

# Mother-to-Child Transmission of Human Immunodeficiency Virus and Its Determinants: Lessons Learnt from the Test and Treat Strategy at a Regional Hospital in Cameroon

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## What is already known on the topic?

- Without maternal anti-retroviral (ARV) treatment, approximately 20–45% of HIV-exposed infants (HEIs) will become infected with the virus during pregnancy, delivery, and breastfeeding.
- A delay in the diagnosis of human immunodeficiency virus (HIV) in children leads to an increase in the death rate.

## What does this study add to this topic?

- There was a drop in the frequency of mother-to-child transmission (MTCT) of HIV.
- Starting maternal ARV after delivery was found to have a 33 times increased risk of MTCT of HIV.
- Being breastfed for more than 12 months was found to increase the likelihood of MTCT of HIV by 6 times.

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## ABSTRACT

**Objective:** With the World Health Organization's (WHO) implementation of the "test and treat all" policy in 2016, there should have been a great change in mother-to-child transmission (MTCT) of human immunodeficiency virus (HIV), and its determinants. This study aimed to assess MTCT of HIV after the adoption of the universal "test and treat" policy.

**Materials and Methods:** A retrospective cohort study of HIV-exposed infants (HEIs) between the ages of 6 weeks to 18 months enrolled from 1 January 1, 2017 to December 31, 2021. The study was carried out at the "Prevention of Mother to Child Transmission" center (PMTCT) of the HIV unit, Regional Hospital Bamenda (RHB) of the Northwest region of Cameroon. Data was collected from files with the aid of predesigned data collection forms.

**Results:** During the study, out of the 294 HEIs included, 13 were positive, giving a frequency of 4.4%. Not taking antiretrovirals by the mother, or taking them 4 weeks prior to delivery, or after delivery, mixed feeding, and breastfeeding duration greater than 12 months were determinants of MTCT of HIV. Also, 4 out of the 294 exposed infants died, giving a death rate of 1.4%. No factor analyzed was found to be significantly associated with the death rate of HEIs at 18 months.

**Conclusion:** This study showed a reduction in the frequency of MTCT of HIV due to the implementation and adoption of the universal "test and treat" policy. Also, starting maternal anti-retroviral treatment after delivery and a breastfeeding duration greater than 12 months were associated with MTCT of HIV.

**Keywords:** Mother to child transmission, human immunodeficiency virus, HIV, test and treat policy, Cameroon

## INTRODUCTION

Mother-to-child transmission (MTCT) of HIV is defined as the transmission of HIV from a positive mother to her baby during pregnancy, labor, delivery, or lactation.<sup>1</sup> According to the United Nations program on HIV/AIDS, 38.4 million people were living with HIV/AIDS worldwide, with 1.7 million cases being children (<15 years old). Around 1.5 million people were newly infected with HIV globally, with 10.67% of these new infections occurring in children.<sup>2</sup> Cameroon is one of 22 prevention of mother-to-child transmission (PMTCT) priority countries in sub-Saharan Africa, accounting for nearly 80% of MTCT of HIV cases in the world.<sup>3</sup> In 2021, Cameroon had about 15,000 new infections, of which 4300 were children. The antiretroviral (ARV) coverage during pregnancy in Cameroon was

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estimated at 67%.<sup>4</sup> Many HEIs still test positive despite the “test and treat” strategy.

Ending the HIV/AIDS pandemic remains a global health priority. Currently, World Health Organization (WHO) recommends rapid anti-retroviral therapy (ART) initiation for everyone diagnosed with HIV, unless there are clinical indications to delay treatment.<sup>5</sup> Consequently, the antiretroviral coverage has increased globally up to 81% in 2021. Studies have proven that ART is effective in preventing HIV transmission by lowering the viral load in treated and adherent patients.<sup>6,7</sup> Interventions recommended for preventing MTCT of HIV have resulted in a reduction in the risk of MTCT, and complete elimination is now attainable.

About 75% of HEIs have delayed access to early infant diagnosis (EID) services, resulting in a high death rate. Without early initiation of ART, about 20% of HIV-positive infants will pass away before 6 months, 35–40% before 1 year, and over 50% by 2 years.<sup>8</sup> Therefore, early diagnosis is critical for early identification, treatment, and long-term outcomes for these infants.<sup>9</sup> The WHO recommends HIV testing for all HEIs before 2 months of age.<sup>5</sup> However, delayed diagnosis of pediatric HIV infections and persistence of vertical transmission continue to be major problem despite the introduction of PMTCT services in 2014.<sup>10</sup> The objective of the study was to assess MTCT of HIV after implementing the universal “test and treat” strategy. With the WHO implementation of the Test and Treat All in 2015, adopted by Cameroon in 2016, there should have been a great change in MTCT and its determinants.

## MATERIALS AND METHODS

### Study Setting

Our study site was the Regional Hospital Bamenda (RHB), situated in Bamenda, in the northwest region of Cameroon. The RHB is a level-2 hospital for 5 district hospitals. It also has one of the largest antenatal clinics that implement the PMTCT program, an extended center for referral of HEIs for follow-up, and the RHB pediatric treatment and care center, where HEIs are enrolled and followed up. Ethical committee approval was obtained from the Institutional Review Board (IRB) of the Faculty of Health Sciences of the University of Bamenda, No2023/0782H/UBa/IRB of 29th March 2023. Informed consent was not applicable because the study was a retrospective study on patients' files and records.

### Study Design

This study was a retrospective cohort study of secondary data from routine follow-up records of HEIs, which were reviewed and collected from the RHB pediatric treatment and care center from January 2017 to December 2021.

During routine antenatal clinics, pregnant women are tested for HIV by serology; those without test records and those who have never known their results or had their HIV test done more than 3 months ago were tested at the maternity ward upon presentation for delivery. Those who tested positive were linked to care and HIV treatment commenced. HIV-exposed infants were placed on nevirapine immediately after birth.

The HIV status of the infants was determined at 6 weeks, 9 months, and 18 months. A heel prick of dried blood was

collected from the infants for HIV DNA polymerase chain reaction (PCR) testing at 6 weeks. Between 9 to 18 months, testing was done with serology first, then confirmatory PCR for positive results. Serology testing was done using determineHIV-1/2 for infants greater than 18 months. Infants were declared positive for HIV if they had 2 consecutively positive PCR results or a positive serology and PCR.

### Study Population

In this study, the records of the HEIs and their corresponding mothers enrolled at the PMTCT service of the BRH from January 1, 2017 to December 31, 2021 were used.

### Inclusion and Exclusion Criteria

#### Inclusion Criteria

- All HEIs between the ages of 6 weeks to 18 months who had their HIV results (PCR and/or serology) including those of their respective mothers registered in their records.
- Records of HIV-infected mothers whose children were being followed-up.

#### Exclusion Criteria

- HIV-exposed infants who did not have any PCR test results and those who were HIV-negative at 9 months and did not have serology test results at 18 months.

### Study Procedure

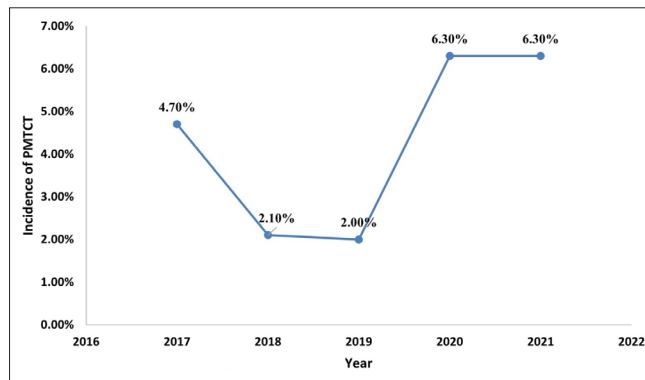
Data was collected from files of infants enrolled at the PMTCT unit of the BRH from January 1, 2017 to December 31, 2021, using predesigned data collection forms. The variables available were maternal socio-demographic characteristics (age, occupation, marital status, level of education), infant demographic characteristics (age, sex), prenatal events (maternal ARV intervention, period of ARV initiation, mean viral load during pregnancy), perinatal event (mode of delivery, term at delivery, birth weight), postnatal events (NVP administration at birth, mean viral load after delivery, feeding option for the first 6 months, duration of breastfeeding), HIV status (positive, negative), and outcome (died, alive).

Daily data collected were assessed, validated, coded, and stored. They were entered into Microsoft Access 2016 and the information was stored on a computer and on an external drive protected by a password.

HIV-exposed infants aged 6 weeks to 18 months enrolled at the PMTCT unit from January 1, 2017 to December 31, 2021 were consecutively recruited in this study (N = 294).

### Statistical Analysis

Data analysis was done with respect to the objectives using the statistical package for social sciences (SPSS) version 26 (IBM SPSS Corp.; Armonk, NY, USA). The authors presented results as means with standard deviations for continuous variables, and categorical variables were expressed using frequencies or percentages. The normality assumption was tested using the normality test, Shapiro-Wilks and Kolmogorov-Smirnov tests. The Fisher exact test was used to assess the association between the dependent and independent variables. Statistical significance was defined by a *P*-value <.05.



**Figure 1.** Yearly trends of HIV infection in the HIV-exposed infants over the study.

## RESULTS

### Frequency of MTCT of HIV

From January 1, 2017 to January 31, 2021, 294 HEIs were recruited and followed up at the PMTCT unit of the pediatric treatment center of the BRH, out of which 13 tested positive, giving a frequency of MTCT of 4.4%. From 2017 to 2018, there was a significant drop in the frequency of MTCT of HIV, followed by a significant rise from 2019 to 2020, which remained high in 2021 (Figure 1).

In this study, out of the 294 infants with PCR and serology results, 13 tested positive, giving an MTCT frequency of 4.4% (Figure 2).

### Maternal and Infant Sociodemographic Characteristics

The mean maternal age was  $30.8 \pm 6.3$  years (min-max: 16 to 43 years), with more than half 169 (57.4%) aged greater than 30 years, with a great majority having liberal occupations (73.5%), and living as couples 211 (71.8%). Most 131 (44.6%) had attained a secondary level of education. Almost all 290 (98.6%) infants were enrolled at birth, with more than half 163 (55.4%) being female, giving a sex ratio of 0.8 (Table 1).

### Determinants of Mother-to-Child Transmission

Among the factors evaluated, the chances of an infant becoming positive were no maternal use of ARV ( $P = .000$ ), starting ARV within 4 weeks prior to delivery ( $P = .017$ ), or starting after

delivery ( $P = .017$ ) and, mixed feeding ( $P = .038$ ) and breastfeeding duration of greater than 12 months ( $P = .002$ ), were found to significantly increase the chances of MTCT of HIV (Table 2).

### Death Rate of HEIs at 18 Months

In this study, out of the 294 infants with PCR and serology results, 4 infants with a confirmed HIV status died, giving a death rate of 1.4%.

### Factors Related to the Death Rate in HEIs at 18 Months

Of the factors analyzed (maternal age, marital status, infant sex, period of maternal Antiretroviral administration, mean viral load during pregnancy and breastfeeding, mode of delivery, birth weight, type of feeding for the first 6 months) none was significantly associated with the death rate at 18 months (Tables 3 and 4).

## DISCUSSION AND CONCLUSION

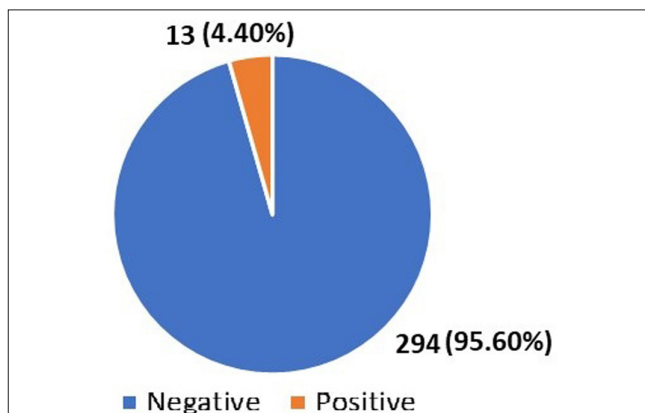
The frequency of MTCT of HIV in the study was 4.4%. This is similar to the 3.8% reported in Ethiopia by Yitayew et al in 2019<sup>11</sup> and the 4.7% reported in Kenya by Ngayaka et al in 2022.<sup>12</sup> However, this was higher than the 1.2% reported in Dschang, Cameroon by Doro et al in 2016,<sup>13</sup> 0.0% reported in Burkina Faso by Ghoma et al in 2019.<sup>14</sup> These frequent low rates are an important confirmation that the adoption of the new criteria of WHO consolidated guidelines ("test and treat" policy, i.e., treatment for everyone living with HIV irrespective of CD4 cell count or clinical symptoms)<sup>5</sup> is a key strategy for PMTCT of HIV.

**Table 1.** Maternal and Infant Sociodemographic Characteristics (N = 294)

Maternal Characteristics	Number (N)	Percentage (%)
Age		
≤ 20	29	9.9
(20-30)	96	32.7
> 30	169	57.4
Occupation		
Liberal*	216	73.5
Non-liberal**	48	16.3
Student	27	9.2
Unemployed	3	1.0
Level of education		
No formal education	3	1.0
Primary	110	37.4
Secondary	131	44.6
University	50	17
Marital status		
Living as a couple	211	71.8
Single	83	28.2
Infant characteristics		
Age at enrolment		
Birth	290	98.6
After birth	4	1.4
Sex		
Male	131	44.6
Female	163	55.4

\*seamstress, business, hair dresser, farmer, cleaner.

\*\*magistrate, civil servant, military.



**Figure 2.** Frequency of MTCT of HIV in the study population.

**Table 2.** Determinants of Mother-to-Child Transmission of HIV (N = 294)

Variables	HIV+ n = 13 (%)	HIV- n = 281(%)	P
Maternal ARV administration			
Yes	9 (69.2)	279 (99.3)	
No	4 (30.8)	2 (0.7)	<b>.000</b>
Period of maternal ARV intervention			
Prior to pregnancy	5 (38.5)	228 (81.1)	
More than 4 weeks prior to delivery	3 (23.1)	48 (17.1)	.16
Within 4 weeks prior to delivery	1 (7.7)	2 (0.7)	<b>.01</b>
After delivery	3 (23.1)	1 (0.3)	<b>.01</b>
Infant ARV prophylaxis at birth			
Yes	11 (84.6)	280 (99.7)	
No	2 (15.4)	1 (0.3)	<b>.002</b>
Feeding option for the first 6 months			
Formula or exclusive breastfeeding	8 (61.5)	238 (84.7)	
Mixed feeding	5 (38.5)	43 (15.3)	<b>.03</b>
If breastfeeding, duration (months)			
0-12	6 (50)	223 (86.8)	

ARV, anti-retroviral.  
P value less than 0.05 is statistically significant.

There was a significant drop in the yearly frequency from 2017 to 2018 and 2019 as compared to 7.1% in 2016, which was<sup>15</sup> probably due to increased maternal ARV coverage during pregnancy.<sup>4</sup> It later on increased in 2021, probably as a result of the sociopolitical crisis in the northwest and south-west regions of Cameroon, which could have contributed to decreased utilization of health services by the population and hence, adherence to ART among persons living with HIV. Also, countries with armed conflict have reported an increase in gender-based violence, especially rape and risky sexual behaviors, which promotes the spread of HIV.<sup>16</sup>

**Table 3.** Sociodemographic Factors Related to the Death Rate in HIV-exposed infants at 18 Months

Variable	Died (N) n = 4(%)	Survived (N) n = 290(%)	P
Maternal age			
≤ 20	0 (0)	29 (10)	
[20-30]	4 (100)	92 (31.7)	.777
> 30	0 (0)	169 (58.3)	.248
Marital status			
Living as a couple	1 (25)	210 (72.4)	
Single	3 (75)	80 (27.6)	.076
Infant sex			
Male	1 (25)	130 (44.8)	
Female	3 (75)	160 (55.2)	.443

Human immunodeficiency virus infection was significantly associated with breastfeeding duration greater than 12 months. Similar results were noted by Potty et al, in 2019, in India.<sup>17</sup> This suggests that prolonged exposure to breastfeeding is likely to have increased HIV transmission rates. After the uptake of breast milk by the baby, containing both cell-free and cell-infected viruses, transmission may be possible in cases of mucosal lesions and local conditions of the breast. However, in some cases, despite intact membranes, transcytosis can be the reason for the passage of the virus with the possible role of the M cells and Peyer's glands and other immune agents of the intestines.<sup>5</sup>

Also, mixed feeding was found to significantly increase the risk of transmission compared to exclusive breastfeeding.<sup>12,18</sup> The possible reason for this risk difference might be that mixed feeding which involves feeding both breast milk and additional foods, including formula food, can increase the likelihood of damaging the epithelial lining of the child, which in turn may result in infection that increases the risk of transmission of the HIV virus.

Furthermore, mothers with a mean viral load of greater than 1000 copies/mL during pregnancy and breastfeeding had increased chances of transmission.<sup>19-21</sup> Starting maternal ARV after delivery significantly increased the risk of transmission

**Table 4.** Prenatal, Perinatal, or Postnatal Factors Related to the Death Rate in HIV-exposed infants at 18 months

Variables	Died (N) n = 4 (%)	Survived (N) n = 290 (%)	P
Period of maternal ARV administration			
Prior to pregnancy	2 (50)	232 (80)	
More than 4 weeks prior to delivery	1 (25)	51 (17.5)	.105
Less than 4 weeks prior to delivery	1 (25)	3 (1.0)	
After delivery	0 (0)	4 (1.4)	
Mean VL during pregnancy			
< 1000	3 (75)	210 (72.4)	.98
≥ 1000	1 (25)	80 (27.6)	
Mean VL during breastfeeding			
<1000	3 (75)	117 (40.3)	.98
≥1000	1 (25)	173 (59.7)	
Mode of delivery			
Vagina delivery	3 (75)	238 (82.0)	.717
Caesarean section	1 (25)	52 (17.9)	
Birth weight (g)			
< 2500	0 (0)	26 (8.9)	.506
≥ 2500	4 (100)	264 (91.1)	
Feeding option for the first 6 months			
Formula and exclusive breast feeding	4 (100)	242 (83.4)	
Mixed feeding	0 (0)	48 (16.6)	.312

ARV, anti-retroviral; VL, viral load.



compared to starting before or during pregnancy. Other studies also noted that there was a higher rate of MTCT of HIV when ART was started after delivery.<sup>22,23</sup> This is because ART requires several weeks to significantly lower the maternal viral load; hence, early initiation and adherence to maternal ART leads to maternal plasma viral load suppression to undetectable levels, thereby reducing HIV transmission risk.<sup>22</sup>

Finally, infants who did not receive nevirapine prophylaxis at birth had a higher risk of transmission.<sup>12,22</sup> This is because NVP is potent and has rapid antiviral activity; it inhibits the enzyme reverse transcriptase and hence the replication of HIV.

A death rate among HEIs of 1.4% was found. Other studies in Zimbabwe noted a death rate of 4.8% in 2020<sup>24</sup> and 8.88% in Ethiopia in 2019.<sup>25</sup> These high rates were observed because the 'Test and Treat' strategy was not implemented in these countries at the time of the study.

On bivariate analysis for factors associated with the death rate, none was statistically significant. In Zimbabwe, low birth weight was found to be associated with the death rate of HEIs,<sup>24</sup> and in Ethiopia, birth weight and infant feeding practices in the first 6 months were significantly associated with the death rate<sup>25</sup>

However, there were some limitations to this study. Since secondary data from the records of HEI enrolled at the PMTCT unit of the RHB Paediatric Treatment and Care Centre were used, it was difficult to control the inconsistencies of missing data from one or more of the parameters. Also, for most of the infants enrolled at the PMTCT unit, their mothers' treatment and follow-up records were not available since they were being followed up in other treatment centers; hence, information about the viral load before pregnancy and during breastfeeding for all the mothers could not be obtained. Despite these limitations, the prior set objectives were attained.

## CONCLUSION

Overall, this study observed a reduction in the frequency of MTCT of HIV during the study period following the adoption of the universal "test and treat" strategy. The findings highlight the importance of maternal antiretroviral therapy and adherence to prevention protocols in reducing MTCT rates. Further research is needed to establish causal relationships and evaluate the long-term impact of the "test and treat" policy.

**Data Availability Statement:** The data that support the findings of this study are available on request from the corresponding author.

**Ethics Committee Approval:** This study was approved by the Ethics Committee of the Faculty of Health Sciences of the University of Bamenda (approval number: N 2023/0782H/UBa/IRB; date: March 29, 2023).

**Informed Consent:** Informed consent was waived since the nature of the study was retrospective based on patients' files and records.

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Collection and/or Processing – A.V.B., E.N.N.; Analysis and/or Interpretation – A.C., A.V.B., Y.D.P.F.; Literature Search – A.C., A.V.B, Y.D.P.F.; Writing – A.V.B, A.C; Critical Review – A.C., Y.D.P.F. Declaration of Interests: The authors have no conflicts of interest to declare.

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