Enhancing EID Services: Healthcare Workers' Perceptives on Health System Challenges in Zambia"

Regina Mabenga M[1*], Brian M Muyunda[2]
[1]School of Public Health, American Texila University, Guyana, South America
[2]The University of Zambia, School of Public Health, Ridgeway Campus, Lusaka, Zambia

Abstract

The pediatric HIV burden is significant, with 46% of 1.7 million affected children lacking treatment in 2020 globally. In sub-Saharan Africa, up to 49% of HIV-infected children remain undiagnosed, contributing to high AIDS-related mortality. In Zambia, early infant diagnosis (EID) coverage for HIV exposed infants (HEI) is suboptimal with 71% receiving timely virologic testing, indicating gaps in case identification. We explored healthcare workers' perceptions on EID, appointment systems and associated challenges. The study utilized a phenomenological research design involving 19 healthcare providers from the mother and child health (MCH) department in Kabwe and Chibombo districts of Central Province of Zambia. All Content and thematic analyses were done using NVivo 10 software. Healthcare providers reported using parallel systems such as paper based registers and an electronic medical records system, SmartCare, while leveraging routine immunization visits to identify and track HEIs' appointments from birth to 9 months. Health care providers highlighted challenges with paper cohort based registers leading to incomplete documentation and difficulties in tracking HEIs' appointments especially after 9 months due to decreased attendance of post-routine immunizations. Parallel data entry in both SmartCare and paper-based registers added more workload, leading to incomplete records, hindering effective appointment tracking due to lack of critical information. Therefore, streamlining data collection processes, removing parallel systems and reducing modules, providing additional training to healthcare workers on electronic management systems may contribute to improved monitoring and tracking of HEI for better outcomes.

Keywords: *Exposed, Early Infant Diagnosis (EID), HIV, Healthcare Workers, Infants.*

Introduction

The pediatric HIV burden is significant, with 46% of 1.7 million affected children lacking treatment in 2020 globally. This surpasses the Joint United Nations Programme on HIV/AIDS target for prevention of mother-to-child transmission of HIV (PMTCT) worldwide by nearly fourfold [5,6]. In sub-Saharan Africa, 38%–49% of children living with HIV (CLHIV) may not have a diagnosis and are missing lifesaving ART, contributing to 86,000 AIDS-related deaths annually in children aged 0–9 years [7]. In Zambia, where 19,000

children died from AIDS-related illnesses in 2019 and an estimated 8,300 children were reported to have become newly infected with HIV in 2020, only 71% of HEIs had a virologic test done within the first 2 months of life and 79% of those found to have HIV infection initiated ART, suggesting ongoing gaps in pediatric case finding and treatment [7,8]. Most of these new infections could have been prevented if these children had been identified, diagnosed, and promptly started on treatment. Many of these children were born to mothers who lacked access to, or only partially accessed

the PMTCT services. Furthermore, among the 21 countries with the heaviest HIV burden, merely three out of ten, totaling 630,000 eligible children, had been identified and enrolled in HIV treatment [9]. This underscores the reality that 70% of infected children are not accessing life-saving HIV care and treatment [10]. Thereby, making it difficult to achieve advancements in extending the reach of virologic testing for infants, particularly within the initial 60 days after birth.

The retention of mothers and HEI in care throughout the entire cascade of services until the determination of a final HIV outcome is less than desirable in most country programs [10]. In Zambia alone, about 29 out of 100 HEI were not evaluated for outcomes, with the Central province showing the highest rates of unknown statuses at 24 months [11 - 12]. Therefore, the Loss of follow-up among mothers and their HEI remains a major challenge to the elimination of new HIV infections among children and to achieving optimal maternal outcomes.

This study acknowledges that effective PMTCT programs, which enable healthcare providers to identify HEIs due for follow-ups and those overdue, starting from the antenatal phase through delivery and into the postpartum period, help bridge the gap of loss to follow-up among HEI.

Therefore, the study aimed to explore the perceptions of healthcare workers regarding EID appointment systems and proactive approaches in selected health facilities in Kabwe and Chibombo districts of Zambia.

Method

The study utilized a phenomenological research design involving 19 healthcare providers from the MCH department in Kabwe and Chibombo districts of Central Province of Zambia.

The study's selection of respondents was conducted using a two-staged sampling method. In the first stage, districts (2) were purposively sampled based on their high

volume of HIV-positive mothers and HEI, ensuring representation from areas with significant PMTCT service delivery. In the second stage, respondents were selected within the districts and facilities based on their significant role and responsibilities within the PMTCT department. This included key positions such as Provincial Nursing Officer (1), District MCH Coordinators (2), and MCH personel including Nurses and community-based volunteers (CBVs) (16) selected from health facilities. This sampling approach aimed to gather insights from key personnel directly involved in the implementation and management of the PMTCT services.

Data collection was conducted in September 2022 and repeated in September 2023. In Kabwe, these facilities included Natuseko, Nakoli, Chowa Urban, Kawama, Mukobeko township, Ngungu, Bwacha, Katondo, Mahatmaghadi, Makululu Urban, and Kasanda Health facilities. In Chibombo, they included Twalumba, Zambia National Service Health Centre, Mwanjuni, Chibombo RHC, Chikobo, and Kayosha.

Furthermore, we conducted interviews with study participants in the English language. During the interviews, we utilized a flexible interview guide comprising a series of open-ended questions to direct the conversation, with each interview lasting approximately 40 minutes. Independent transcribers employed a one-step process to transcribe the interviews using Microsoft Word (Microsoft, Redmond, WA, 2015). Before commencing the analysis, a codebook featuring deductive codes was established, supplemented by inductive codes as emerging themes surfaced during the coding process.

The assessment of data saturation occurred during thematic analysis, indicating that no new codes emerged, and the information gathered during caregiver interviews became repetitive.

The transcribed data were then imported into NVivo 10 software (QSR International, 2012) for content and thematic analysis.

Ethical Considerations

The research proposal was reviewed and approved by ERES CONVERGE Research Ethics Committee (2023-Mar-003). Approval was also obtained from the Zambia Ministry of Health (MOH) National Health Research Authority (0027/11/05/2023). Furthermore, written consent was obtained from all participants in the study. Participants were assured of confidentiality and that no personally Identifiable Information (PII) was to be obtained during data collection and that they were free to withdraw from the interview at anytime without any consequencies.

Results

Demographic Characteristics

The study's results in Table 1 reveal demographic characteristics and work-related factors among early infant service providers. Most providers were aged between 25-29 and 35-39 years, with all respondents being female. Experience levels varied, with significant proportions having 1-5 years and 6-10 years of experience. Training backgrounds were diverse, with half having unspecified backgrounds of mostly Community Based Volunteers (CBVs) 47%, followed by Nurses (37%), and public health officers (16%). Notably, there was an absence of doctors or laboratory technicians. Workload distribution varied, with a considerable subset reporting very high workloads (68%).

Health Providers Perspective

The study yielded several key themes related to the existing appointment system for EID Services and timed dried blood spot (DBS) collection and polymerase chain reaction (PCR) testing among healthcare workers in Kabwe and Chibombo Districts, Zambia.

Existing Standard Appointment Systems

Theme 1: Paper Based Registers

The study participants detailed the conventional appointment systems utilized for identifying HEI and monitoring their EID progress up to 24 months.

"We start with maternal HIV testing during antenatal care (ANC) visits. Maternal HIV status, whether negative or positive, is documented in the Antenatal Care Register (ANC). For HIV-positive mothers, monitoring continues until childbirth, where we confirm the infant's exposure to HIV. Infants are classified as HIV-exposed if born negative for HIV, and they are promptly started on antiretroviral (ARV) prophylaxis"-------PHN 1 Health Facility 1

Additionally, the study respondents elaborated on how HEIs are documented and tracked:

"So, for HEI it's a cohort monitoring for PMTCT which always requires us to segregate and track specific groups of HIV-positive pregnant and breastfeeding women undergoing antiretroviral therapy, as well as HEI until their HIV status is definitively determined at 24 months in an under 5 child health register called 0 -23 register." ------- CBV 17.

Furthermore, another respondent provided insight into appointment tracking and follow-up procedures while using the 0 – 23 registers:

"What we do at the end of the month is identify those mothers who have missed appointments in that month by going back as far as 6, 9, 12 18 months ago. Let me say when we reach the end of the month, we check through the registers to identify missed appointments for at 18 months and then we submit them to the Community-Based Volunteers for follow-up." ------ PHN,8

Theme 2: Integrating EID Services into Routine Under-Five Immunization Visits

Study participants further reported various approaches to monitoring appointments for HEI. This included utilizing under-five immunization visits for identifying HEIs due for DBS and PCR testing and involving Community-Based Volunteers for follow-up.

"Our mothers respect routine under child health monitoring compared to EID scheduled visits. I can say [i.e. during the under-five immunization visits we have all mothers bring their children at 6 weeks, 6 months, 9 months for routine child health growth monitoring and we take the opportunity to identify exposed babies from the 0 – 23 register that are due for their DBS and PCR testing."--------MCH Provider, 16

The study also explored during the interview suggestions from the district health offices.

"It will be a great idea if the Ministry of Health aligns the PCR testing with immunizations as a guideline for all to implement" ------ DNO 2 and 3

Theme 3: Use of Electronic Health Records (EHR) SmartCare

The study participants provided insights into the utilization of SmartCare at their facility, discussing its mandatory nature, varying usage patterns, and the facilitation of its implementation.

At our facility, categorized as a high-volume site, SmartCare usage is mandatory, designated as e_first. However, its utilization varies as data entry is typically managed by a USAID-employed data clerk. The implementation of SmartCare at our facility was facilitated by SAFE USAID in partnership with the Ministry of Health (MoH), while other similar institutions were mandated to adopt the software." — Nurse 19

Another respondent added,

"We implemented the MCH module, including EID, two years ago. While the appointment system is supposed to be used, data entry in SmartCare is often not up-to-date due to the extensive 6–7-page forms required per visit by various stakeholders. Consequently, we resort to using registers alongside the system to track HEI appointments, as SmartCare data is typically not accurate mostly for appointment date follow-ups and reminders to mothers at month-end."------ CBV 17

Challenges in the Existing Patient Tracking Systems

The research delved into various challenges reported by participants that impede adherence to timely EID (EID) appointments.

Theme 4: Challenges of Using Standard Registers (Paper Based)

"The register contains records of all children under the age of five, which I find cumbersome. With over 5000 visits monthly, I am required to flip through pages searching for details of HEI from 11 to 23 months ago while others are waiting in line. As a result, I often fail to document, hence postpone updates until after the under-five visits are completed". --- Nurse 11, Health.

In the same theme, the study recognized that the issue of incomplete documentation within health systems (registers) emerged as a significant challenge for a proactive appointment system.

'This process consumes a considerable amount of our time, which is why we primarily attend to those who used their appointment cards we gave them and show up, given our busy schedule." (MCH Nurse,15).

Other Health care providers shared their experiences.

"The use of the 0 – 23 registers, covering all under-five children, has created challenges in focusing on documenting outcome status at each DBS and PCR testing schedule" (MCH Nurse,6).

A respondent underscored the difficulty in contacting mothers due to inaccurate contact information in the registers. She explained:

"Mothers sometimes provide incorrect phone numbers and physical addresses when we identify the HEI due to fear of stigmatization in their community, this complicates our efforts to contact them and remind them of their appointments, leading to the baby not returning for the test on time or not at all" (PHN, 9)

Theme 5: Challenges of Relying on Routine Under Five Immunization Visits

Furthermore, the study findings revealed challenges of loss to follow-up among children at and after 9 months. The healthcare worker reported encountering a notable increase in the rate of losses to follow-up after this 9-month milestone. She noted that,

"Once the children no longer receive routine immunizations, which typically accompany the under-five growth monitoring appointments, there is a decline in attendance for EID services also" (PNO, 1).

In a similar theme another healthcare provider observed during the interview:

"Our HIV+ Mothers prefer coming during routine growth monitoring immunizations more than the EID monitoring schedules hence our missed opportunities for EID Cascade are usually observed at 12 months, 18 months, and worse 24 months" when the mothers are done with the routine immunizations for under five (Nurse,5)

Theme 6: Challenges of Using the Existing EHRs

According to a participant's account, the Ministry of Health's SmartCare system faces notable challenges.

"This process, taking 20–30 minutes for a single interaction, poses significant hurdles, particularly when there is a backlog of clients requiring attention. ----- Nurse,4

Dual documentation for paper-based and smart care.

"Consequently, we often opt to use paper registers and postpone updating SmartCare later. While in some cases, due to the competing demands of workload, I fail to update it altogether" ------PHN.10.

"I believe that the incomplete data in SmartCare largely stems from the considerable time it takes for me to input data during client interactions while others are waiting. As a result, I choose to jot down information on a piece of paper and update the system at the end of the clinic session. Consequently,

SmartCare presents challenges in accurately reflecting the due dates for HEI (HEIs). Therefore, I sometimes resort to using the register to check for those who have come in for tests-----EHT,12

Discussion

The quality of healthcare services is contingent upon a collaborative effort between patients and healthcare providers within a supportive environment [13]. Specifically, appointment systems are utilized to track HEI who are due and overdue for their PCR/DBS tests, thus contributing to the mitigation of loss to follow-up among this demographic. [2,9,13,].

In our study, the demographic characteristics and work-related factors among early infant service providers presented both advantages and disadvantages in tracking HEIs' timeliness in HIV testing appointments. The diversity of

training backgrounds, including nurses and public health officers, offers a multidisciplinary approach and potential for comprehensive care. However, the absence of specific training backgrounds for over half of the providers, along with the lack of doctors or laboratory technicians, raises concerns about readiness and access to essential services. The findings underscore the importance of healthcare quality, as defined by Schuster et al., which emphasizes the provision of appropriate services in a technically competent manner [14].

Additionally, the high workload distribution among providers may impede efficient scheduling and follow-up for HIV testing appointments.

The results of our study are consistent with a qualitative inquiry into implementing an EHR system (SmartCare) in Zambia, which pointed out that workload affected the documentation, this is substantiated by a quantitative examination of SmartCare for PMTCT [15]. Addressing these challenges through targeted training, reduction in several modules (streamlining indicators) workload management and ensuring timely interventions for HEI.

Availability of Appointment Systems

Our study results described several strategies for monitoring appointments, such as utilizing under-five immunization visits, providing mothers with appointment cards, and conducting monthly reviews of EID registers. In addition, participants reported that it has been difficult to use smart care to monitor appointments proactively due to inconsistency in the use of the system to document EID services by providers.

However, despite the availability of monitoring approaches, inconsistencies in implementation were noted due lack of training in smartcare (not all staff are mentored, and data entry is usually done by implementing partners)

and to other competing activities among providers.

Use of Under 5 Routine Immunizations to Monitor HEI Appointments

In our study participants highlighted the use of routine under-5 immunization visits as a mechanism to monitor appointments for HEI. During these immunization visits, healthcare providers take the opportunity to identify HEIs who are due for their diagnostic tests, such as dried blood spot (DBS) or polymerase chain reaction (PCR) testing, particularly up to 9 months of age. These methods aimed to ensure follow-up for HEI. Tanzania supports these findings. In a similar study conducted in Tanzania, the study found the integration of HIV-related services at immunization visits identified HEI, HIV-infected infants, and HIV-infected mothers who were due or late for their appointment [16].

While integrating HIV-related services with routine immunization service delivery holds promise for identifying HIV-infected infants, its implications require careful evaluation. Our observations from the participants revealed a significant reactive approach in the appointment system among respondents, who reported decreases in attendance for HIV testing and prophylaxis for mothers and infants beyond 9 months of age, coinciding with the period of routine immunization [17]. This lack of proactiveness concern was also observed in other studies for integrating HIV services with routine immunization in South Africa. Mothers accepted HIV testing during immunization visits, and EID at the first-month visit had positive effects on child health outcomes [16]. Similarly, a study conducted in Zambia, the study was successful in estimating the MTCT rates for infants below the age of 12 months thus indicating that infant testing in immunization services is a feasible strategy for estimating MTCT rates among the population of HEI in the age coinciding with routine immunizations for Under 5 [16,17].

This finding suggests a potential negative impact on tracking the HEIs' outcomes up to 24 months, as healthcare providers primarily tracked HEIs during routine immunization appointments, which typically only occur up to 9 months of age, leading to a risk of incomplete monitoring and follow-up beyond the 9-month milestone.

Utilizing Paper-Based Registers for HEI Appointment Tracking

Our study uncovered the absence of a structured appointment system for EID services among respondents. We found that health workers faced challenges with longitudinal registers, needing to flip through pages to document and locate client services while attending to other clients, thus impeding complete documentation.

These findings are consistent with observations from other studies, such as those conducted in African clinics, where tracking HEIs is complicated using multiple paper-based registers [15]. In Tanzania and Malawi, for instance, their study revealed a significant paperwork burden, duplication of information, and increased workload for staff. [18].

An assessment by the WHO also observed that while paper-based (Registers) cohort monitoring for PMTCT Transmission (PMTCT) outcomes is good, it also presents significant challenges. One major issue is that healthcare workers at clinical facilities bear the highest burden of this monitoring and evaluation process [9]. Furthermore, a study in Malawi, and our research study revealed similar challenges related to incomplete data and compromised data quality in manual documentation processes within healthcare settings [18]. In this study, challenges of incomplete documentation affected proactive tracking of Mothers and Infants before their appointment date.

Our study findings on the use of registers for tracking HEIs must be interpreted within the following two limitations: The first constraint faced by providers is the workload of having to document outcomes and services for HEIs as far back as 12 to 24 months ago manually a cohort register while attending to clients and secondly, the registers were reported to lack a provision for scheduling the subsequent appointment hence difficult for different providers to know who is due for proactive follow up and reminders to mothers, even when there is a desire by the provider to do so.

Utilizing Health Electronic Tools for Tracking HEI Appointments

In our study respondents explained using the existing SmartCare system as a health electronic tool for tracking appointments of HEIs. The SmartCare system is a digital platform designed to manage patient records, appointments, and healthcare services electronically [15]. Within this system, healthcare providers can input and monitor HEI appointments, and get reminders of who is due, follow-up schedules, and diagnostic testing dates, aiming to streamline appointment management and improve the continuity of care for HEIs.

However, our study reported challenges such as system usability issues or delays in data entry that may impact the effectiveness of the SmartCare system in tracking HEI appointments because not all staff were adequately oriented, resulting in some using registers while others used SmartCare when attending to clients. In line with our study's findings, Adekunle et al. highlighted limited computer skills as one of the factors impeding the adoption of EHRs in sub-Saharan Africa [14].

Furthermore, our study learned that dual reporting has led to incomplete information in both registers and SmartCare, affecting the proactiveness of the appointment system of health workers in EID services. Since neither primary data source was reported to provide accurate appointment dates for HEIs, this led to a notable gap in the reliability of appointment

scheduling for this vulnerable group. Supporting this study's findings, research conducted in Ethiopia exhibited comparable patterns of dual documentation, where the quality of data was compromised due to the simultaneous use of paper-based and electronic systems [15,19].

Our study findings also uncovered that the system captures numerous data modules, exacerbating the workload of healthcare. This was also evident in a study conducted in Zambia which revealed that providers failed to complete certain fields due to workload and long queues of clients waiting to be attended to. The study emphasized that reducing the number of fields collected while maintaining data of higher quality for HEI management could streamline data collection processes, making the system more user-friendly and facilitating a proactive appointment system among providers [15].

These findings align with a systematic review of literature on the role of EHR systems in developing countries, which also highlighted the importance of simplifying data collection processes to enhance usability and efficiency [19]. Studies in Ethiopia also echoed similar challenges, suggesting improvement strategies such as collecting less but better data, providing regular feedback to clinic staff, and enhancing software functionality [18,19]. In contrast with our results and those in support, other research has shown varying opinions regarding the use of EHR in improving retention among HEIs. A system review for PMTCT in rural Zambia by ICAP demonstrated significant success in the improvement of EID outcomes particularly in improving the efficiency and quality of key EID outcomes [20]. This system sends reminders via phone or through health care providers/community-based volunteers, resulting in increased HIV tests/PCR among HEI.

Similar successful tracking processes were reported in South Africa, Nigeria, and Kenya, with electronic follow-up methods [21,22].

Furthermore, a study in Kenya supported findings on using EHR to improve tracking of this vulnerable group among healthcare providers [21]. However, our study reported challenges with wrong contact information provided by mothers. Which hinders reminders from being effective in reducing loss of follow-up. These study findings were corroborated by another qualitative assessment of targeted community-based point-of-care EID of HIV in Lusaka [23]. Our study findings underscore the importance of fostering good relationships and providing counseling to clients to ensure accurate contact information is provided to support easy tracking and reminder follow-ups by healthcare workers.

Limitations and Strengths

The study demonstrated several strengths. Firstly, it employed robust data collection methods, ensuring the thorough investigation of existing appointment systems. This approach provided comprehensive insights into enabling factors and barriers to the monitoring and tracking of HEI. Moreover, engagement of healthcare workers and getting their firsthand experience further bolstered the reliability of the findings. However, like any other study, we encountered some limitations, particularly relying on self-reported information from healthcare workers, which could be biased. Additionally, not having an opportunity to get perceptions from Laboratory technicians who are very key in the tracking of EID for HEI monitoring. Nonetheless, despite these limitations, the study provides valuable insights into the existing systems for tracking of HEI, offering pointers to strategies that could potentially improve the routine monitoring and tracking of HEI by addressing challenges related to EID appointment system and improving the healthcare outcomes for HEI.

Conclusion

Despite the benefits of using the parallel systems such as SmartCare, paper-based

registers, and routine immunization visits in tracking and monitoring of HEI, optimizing the management and tracking of HEI for better outcomes, this study underscores the challenges that come up as a result. Among the challenges faced with the use of parallel monitoring systems is increased data collection workload, posing significant challenges in efficiently monitoring and tracking of HEI due to lack of adequate information. Additionally, the complexity with tracking of appointments for HEI using cohort paper-based registers, particularly the 0 to 23 child health register because of its bulkiness is another challenge. Study findings also showed that lack of adequate healthcare workers in MCH, responsibilities such as documentation of registers and monitoring of HEI are sometimes left to CBVs. This compromises the efficiency in the monitoring of HEI as they lack the needed skills.

Therefore, streamlining data collection processes, removing parallel systems and reducing modules, providing additional training to healthcare workers on electronic medical record systems and retaining qualified personel to ensure high-quality tracking and monitoring systems for HEI in MCH could potentially enhance the appointment system reliability and efficiency, thereby contributing to improved monitoring and tracking of HEI for better outcomes.

Conflict of Interest

Authors declare that there is no conflict of interest regarding the publication of this research study.

Acknowledgment

Table 1. Background Characteristics and Work-Related Factors of Early Infant Service Providers (n= 19)

Variable	Frequency (n)	Percent (%)
Age		
25 – 29 years	6	32%
30 – 34 years	5	26%
35 – 39 years	6	32%
40 – 45years	2	10%
Total	**19**	**100%**
Sex		
Female	19	100%
Total	**19**	**100%**
Years of Experience		
1-5 years	7	37%
6 -10 years	6	32%
11 – 15 years	4	21%
16 years and above	2	10%
Total	**19**	**100%**
Training Background		

Nursing	7	37%
Public Health	3	16%
Social work/Counselling	9	47%
Total	**19**	**100%**
Job Role/Position		
Nurse	7	37%
Public Health Officer	3	16%
Community Based Volunteers	9	47%
Total	**19**	**100%**
Workload		
Low workload	3	16%
Moderate workload	1	5%
High workload	4	21%
Very high workload	13	68%
Total	19	100%
Presence of MoH Partner		
Yes	3	16%
No	16	84%
Total	**19**	**100%**

EID Algorithm Matrix for HIV Testing for HEI

Table 2 shows the EID algorithm matrix for HIV testing for HEI (Zambia Consolidated Guidelines for Treatment and Prevention of HIV Infection, 2023). This authoritative guideline offers a comprehensive overview of the testing protocol, including recommendations for the targeted population, timing of HIV testing, and specific types of testing based on factors such as maternal status, infant age, breastfeeding status, and symptomatology.

Healthcare providers can rely on this guideline to effectively manage HIV testing and diagnosis among HEI, ensuring timely and appropriate care.

Table 2. EID Algorithm Matrix for HIV Testing for HEI (Zambia Consolidated Guideline for Treatment and Prevention of HIV Infection 2023)

Whom to test	When to test	Type of HIV testing
Pregnant women, breastfeeding women (and their sexual partners)	During antenatal care (ANC): at first ANC visit and retest every 3 months if negative. In labour and delivery (L&D): test if last test >6 weeks ago During postnatal care (PNC): test at first contact if unknown status. Serological test at 6 weeks if negative. If breastfeeding: retest every 3 months if negative until cessation of breastfeeding. Partner testing: same time points	Serological test
Well, never breastfed HIV. Exposed Infant (HEI) 0 – 24 months olds	At birth/first week of life or at first contact	NAT*
	6 weeks old	
	24 months old	Serological test
Well, breastfed HEI	At birth/first week of life or at first contact	NAT*
	6 weeks old	
	6 months old	
	9 months old	NAT
	12 months old	Serological test, if positive, follow up with NAT. If negative, follow up with serological test at 18 months
	18 months old	Serological test; if positive, follow up with NAT. If negative, follow up with serological test at 24 months
	24 months ol	Serological test; if positive, follow up with NAT
Infant or child who has completely stopped breastfeeding	≥6 weeks after breastfeeding cessation in children <24months old	Serological test; if positive, follow up with NAT
	>24 months old	Serological test
Asymptomatic infant with	At first contact	Maternal serological test and/or infant

unknown HIV exposure		serological test; follow up with NAT for positive serological child ≤24 months old
Infant or child symptomatic for HIV infection	Immediately regardless of age	Serological test; follow up with NAT for positive serological child ≤24 months old
Positive serological child <24 months old	At first contact	NAT

References

[1] Newell, M. L., Coovadia, H., Cortina-Borja, M., Rollins, (2004). Mortality of infected and uninfected infants born to HIV-infected mothers in Africa: a pooled analysis. Lancet, 364, 1236–1243. [PubMed]

[2] Chintu, C., Bhat, G. J., Walker, A. S., Mulenga, V., Sinyinza, et al. (2004). Co-trimoxazole as prophylaxis against opportunistic infections in HIV-infected Zambian children (CHAP): a double-blind randomized placebo-controlled trial. Lancet, 364, 1865–1871. [PubMed]

[3] Kabue, M. M., Buck, W. C., Wanless, S. R., Cox, C. M., McCollurg, E. D. (2012). Mortality and clinical outcomes in HIV-infected children on antiretroviral therapy in Malawi, Lesotho, and Swaziland. Pediatrics, 130, e591–e599. [PMC free article] [PubMed]

[4] Brady, M. T., Oleske, J. M., Williams, P. L., Elgie, C., (2010). Declines in mortality rates and changes in causes of death in HIV-1-infected children during the HAART era. J Acquire Immune Defic Syndr, 53, 86–94. [PMC free article] [PubMed]

[5] World Health Organization. (2010). Antiretroviral therapy for HIV infection in infants and children: towards universal access. Recommendations for a public health approach. Geneva, Switzerland: World Health Organization. [PubMed]

[6] The United Nations Children's Fund (UNICEF). (2019). Children, HIV and AIDS. Regional Snapshot: sub-Saharan Africa. UNICEF. Retrieved from https://www.childrenandaids.org/sites/default/files/2020-08/SSA%20Regional%20snapshot-%20v5-%206%20Nov%20%281%29.pdf.

[7] HIV/AIDS Zambia. UNICEF (2021). Retrieved from https://www.unicef.org/zambia/hivaids.

[8] Mutanga, J. N., Mutembo, S., Ezeamama, A. E., et al. (2020). Tracking progress toward elimination of mother to child transmission of HIV in Zambia: findings from the EID of HIV Program (2009–2017). Journal of Tropical Pediatrics, 66(1), 56–65. doi:10.1093/tropej/fmz030. pmid:31089687

[9] Modi, S., Callahan, T., Rodrigues, J., Kajoka, M. D., Dale, H. M. (2017). Overcoming Health System Challenges for Women and Children Living with HIV Through the Global Plan. Journal of Acquired Immune Deficiency Syndromes, 75(Suppl 1), S76-S85. doi:10.1097/QAI.0000000000001336

[10] Ahmed, S., Kim, M. H., Sugandhi, N., Phelps, B. R., Sabelli, R., Diallo, M. O. (2013). Beyond EID: Case finding strategies for identification of HIV-infected infants and children. AIDS, 27(0 2), S235–S245. doi: 10.1097/QAD.0000000000000099

[11] MoH. (2022). Annual Health Statistical Report 2017-2021 (Tracking Performance of the NHSP 2017-2021). P.O BOX 30205 Ndeke House, Lusaka Zambia. Retrieved from www.moh.gov.zm.

[12] Ministry of Health, Zambia. (2017). Zambia National Health Strategic Plan 2017 – 2021. Retrieved from https://www.moh.gov.zm/.

[13] Mosaddegh, A.M. (2014). Factors influencing healthcare service quality. International Journal of Health Policy and Management, 3(2), 77-89. DOI: 10.15171/ijhpm.2014.65. PMID: 25114946; PMCID: PMC4122083.

[14] Odekunle, F.F., Adekunle, R.O., & Shankar, S. (2017). Why sub-Saharan Africa lags in EHR adoption and possible strategies to increase its adoption in this region. International Journal of Health Sciences, 11, 59-64. [PMC free article] [PubMed]

[15] Gumede-Moyo, S., Todd, J., Bond, V., Mee, P., & Filteau, S. (2019). A qualitative inquiry into implementing an EHR system (SmartCare) for PMTCT transmission data in Zambia: a retrospective study. BMJ Open, 9(9), e030428. doi: 10.1136/bmjopen-2019-030428.

[16] Simbaya, J., Funjika, P., Moonga, A., Mwale, J., & Kankasa, C. (2021). Feasibility of using infant testing during immunization to estimate HIV mother-to-child transmission rates in Zambia. BMC Infectious Diseases, 21(1), 1239. doi: 10.1186/s12879-021-06892-0. [PMID: 34886792; PMCID: PMC8655713]

[17] Dunning, L., Gandhi, A. R., Penazzato, M., Soeteman, D. I., Revill, P., Frank, (2021). Optimizing infant HIV diagnosis with additional screening at immunization clinics in three sub-Saharan African settings: A cost-effectiveness analysis. Journal of the International AIDS Society, 24(1), e25651. https://doi.org/10.1002/jia2.25651

[18] Douglas, G. P., Gadabu, O. J., Joukes, S., et al. (2010). Using touchscreen electronic medical record systems to support and monitor national scale-up of antiretroviral therapy in Malawi. PLoS Med, 7, e1000319. https://doi.org/10.1371

[19] Abiy, R., Gashu, K., Asemaw, T., et al. (2018). A comparison of electronic records to paper records in antiretroviral therapy clinic in Ethiopia: what is affecting the quality of the data? Online Journal of Public Health Informatics, 10, e212. doi: 10.5210/ojphi.v10i2.8309.

[20] ICAP. (2023). ICAP in Zambia supports improved HIV care and PMTCT transmission. Retrieved from https://icap.columbia.edu/news-events/icap-in-zambia-supports-improved-hiv-care-and-prevention-of-mother-to-child-transmission/.

[21] Finocchario-Kessler S, Brown M, Maloba M, Nazir N, Wexler C, Goggin K, D., et al (2021). A Pilot Study to Evaluate the Impact of the HIV Infant Tracking System (HIT System 2.0) on Priority PMTCT Transmission (PMTCT) Outcomes. AIDS Behav, 25(8), 2419-2429. Doi: 10.1007/s10461-021-03204-0.

[22] Mate, K. S., Bennett, B., Phase, W., Barker, P., & Rollins, N., et al (2009). Challenges for routine health system data management in a large public program to prevent mother-to-child HIV transmission in South Africa. PLoS One, 4, e5483.

[23] Tembo, T., Dale, H., Muttau, N., Itoh, M., Williamson, D., Mwamba, C., Herce, M. E., et al (2022). "Testing Can Be Done Anywhere": A Qualitative Assessment of Targeted Community-Based Point-of-Care EID of HIV in Lusaka, Zambia. Global Health: Science and Practice, 10(3), e2100723. https://doi.org/10.9745/GHSP-D-21-00723

[24] Ministry of Health, Zambia. (2023). Zambia consolidated guidelines for treatment and prevention of HIV infection. Retrieved from https://www.differentiatedservicedelivery.org/wp-content/uploads/August-2023-Zambia-Consolidated-Guidelines.pdf.