<tr>
<th>Question</th>
<th>Very dissatisfied</th>
<th>Dissatisfied</th>
<th>Neither satisfied nor dissatisfied</th>
<th>Satisfied</th>
<th>Very satisfied</th>
</tr>
</thead>
<tbody>
<tr>
<td>Do you satisfied with the daily services you provide to your patients?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Do you satisfied with the environment of care used to provide services to under five children?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Do you satisfied with the assistance you receive from your head of department concerning providing care to under five children?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>How satisfied are you with availability of HIV testing and diagnosis services provided to your child?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Do you believe on the advices you give to your patients regarding the care, nutritional and social support for your child</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>
is understood?

<table>
<thead>
<tr>
<th>Do you received any barriers from regarding providing services to under five children?</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
</table>

In general as a whole how do you rate your satisfaction with the quality of services at the health facility?[reception, time spent to be seen, environment, medicines, etc]

1. High 2. Low

Elaborate briefly any barriers you receive regarding providing services to your patients as well as accessing HIV testing and diagnosis services for under five children, if any and suggest solution?

<table>
<thead>
<tr>
<th>Problems)</th>
<th>Solution</th>
</tr>
</thead>
</table>

Any other comments? __________ Time to finish: _____ Phone contact: __________

DO YOU HAVE ANY QUESTION?

THANK YOU VERY MUCH FOR YOUR TIME

Appendix 6 Ethical approvals from Zambia and Tanzania
THE UNIVERSITY OF ZAMBIAN

BIOMEDICAL RESEARCH ETHICS COMMITTEE

Telephone: 260-1-256067
Telegram: UNZALU, LUSAKA
Telex: UNZALU ZA 44370
Fax: + 260-1-259753
E-mail: unzarec@unza.zm

Assurance No. FWA00000338
IRB00001131 of IORG0000774

31st March, 2015.

Our Ref: 001-02-15.

Dr. Veneranda M. Bwana,
C/o University of Zambia,
School of Medicine,
Department of Public Health,
P.O. Box 50110,
Lusaka.

Dear Dr. Bwana,

RE: RESUBMITTED RESEARCH PROPOSAL: "DETERMINATION OF FACTORS ASSOCIATED WITH EARLY INFANT DIAGNOSIS OF HUMAN IMMUNODEFICIENCY VIRUS INFECTION AMONG UNDER FIVE CHILDREN IN MUHEZA DISTRICT, TANZANIA" (REF. No. 001-02-15)

The above-mentioned research proposal was presented to the Biomedical Research Ethics Committee on 25th March, 2015. The proposal is approved.

CONDITIONS:

- This approval is based strictly on your submitted proposal. Should there be need for you to modify or change the study design or methodology, you will need to seek clearance from the Research Ethics Committee.
- If you have need for further clarification please consult this office. Please note that it is mandatory that you submit a detailed progress report of your study to this Committee every six months and a final copy of your report at the end of the study.
- Any serious adverse events must be reported at once to this Committee.
- Please note that when your approval expires you may need to request for renewal. The request should be accompanied by a Progress Report (Progress Report Forms can be obtained from the Secretariat).
- Ensure that a final copy of the results is submitted to this Committee.

Yours sincerely,

M.M. Mbwca (Mrs)
CHAIRPERSON

Date of approval: 31st March, 2015.
Date of expiry: 30th March, 2016.
THE UNITED REPUBLIC OF TANZANIA

National Institute for Medical Research
3 Barack Obama Drive
P.O. Box 9653
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Tel: 255 22 2121400
Fax: 255 22 2121360
E-mail: headquarters@nimr.or.tz
NIMR/HQ/R.8a/Vol IX/1978

Ministry of Health and Social Welfare
6 Samora Machel Avenue
P.O. Box 9083
11478 Dar es Salaam
Tel: 255 22 2120262-7
Fax: 255 22 2110986
26th June 2015

Dr Veneranda M Bwana
NIMR Armani
P O Box 81 MUHEZA,
Tanga

CLEARANCE CERTIFICATE FOR CONDUCTING MEDICAL RESEARCH IN TANZANIA

This is to certify that the research entitled: Determination of factors associated with early infant diagnosis of Human immunodeficiency virus infection among under five children in Muheza District, Tanzania (Bwana V M et al), has been granted ethical clearance to be conducted in Tanzania.

The Principal Investigator of the study must ensure that the following conditions are fulfilled:

1. Progress report is submitted to the Ministry of Health and the National Institute for Medical Research, Regional and District Medical Officers after every six months.
2. Permission to publish the results is obtained from National Institute for Medical Research.
3. Copies of final publications are made available to the Ministry of Health & Social Welfare and the National Institute for Medical Research.
4. Any researcher, who contravene or fails to comply with these conditions, shall be guilty of an offence and shall be liable on conviction to a fine. NIMR Act No. 23 of 1979, PART III Section 10(2).
5. Sites: Muheza District.

Approval is for one year: 26th June 2015 to 25th June 2016.

Name: Dr Julius J Massaga

Signature
Ag CHAIRPERSON
MEDICAL RESEARCH
COORDINATING COMMITTEE

Name: Dr Margaret E Mhando

Signature
Ag CHIEF MEDICAL OFFICER
MINISTRY OF HEALTH, SOCIAL WELFARE

CC: RMO
DED
DMO