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KEY CONSIDERATIONS FOR PROGRAMMING AND PRIORITIZATION

GOING THE 'LAST MILE' TO EMTCT:

A road map for ending the HIV epidemic in children

UNAIDS

World Health Organization

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Front cover: Eba Ndongo with her baby Carla, at the post-natal clinic at the Ebolowa Regional Hospital, Cameroon.

Contents

Acronyms and abbreviations

ANC	antenatal care
ART	antiretroviral therapy
CDC	Centers for Disease Control and Prevention (United States)
CI	confidence interval
EMTCT	elimination of mother-to-child transmission of HIV
MCH	maternal and child health
OR	odds ratio
PEPFAR	United States President's Emergency Plan for AIDS Relief
PMTCT	prevention of mother-to-child transmission of HIV
PrEP	HIV pre-exposure prophylaxis
QI	quality improvement
RR	relative risk
UNAIDS	The Joint United Nations Programme for HIV/AIDS
WHO	World Health Organization

Nine-month-old Alinafe, held by her mother, in the Nkhuloawe Village, Malawi. She has tested free of HIV thanks to PMTCT.

Overview

In less than two decades, efforts to prevent mother-to-child HIV transmission have transformed the paediatric HIV epidemic globally. The number of new child infections resulting from vertical transmission has decreased from over 400,000 in 2000 to 160,000 in 2018. This has been a remarkable achievement, driven by political will, financial investment and programme implementation across a wide range of settings.

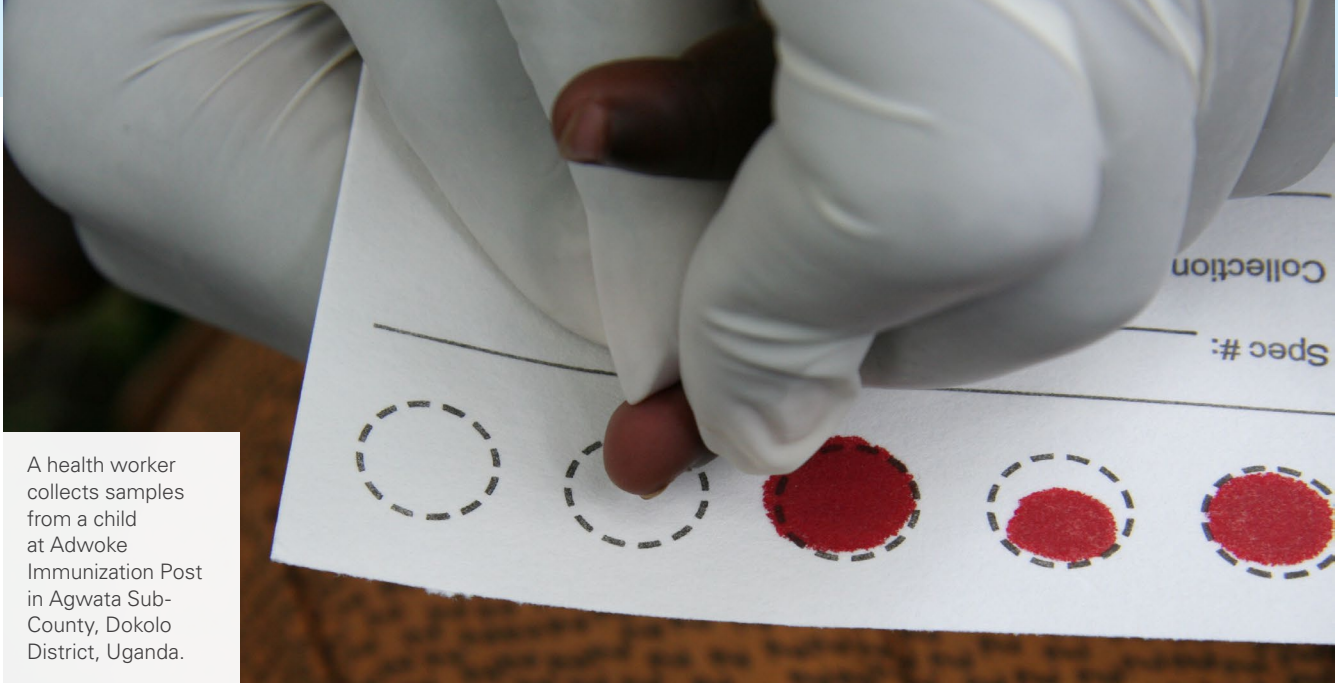
Despite early impressive gains, the pace towards reaching global goals for ending AIDS has slowed. The estimated 160,000 new HIV infections in children globally in 2018 is four times the target of 40,000 set forth by the *Start Free Stay Free AIDS Free* initiative. This is consistent with plateauing estimates of global antiretroviral therapy (ART) coverage among pregnant and breastfeeding women living with HIV; estimates of coverage have increased from 80 per cent to only 82 per cent between 2015 and 2018[1] – well short of the 95-95-95 targets for testing, treatment and viral suppression in women, children and adolescents living with HIV. There is growing concern that – at the current trajectory – progress towards the elimination of mother-to-child HIV transmission (EMTCT) has stalled and that the target for the year 2020 – fewer than 20,000 new child HIV infections – is in jeopardy.

The *Last Mile to EMTCT* represents a structured and coordinated approach to dramatically reduce the number of new infant HIV infections at the country level. This data-driven approach seeks to identify programmatic gaps in the prevention of mother-to-child transmission (PMTCT) and then – through consultation with key stakeholders – plan and prioritize new strategies to address those gaps. To this end, the approach includes four major steps, each with embedded activities *(see Table 1)*.

The goal of this document is to provide guidelines for coordinated action so that national programmes address local priority areas to achieve EMTCT in an effective, people-centred, efficient and directed manner.

Table 1. Road map to the *Last Mile to EMTCT*

STEPS	ACTIVITIES
1 Developing a consultative process	• Identify a country team to drive assessment and planning processes
2 Taking stock of progress and remaining gaps in PMTCT	• Conduct a missed opportunity analysis • Characterize and contextualize programmatic gaps using data from other sources
3 Planning and prioritizing	• Articulate the priority factors necessary for programmatic change • Prioritize interventions according to gaps and contextual factors • Seek broader stakeholder engagement and finalize strategies, guidelines and/or policies
4 Implementing, monitoring and evaluating for PMTCT	• Disseminate planned strategies, guidelines and/or policies • Monitor and evaluate implemented interventions



A health worker collects samples from a child at Adwoke Immunization Post in Agwata Sub-County, Dokolo District, Uganda.

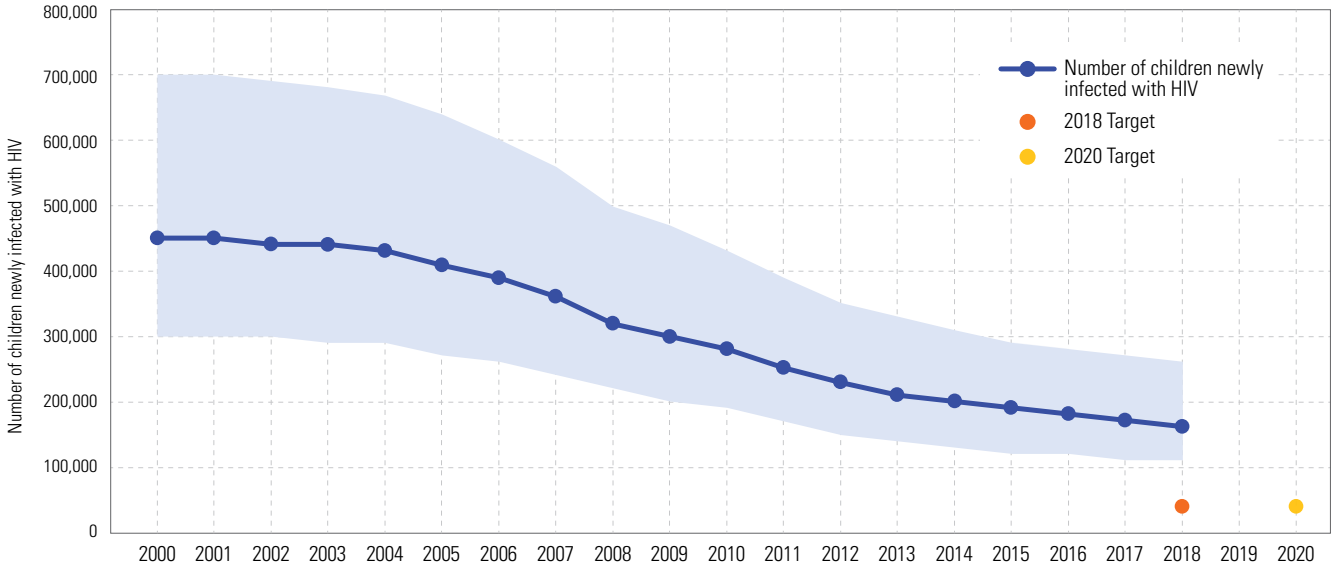
Background

In the past two decades, tremendous gains have been made globally in the prevention of vertical transmission of HIV. The number of new child infections resulting from vertical transmission has decreased from over 400,000 in 2000 to 160,000 in 2018.[2] These achievements have been the result of bold policies, including universal antiretroviral therapy for pregnant and breastfeeding women, that have catalysed important programmatic leaps.

Despite unquestionable early momentum, the pace of progress towards the elimination of mother-to-child HIV transmission (EMTCT) has slowed. The 160,000 children estimated to have acquired HIV in 2018 represent a nearly 40 per cent decline from 2010 figures. However, this remains far above the year's target of fewer than 40,000 new child HIV infections set by the United Nations-supported *Start Free Stay Free AIDS Free* initiative. Similarly, the estimated coverage of ART among pregnant and breastfeeding women living with HIV worldwide is well below the global target of 95 per cent. In West and Central Africa, ART coverage rates appear to have even decreased in some countries, a trend that is worrying. Without a paradigm shift in global PMTCT efforts – and concerted and coordinated activities at the national level – the target for 2020 (fewer than 20,000 new child HIV infections) is in jeopardy.[3] *(See Figure 1.)*

Figure 1. Number of children newly infected with HIV

Children aged 0–14 years newly infected with HIV in 23 focus countries, 2000–2018, and 2018 and 2020 targets



Source: UNAIDS 2019 estimates.

Guidance from the World Health Organization has described the key milestones needed to achieve EMTCT validation;[4] however, to date, only a handful of countries and territories have reached these targets and none are in high-burden HIV settings.[5] The *Last Mile to EMTCT* serves as operational guidance for national programmes as they move towards the ambitious goals of EMTCT – including milestones on the path to elimination – using a structured approach to support a more efficient and directed process *(see Box 1 and Box 2)*.

Box 1. Required indicators for global validation of EMTCT of HIV and syphilis

EMTCT of HIV and syphilis impact indicators (must be achieved for at least one year)

- **MTCT rate of HIV of <2% in non-breastfeeding populations OR <5% in breastfeeding populations**
- **A case rate of new paediatric HIV infections due to MTCT of ≤50 cases per 100,000 live births**
- **A case rate of congenital syphilis of ≤50 per 100,000 live births**

EMTCT of HIV and syphilis process indicators (must be achieved for two years)

- **ANC coverage (at least one visit) (ANC-1) of ≥95%**
- **Coverage of HIV and/or syphilis testing of pregnant women of ≥95%**
- **ART coverage of HIV-positive pregnant women of ≥95%**
- **Adequate treatment of syphilis-seropositive pregnant women of ≥95%**

Source: World Health Organization, *Global Guidance on Criteria and Processes for Validation: Elimination of mother-to-child transmission of HIV and syphilis*, 2nd ed., WHO, Geneva, 2017, p. 17.

Box 2. Indicators for certification on the path to EMTCT of HIV and/or syphilis (high-prevalence countries)

MATERNAL HIV PREVALENCE >2% MATERNAL SYPHILIS PREVALENCE >1%			
Process indicators		**Impact indicators**	
GOLD TIER	• Antenatal care (ANC) coverage (at least one visit) (ANC-1) of ≥**95%** • Coverage of HIV and/or syphilis testing of pregnant women of ≥**95%** • ART coverage of HIV-positive pregnant women of ≥**95%** • Treatment coverage of syphils-seropositive pregnant women of ≥**95%**	**HIV**	• MTCT rate of HIV of <**2%** in non-breastfeeding populations OR <**5%** in breastfeeding populations • A case rate of new paediatric HIV infections due to MTCT of ≤**250 cases per 100,000** live births
		Syphilis	• A case rate of congenital syphilis (CS) of ≤**250 per 100,000** live births
SILVER TIER	• ANC coverage (at least one visit) (ANC-1) of ≥**90%** • Coverage of HIV and/or syphilis testing of pregnant women of ≥**90%** • ART coverage of HIV-positive pregnant women of ≥**90%** • Treatment coverage of syphilis-seropositive pregnant women of ≥**90%**	**HIV**	• MTCT rate of HIV of <**2%** in non-breastfeeding populations OR <**5%** in breastfeeding populations • A case rate of new paediatric HIV infections due to MTCT of ≤**500 cases per 100,000** live births
		Syphilis	• A case rate of congenital syphilis (CS) of ≤**500 per 100,000** live births
BRONZE TIER	• ANC coverage (at least one visit) (ANC-1) of ≥**90%** • Coverage of HIV and/or syphilis testing of pregnant women of ≥**90%** • ART coverage of HIV-positive pregnant women of ≥**90%** • Treatment coverage of syphilis-seropositive pregnant women of ≥**90%**	**HIV**	• MTCT rate of HIV of <**2%** in non-breastfeeding populations OR <**5%** in breastfeeding populations • A case rate of new paediatric HIV infections due to MTCT of ≤**750 cases per 100,000** live births
		Syphilis	• A case rate of congenital syphilis (CS) of ≤**750 per 100,000** live births
Interventions to meet targets must have been met in a manner consistent with protecting human rights and ensuring gender equality and the engagement of civil society for certification in all tiers.			

Source: World Health Organization, *Global Guidance on Criteria and Processes for Validation: Elimination of mother-to-child transmission of HIV and syphilis*, 2nd ed., WHO, Geneva, 2017, p. 23.

Scope, approach and guiding principles

The *Last Mile to EMTCT* is intended as a roadmap for programmes seeking to systematically evaluate and improve maternal and child health services. The relative 'distance' to EMTCT may vary by country, subregion and region. Similarly, given the varying characteristics – and burden – of the HIV epidemic within each context, the attainment of EMTCT may require different types of political support, financial investment and programme implementation. Nevertheless, this operational guidance can provide a helpful framework for moving towards the eventual goal of EMTCT.

This operational guidance is directed at national HIV programmes that have adopted universal provision of ART for pregnant and breastfeeding women living with HIV (also referred to as Option B+),[6] an approach recommended by the World Health Organization.[7] Given the strength of evidence supporting this strategy – and growing body of literature demonstrating its real world impact – this guidance targets national PMTCT programmes with this important policy backbone in place.

Overall, the approach outlined in this document includes four major steps: (1) developing a consultative process, (2) taking stock of progress and remaining gaps in PMTCT, (3) planning and prioritizing, and (4) implementing, monitoring, and evaluating for PMTCT. Across these four steps, eight activities are described in greater detail below.

This roadmap is not intended to be prescriptive; rather, it provides a framework to structure and facilitate discussions between programme managers, policymakers, researchers, implementers, community representatives and funders. Underpinning this approach are the following guiding principles:

- The *Last Mile* is a consultative approach that engages representatives across a range of sectors. With input from a diverse body of key stakeholders, the final plan will be better positioned to address the programmatic needs of the country.
- This is a data-informed process to characterize and contextualize the programmatic gaps. At minimum, this relies on routinely collected indicators from national programmes and mathematical models; however, data from international funders, individual initiatives and/or clinical or implementation research can further refine the prioritization process.
- This is a tailored approach to addressing programme needs. Relevant evidence-based practices should be adapted, implemented and evaluated. Where such evidence does not yet exist, policymakers and programme managers should pilot new approaches to generate the necessary supporting data.
- In this document, the focus is on national-level assessments of national PMTCT programmes. However, if more granular assessment data are available, the approach is adaptable – and in fact could be more informative – at the provincial, district or facility level.
- The described process should be integrated into ongoing activities at the country level. To reduce the overall burden to individual patients, new interventions should align to local visit schedules for both mothers and infants. Such an approach helps to ensure the sustainability of new programme activities.
- This is envisioned as a cyclic, iterative process and not a one-off evaluation followed by a one-time rollout of interventions. In many ways, the approach described in this document follows the principles of quality improvement. The capacity of programmes to monitor, evaluate and then refine their services is a strength of this approach.

UNAIDS has made it clear that a core part of HIV programming is eliminating human rights barriers. This is reflected in WHO guidance on EMTCT, which requires that countries ensure that interventions to reach the targets have been implemented in a manner consistent with international, regional and national human rights standards. These standards include human rights in relation to autonomy in decision-making; informed consent; respect of privacy and confidentiality; freedom from violence, abuse and coercive practices; and meaningful participation.

Box 3. The *Last Mile to EMTCT* in context

This operational guidance builds upon numerous frameworks and campaigns designed for prevention – and elimination – of mother-to-child HIV transmission at a population level. The goals of this document are aligned with those of EMTCT efforts globally, which include well-established criteria for validation and the path to elimination.[8] In addition, other important opportunities and synergies are noted as follows.

Four prongs for PMTCT. Since 2002, PMTCT has focused on four strategies: (1) primary prevention of HIV infection among women of child-bearing potential, (2) prevention of unintended pregnancies among women living with HIV, (3) prevention of HIV transmission from mothers living with HIV to their children, and (4) provision of continuous care and treatment for mothers, partners and children living with HIV.[9] Given their important but complementary roles in achieving EMTCT, each of these four prongs are needed for strong PMTCT programmes. This operational guidance addresses key elements within prongs 1, 3, and 4.

The UNAIDS Fast-Track targets. UNAIDS set Super-Fast-Track targets for ending the AIDS epidemic in children, adolescents and young women by 2020, including 95 per cent coverage of ART among pregnant women living with HIV to prevent vertical transmission. This target is aligned with the 95 per cent targets set by UNAIDS (commonly known as '95-95-95') in the general population for: (1) the percentage of individuals living with HIV who know their HIV status, (2) the percentage of individuals who know their status who have started ART, and (3) the percentage of individuals on ART who are virologically suppressed. These targets provide an important framework for assessing current needs in PMTCT programmes – particularly when ART initiation, medication adherence and programme retention are identified gaps. However, because these targets focus on individuals living with HIV, consideration of broader barriers and of women who are at risk for HIV acquisition may fall short. The second two fast-track targets – reducing new infections to less than 20,000 per year and ensuring zero HIV-related discrimination – should therefore be incorporated into any frameworks.

Undetected = Untransmittable (U=U). The U=U campaign provides a simple but effective message to reduce the stigma associated with HIV and motivate people living with HIV to stay on ART and achieve viral suppression.[10] Although the U=U campaign has not included pregnant and breastfeeding women, in generalized HIV epidemics – where over half of people living with HIV are women – expanded messaging could have an important impact on mother-to-child HIV transmission. When HIV is diagnosed, ART is initiated, and viral suppression (to <50 copies/mL) is achieved prior to conception – and maintained over the course of pregnancy and breastfeeding – the risks for mother-to-child HIV transmission are extremely low. An expanded U=U perspective, with its emphasis on viral suppression and pregnancy planning **prior** to conception, also helps to frame EMTCT within the broader context of health care for women living with HIV.

EMTCT of other communicable diseases. Programmes designed to eliminate vertical transmission of HIV may serve as robust platforms for eliminating other communicable diseases that can be passed from mother to infant. Validation criteria for the EMTCT of syphilis have been included as part of dual elimination.[11] Guidance from the World Health Organization and others have also included elimination targets for hepatitis B and, more recently, Chagas disease.[12] Such integrated approaches are likely to be effective, cost-efficient and sustainable; however, the elimination of these other communicable diseases are not within the scope of the current guidance.

WHO has created a tool collecting key human rights issues identified by women living with HIV as the main barriers to achieving EMTCT of HIV and syphilis. At a minimum, countries are required to ensure the following in law and policy and in practice: (1) non-criminalization of HIV/syphilis transmission; (2) ensuring voluntary HIV and syphilis testing and treatment; (3) ensuring informed consent; (4) ensuring the elimination of forced, coerced and otherwise involuntary sterilization, contraception and/or abortion; (5) ensuring confidentiality and privacy of HIV and health information; (6) ensuring gender equality and non-discrimination; (7) ensuring accountability, community engagement and participation of people affected by HIV and other key populations; (8) addressing gender-based violence; (9) ensuring availability, accessibility, acceptability and quality of services; and (10) ensuring access to justice, remedies and redress.[13]

The *Last Mile to EMTCT* was born out of country-level discussions with local policymakers and stakeholders. Through a participatory process – similar to the one recommended in this document – we have engaged public health experts, researchers, donors and other United Nations agencies in the development of this operational guidance.

Agness Chabu holds her 14-month-old son, Lackson, in their home in Lusaka, Zambia. She participates in the PMTCT programme at the Chelstone Clinic.

Part 1: Framework

The *Last Mile* is a stepwise approach to identify existing gaps in PMTCT programmes and prioritize programme and policy efforts to best fill these gaps. This approach includes four major steps.

First, national programmes are encouraged to *develop a consultative process* for PMTCT evaluation and planning. Although such efforts will be led by government agencies – representing sectors such as health and finance – the country team should include funders, partners, United Nations agencies, academicians and researchers, and community stakeholders. This is represented by Activity 1 in the overall process.

Second, programmes *take stock of progress and remaining gaps in PMTCT*. Programmatic gaps can be assessed using the missed opportunity analysis. These outputs estimate the number of anticipated paediatric HIV infections attributable to different gaps in service delivery. It may take the form of the PMTCT 'stacked bar' generated from the UNAIDS Spectrum model or it may be developed using locally available empiric data. Additional information is collected to better characterize and further refine the general picture portrayed in the missed opportunity analysis. Information about the local HIV epidemic – as well as its policy and programmatic contexts – can be obtained from population-level surveys, programme indicators and research studies. This is represented by Activities 2 and 3 in the overall process.

Third, programmes consider these contextual data to appropriately *plan and prioritize*. Based on the identified programmatic gaps, managers and policymakers prioritize key interventions and sharpen programme investments in high-impact strategies. We advocate a tailored approach that carefully considers the local settings – including infrastructure and human resource capacity – to maximize public health gains. In this document, we describe potential interventions in six principal domains: HIV prevention services for women at risk, timely engagement in antenatal care, timely access to HIV testing, timely access to ART, programme retention and medication adherence support, and services for newborns at highest risk of HIV acquisition. Programmes may prioritize interventions based on a number of factors, but the potential impact of the strategy and its appropriateness to the local setting should be carefully considered. This is represented by Activities 4–6 in the overall process.

Fourth, programmes *implement, monitor and evaluate for PMTCT.* Given the multitude of considerations that may influence the effectiveness of interventions in individual settings, we do not make specific recommendations about best practices. However, this critical step should be guided by local health-care priorities and in coordination with relevant government agencies, implementing partners, international funders and civil society. Importantly, systems for monitoring and evaluation should be designed, implemented and/or strengthened to measure the relative success of implementation over time. These data will inform future programmatic evaluations and further refinement of EMTCT services. This is represented by Activities 7 and 8 in the overall process.

A summary of the *Last Mile to EMTCT* steps and their embedded activities was presented in Table 1. Table 2 expands the descriptions of the activities embedded in each step.

Table 2. Description of the four steps in the *Last Mile to EMTCT* and their embedded activities

STEP 1. DEVELOPING A CONSULTATIVE PROCESS	
ACTIVITY 1: Identify a country team to drive assessment and planning processes	A team approach, one that represents the diverse perspectives of key stakeholders, is critical to the success of this planning process. Team members should be identified at the start of the process and include representatives from local government (including ministries of health), national AIDS organizations, national HIV estimates teams, UN agencies, implementing partners, funding agencies, academicians and researchers, and community stakeholders, including from communities of women living with and at risk of HIV. Where possible, this should be built upon existing government structures, including technical working groups, EMTCT national validation committees and other existing groups.
STEP 2. TAKING STOCK OF PROGRESS AND REMAINING GAPS IN PMTCT	
ACTIVITY 2: Conduct a missed opportunity analysis	We recommend use of the UNAIDS Spectrum model to identify missed opportunities at the national and (where possible) subnational levels. The Spectrum stacked bar can provide proportional estimates of the causes of new child HIV infections in a given country or region.
ACTIVITY 3: Characterize and contextualize programmatic gaps using data from available sources	While the missed opportunity analysis identifies groups in need of PMTCT services, data from other sources are used to characterize and contextualize the programmatic gaps. This information can provide a clearer picture of where and when new infant HIV infections occur.
STEP 3. PLANNING AND PRIORITIZING	
ACTIVITY 4: Articulate the priority factors that are necessary for programmatic change	PMTCT services should be tailored to the local context. This should be a participatory process – including members of the country team – to identify those intervention characteristics that should be considered for widespread and effective implementation.
ACTIVITY 5: Prioritize interventions according to gaps and contextual factors	Country teams review relevant and resource-appropriate interventions and strategies to address identified programmatic gaps and reduce the number of new infant HIV infections. These are then prioritized according to the key contextual factors articulated in Activity 4.
ACTIVITY 6: Seek broader stakeholder engagement and finalize strategies, guidelines and/or policies	Once a set of strategies, guidelines and/or policies has been agreed upon, it should be vetted more broadly across different stakeholder groups. This input can help the country team to further refine their proposed changes, with particular focus on implementation.
STEP 4. IMPLEMENTING, MONITORING AND EVALUATING FOR PMTCT	
ACTIVITY 7: Disseminate planned strategies, guidelines and/or policies	For most countries, dissemination procedures are established at the national level. Once finalized, planned PMTCT activities should be disseminated according to those practices. Accompanying materials for implementation guidance, monitoring and evaluation, and community outreach should be developed and disseminated.
ACTIVITY 8: Monitor and evaluate implemented interventions	The successful implementation of new policies typically requires ongoing monitoring and evaluation. Such practices should be designed early and implemented alongside the PMTCT interventions themselves. Data reports and real-time dashboards can be used to drive programmatic change and serve as the foundation for quality improvement efforts at the provincial, district and facility levels.

STEP 1 DEVELOPING A CONSULTATIVE PROCESS

ACTIVITY 1: IDENTIFY A COUNTRY TEAM TO DRIVE ASSESSMENT AND PLANNING PROCESSES

The processes described in this operational guidance should consider the roles of different actors and stakeholders within PMTCT programmes. A consultative process, led by experienced facilitators, can help to ensure that an inclusive approach is developed.

Planning and prioritization should be directed by policymakers – typically national health departments or ministries of health – but consider the input of other government agencies, implementing partners, donors, academicians and researchers, and civil society, including women living with and at risk of HIV. Given the cross-cutting nature of PMTCT, groups should include programme officials and stakeholders working in maternal and child health, sexual and reproductive health and broader HIV testing, prevention and treatment.

Such an approach has been implemented with success in previous initiatives for EMTCT. In many countries, for example, such groups may already convene under the auspices of technical working groups, HIV/AIDS commissions charged with supporting the government in HIV health policy, or national EMTCT validation committees. Where possible, the linking – and even integration – of such activities should be fostered, given the experience and expertise of such existing bodies. Where such committees are not yet in place, deliberate efforts should be made to ensure that diverse perspectives and viewpoints are represented within the programme and policy discussions.

The country team will lead activities described in the *Last Mile to EMTCT*, playing a central role in the individual steps that follow. While the organizational aspects are not described in this document, the creation of goals, targets and deliverables can help to ensure that the process is carried out in a targeted manner. The roles and responsibilities of individual members should also be articulated, including possible focal person(s) who will coordinate activities across different agencies within the local government.

STEP 2 TAKING STOCK OF PROGRESS AND REMAINING GAPS IN PMTCT

ACTIVITY 2: CONDUCT A MISSED OPPORTUNITY ANALYSIS

We recommend a missed opportunity analysis as the initial step to guide programmatic efforts. In this analysis, a population of new child HIV infections is identified. For each mother-child pair, the new infection is attributed to a failure at one of many different steps along the PMTCT service cascade. While the analysis below addresses new HIV infections in children, similar assessments should also be undertaken to identify the modes of new infections among women.

At the national level (or subnational level where data are available), these outputs can be modelled via the Spectrum 'stacked bar' analysis, introduced by UNAIDS in 2019 using routine output from the Spectrum model. The model calculates population-level estimates of women living with HIV to estimate new HIV infections due to mother-to-child transmission. The population-level model allows countries to estimate how many women are missed because they are not within a PMTCT programme or because the mother seroconverted after delivery and other difficult-to-measure aspects of a PMTCT programme. The resulting output estimates the number of new child HIV infections overall due to mother-to-child transmission, while categorizing these new HIV infections into one of six mutually exclusive groups, stratified by pregnancy and breastfeeding:

- Mother infected during pregnancy or breastfeeding
- Mother did not receive ART during pregnancy or breastfeeding
- Mother dropped off ART during pregnancy or breastfeeding
- Mother started ART late in pregnancy
- Mother started ART during pregnancy
- Mother started ART before pregnancy

Box 4. Internal validation of the Spectrum stacked bar

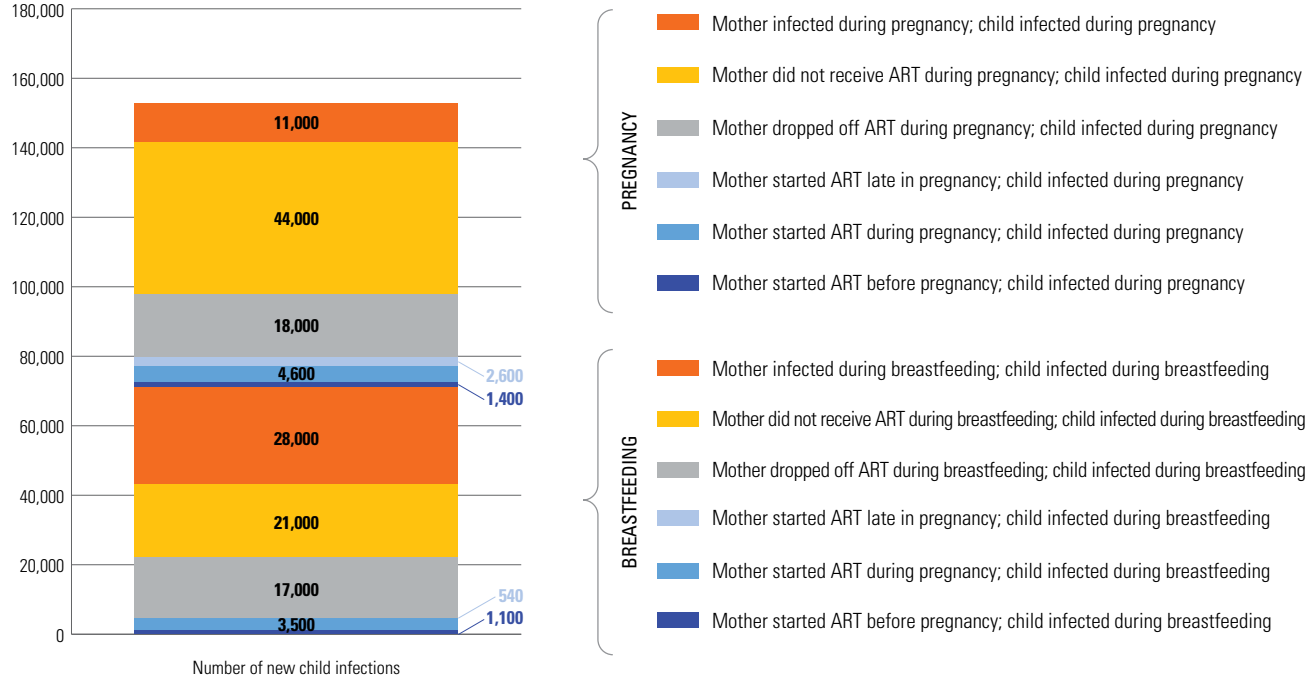
The Spectrum model uses country-level inputs to estimate the numbers of new child HIV infections. It is critical that stakeholders carefully review the country data entered into Spectrum before using the stacked bar. Specific items to check include:

- **HIV prevalence among pregnant women at antenatal care (ANC) clinics and whether the combination of the women found to be positive, the number already known to be positive before ANC and the number found to be negative is equal to or less than the estimated total number of births**
- **number of women provided with antiretroviral medications and how that compares to the number of women found to be positive or known to be positive before coming to ANC clinics**
- **percentage of pregnant women living with HIV retained on ART at delivery**
- **monthly drop-out rate from ART during breastfeeding**

Countries using the Spectrum stacked bar should ensure that their national HIV estimates teams are part of the discussions to identify the gaps in PMTCT services. The estimates team can explain the strengths and weaknesses of the data and assumptions being used to determine the gaps in the PMTCT programme, especially on treatment adherence and retention. The team will also be able to provide updates to the data and provide supplemental data to the analysis step.

An example of the Spectrum stacked bar is shown below, demonstrating the relative contribution of different groups to the global paediatric HIV burden *(see Figure 2)*. Globally, the Spectrum model estimated 160,000 new HIV infections in 2018 during pregnancy and breastfeeding. Pregnant women contributing to new child HIV infections include those who did not receive ART during pregnancy [44,000 (29 per cent) of all estimated child HIV infections], those who dropped out of ART care during pregnancy and whose child became infected antenatally [18,000 (12 per cent)], and those who acquire new maternal HIV infection while pregnant [11,000 (7 per cent)]. In contrast, during breastfeeding, the largest proportion of infants who became infected with HIV had mothers who newly acquired HIV themselves during this period [28,000 (18 per cent)]. This was followed by women who did not receive ART during breastfeeding [21,000 (13 per cent)] and those who dropped out of ART during breastfeeding [17,000 (11 per cent)].

Figure 2. Distribution of new child infections by cause, global, 2018



Source: UNAIDS 2019 estimates.

The distribution of the causes of new child infections differs by region. For example, in Eastern and Southern Africa – where the majority of new infant HIV infections occur globally – the contribution to new infant HIV infections from women who did not receive ART, either during pregnancy or during breastfeeding, is lower than global estimates *(see Figure 3).* This is consistent with the dramatic increases in ART coverage in this region, to over 90 per cent regionally among pregnant women diagnosed with HIV.[14] Compared to global estimates, the proportion of new infant HIV infections occurring among infants born to women newly infected with HIV and women who dropped out of ART are slightly higher, suggesting that these may be important areas for future focus in these regions.

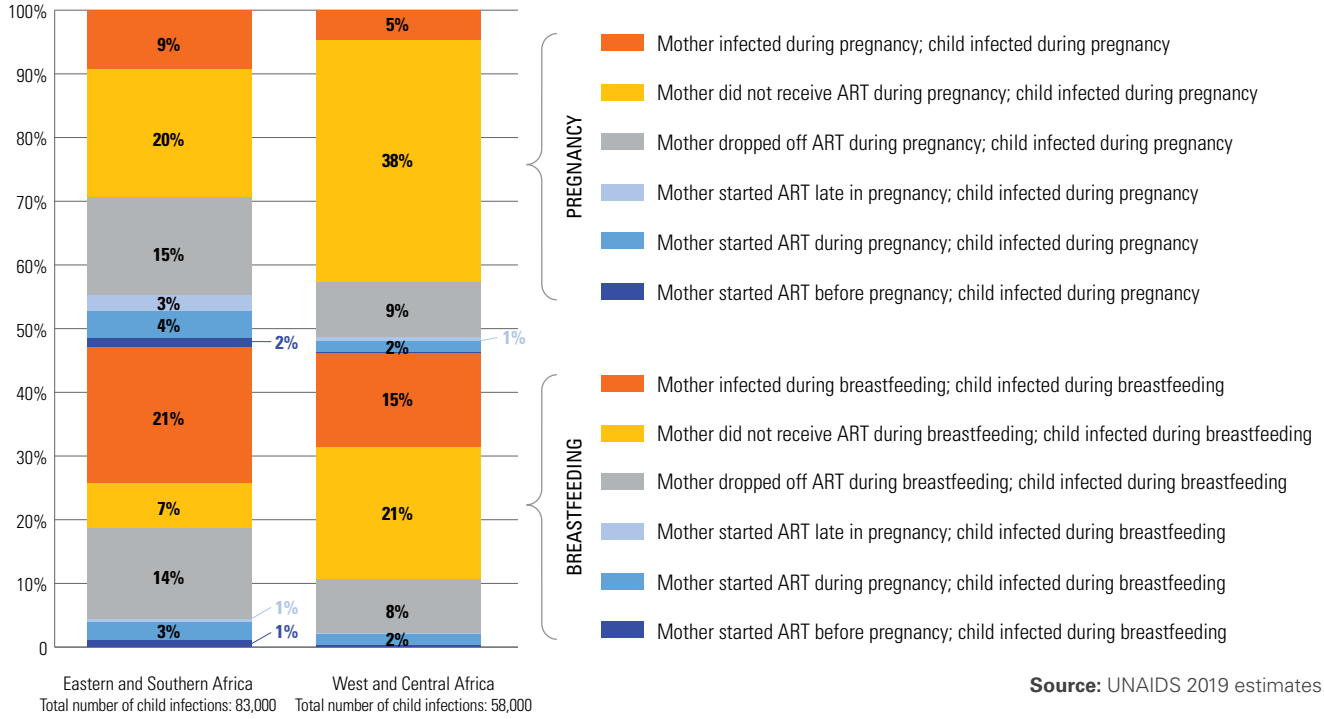
This picture contrasts that of West and Central Africa *(see Figure 3).* Here, new infant HIV infections are driven by the lack of ART coverage for women living with HIV [59 per cent (34,000) overall; 38 per cent (22,000) in pregnancy and 21 per cent (12,000) in breastfeeding], with smaller estimated proportions of new infections estimated to be due to women who newly acquire HIV [16 per cent (11,200) overall; <1 per cent (2,700) in pregnancy and 15 per cent (8,500) in breastfeeding] and those who dropped out of ART care [15 per cent (9,900) overall; 8 per cent (5,000) in pregnancy and 8 per cent (4,900) in breastfeeding].

We recommend the missed opportunity analysis using the Spectrum stacked bar because these estimates are readily obtainable at the national level and resources are available to generate them at the subnational (e.g., provincial, district) level as well. However, when reliable data are available from alternate sources – especially at the facility level – these can also be used to inform a missed opportunity analysis.

In South Africa, for example, Moyo and colleagues used an electronic HIV polymerase chain reaction (PCR) reporting platform to gather maternal and newborn information about infants newly diagnosed with HIV. Across three districts, the study team was able to characterize in real time the mothers living with HIV and their newborns (n=400) and identify service gaps based on these collected data.[15] In Zambia, Bonawitz and colleagues identified all HIV-positive infant test results from five health facilities over a six-month period and explored service gaps associated with transmission through chart review. Although the number of new infant HIV infections was small (n=17), this approach can be used on a larger scale to characterize missed opportunities via chart review.[16]

Many studies on PMTCT impact, such as those mentioned above, are limited to women within the PMTCT programme. While these studies are useful to identify potential reasons for transmission and actions to fill identified gaps, it is important to note that they do not capture the full set of possible reasons for mother-to-child transmission as they miss women outside of the system.

Figure 3. Distribution of new child infections by cause, Eastern and Southern Africa and West and Central Africa, 2018



Source: UNAIDS 2019 estimates.

In summary, in Activity 2, the missed opportunity analysis quantifies the number of new child HIV infections and their potential root causes. In Activity 3, the *Last Mile* process highlights the contextual factors – including programmatic gaps – that may contribute to these outcomes.

ACTIVITY 3: CHARACTERIZE AND CONTEXTUALIZE PROGRAMMATIC GAPS USING DATA FROM OTHER SOURCES

Additional assessment information – derived from a variety of sources – can help to produce a fuller picture of the current epidemiologic, programmatic and policy landscapes. Such data may be a mix of both qualitative and quantitative findings; they may be comparative or descriptive. Documentation of these contextual factors is essential for monitoring progress over time while ensuring that PMTCT programmes are addressing the current and most relevant gaps, which may change over time.

Understanding the HIV epidemic. Understanding the epidemiology of HIV in a specific setting is central to this assessment step. This includes estimates of HIV incidence and prevalence, type of epidemic and, where applicable, vulnerable groups at elevated risk for HIV acquisition. In the context of vertical transmission, this may include adolescent girls and young women, commercial sex workers, intravenous drug users and the female partners of men at elevated risk (e.g., men who have sex with men, intravenous drug users). Mapping of key epidemic indicators can enhance descriptions of nationwide estimates. Where data are available, this should include national and subnational trends in HIV prevalence and incidence, particularly for pregnant women. In addition, in countries supported by the United States President's Emergency Plan for AIDS Relief (PEPFAR), the population health impact assessments, also known as PHIAs, have provided national-level data in over 13 African countries to date via rigorous community- based surveys.[17] Subnational HIV prevalence estimates – both for the general and antenatal populations – are also available in the Demographic and Health Surveys conducted regularly in countries.[18] The ability to identify hot spots, where the HIV epidemic is concentrated, can help programme managers and policymakers to strategically direct resources where they are most needed.

Understanding the policy landscape. Understanding the policy landscape is also critical to this step. For PMTCT efforts, this includes a review of health policies for both HIV care and maternal and child health services. Through this process, clinical and programme recommendations are articulated, providing a common understanding about the interventions and strategies that are currently supported. This may help to identify areas where policymakers and programme managers agree that more evidence is necessary and thereby direct new areas of exploration and research. Often the downstream effects of new policies are direct and can be easily anticipated. The introduction of universal ART for pregnant and breastfeeding women

(known as Option B+), for example, increased the number of women living with HIV who initiated ART and created demand for adherence and retention support.

At other times, however, there may be indirect consequence and opportunities that may not be immediately obvious. For example, the recent shift in World Health Organization guidelines for antenatal care – increasing the number of recommended encounters from four to eight during pregnancy[19] – could result in new opportunities for PMTCT engagement. Assessments of the policy landscape should consider cross-cutting issues that may affect the entire health system and not just PMTCT services alone. One critical issue is how health care is funded at the local level. User fees, for example, can limit access to health services for a significant proportion of eligible patients, especially in the public sector.[20] National health insurance schemes could help to improve the coverage of health services, including for PMTCT. Legal and legislative barriers should be identified and addressed to ensure that new services are sustainable over time. Broad government policies towards age of consent, comprehensive sexuality education, contraception, community-based care and task-shifting could have an important impact on the feasibility of newer outreach interventions. Finally, programme coordination should be critically assessed, given its integral role in overall success. Data in many of these areas have been compiled by UNAIDS;[21] where needed, they should be updated and revised by the country team.

Understanding the programmatic context for HIV services. In many settings, forward-thinking policies have been adopted for PMTCT; however, the extent – and quality – of implementation of these health services may vary greatly. An understanding of this programmatic context is necessary for sound decision-making, especially when discrepancies exist. The PMTCT service cascade – those key steps that clients must navigate to derive maximum maternal and child benefit from PMTCT services – can be a valuable tool for assessing programme performance.[22] For example, routinely collected process indicators can provide insights into HIV testing (e.g., percentage of pregnant women who know their HIV status, percentage of pregnant women living with HIV who know their HIV status), antiretroviral regimen uptake (e.g., percentage of pregnant women living with HIV who received ART), and programme retention (e.g., percentage of pregnant women living with HIV who are retained in care at 6 and 12 months). Attrition at various steps along this cascade can help to identify areas for targeted support, monitoring and innovation.[23]

While this information can highlight bottlenecks within the health system, they mostly focus on areas where PMTCT programmes are already in place. Such data must be evaluated alongside service mapping, particularly in rural and remote areas, to guide PMTCT programme expansion efforts where needed. Population-level assessments also offer a broadened perspective, additionally providing information about women who access institutional health care inconsistently or who fail to access it at all.

Understanding the programmatic context for maternal-child health services. Contextual information about antenatal and post-natal care can be used to further strengthen the PMTCT programmes. Although maternal-child services are available in many settings, the uptake of antenatal care and institutional delivery varies greatly. An understanding of when most women engage the formal health-care system – either during or after pregnancy – can guide the design of population-based interventions to optimize PMTCT. Earlier enrolment into antenatal care, for example, provides opportunities for delivering HIV prevention education and services for HIV-negative women, increases the opportunities for ART initiation and extends the window of antiretroviral coverage over the course of pregnancy and breastfeeding. Routine immunization visits can be leveraged to support service utilization for both mother (e.g., HIV testing, ART adherence, programme retention) and child (e.g., infant HIV testing, referral for HIV treatment if positive) during the post-partum period.[24] Given their role in vertical HIV transmission during the post-natal period and long-term child outcomes, policies and practices on infant feeding – especially around breastfeeding – should also be carefully considered. HIV-related stigma and discrimination, either internalized or enacted by health care providers, concerns around confidentiality, coercion and consent can all affect uptake of and retention in services. Women living with HIV who become pregnant have been found to be particularly vulnerable to HIV-related stigma. Household surveys and stigma index surveys can provide insight into levels of stigma, as can engagement with communities of women living with HIV.

STEP 3 PLANNING AND PRIORITIZING

ACTIVITY 4: ARTICULATE THE PRIORITY FACTORS THAT ARE NECESSARY FOR PROGRAMMATIC CHANGE

With the primary gaps in health services identified, the next step is to develop a PMTCT plan that is tailored for the local setting, addressing the key barriers to optimal service delivery. Given the potentially broad scope of such activities, a structured approach is recommended.

Box 5. Notes on data sources

Numerous types of data may contribute to this assessment phase, including routine monitoring and evaluation indicators, community-based surveys, or population-based research studies. In preparation for this assessment step, ministries of health and affiliated agencies should consult with stakeholder groups about the types of data needed and what sources may be available.

- **Data sources vary from setting to setting, particularly at the national level. In countries supported by PEPFAR, for example, significant investments have been made to harmonize the collection, aggregation and reporting of key metrics, including the standardization of process indicators across all supported sites. Regardless of circumstances, the best available information should be used for assessment purposes.[25]**
- **Where deficiencies in data quality are identified through the *Last Mile* process, efforts should be made to strengthen data systems to provide a more solid foundation for programmatic decision-making. This should be prioritized by host governments, with support – where needed and possible – from international funders.**
- **While Activity 2 focuses on a national-level missed opportunity analysis, subnational data – disaggregated by province, district, or even facility – can provide the needed granularity to target interventions within specific settings.**
- **Observational data, including those routinely collected by national health programmes, can be a powerful resource to guide programmatic change. However, key limitations – including biases and missing observations – must be considered. Analytical methods are available to account for such limitations, enhancing the utility of these types of resources.**
- **Although quantitative data is emphasized in this section, qualitative information may play an important role in the planning process. Findings from interviews and focus groups can bring to light new barriers and opportunities, especially for issues poorly supported by current data collection systems.**
- **Implementation science frameworks can help to strengthen the evaluation approach and inform the key data elements needed to monitor progress. Information about fidelity (i.e., the degree to which an intervention or strategy is delivered as intended) can also further characterize the quality of programme implementation.**

Finally, because of its reliance on valid data, the *Last Mile* process may catalyse investment in existing or new monitoring platforms, encourage local surveillance and integration into routine health information systems, and promote new efforts to obtain longitudinal cohort outcomes among pregnant and breastfeeding women living with HIV. In this manner, gaps identified early in this iterative process may play an important role subsequently in strengthening data systems, including for PMTCT.

First, it is essential to determine the level at which intervention is needed. The framework for the control of HIV in the context of maternal and child health (MCH) – developed by the CDC, using health systems strengthening principles from the World Health Organization[26] – may provide some guidance. This approach describes four domains: (1) *national policies* that support and sustain the control of HIV in MCH populations, (2) *health systems* such as human resources, financing, and data systems for MCH populations, (3) *service delivery* models that address the needs of MCH populations, and (4) *quality monitoring and improvement* that ensure achievement of key milestones (e.g., EMTCT, 95-95-95 targets) for MCH populations. Understanding at which levels support is required can be critical for planning and prioritizing.

Second, the country team should articulate the intervention attributes deemed important for successful implementation. This is highly dependent on local factors, including ones characterized in the preceding activities. In settings where coverage of antenatal care and institutional delivery is low, for example, interventions should consider these structural barriers to generate demand for health services. When facilities are crowded and understaffed, programmes should consider approaches that ease this burden on frontline providers, including decentralization, community-based interventions, and/or task-shifting. The available health-care infrastructure may also be a key consideration in the design of new interventions. The design of Option B+ (i.e., universal ART for all pregnant and breastfeeding women living with HIV) in Malawi, for example, was driven in part by recognized bottlenecks in ART eligibility screening, including for CD4 testing.[27]

Third, understanding the size of the populations at risk can also provide important contextual information when prioritizing interventions. For example, the Spectrum model can be used to estimate the number of women at risk for each source of child HIV infection. Prioritizing larger groups at high risk for paediatric HIV infection could result in measurable reductions in mother-to-child HIV transmission.

Fourth, consideration should be given as to how interventions may affect national and subnational targets for PMTCT. Most if not all PMTCT programmes have articulated goals and milestones towards EMTCT. Understanding the existing targets – and how they might be revised based on an analysis of missed opportunities – helps provide a unified vision among members of country teams about what needs to be achieved. Such information can also be used to inform timelines and estimate costs.

Contextualization of available data further enriches the discussion, specifying important criteria by which interventions should be planned and prioritized. The identification of these characteristics early in the process helps to ensure that they are considered systematically during later decision-making.

ACTIVITY 5: PRIORITIZE INTERVENTIONS ACCORDING TO GAPS AND CONTEXTUAL FACTORS

The next activity is to identify strategies that are aligned with the articulated programmatic gaps and contextual drivers. Using the information obtained from prior reviews and discussions, a short list of potential interventions can be developed that align with immediate needs. In Figure 4, we show key domains for consideration, mapped to programmatic gaps. Many of these will be evidence-based practices, but some may represent promising interventions that require further evaluation, including in demonstration projects or pilot programmes.

Stakeholders should discuss the overall prioritization of different strategies and their feasibility from the perspectives of impact, cost and management (as well as other potential criteria). These decisions may also require additional assessment to identify the optimal mix of interventions and strategies. Critically, they must be considered alongside broader government priorities for maternal and child health to better understand the overall impact of provided services. Such prioritization requires careful consideration and should include proposals for implementation of suitable strategies as well as 'de-implementation' of strategies that have not fulfilled their intended promise.

We provide an overview of interventions that may be considered as part of the planning and prioritizing process *(see Table 3).* These strategies are meant to enhance foundational PMTCT services, which should include maternal HIV testing, universal ART for pregnant and breastfeeding women, infant/child HIV testing, infant HIV prophylaxis, and ART for all children diagnosed with HIV. They are categorized across six domains, each mapped to different missed opportunities for PMTCT as seen in Figure 4. A full review of the supporting evidence is provided in Part 2 of this paper.

When the missed opportunity analysis clearly highlights one or two gaps, selecting the related intervention domains may be relatively straightforward. In the Democratic Republic of the Congo, for example, the Spectrum stacked bar shows that the majority of children newly diagnosed with HIV are born to women who did not receive ART either during pregnancy [2,900 (42 per cent)] or breastfeeding [1,900 (26 per cent)] *(see Figure 5).* In contrast, the scenario in Malawi – where universal ART for pregnant and breastfeeding women was first implemented – is quite different. Here, the Spectrum stacked bar identifies new maternal HIV infections [1,500 (44 cent) during pregnancy and breastfeeding combined] and mothers dropping off of ART [1,300 (38 per cent) during pregnancy and breastfeeding combined] as the two major causes for new child HIV infections. For both causes, the contribution of new child HIV infections is greater during breastfeeding *(see Figure 6).* These cases highlight the prioritization that must occur, at the level of the missed opportunities themselves and at the level of the interventions to address them.

Figure 4. Intervention domains mapped to programmatic gaps

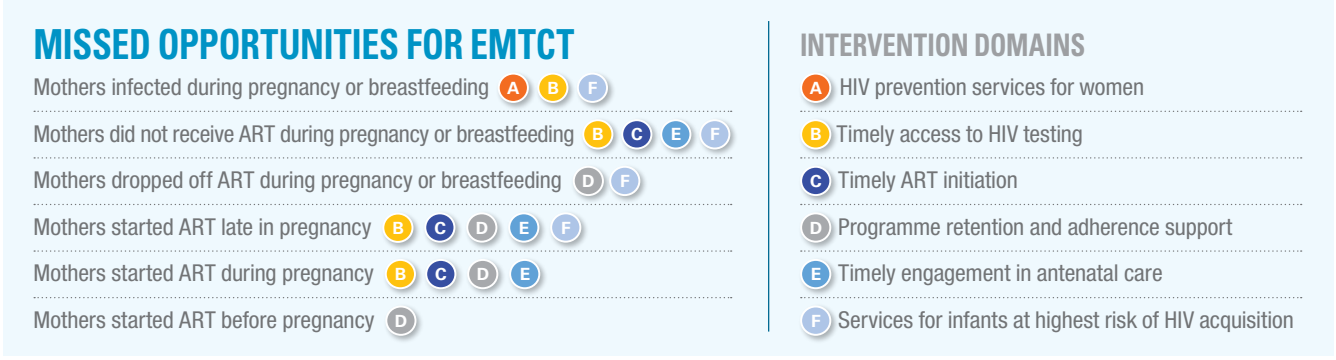


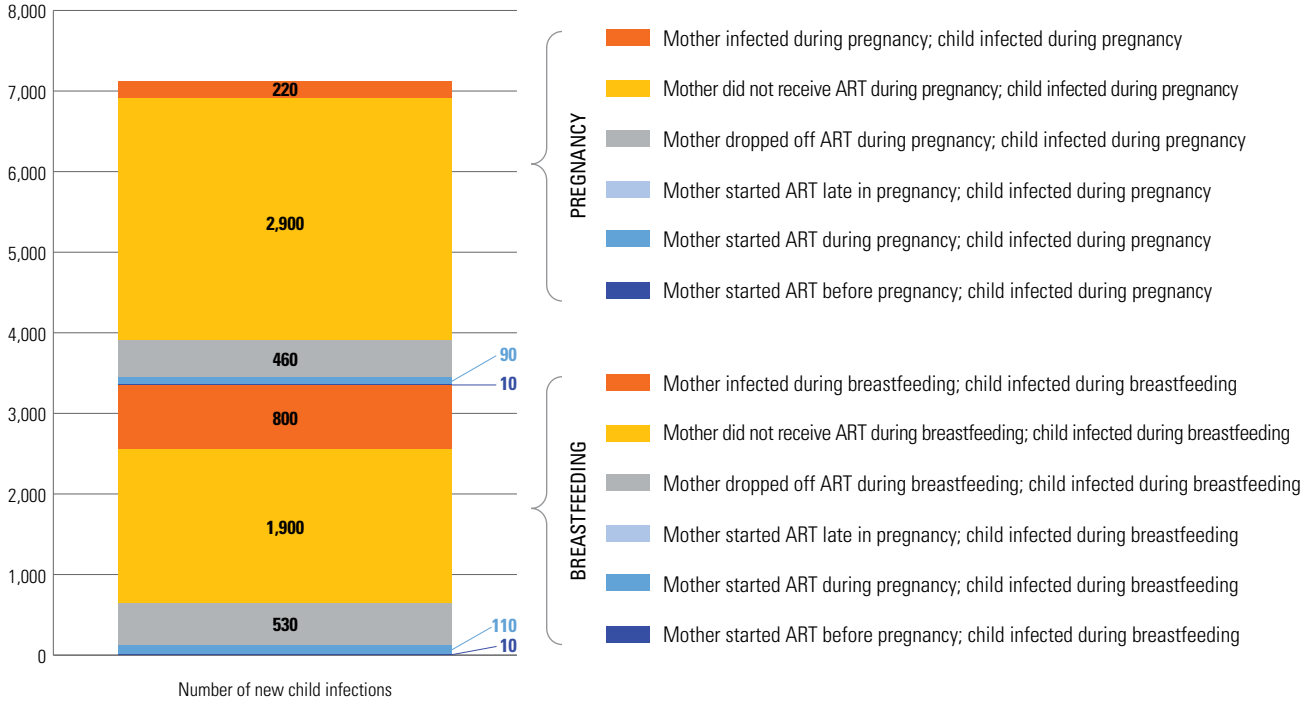
Table 3. Potential strategies for improving PMTCT services, listed by intervention domains and categorized by supporting evidence

DOMAIN / INTERVENTION	PROMISING STRATEGY	AVAILABLE EVIDENCE	POLICY GUIDELINES
(A) HIV prevention services for women			
Partner HIV testing	✓	✓	✓
Index testing / partner notification	✓	✓	✓
Home-based HIV testing	✓	✓	
HIV self-testing	✓	✓	✓
Campaign-based HIV testing	✓	✓	
Combination HIV testing strategies	✓	✓	
Education, counselling and support	✓	✓	
ART initiation and adherence support for male partners living with HIV	✓		
Pre-exposure prophylaxis for HIV during pregnancy and breastfeeding	✓	✓	✓
(B) Timely access to HIV testing			
Provider-initiated HIV testing	✓	✓	✓
Repeat HIV testing during pregnancy and breastfeeding	✓	✓	✓
(C) Timely ART initiation			
Integrated ART-MCH services	✓	✓	✓
Same-day ART initiation	✓	✓	✓
Community-based ART initiation	✓	✓	
(D) Programme retention and adherence support			
Peer support (e.g., mentor mothers)	✓	✓	
Community health worker support	✓	✓	
Facility- or community-based support groups (including for adherence)	✓	✓	
Text (SMS) reminders	✓	✓	
Viral load monitoring in third trimester and during breastfeeding	✓		
(E) Timely engagement in antenatal care			
Access to urine pregnancy tests in early gestation	✓		
Community health worker engagement	✓	✓	
Financial or non-financial incentives	✓	✓	
Group antenatal care	✓	✓	
Text (SMS) reminders	✓	✓	
(F) Services for infants at highest risk for HIV acquisition			
Birth HIV testing*	✓	✓	
Extended infant HIV prophylaxis*	✓	✓	✓

** Birth HIV testing and extended infant HIV prophylaxis should be considered among newborns whose mothers report limited or no ART use during pregnancy.*

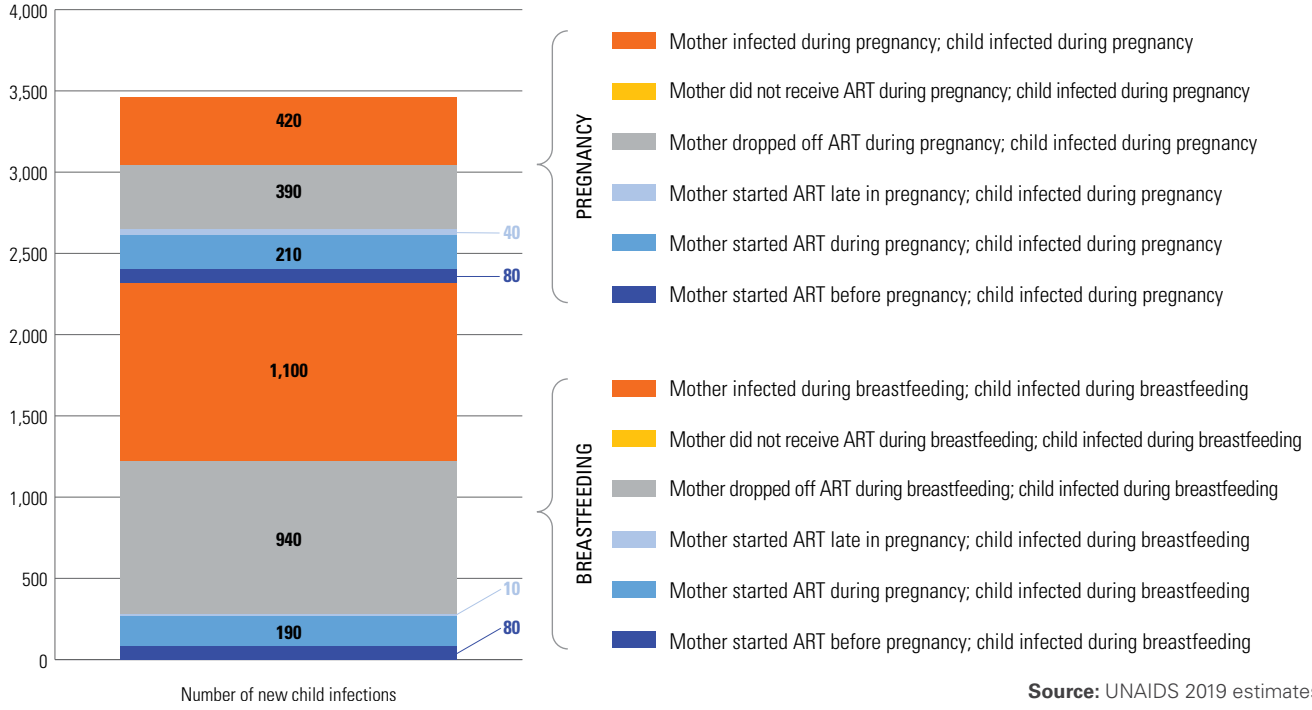
Cross-cutting interventions on human rights, gender, violence, stigma and discrimination, as recommended by UNAIDS and WHO, should be implemented alongside the interventions above.

Figure 5. Spectrum stacked bar for PMTCT, Democratic Republic of the Congo, 2018



Source: UNAIDS 2019 estimates.

Figure 6. Spectrum stacked bar for PMTCT, Malawi, 2018



Source: UNAIDS 2019 estimates.

The strategies and interventions listed in Table 3 are best framed within a broader health systems context. Important, but outside the scope of the current guidance, are strategies to link maternal and child health platforms with other units within health facilities. For adolescents and young women living with HIV, for example, early HIV diagnosis and ART initiation could lead to virologic suppression prior to conception. If maintained through pregnancy and breastfeeding, this could dramatically reduce the risk of horizontal and vertical HIV transmission. Strengthened links between sexual and reproductive health and HIV services, including integrated family planning models, could reduce the number of unintended pregnancies among women living with HIV. WHO and UNAIDS recommend that services for victims of violence be integrated with sexual and reproductive health and

HIV services, given the risks that women living with HIV may fear and face in relation to violence. Cross-cutting initiatives that reduce community-level barriers (e.g., stigma and discrimination) could further increase demand for PMTCT services and positively influence uptake and retention within programmes. Efforts to strengthen health systems and to fully deliver quality services can also have important downstream benefits. Such systems-wide approaches – including ongoing monitoring and evaluation and quality improvement – have been formally evaluated in many settings and shown to improve key indicators for PMTCT (Activity 8).

ACTIVITY 6: SEEK BROADER STAKEHOLDER ENGAGEMENT AND FINALIZE STRATEGIES, GUIDELINES AND/OR POLICIES

Although the proposed policy changes will be developed using a team-based approach, with input from key stakeholder groups, this plan should be vetted widely. An iterative process can help to ensure that the prioritized interventions and strategies are responsive to local needs.

Presentation of the situational assessment – including the missed opportunity analysis (Activity 2) and triangulating contextual data (Activity 3) – will provide a clear picture of existing gaps. The team should also articulate the prioritization process, including articulation of the factors that drove decision-making and justification for why specific interventions and strategies were selected.

An open comment period, aligned with local policies and procedures, can provide valuable feedback, particularly as new strategies, guidelines, and/or policies are considered for full dissemination and implementation. Such input can be considered by the country team as they refine or redirect plans for PMTCT.

With a finalized plan, the country team should consider the likely impact of these new strategies, guidelines and/or policies and revise targets towards EMTCT accordingly. These can serve as the basis of future impact evaluations through iterative cycles of the *Last Mile* guidance.

STEP 4 IMPLEMENTING, MONITORING AND EVALUATING FOR PMTCT

ACTIVITY 7: DISSEMINATE PLANNED STRATEGIES, GUIDELINES AND/OR POLICIES

Most countries have established procedures for disseminating new health directives at the national level. Strategy, guidelines and policy changes that result from the above-described process should be aligned with these standard practices for dissemination and implementation.

An operational guidance for implementation should accompany new directives. For example, descriptions of the intervention itself – and guidance on how it might be delivered in the field – will help to ensure greater fidelity in its implementation, even if the approach itself may require adaptation to diverse local settings.

A monitoring and evaluation plan (see Activity 8 below), implemented alongside new health services, can also strengthen PMTCT programmes. This may include process indicators for coverage and intervention fidelity. These should also be mapped to downstream health indicators to assess their programme impact. Similarly, programme targets over time should be identified and articulated to implementing facilities, with appropriate resources allocated in support of these activities.

Tailored messaging about new PMTCT guidelines should also occur within communities. Expanding the dissemination of health policies – via platforms outside of the health sector – can generate the necessary demand for these new services. At the same time, appropriate outreach and education can help to dispel misconceptions about these interventions and ensure their acceptance within communities.

ACTIVITY 8: MONITOR AND EVALUATE IMPLEMENTED INTERVENTIONS

The implementation of new PMTCT policies may lag, resulting in important gaps between clinical guidelines and the services available to pregnant and breastfeeding women. The magnitude of these gaps is likely to vary by setting and geographic location, highlighting the importance of continued monitoring and evaluation to guide implementation.

Quality improvement (QI) approaches have generated great interest, both for their tailored response to local needs and for their broader impact within health systems. Numerous QI initiatives have been implemented, including in the context of vertical transmission of HIV. Programmatic experience with such approaches has been generally positive across a range of settings.[28] In the Systems Analysis and Improvement Approach (SAIA) trial – conducted in Côte d'Ivoire, Kenya and Mozambique – a systems engineering intervention incorporating key elements of QI led to increased ART coverage among pregnant women living with HIV and increased HIV testing among HIV-exposed children.[29] In a cluster-

Box 6. Considerations for low HIV-prevalence settings

The *Last Mile to EMTCT* approach is universal and can be applied in settings of high and low HIV burden. However, where HIV prevalence is low at the national level, key considerations are needed:

- **In low-prevalence settings with concentrated HIV epidemics, the ability to estimate the total number of pregnant women living with HIV can be challenging. The stacked bar may not be reliable because key assumptions within the Spectrum model can introduce uncertainty into model outputs, including the timing of ART initiation and fertility rates among key populations (e.g., intravenous drug users, commercial sex workers, female partners of men at elevated HIV risk). Empiric data should be used to characterize high-risk populations. Although subnational data are most useful in these circumstances, Spectrum's capacity to generate such analyses may be limited. Case finding and case reporting can provide the necessary information for missed opportunity analyses. Where such data are not routinely collected, case surveillance systems should be modified to capture the information needed to determine the underlying causes of new child HIV infections.**
- **In settings of low HIV prevalence, additional efforts may be required to mobilize the necessary support and resources for PMTCT programmes. Such prioritization – alongside competing health domains – may require outreach and advocacy. Greater emphasis on cross-cutting initiatives, including efforts to reduce stigma and discrimination, should be considered as part of systemwide efforts and approaches that integrate HIV testing into broader ANC testing (e.g., for syphilis or hepatitis).**
- **All the countries and territories that have achieved EMTCT provide some form of universal health care. The integration of PMTCT services into routine health services is essential for the sustainability of PMTCT services. This includes universal HIV testing for all pregnant women and access to ART for mothers and children who are diagnosed with HIV. Strong linkages between HIV treatment programmes and antenatal/post-natal services are also critical.**

randomized trial of continuous QI in Nigeria, Oyeledun and colleagues found no differences in the resulting PMTCT programme indicators. However, there was evidence of benefit in health domains outside of HIV, suggesting a broader potential impact of the intervention.[30]

Assessment tools can greatly enhance these QI efforts. In South Africa, for example, the National Department of Health led the creation of a monitoring system to assess performance within the national PMTCT programme. Through a participatory process, important steps along the PMTCT cascade were mapped to process indicators. These indicators were then reported on a regular basis – at the district, provincial and national levels – via a color-coded dashboard.[31]

Similarly, as part of the SAIA trial, a spreadsheet-based tool was developed to generate a diagnostic, seven-step PMTCT cascade. With this rapid assessment tool, health providers and clinic managers could quickly identify and address gaps in local health services.[32] Mobile phone-based versions of this instrument have been developed, which could further increase its use in clinical settings.[33]

Such tools are most effective when the frontline providers using them are able to draw upon responsive health systems. Where health systems require further strengthening, the ongoing monitoring of programme operations (e.g., supply chain, laboratory, human resources) may help to identify bottlenecks and direct solutions to improved service delivery.

Finally, programmes should chart their continued performance in relation to national PMTCT targets, through ongoing monitoring at the national and subnational levels and through iterative review via the *Last Mile to EMTCT* process. Understanding the movement towards articulated PMTCT goals allows programmes to highlight their successes while identifying potential barriers that still remain. This, in turn, may inform future actions to accelerate progress in a meaningful and effective manner.

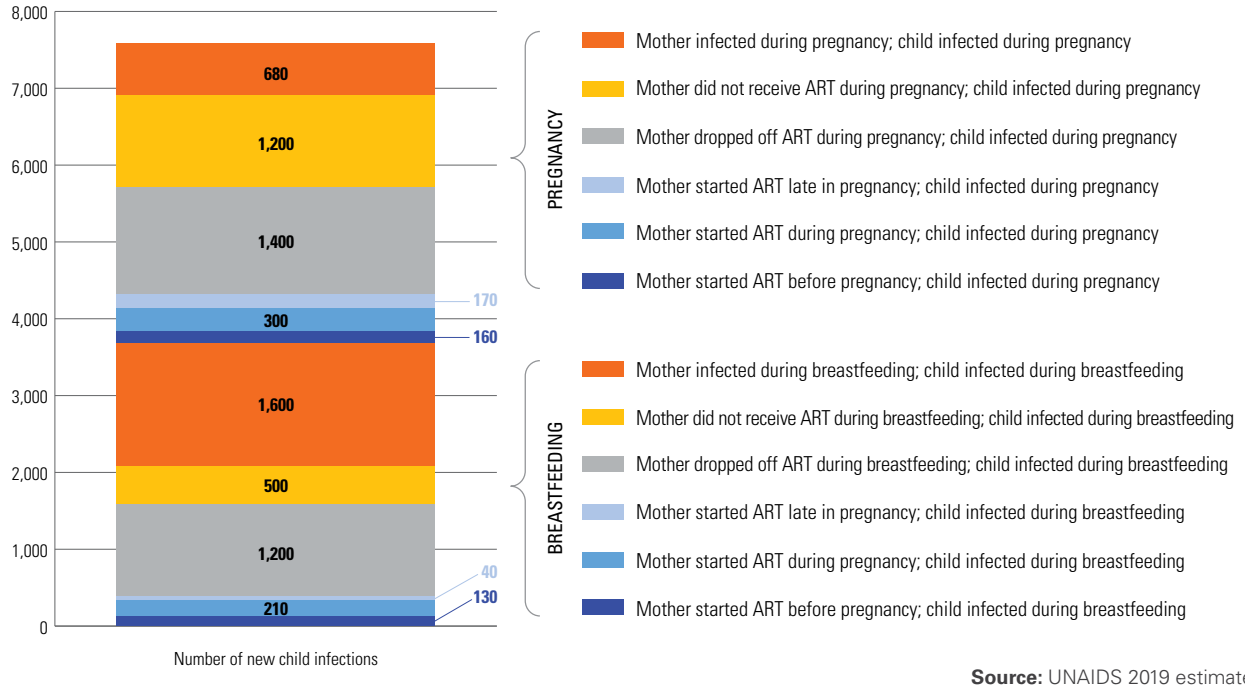
Gaps and priorities for two African countries: case examples

In May 2019, teams from five countries (Malawi, Seychelles, Uganda, Zambia and Zimbabwe) joined a data use workshop in Harare, Zimbabwe, focused on PMTCT programme monitoring. The goal of the meeting was to provide experience in visualizing, interpreting and prioritizing strategies based on Spectrum outputs. Each country's stacked bar was generated at the national level and internally reviewed for consistency. Although

abbreviated, key programme indicators were also provided by each country team. Below, we provide summaries from two country teams (Uganda, Zimbabwe) to illustrate how this methodology might be used to direct decision-making.

Country teams found the Spectrum stacked bar analysis to be a useful tool to guide programme implementation. While many countries reported over 90 per cent PMTCT programme coverage, triangulating these data with other HIV and maternal and child health indicators helped participants to better understand their local situations and to design targeted EMTCT plans. The stacked bar also highlighted areas not typically captured by PMTCT coverage rates, including late initiation of ART, programme attrition and incident maternal HIV infections. All countries noted the importance of using population-based denominators for the path to elimination agenda as they cover the *Last Mile* and leave no mother and child behind. However, there was general consensus on the need to strengthen the quality of data used for generating the stacked bar.

Figure 7. Spectrum stacked bar for PMTCT, Uganda



Source: UNAIDS 2019 estimates.

TOP THREE SOURCES OF NEW INFANT HIV INFECTION NATIONALLY

- Women who drop off ART during pregnancy or breastfeeding
- Women who become newly infected with HIV during pregnancy or breastfeeding
- Women who did not receive ART during pregnancy or breastfeeding

IMPORTANT UNICEF INDICATOR DATA

- Antenatal care with at least one visit (2012–2018): 97.3 per cent
- Antenatal care with at least four visits (2012–2018): 59.9 per cent
- Institutional delivery (2012–2018): 73.4 per cent
- Pregnant women with known HIV status: >95 per cent
- Pregnant women living with HIV receiving ART: 92.9 per cent
- Mother-to-child HIV transmission rate: 7.4 per cent

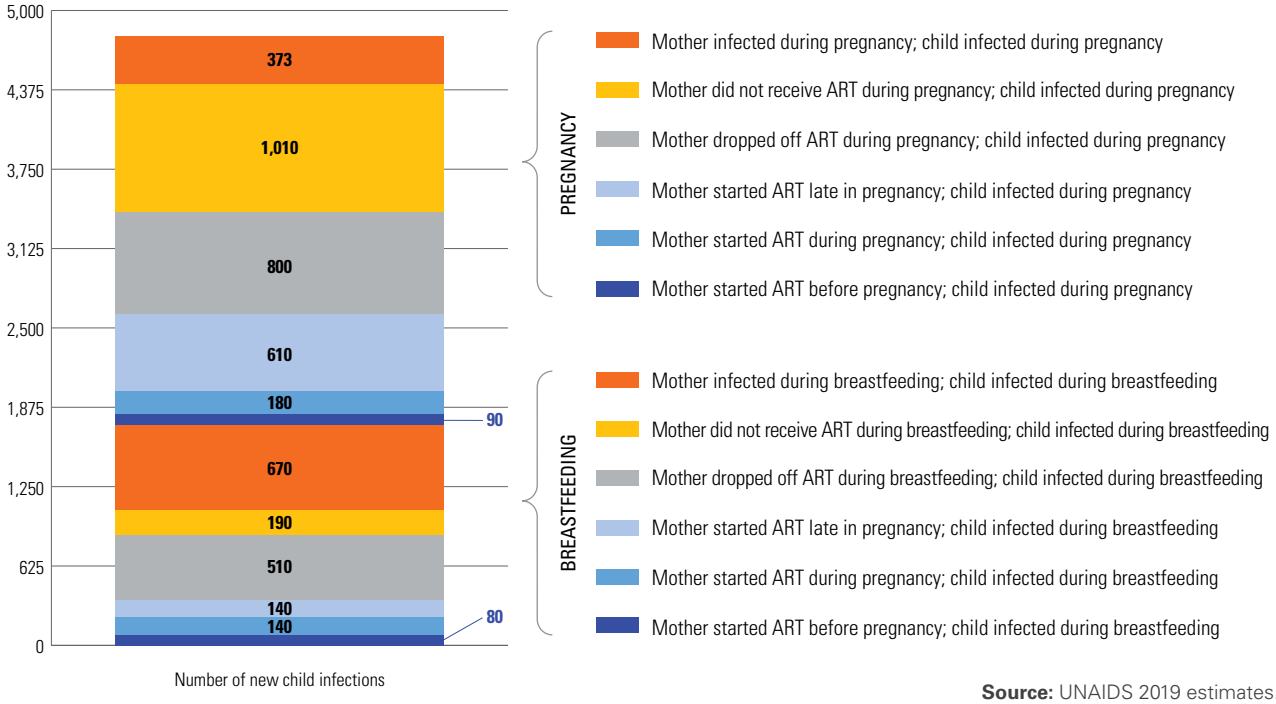
PROGRAMMATIC GAPS

- Limited services for primary HIV prevention for pregnant and breastfeeding women, especially among adolescent girls and young women
- Inadequate focus on repeat HIV testing
- High rates of loss to follow-up during pregnancy and breastfeeding, including among adolescent girls and young women
- Gaps in linkages to care following initial HIV diagnosis

PRIORITY ACTIONS

- Focus programming efforts on adolescent girls and young women, including outreach and educational campaigns and novel differentiated care models
- Intensify the Bring Back Mother-Baby Pair campaign to improve retention for mother-infant pairs in the context of mother-child health services
- Support routine national and subnational PMTCT cascade analysis for quality improvement
- Advocate for new school health policies that support HIV prevention, care and treatment for young people, including linkages to care

Figure 8. Spectrum stacked bar for PMTCT, Zimbabwe



Source: UNAIDS 2019 estimates.

TOP THREE SOURCES OF NEW INFANT HIV INFECTION NATIONALLY

- Women who drop off ART during pregnancy or breastfeeding
- Women who become newly infected with HIV during pregnancy or breastfeeding
- Women who did not receive ART during pregnancy or breastfeeding

IMPORTANT UNICEF INDICATOR DATA

- Antenatal care with at least one visit (2012–2018): 93.8 per cent
- Antenatal care with at least four visits (2012–2018): 75.7 per cent
- Institutional delivery (2012–2018): 77.0 per cent
- Pregnant women with known HIV status: 86.0 per cent
- Pregnant women living with HIV receiving ART: 93.9 per cent
- Mother-to-child HIV transmission rate: 7.6 per cent

PROGRAMMATIC GAPS

- Low rates of repeat HIV testing for women previously found to be HIV-negative in antenatal and postnatal care
- Few coordinated services for HIV prevention during pregnancy and breastfeeding, especially for adolescent girls and young women
- Low male involvement and low rates of couples counselling to identify HIV-negative women in HIV serodiscordant couples
- Uptake of antenatal care is not universal and, among women who do access services, timing of first visit is typically in mid- to late second trimester
- Support for HIV care requires strengthening across the continuum of care
- Inconsistent longitudinal follow-up of mother-infant pairs with current monitoring and evaluation systems

PRIORITY ACTIONS

- Expand repeating HIV testing for women who previously tested HIV-negative in antenatal and postnatal care
- Implement comprehensive HIV prevention services, including PrEP, for adolescent girls and young women who are pregnant or breastfeeding
- Collaborate with village health workers and community stakeholders to increase early pregnancy detection, early antenatal booking, and repeat antenatal visit attendance
- Engage community members, including 'male mobilizers', to increase male engagement for pregnant and breastfeeding women
- Incorporate peer support initiatives, including mentor mother initiatives, to strengthen ART uptake, adherence and retention, particularly among adolescent girls and young women
- Increase access to point-of-care testing platforms – including viral load monitoring for mothers and early infant diagnosis testing for infants – and optimize current specimen transport and results reporting
- Strengthen longitudinal tracking of mother-child pairs to ensure that services are routinely monitored and evaluated

Part 2: Supporting evidence

Central to the *Last Mile to EMTCT* is the planning and prioritizing of different strategies to address programmatic gaps identified through a systematic evaluation of national PMTCT programmes (Activity 5). In Part 2 of this paper, we describe the evidence supporting these PMTCT strategies. The overarching goal of this review is to map the different interventions that have been proposed and evaluated in the medical literature to specific gaps in PMTCT programming.

For this narrative review, we focused on the PMTCT literature in the era of universal antiretroviral therapy (ART) for pregnant and breastfeeding women (i.e., Option B+), which was adopted by the World Health Organization in 2013.[34] Where studies were sparse, however, relevant studies from the general HIV treatment literature or from prior eras of PMTCT programme implementation were considered.

Potential interventions are summarized in the main operational guidance, categorized into six separate domains (Table 3): HIV prevention services for women, timely access to HIV testing, timely access to ART, programme retention and adherence support, timely engagement in antenatal care, and services for infants at highest risk of HIV acquisition.

HIV PREVENTION SERVICES FOR WOMEN

A growing body of work confirms the high incidence of HIV among pregnant and breastfeeding women in many sub-Saharan Africa settings. A meta-analysis of 19 cohorts (and over 22,000 person-years), published in 2013, showed an elevated HIV incidence during pregnancy (4.7 per 100 person-years) and breastfeeding (2.9 per 100 person-years),[35] rates that are near or exceed World Health Organization thresholds for recommending HIV pre-exposure prophylaxis (3.0 per 100 person-years). Such incidence rates are dependent on a number of local factors, including overall HIV prevalence. However, women appear to have an increased biological risk for HIV acquisition during pregnancy and the early post-partum period independent of reported sexual frequency.[36]

New HIV infections have long-term consequences, including increased lifetime morbidity and mortality. During pregnancy and breastfeeding, however, there are additional concerns around mother-to-child HIV transmission. In settings of high HIV prevalence and high ART coverage, new but undiagnosed HIV infection in pregnant and breastfeeding mothers may account for a growing proportion of new infant HIV infections,[37] as high as 43 per cent in some settings.[38] Currently, there are few instruments to identify women at high risk for acquiring HIV during pregnancy. In Kenya, Pintye and colleagues developed a risk score to triage pregnant and breastfeeding HIV-negative women to identify and prioritize women who may benefit from PrEP; the score included lifetime sexual partners, male partner HIV status and syphilis status.[39] To date, however, this tool has not been validated in other settings.

A couples-based framework may be useful to guide HIV prevention during pregnancy and breastfeeding.[40] When pregnant women know their HIV status and that of their partners, they can better understand their individual risks for HIV acquisition/transmission and access appropriate HIV prevention, care and treatment services. According to this model, a vital early step is HIV testing for both the index pregnant woman and her partner(s). While HIV testing services have expanded rapidly in antenatal settings, programmatic efforts to engage male partners have not kept pace and, even where attempted, have met with limited success.[41] Many PMTCT programmes offer facility-based couples counselling and these services can be enhanced with different options for partner notification.[42] Further, in a randomized trial in Kenya, home-based HIV testing for couples has been shown to be acceptable, feasible and cost-effective.[43] Provision of HIV self-test kits may provide another important avenue for HIV testing that is further decentralized. The woman is taught how to administer an HIV self-test and then sent home with HIV self-test kits for her partner.[44] Confirmatory testing of positive HIV self-test results are still required, but improved privacy and confidentiality are important benefits to this approach.

Despite a high burden of new HIV infections during pregnancy and breastfeeding, women initially testing HIV-negative during antenatal care often do not receive HIV prevention services following post-test counselling. A number of behavioural interventions have been proposed, but results thus far have been mixed. Jones and colleagues, for example, studied a combination intervention comprising two evidence-based components:

a couples' behavioural risk reduction and an intervention designed to enhance PMTCT uptake. The intervention was associated with decreases in unprotected sex and increased HIV knowledge; while the number of new maternal HIV infections was small, none occurred among women in the intervention arm (versus six in the control arm).[45] Homsy and colleagues found that an enhanced, longitudinal HIV counselling and testing strategy designed to prevent HIV acquisition in pregnant women did not result in significant differences in behavioural outcomes such as reported condom use. No differences were noted in HIV incidence, but observed rates were low overall (0.2 per 100 person-years).[46] When HIV-negative women were provided community health worker support in South Africa – including individualized HIV counselling, regular individual- and couples-based HIV testing, and referral services for male partners (e.g., circumcision, treatment of sexually transmitted infections, HIV treatment) – lower rates of incident HIV infection were observed antenatally (1.49 per 100 person-years) and post-natally (1.03 per 100 person-years).[47] Although direct comparisons were not made as part of the study, rates were substantially lower than has historically been reported in prior studies in the same region in South Africa – and in the meta-analysis discussed previously.[48] Given varying results of such interventions to date, it would be critical to include an evaluation component when planning, piloting or implementing such prevention strategies.

ART has been shown to be highly effective in reducing horizontal HIV transmission. HIV Prevention Trials Network (HPTN) 052 demonstrated that, when the HIV-positive partner within a HIV serodiscordant couple initiates ART and achieves viral suppression, the risk of transmission to the HIV-negative partner drops by as much as 96 per cent.[49] This further highlights the role of rapid ART initiation following HIV diagnosis, including among HIV-positive male partners of HIV-negative pregnant women. Results from several large-scale trials of a universal 'test and treat' strategy for HIV, however, highlight the inherent challenges to bringing the intervention to scale at a population level.[50] These include coverage of HIV services, especially for those at elevated risk (e.g., young people, men, and communities with high mobility); linkages to care following HIV diagnosis; and support for medication adherence and programme retention.

PrEP has an important role in HIV prevention, including for pregnant and breastfeeding women.[51] When adherence is maintained, PrEP – formulated as once daily tenofovir disoproxil fumarate and emtricitabine (TDF-FTC) – has been shown in numerous studies to be highly effective across numerous randomized trials in women.[52] Although the World Health Organization supports its use during pregnancy and breastfeeding,[53] many national programmes have not adopted full-scale implementation for pregnant and breastfeeding women.[54] Nevertheless, early studies support the promise of PrEP in these populations. In an evaluation of PrEP delivery in 16 maternal and child health clinics in Kenya, 22 per cent of women initiated PrEP. Pregnant women with known HIV-positive partners most frequently initiated PrEP (79 per cent) and this was an important predictor of PrEP continuation.[55] Acceptability and feasibility has been reported in qualitative studies from the region.[56] Modelling studies also suggest that integration of PrEP into antenatal services could significantly reduce the number of new HIV infections. Powers et al. showed that a 20 per cent absolute increase in PrEP use alone could result in 13 per cent of horizontal and 12 per cent of vertical HIV transmissions averted; when used in combination with other strategies, this could increase to 32 per cent and 29 per cent, respectively.[57] Davey and colleagues found that, across a range of assumptions regarding PrEP uptake during pregnancy, access to PrEP could reduce vertical HIV transmission by 13–40 per cent.[58] The identification of pregnant and breastfeeding women at highest risk of HIV acquisition could make this potential yield even greater.

Finally, while primary HIV prevention is an important pillar of PMTCT, we recognize that some women may acquire HIV during pregnancy and breastfeeding despite the best programmatic efforts. Strategies are needed to diagnose such women as early as possible, so that PMTCT interventions – including ART – may be rapidly initiated. The World Health Organization currently recommends repeat HIV testing for pregnant women with initial HIV-negative test results, beginning in the third trimester and continuing post-partum during breastfeeding.[59] In a recent review of 49 national HIV testing policies, approximately three quarters (78 per cent) of the policies recommended repeat HIV testing, though the timing and target populations varied. Eleven national guidelines did not include HIV retesting, including several UNAIDS priority countries for EMTCT. While HIV prevalence in these countries was low to very low, they also had high to intermediate vertical HIV transmission rates, signifying an important potential area for future programmatic efforts.[60] To increase repeat HIV testing, programmes should focus on minimizing missed opportunities for retesting: poor retention in antenatal care, not returning to the clinic when eligible and late entry into antenatal care (that may

result in ineligibility for later HIV testing).[61] Integration of HIV retesting into routine health services and use of newer HIV testing approaches (e.g., community campaigns, HIV self-testing, home-based testing) are also promising strategies. These are described in greater detail below, in the subsequent sections.

TIMELY ACCESS TO HIV TESTING

Diagnosis of HIV is essential for women to enter the PMTCT continuum of care. The earlier this can be accomplished, the greater the likelihood of virologic suppression prior to delivery, which in turn dramatically reduces the risk for vertical HIV transmission. For women who test HIV-negative, post-test counselling can provide opportunities to discuss risk reduction and, where available, provide linkages to existing HIV prevention services.

A number of evidence-based strategies have been deployed to increase coverage of HIV testing during antenatal care. Widespread availability of rapid HIV antibody tests – assays that are high performing, inexpensive, easy to store and can provide results quickly – has greatly increased access to these services. In many settings, there has been widespread adoption of routine HIV testing during pregnancy,[62] a strategy that decreases stigma by incorporating it into routine antenatal services while keeping in mind the need for affirmative consent to the HIV test. Integration of HIV counselling and testing into already busy antenatal clinics has required task-shifting, including use of trained lay counsellors.[63] HIV testing should be performed early, ideally at a pregnant woman's initial enrolment into antenatal care. Repeat HIV testing in the third trimester, during labour and/or during breastfeeding can further identify women who are newly infected with HIV, so they may initiate ART and enrol in long-term HIV care. The addition of a second HIV test during pregnancy for women initially testing HIV-negative has been shown to be cost-effective in settings of high HIV prevalence (i.e., Uganda) and low HIV prevalence (i.e., India).[64]

Strategies that decentralize HIV testing – either outside of the health facility or out of the hands of overburdened facility-based providers – have also been shown to be effective. Ezeanolue and colleagues, for example, demonstrated the effectiveness of a congregation-based strategy to increase HIV testing among pregnant women in a cluster-randomized trial across 40 churches in Nigeria. When HIV testing was integrated into church-led 'baby showers' (n=3002), the rates of HIV testing increased significantly compared to those receiving standard referrals (92 per cent vs. 55 per cent).[65] Integration of HIV testing into maternal, newborn and child health (MNCH) 'weeks' (biannual campaign-style events designed to expand health service access) may also be promising. In a single week, across 13 local government areas in Nigeria's Benue State, more than 50,000 pregnant women were educated about HIV testing and greater than 99 per cent subsequently provided verbal consent and underwent testing and counselling via an opt-out approach.[66] Such approaches should ensure confidentiality of results and positive consent and should complement strong, existing services for HIV testing within health facilities. While these community-based approaches may expand access to HIV testing, in order to reach their full potential, they must also ensure linkages to follow-on health services, particularly for those newly diagnosed with HIV.

Efforts should be made to promote partner HIV testing, including as part of couples counselling. Knowledge of a partner's HIV status – and disclosure of one's own HIV status – has been shown, across a range of studies, to improve outcomes. It also provides an important platform for family-based HIV prevention, care and treatment. Approaches to increase partner HIV testing are described in greater detail in the sections below, on *HIV prevention services for women* and *Programme retention and adherence support*.

TIMELY ACCESS TO ART

Once women are diagnosed with HIV, ART initiation should be offered as soon as possible. Geographic coverage of HIV care and treatment should be critically evaluated to ensure that HIV-positive women have ready access to these services. Distance to health facilities has been inversely associated with service uptake[67] and this should be considered in planning. Other structural barriers, including user fees and waiting times, should be examined and addressed where possible.

Even when services are available at nearby facilities – or even in different units at the same health facility – additional support may be needed. Studies investigating the integration of HIV and maternal and child health services have been encouraging. In a cluster-randomized study in rural Kenya, for example, Turan and colleagues showed that integrating antenatal care and HIV care led to greater HIV care enrolment (69 per cent vs. 36 per cent, odds ratio (OR)= 3.94, 95 per cent confidence interval (CI): 1.14–13.63) and higher ART initiation (40 per cent vs. 17 per cent, OR= 3.22, 95 per cent CI:

1.81-5.72) compared to the standard of care.[68] Similar results were reported from a stepped wedge evaluation in Zambia, where integrated services were associated with increases in HIV care enrollment (44.4 per cent vs. 25.3 per cent, adjusted OR= 2.06, 95 per cent CI: 1.27-3.34) and ART initiation (32.9 per cent vs. 14.4 per cent, adjusted OR= 2.01, 95 per cent CI: 1.37-2.95).[69] In Malawi, Chan and colleagues found – as part of a retrospective analysis – that full integration of HIV testing and ART provision within antenatal care resulted in significantly higher ART initiation than partial integration model (HIV testing only, referrals for ART initiation; 63 per cent vs. 51 per cent). However, the fully integrated model was also associated with lower retention (79 per cent vs. 87 per cent). Regardless of the service provision model, same-day HIV diagnosis and ART initiation was independently associated with an increased risk for attrition at six months (adjusted OR= 2.27, 95 per cent CI: 1.34-3.85).[70] Given the importance of rapid ART initiation, additional support should be given to new starters so the risk for early default is minimized. Programmatic experience with integrated HIV and maternal and child health care have largely echoed these study findings.[71]

PROGRAMME RETENTION AND ADHERENCE SUPPORT

To reach the ambitious targets of EMTCT, ART adherence and programme retention are critical. Unfortunately, both present unique challenges over the course of pregnancy and breastfeeding.[72] Several approaches have been shown to improve retention and/or adherence among pregnant and breastfeeding women living with HIV.

Different forms of peer support have been shown to be effective.[73] The 'mentor mothers' approach, for example, trains HIV-positive women with PMTCT experience to provide education, psychosocial support and operational guidance navigating the health system. In a comparative cohort study in Nigeria, women receiving mentor mother support had significantly higher odds of retention (adjusted OR= 5.9, 95 per cent CI: 3.0-11.6) and viral suppression (adjusted OR= 4.9, 95 per cent CI: 2.6-9.2) at six months post-partum.[74] The PURE Malawi trial found that, compared to the prevailing standard of care, facility- and community-based peer support models led to better uptake of ART (81 per cent vs. 86 per cent and 90 per cent, respectively) and retention at 24 months (66 per cent vs. 80 per cent and 83 per cent, respectively).[75] Other studies have shown that peer-centred approaches can effectively be combined with other interventions[76] and encourage other reproductive health behaviours.[77]

These trial findings are largely supported by qualitative research, which confirms the overall feasibility and acceptability of the intervention,[78] including among adolescents.[79] For widespread implementation, however, adaptations may be required to fully optimize the role of peer supporters within the health system.[80]

Community-level health providers may also serve in this supporting role. The MIR4Health study, for example, deployed trained lay counsellors to provide pregnant women with coordinated support, including individualized health education, retention/adherence support, phone and SMS appointment reminders, and missed visit tracking. Women in the intervention arm had lower rates of attrition by six months post-partum when compared to the standard of care (18.8 per cent vs. 28.2 per cent, relative risk (RR): 0.67, 95 per cent CI: 0.45-0.99).[81]

Identifying support within the woman's own social network may also increase adherence and retention. Engagement of male partners has been shown to improve progression along the EMTCT cascade, including uptake of HIV testing and ART among HIV-positive women.[82] Partner involvement has also been shown to improve outcomes – including new HIV infections and overall HIV-free survival – among HIV-exposed infants.[83] Conversely, a lack of engagement can have negative consequences. In a cross-sectional study in Malawi, being in a couple in which neither partner disclosed their HIV status was associated with higher risk of not initiating maternal ART (adjusted OR= 4.7, 95 per cent CI: 2.5-8.8), suboptimal treatment adherence (adjusted OR= 1.8, 95 per cent CI: 1.1-2.8), and HIV transmission from mother to infant (adjusted OR= 2.1, 95 per cent CI: 1.1-4.1).[84] Strategies to increase male partner engagement typically start with couples HIV counselling and testing (see *HIV prevention for women*). Community-based outreach activities to engage male partners have been effective in Mozambique and the United Republic of Tanzania.[85] However, the potential risks associated with these approaches, including intimate partner violence and social harms, should be carefully considered when implementing such services at a population level.

Other evidence-based strategies, shown to be effective in other populations, may be adapted for pregnant and breastfeeding women. Community- or facility-based adherence groups, for example, have shown promise among 'stable' ART patients who have already achieved virologic suppression. Health-care staff

convene patients – typically every few months – for group counselling, prescription refills, and referrals to the health facility (where needed). In a cohort study of 129 women with HIV viral load <1,000 copies/mL for at least three months, Myer and colleagues reported favourable outcomes with adherence groups during the post-partum period.[86] The feasibility and acceptability of the approach was confirmed via in-depth interviews with health-care providers and patients.[87] Although encouraging, further research is needed about patient preferences and long-term outcomes in this population. Similarly, mobile health (or mHealth) technologies have been shown, across numerous studies, to improve retention and adherence in the general adult HIV population. In contrast, those focused on antenatal and post-partum populations have been limited. In separate trials, two-way messaging and biweekly phone calls were associated with increased retention of new mothers within the first 8–10 weeks following delivery.[88] For longer-term retention (i.e., up to 12 months post-partum), the data appear equivocal.[89] Such approaches deserve further study, especially given the growing landscape for mHealth in maternal and child services;[90] however, the effectiveness of such interventions at a public health scale will likely depend on evolving structural, social and cultural factors.

Several strategies appear promising for pregnant and breastfeeding women but require further evaluation. One such example is enhanced viral load monitoring during pregnancy and breastfeeding, a strategy that provides important feedback to providers and patients alike about drug adherence and/or antiretroviral drug resistance. Although viral load monitoring is now recommended in many settings, coverage remains limited and its timing infrequent (e.g., 6–24 months apart). Without intensified monitoring, as many as 70 per cent may not receive routine viral load testing during pregnancy and breastfeeding, with potentially negative consequences.[91] Viral load testing at entry into antenatal care (for women on ART prior to conception) can help to identify other undiagnosed treatment failure. Detectable HIV viremia in the third trimester and/or during breastfeeding can be used to guide adherence counselling and support. Due to the delays in turnaround time, particularly in remote and rural areas, the integration of point-of-care (POC) viral load assays can increase coverage of virologic monitoring. However, such POC instruments should be placed in a way that maximizes centralized laboratories (and their existing specimen transport networks) and minimizes overall costs.[92]

Rapid viral load reductions can be achieved with integrase inhibitor–based ART regimens, which may be particularly important for women first presenting late in pregnancy. In pregnant women with detectable viral load on an existing non-integrase inhibitor regimen, switching to an integrase inhibitor–based ART regimen may provide rapid reduction of viral load.[93] In this situation, however, a change in the nucleoside reverse transcriptase (NRTI) backbone may also be needed to ensure two active drugs are being used when making a switch.[94] Despite initial concerns about pre-conception dolutegravir use and its association with fetal neural tube defects,[95] subsequent data suggest that the overall risks remain small.[96] Initiation of dolutegravir-containing regimens during pregnancy was not associated with elevated risk for adverse birth outcomes, when compared to efavirenz-containing regimens.[97] This led the World Health Organization to recommend dolutegravir-based regimens as part of first-line ART for all populations, including pregnant women.[98]

ENGAGEMENT IN ANTENATAL CARE

Early and continued engagement in antenatal care is foundational to strong PMTCT programmes. Delayed registration for antenatal care may diminish the time for HIV testing and ART initiation among pregnant women not yet diagnosed with HIV. While the World Health Organization has expanded the minimum number of recommended provider contacts from four to eight,[99] novel approaches are needed to promote antenatal care engagement as early as the first trimester.

To date, evidence for community-based interventions to support antenatal care engagement has been mixed. In the United Republic of Tanzania, for example, a community health worker programme contacted more than 42,000 pregnant women over the course of 16 months. Of these, 75 per cent had not yet attended antenatal care (including 40 per cent of whom were in the first trimester) and were actively referred.[100] When the programme was formally evaluated via a cluster-randomized trial, however, the proportion of women who reported fewer than four antenatal visits over the course of pregnancy did not differ between the intervention and standard-of-care arms (59.1 per cent vs. 60.7 per cent, RR: 0.97, 95 per cent CI: 0.82-1.15). Similarly, the proportions of women who did not attend antenatal care in the first trimester also did not differ (69.7 per cent vs. 70.3 per cent, RR: 0.99, 95 per cent CI: 0.87-1.13).[101]

Incentives may be promising. In a systematic review, Till and colleagues found that incentive-based strategies

may not increase the likelihood of antenatal care access but pregnant women already attending institutional antenatal care were more likely to continue on a frequent basis.[102] In a small pilot trial in South Africa, Rossouw and colleagues evaluated an intervention comprising the Thula Baba Box – modelled on the Finnish baby box, including maternal and newborn supplies – and monthly community health worker visits. The incentive was given conditional on early (i.e., within four weeks of the initial community health worker interaction) and continued (i.e., at least four antenatal care visits) engagement in antenatal care. Women randomized to the intervention arm appeared more likely to attend more than four antenatal care visits (adjusted OR= 4.85, 95 per cent CI: 0.84-27.88) and initiate antenatal care prior to five months' gestation (adjusted OR= 10.51, 95 per cent CI: 10.51 (1.80-61.83).[103]

Other strategies deserve consideration as well. Group antenatal care has gained considerable attention and is now recommended by the World Health Organization.[104] Preliminary assessments of this approach have been encouraging, including increases in pregnancy-related empowerment in some settings.[105] Larger trials of group antenatal care are nearing completion and should further solidify the evidence base for this strategy.[106] Similarly, SMS reminders may be effective for promoting antenatal care visits. In a systematic review and meta-analysis, pregnant women who received text messaging were more likely to complete the four, focused antenatal care visits previously recommended by the World Health Organization (OR= 2.74, 95 per cent CI: 1.41-5.32).[107] National programmes have begun to integrate such strategies into routine antenatal care.[108] Connections through internet-based texting platforms (e.g., WhatsApp) could also replicate elements of patient group support and deserve further study.

SERVICES FOR INFANTS AT HIGH RISK OF HIV ACQUISITION

When women initiate ART late in pregnancy, or fail to start at all, higher rates of vertical HIV transmission are observed. The World Health Organization considers the following groups at high risk of acquiring HIV: (1) infants born to women with established HIV infection who have received less than four weeks of ART before delivery, (2) infants born to women with established HIV infection with viral load >1,000 copies/mL in the four weeks before delivery, (3) infants born to women with incident HIV infection during pregnancy and breastfeeding, or (4) infants identified for the first time as HIV-exposed during the post-partum period, with or without a negative HIV test prenatally.[109] Since maternal HIV antibodies are passively transmitted from mother to fetus and do not decay for months following birth, newborns should be screened via HIV nucleic acid tests.

For programmes with established capacity for early infant HIV diagnosis (EID) – and demonstrated links to paediatric HIV treatment services – HIV testing at birth can be considered for high-risk infants. At present, EID at birth has not been routinely incorporated in most public health settings, although there are exceptions. South Africa, for example, has introduced universal birth testing for all HIV-exposed infants because, in this setting of high HIV prevalence and limited maternal viral load testing, it was estimated that 'targeted' birth HIV testing may miss up to 20–25 per cent of in utero HIV infections.[110] While promising, the strategy of birth HIV testing could negatively affect routine early EID testing at 4–8 weeks for infants who initially test HIV-negative. For this reason, birth HIV testing programs must be accompanied by careful evaluation of the impact on subsequent required EID testing, and structured interventions may be needed to support follow-up EID services after negative birth HIV testing.[111] Point-of-care assays for EID may facilitate implementation of birth HIV testing, although service delivery models may require further refinement.[112] Infants who test positive for HIV at birth require urgent linkages to HIV services, since universal ART initiation has been shown to significantly reduce infant morbidity and mortality.[113]

All women newly diagnosed with HIV should start ART immediately, regardless of the timing in relation to delivery or post-partum, and receive support for adherence and retention. Maternal virologic suppression is associated with low rates of vertical HIV transmission, as well as improved maternal health. For infants at high risk for HIV acquisition, infant prophylaxis provides added antiretroviral coverage during the important bridging period between initiation of maternal ART and achievement of maternal viral suppression. For breastfeeding infants born to HIV-positive mothers on ART, the World Health Organization currently recommends six weeks of infant prophylaxis with daily nevirapine. This guidance is based on numerous clinical trials showing the safety of infant nevirapine prophylaxis at different durations.[114] Other infant HIV prophylaxis regimens have been associated with similarly low rates of mother-to-child HIV transmission, including lamivudine, lopinavir/ritonavir and zidovudine;[115] these can be considered when nevirapine is not available. When infants are considered to be at high risk of mother-to-child HIV transmission (see above), dual infant prophylaxis – with twice daily

zidovudine and daily nevirapine – is recommended for the first six weeks of life, followed by an additional six weeks of dual prophylaxis or daily nevirapine for a total duration of 12 weeks in breastfeeding infants.[116] An alternative consideration for prophylaxis in infants at very high risk would be to initiate enhanced post-natal prophylaxis using an enhanced 'presumptive treatment' regimen of three drugs (e.g., zidovudine, lamivudine and raltegravir; or if raltegravir is not available, zidovudine, lamivudine and nevirapine) while awaiting results of a birth HIV test.[117] Such an approach needs to be paired with careful review of infant testing practices to ensure that at least one diagnostic specimen is collected prior to initiating any presumptive treatment, which could impact the results of viral assay performance. Studies evaluating wide-scale implementation of such presumptive treatment strategies are not yet available.

Conclusion

In this operational guidance, we advocate a deliberate and coordinated approach that is led locally by ministries of health and national HIV programmes and engages a range of stakeholders. The process should be data-driven and consider both the gaps in PMTCT and the contextual priorities that will inevitably shape their resolution. We envision a cyclic course by which progress is monitored and measured over time to ensure that the services in place are addressing the country's most urgent needs. It is also aligned to and guided by the country's national targets for PMTCT, to ensure that activities are aligned with these overarching goals. Importantly, we envision an approach that renews the commitment of national PMTCT programmes in a manner that is efficient and effective. After decades of progress, the goals of EMTCT are finally within reach. Through this structured and iterative process, we chart the pathway to reach – and complete – the *Last Mile to EMTCT*.

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Statistical table

Maternal and child health data and PMTCT data for 23 focus countries, 2018

Country	Antenatal care: at least one visit (%) 2012–2018*	Antenatal care: at least four visits (%) 2012–2018*	Institutional delivery (%) 2012–2018*	Pregnant women with known HIV status (%)	Pregnant women living with HIV receiving ARVs for PMTCT (%)	Mother-to-child HIV transmission rate
Angola	81.6	61.4	45.6	–	38.2 [29.0-47.8]	27.8 [25.4-30.3]
Burundi	99.2	49.3	83.9	–	79.7 [61.2->95]	16.4 [12.5-21.3]
Botswana	94.1 ×	73.3 ×	99.7	>95	>95 [76.7->95]	2.5 [1.9-4.5]
Chad	54.7	31.0	21.7	–	55.8 [39.7-71.8]	21.4 [15.6-25.4]
Côte d'Ivoire	93.2	51.3	69.8	–	89.8 [65.2->95]	14.2 [9.3-20.2]
Cameroon	82.8	58.8	61.3	86.3	80.0 [60.7-94.5]	16.5 [13.5-18.9]
Democratic Republic of the Congo	88.4	48.0	79.9	35.3	43.9 [33.1-52.3]	27.1 [24.4-30.0]
Eswatini	98.5	76.1	87.7	91.3	79.2 [65.7-88.8]	7.8 [5.7-9.6]
Ethiopia	62.4	31.8	26.2	88.9	91.7 [62.7->95]	13.4 [10.2-19.7]
Ghana	90.5	87.3	73.1	–	78.9 [58.4->95]	20.2 [16.9-23.9]
Indonesia	97.5	77.4	73.6	36.9	15.4 [13.2-18.0]	29.3 [27.5-31.1]
India	79.3	51.2	78.9	–	–	–
Kenya	93.7	57.6	61.2	91.9	91.2 [70.1->95]	12.1 [8.6-16.5]
Lesotho	95.2	74.4	76.5	–	77.2 [59.4-89.5]	12.7 [9.9-14.4]
Mozambique	87.2	51.7	54.8 ×	>95	>95 [72.8->95]	15.0 [11.8-19.0]
Malawi	97.6	50.6	91.4	>95	>95 [80.1->95]	7.8 [6.9-9.4]
Namibia	96.6	62.5	87.4	–	>95 [92.0->95]	3.9 [3.6-5.1]
Nigeria	67.0	56.8	39.4	41.3	43.6 [28.2-61.9]	24.1 [19.9-27.7]
United Republic of Tanzania	98.0	62.2	62.6	91.1	93.3 [70.3->95]	10.5 [9.0-13.2]
Uganda	97.3	59.9	73.4	>95	92.9 [73.5->95]	7.4 [5.9-9.6]
South Africa	93.7	75.5	95.9	88.1	86.5 [63.1->95]	4.9 [4.3-9.6]
Zambia	95.7	55.5	67.4	88.7	>95 [94.0->95]	11.2 [9.2-14.0]
Zimbabwe	93.3	75.7	77.0	86.0	93.9 [71.1->95]	7.6 [5.9-10.3]
23 focus countries	**81.8**	**31.9**	**68.0**	**–**	**84.7 [68.3->95]**	**11.7 [7.8-19.3]**

Notes: – Data not available; × Data refer to years or periods other than those specified in the column heading. Such data are not included in the calculation of regional and global averages. Estimates from years prior to 2000 are not displayed; * Data refer to the most recent year available during the period specified in the column heading.

Indicator definitions: **Antenatal care: at least one visit (%) 2012–2018*** – Percentage of women (aged 15–49) attended at least once during pregnancy by skilled health personnel (typically a doctor, nurse or midwife); **Antenatal care: at least four visits (%) 2012–2018*** – Percentage of women(aged 15–19 and 15-49) attended by any provider at least four times; **Institutional delivery (%) 2012–2018*** – Percentage of women (aged 15–49) who gave birth in a health facility; **Pregnant women with known HIV status (%)** – Percentage of pregnant women presenting at antenatal care (ANC) who were tested for HIV or already knew their HIV positive status; **Pregnant women living with HIV receiving ARVs for PMTCT** – Percentage of the estimated number of pregnant women living with HIV who received effective regimens (excluding single-dose nevirapine) of antiretroviral medicines (ARVs) for prevention of mother-to-child transmission (PMTCT) of HIV in 2018; **Mother-to-child HIV transmission rate** – Estimated number of children aged 0-4 newly infected with HIV from mother-to-child transmission for every 100 women living with HIV delivering in the past 12 months

Data sources: **Antenatal care: at least one visit (%) 2012–2018*** – DHS, MICS and other national household surveys. Last update: May 2019; **Antenatal care: at least four visits (%) 2012–2018*** – International Center for Equity in Health, Federal University of Pelotas, Brazil, based on Demographic and Health Surveys (DHS), Multiple Indicator Cluster Surveys (MICS) and other national surveys. Last update: August 2019; **Institutional delivery (%) 2012–2018*** – DHS, MICS and other national household surveys. Last update: May 2019; **Pregnant women with known HIV status (%)** – Global AIDS Monitoring and UNAIDS 2019 estimates. Last update: July 2019; **Pregnant women living with HIV receiving ARVs for PMTCT** – Global AIDS Monitoring and UNAIDS 2019 estimates. Last update: July 2019; **Mother-to-child HIV transmission rate** – UNAIDS 2019 estimates. Last update: July 2019.

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