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FROM PREGNANCY TO POSTPARTUM: COMPREHENSIVE APPROACHES TO PEDIATRIC HIV PREVENTION

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Abstract

Mother-to-child transmission (MTCT) of HIV remains a significant cause of pediatric HIV infection globally, particularly in low-resource settings. Preventing HIV in children under five requires a comprehensive approach that spans the entire maternal and infant care continuum—from early pregnancy through the postpartum period. This review explores key strategies including maternal antiretroviral therapy (ART) initiation and adherence, infant prophylaxis, early infant diagnosis (EID), and innovations in diagnostic and treatment technologies. Effective prevention hinges on early and sustained viral suppression in pregnant and breastfeeding women, complemented by timely infant prophylaxis and rapid HIV testing to ensure early treatment initiation for infected infants. Innovations such as long-acting ART formulations, point-of-care diagnostic tools, and digital health interventions enhance adherence and facilitate timely care, particularly in resource-limited environments. Integration of HIV services with routine maternal and child health care and community engagement plays a crucial role in overcoming barriers like stigma and loss to follow-up

Keywords: *Pediatric HIV prevention, mother-to-child transmission, antiretroviral therapy, early infant diagnosis, postpartum care*

Introduction

Human immunodeficiency virus (HIV) infection in children remains a major global public health challenge, with mother-to-child transmission (MTCT) representing the predominant route of new pediatric infections [1-2]. Despite significant progress in reducing transmission rates through antiretroviral therapy (ART) and preventive interventions, approximately 150,000 children worldwide were newly infected with HIV in 2022, predominantly in sub-Saharan Africa. Pediatric HIV not only affects child survival but also poses lifelong challenges in treatment and care, emphasizing the critical need for effective prevention strategies spanning from pregnancy through the postpartum period [3-5]. The transmission of HIV from mother to child can occur during pregnancy, labor and delivery, or breastfeeding. Each phase presents unique biological and social risks that necessitate tailored interventions. Preventing vertical transmission requires a continuum of care that begins early in pregnancy with maternal HIV testing and initiation of ART, continues through labor and delivery with safe practices, and extends into the breastfeeding period where ongoing prophylaxis and monitoring are vital. The World Health Organization (WHO) has promoted the Option B+ strategy—lifelong ART for all pregnant and breastfeeding women living with HIV—which has substantially improved maternal viral suppression and reduced MTCT rates [6-7].

Achieving and maintaining maternal viral suppression is the cornerstone of pediatric HIV prevention. Viral load monitoring during pregnancy and postpartum ensures that ART is effective and adherence is sustained. However, adherence challenges, socio-economic barriers, and health system constraints often limit the success of these interventions. Additionally, infant prophylaxis and early infant diagnosis (EID) complement maternal treatment by providing direct protection and enabling prompt identification of HIV infection in exposed infants. EID allows timely initiation of ART in infected infants, significantly improving survival rates [8-9]. Innovations in pediatric HIV prevention have transformed programmatic approaches. Long-acting antiretroviral drugs, which reduce the dosing frequency for both mothers and infants, show promise in improving adherence and reducing transmission risk. Point-of-care (POC) diagnostic technologies offer rapid HIV testing with immediate results, critical for initiating early treatment and reducing loss to follow-up. Furthermore, digital health interventions such as mobile reminders and virtual support networks bolster adherence and retention in care [10-11]. Integration of HIV services with routine maternal, neonatal, and child health programs enhances access and reduces stigma, facilitating comprehensive care for mother-infant pairs. This holistic approach addresses not only biomedical factors but also social determinants such as stigma, gender inequality, and poverty, which impact service uptake and adherence. Community involvement through peer support, male partner engagement, and culturally sensitive education programs plays a vital role in sustaining prevention efforts [12-13].

Aim

This narrative review aims to explore and synthesize current strategies and innovations in the prevention of HIV transmission from mother to child, with a specific focus on the continuum of care spanning pregnancy, delivery, and the postpartum period.

Methods

This narrative review was conducted using a structured literature search and integrative approach to synthesize current evidence on strategies for preventing pediatric HIV across the maternal–infant continuum. Searches were performed in PubMed, Scopus, Web of Science, and Google Scholar for articles published up to December 2025. Keywords and combinations included: "pediatric HIV prevention," "prevention of mother-to-child transmission," "PMTCT," "antenatal HIV care," "maternal viral suppression," "infant prophylaxis," "breastfeeding and HIV," "early infant diagnosis," and "postpartum HIV interventions."

Inclusion criteria encompassed peer-reviewed original research, systematic and narrative reviews, clinical guidelines, implementation science reports, and relevant policy documents addressing maternal and infant HIV care during pregnancy, delivery, and postpartum. Exclusion criteria included studies not related to vertical HIV transmission, non-human studies, or publications without accessible full text.

Data extraction focused on maternal testing strategies, ART regimens, viral load monitoring, obstetric and neonatal interventions, breastfeeding guidance, early infant diagnosis, community-based support, and innovations in care delivery. Evidence was analyzed narratively, organized by chronological continuum (pregnancy, delivery, postpartum), and synthesized to identify best practices, implementation challenges, and emerging approaches. No formal meta-analysis was performed due to heterogeneity in study designs, settings, and outcome measures.

Maternal Interventions to Prevent Vertical Transmission

Preventing mother-to-child transmission (MTCT) of HIV fundamentally relies on optimizing maternal health before and during pregnancy. Early identification of HIV infection through routine antenatal screening is critical, as timely initiation of antiretroviral therapy (ART) can dramatically reduce viral load and the risk of transmission. The World Health Organization's (WHO) Option B+ approach—offering lifelong ART to all pregnant and breastfeeding women living with HIV regardless of clinical stage—has been widely adopted due to its simplicity and effectiveness in achieving viral suppression [14-16]. Initiating ART as early as possible during pregnancy is vital to maximize viral suppression before delivery. Studies have demonstrated that women who start ART in the first trimester have significantly lower transmission rates compared to those who initiate treatment later or during labor. Viral load monitoring throughout pregnancy and the postpartum period is essential to assess treatment efficacy and identify adherence challenges or drug resistance, enabling timely interventions to prevent transmission [17-18].

Maternal adherence to ART is influenced by numerous factors including medication

side effects, psychosocial stressors, stigma, and access to health services. Programs that incorporate counseling, peer support, and male partner involvement have been shown to improve adherence and retention in care. Addressing barriers such as poverty, gender inequality, and intimate partner violence is also crucial for ensuring that women can consistently access and benefit from ART services [19-20]. Beyond ART, managing co-infections such as tuberculosis, sexually transmitted infections, and malaria during pregnancy can further reduce MTCT risk by improving maternal immune function. Nutritional support and education on safe delivery practices, including elective cesarean section when indicated, contribute to minimizing the risk of HIV transmission during labor [21]. Breastfeeding poses an ongoing risk for postnatal transmission; however, it remains critical for infant nutrition and survival in many settings. WHO guidelines recommend exclusive breastfeeding for the first six months with continued maternal ART to reduce transmission risk. Close monitoring and support during the breastfeeding period are essential to maintain maternal viral suppression and ensure infant health (Table 1) [22-23].

Table 1: Maternal Interventions to Prevent Vertical Transmission of HIV

Intervention Category	Specific Strategies	Timing/Notes	Evidence-Based Impact
HIV Testing and Diagnosis	- Routine opt-out HIV testing at first antenatal visit - Repeat testing in 2nd and 3rd trimesters in high-risk areas - Partner testing	Antenatal care	Early diagnosis enables timely ART initiation; reduces in utero and intrapartum transmission
Antiretroviral Therapy (ART)	- Lifelong ART (Option B+) - Dolutegravir-based regimens preferred - Intensified ART for acute seroconversion	Pregnancy, continued postpartum	Sustained maternal viral suppression is the cornerstone of preventing vertical transmission
Viral Load Monitoring	- Viral load testing each trimester and during breastfeeding - Point-of-care viral load where available	Antenatal and postpartum	Early detection of treatment failure; informs adherence interventions and risk-stratified delivery planning
Adherence Support & Retention	- Differentiated service delivery (DSD) - Multi-month dispensing (MMD) - Peer support and counseling	Pregnancy through breastfeeding	Improves maternal retention, ART adherence, and viral suppression
Intrapartum Management	- Elective cesarean section if viral load >1000 copies/mL - Avoidance of invasive procedures (e.g., fetal scalp electrodes) - Intravenous zidovudine for high-risk cases	During delivery	Reduces intrapartum HIV exposure for the infant
Breastfeeding Guidance	- Exclusive breastfeeding for first 6 months - Maternal adherence and viral suppression monitoring - Extended infant prophylaxis for high-risk infants	Postpartum	Minimizes postnatal transmission while supporting infant nutrition
Maternal Health &	- Mental health screening	Antenatal and	Enhances ART adherence, retention

Psychosocial Support	and counseling - Stigma reduction interventions - Nutritional support and socioeconomic assistance	postpartum	in care, and overall maternal well-being

Infant Prophylaxis and Early Infant Diagnosis

Infant prophylaxis is a critical component of pediatric HIV prevention, serving as a direct safeguard against HIV acquisition during the peripartum and breastfeeding periods. The administration of antiretroviral drugs to HIV-exposed infants reduces the likelihood of viral establishment following potential exposure. Standard regimens typically include daily doses of nevirapine or zidovudine starting immediately after birth and continuing for a minimum of 4 to 6 weeks. The duration and choice of prophylaxis may be adjusted based on maternal viral suppression status and infant feeding practices, with extended prophylaxis recommended for infants who are breastfed [24]. Early infant diagnosis (EID) is essential to promptly identify HIV infection in exposed infants, allowing for immediate initiation of antiretroviral therapy (ART) that significantly improves survival and health outcomes. Traditional antibody-based HIV testing is unreliable in infants younger than 18 months due to the presence of maternal antibodies; therefore, nucleic acid amplification tests (NAAT) such as PCR are the gold standard for early detection. Despite their accuracy, laboratory-based NAATs often face logistical challenges including long turnaround times, transportation delays, and loss to follow-up, especially in resource-limited settings. [25-26]

To overcome these barriers, point-of-care (POC) technologies for EID have been developed and implemented in many settings. POC diagnostic tools provide rapid, onsite molecular testing with same-day results, enabling immediate linkage to care and reducing the risk of delayed treatment initiation. Integrating EID services into routine immunization and postnatal visits increases coverage and retention, while caregiver education about the importance of repeat testing during breastfeeding enhances detection of late postnatal infections [27-28]. Ensuring adherence to infant prophylaxis and follow-up testing requires strong health system support and caregiver engagement. Counseling, peer support programs, and community health workers play vital roles in reinforcing adherence and facilitating timely clinic visits. Additionally, maintaining uninterrupted supply chains for prophylactic drugs and testing reagents is critical to the success of these programs (Table 2) [29].

Table 2: Infant Prophylaxis and Early Infant Diagnosis (EID) in Pediatric HIV Prevention

Intervention Category	Specific Strategies	Timing/Notes	Evidence-Based Impact
Neonatal Prophylaxis	- Low-risk infants: single-drug prophylaxis (e.g., zidovudine) for 4–6 weeks - High-risk infants: dual or triple prophylaxis (e.g., zidovudine + nevirapine ± lamivudine)	Initiate within 6–12 hours after birth	Reduces in utero and intrapartum HIV acquisition; stratified by maternal viral load and ART adherence
Extended Prophylaxis During Breastfeeding	- Daily nevirapine for infants exposed to HIV during breastfeeding - Duration: until cessation of breastfeeding (or 12 weeks for high-risk exposure)	Postnatal	Protects against postnatal HIV transmission, especially in high-burden settings
Early Infant Diagnosis (EID) – Birth Testing	- HIV nucleic acid test (NAT/PCR) for high-risk infants (maternal viral load >1000 copies/mL, late ART initiation)	Within first 48 hours	Enables rapid identification of HIV-positive infants and prompt ART initiation
Routine EID Testing	- NAT/PCR at 6 weeks for all HIV-exposed infants - Follow-up testing at 3 months, 6 months, and 6 weeks post-breastfeeding cessation	6 weeks to post-weaning	Detects early infection to reduce morbidity and mortality; guides infant treatment
Point-of-Care EID	- Rapid NAT/PCR or other validated point-of-care tests	Birth, 6 weeks, or high-risk exposure points	Shortens turnaround time, allowing immediate clinical decision-making
Linkage to Care and Follow-Up	- Enrollment in child HIV care programs - Immunization integration and mother–infant clinic visits - Community health worker support	Birth to 24 months	Ensures timely ART initiation, adherence, and retention in care for HIV-positive infants

Innovations in Pediatric HIV Prevention

Recent advances in pediatric HIV prevention have introduced promising innovations that enhance the effectiveness, accessibility, and acceptability of interventions targeting children under five years. These innovations address key challenges such as adherence difficulties, diagnostic delays, and limitations of conventional drug regimens.

By integrating novel biomedical technologies and digital health solutions, pediatric HIV prevention is evolving toward more patient-centered and sustainable models of care [30]. One of the most significant innovations is the development of long-acting antiretroviral formulations for both mothers and infants. Injectable long-acting drugs, such as cabotegravir and rilpivirine, offer the potential to reduce the frequency of dosing from daily oral pills to monthly or bi-monthly injections. This approach can substantially improve adherence by alleviating pill fatigue and minimizing the risk of missed doses, which are critical factors in preventing vertical transmission and maintaining viral suppression [31].

Point-of-care (POC) diagnostic technologies have revolutionized early infant diagnosis by enabling rapid, onsite detection of HIV in resource-constrained settings. These portable devices deliver results within hours, eliminating the delays associated with centralized laboratory testing and allowing immediate clinical decision-making. The integration of POC testing with mobile health platforms facilitates real-time data reporting and enhances patient tracking, thereby reducing loss to follow-up and improving retention in care [32-33]. Digital health innovations also support prevention efforts by enhancing adherence and engagement among mothers and caregivers. Mobile phone-based reminders, telehealth consultations, and interactive applications provide personalized support, education, and linkage to services. These tools help overcome geographic and social barriers, offering discreet and continuous communication that empowers families to adhere to treatment and prophylaxis schedules [34].

Furthermore, advances in maternal immunization strategies are being explored as adjunctive approaches to reduce infant HIV risk. Research on maternal vaccines aimed at eliciting protective antibodies during pregnancy holds promise for passive immunization of the infant, potentially complementing existing ART regimens and prophylaxis [35]. Integration of HIV services with maternal, neonatal, and child health programs through innovative models of care delivery improves service uptake and reduces stigma. Multidisciplinary teams and community-based interventions facilitate holistic care that addresses the biomedical and psychosocial needs of mother-infant pairs, reinforcing the continuum of prevention from pregnancy through early childhood [36].

Community and Health System Strengthening

Effective prevention of pediatric HIV extends beyond biomedical interventions to encompass robust health systems and active community engagement. Strengthening both domains is essential to ensure sustained access to comprehensive services for mothers and infants, particularly in resource-limited settings where the burden of HIV is highest. A resilient health system coupled with empowered communities forms the backbone of successful pediatric HIV prevention programs [37-39]. Health system strengthening focuses on improving infrastructure, workforce capacity, supply

chain management, and data systems to support the continuum of care from pregnancy to early childhood. This includes training healthcare providers in the latest prevention protocols, ensuring availability of antiretroviral drugs and diagnostic tools, and implementing efficient patient tracking and follow-up mechanisms. Strengthened referral systems facilitate timely access to specialized care when needed, while integration of HIV services with maternal, neonatal, and child health (MNCH) platforms enhances service delivery efficiency and acceptability [40-41].

Community engagement plays a pivotal role in addressing social determinants that affect HIV prevention outcomes. Stigma, discrimination, gender inequality, and misinformation can undermine adherence to treatment and discourage uptake of services. Community health workers, peer educators, and support groups act as critical bridges between health facilities and households, providing education, psychosocial support, and linkage to care. Male partner involvement initiatives have also proven beneficial in improving maternal ART adherence and reducing transmission risk by fostering shared responsibility and support [42-43]. Innovative community-based models, such as home visits, mobile clinics, and group antenatal care, increase accessibility for hard-to-reach populations and reduce barriers related to transportation, cost, and social constraints. These approaches empower communities to take ownership of health outcomes and facilitate culturally sensitive interventions that resonate with local beliefs and practices [44-45]. Robust health information systems enable the collection and use of quality data to monitor program performance, identify gaps, and guide policy decisions. Digital tools for data management, patient reminders, and telemedicine enhance communication between providers and patients, improving retention and continuity of care [46-48].

Conclusion

The prevention of pediatric HIV requires a comprehensive, sustained approach that begins before childbirth and continues through infancy and early childhood. Interventions targeting maternal health—particularly through early HIV diagnosis, antiretroviral therapy, and management of co-infections—serve as the first and most critical line of defense against vertical transmission. Coupled with infant-focused strategies such as antiretroviral prophylaxis and early diagnosis, these efforts significantly reduce the risk of HIV acquisition during both delivery and breastfeeding. Recent innovations in diagnostics, drug formulations, and service delivery models have further advanced the pediatric HIV prevention agenda. Long-acting antiretroviral agents, point-of-care testing, digital health tools, and maternal immunization research provide new opportunities to overcome traditional barriers such as poor adherence, delayed diagnosis, and limited access to care. These breakthroughs must be integrated into broader public health strategies that prioritize maternal-infant health and equitable access to prevention services.

Conflicts of Interest

The author declares no conflict of interest

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Abbreviations
ABC – Abacavir
AFASS – Acceptable, Feasible, Affordable, Sustainable, and Safe
ART – Antiretroviral Therapy
ARV – Antiretroviral
BF – Breastfeeding
CAB-LA – Long-Acting Cabotegravir
CEC – Caesarean Section
CIC – Community Infant Care
CWC – Child Welfare Clinic
DSD – Differentiated Service Delivery
DTG – Dolutegravir
EACS – European AIDS Clinical Society
EID – Early Infant Diagnosis
ELISA – Enzyme-Linked Immunosorbent Assay
EMTCT – Elimination of Mother-to-Child Transmission
HAART – Highly Active Antiretroviral Therapy
HIV – Human Immunodeficiency Virus
IEC – Information, Education and Communication
IPT – Infant Prophylactic Therapy
MCH – Maternal and Child Health
MMD – Multi-Month Dispensing
MOH – Ministry of Health
MTCT – Mother-to-Child Transmission
NACS – Nutrition Assessment, Counselling and Support
NAT – Nucleic Acid Test
NVP – Nevirapine
PCR – Polymerase Chain Reaction
PEPFAR – President's Emergency Plan for AIDS Relief
PMTCT – Prevention of Mother-to-Child Transmission
POC – Point of Care
PrEP – Pre-Exposure Prophylaxis
RNA – Ribonucleic Acid
SD BI – Safe Delivery Bundle Initiative
SMS – Short Message Service
SSA – Sub-Saharan Africa
TAF – Tenofovir Alafenamide
TDF – Tenofovir Disoproxil Fumarate
UNAIDS – Joint United Nations Programme on HIV/AIDS
VL – Viral Load
WHO – World Health Organization

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