# Evaluation of the Prevention of Mother-To-Child Transmission Programme at the Primary Health Care Centre in South Africa

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# ABSTRACT

**Aim:** The primary aim of the study was to monitor the effectiveness of the prevention of mother-to-child transmission (PMTCT) of HIV programme at Levai Mbatha Community Health Centre (CHC), Evaton, South Africa.

**Methods:** Analysis of a retrospectively collected data on HIV infected mothers and their infants. The infants’ HIV status was determined using HIV specific qualitative DNA PCR. Data were collected through the review of records of the HIV infected pregnant women who were enrolled in a PMTCT programme between 1st August 2009 and 31st July 2010. Of the 222 records reviewed, 206 participants with complete data on mother/infant pair were included in the analysis. Data were collected on the following parameters: age, marital status, employment status, mode of mother to child transmission (MTCT), choice of infant feeding, mode of delivery and CD4 count at booking.

**Setting:** Levai Mbatha CHC, Evaton, South Africa (a primary health care setting).

**Results:** Of the 206 mothers, 10 infants had positive DNA PCR results at 6 weeks. The MTCT rate was 4.9%. The mean age of HIV-infected mothers was 28 years (SD 5.7, range 16 – 42 years). Overall 74.2% (152) HIV positive mother received dual therapy and 28.8% (53) were on HAART alone. Mother with CD4 count < 200cells/µl [OR = 0.09 (CI, 0.01 – 0.75); p = 0.026] and lack of prophylaxis during labour [OR = 9.50 (CI, 1.59 – 56.66); p = 0.013] were identified as significant risk factors associated with MTCT.

**Conclusions:** The PMTCT programme at Levai Mbatha CHC is relatively effective in reducing MTCT of HIV and has achieved outcomes comparable to what is obtained in similar settings. Lack of ART prophylaxis and low CD4 count among HIV-infected mothers were significant determinants of the mother-to-child transmission.

**Keywords:** Prevention of mother to child transmission, rates**,** DNA PCR,HIV-infected, South Africa

**Introduction**

Globally, between 2009 and 2014, there has been a 48% reduction of new HIV infections in children, due to the success of the World Health Organization (WHO) HIV programme on Prevention of Mother to Child Transmission (PMTCT).1 A substantial improvement in the implementation of PMTCT has been achieved, since the first case of HIV by mother to child transmission (MTCT) was identified in 1983.2 The World Health Organization (WHO) has proposed Option A, Option B, and Option B+ according to availability of resources for the optimization of PMTCT care and support. According to Option A, HIV positive women are eligible for anti-retroviral therapy (ART) prophylaxis during pregnancy and intra-partum to reduce the risk of MTCT. In Option B, a woman is eligible for triple ART and continued until one week after the cessation of breastfeeding if she does not qualify for life long ART. According to Option B+, all pregnant women in the PMTCT programme are offered life-long ART, regardless of their CD4 count. Women are offered fixed dose triple ART starting on first antenatal care (ANC) visit.3

Since 2009 the Ethiopia, Mozambique, Namibia, Swaziland, Uganda and the United Republic of Tanzania have achieved 60% reduction in new infections among children. Other countries like Angola, Cameroon, Chad, Cote d’Ivoire, the Democratic Republic of the Congo, Kenya and Nigeria have shown slow progress with 30% reduction of MTCT.1

South Africa (SA) has the highest burden of HIV among women in child bearing age but a significant progress has been made by achieving 76% reduction in MTCT since 2009.1 Inconsistencies in the implementation of the evidence-based interventions (WHO Option A and B) in South African health facilities have led to variable outcomes.4 The nationwide surveys of the effectiveness of PMTCT programme showed significant progress towards achieving elimination of MTCT of HIV infections.4 In spite of the knowledge of the efficacy of PMTCT, there is a poor understanding of the field performance of these interventions outside closely monitored clinical trials.5 Variable levels of success of the PMTCT programme have been recorded in SA.6 Despite the best efforts of the South African government to improve the effectiveness of the PMTCT programmes, there are variations in the implementation of PMTCT guideline at health facilities level. As such, the outcomes of PMTCT programme implementation vary across the country.6 In order to understand and address the programmatic challenges at Primary Health Care facility level, it was important to evaluate the PMTCT programme. This study evaluated the effectiveness of PMTCT programme by determining the rate of MTCT of HIV and also, by examining the factors influencing the MTCT outcomes at Levai Mbatha Community Health Centre, Evaton, South Africa.

## Methods

**Study design and area**

This was a cross-sectional study, conducted at Levai Mbatha Community Health Centre (LMCHC) in Evaton, Gauteng Province, South Africa. An average of 80 to 90 delivery were conducted every month and the antenatal prevalence of HIV was 30% during the study period. LMCHC provides health services to over 220 000 residents of Evaton.7

## Study population and sampling

The study population were all HIV infected mothers and their infants, enrolled in the PMTCT programme at LMCHC between 1st August 2009 and 31st July 2010. A total of 250 HIV-infected pregnant women were enrolled in the PMTCT programme during the review period. Of these subjects, 16 records were missing and were excluded from our sample. Among the remaining 234 subjects, 12 were still pregnant during the study period and they were excluded from the study. A total of 222 records were eligible for inclusion in the study and of these records 14 infants were not tested for HIV PCR and two died before six weeks. The total sample include in our analysis was 206. The sampling process is reflected in figure 1.

**Figure 1. Process of record selection**

**Data collection tool**

### A data collection tool was designed and used for extracting information relevant to the study. The tool was revised after piloting with 10 records to ascertain its suitability in the data collection process.

Every record included in the study was assigned an identification number written boldly in the record review tool. Data was extracted from three sources of clinic records: antenatal clinic, maternity and laboratory sections of the Levai Mbatha CHC. The maternity records of some of the women were obtained in Sebokeng hospital where they were referred for specialized obstetric care. We extracted data and documented in the record review tool per subject. Relevant items on demography (age, marital status and employment status) and maternal history (mode of PMTCT obtained, choice of infant feeding, mode of delivery, CD4 count at booking and the occurrence of adherence problems) were obtained. Variables such as the viral load of the mothers, educational status of the mothers and co-morbidities in pregnancy were not present in almost all the antenatal record reviewed, hence, were excluded.

**Ethical considerations**

Ethics approval was obtained from the University of Liverpool Research Ethics Committee and Pharma-Research Ethics Committee affiliated to Gauteng Department of Health.

## Data analysis

We analysed data using Stata [Statistics/Data Analysis software, version 10; StataCorp Texas 77845 USA]. Analysis began with the determination of the proportion of mothers with HIV infected infants compared to the proportion with HIV uninfected infants. In the second stage, bivariate analysis was used to assess whether or not differences existed between the two groups of mothers as a result of any independent variables. For continuous independent variables, two sample t-test was used to compare means between the two groups of mothers. For categorical variables, cross tabulations was used to obtain proportions of each group of mothers corresponding to each category of the explanatory variable. Difference between groups was assessed using the distribution of Pearson chi-square (χ2) test and the corresponding two tail probabilities (p-value). In certain cases where some cells in cross-tabulation tables had small counts (due to small sample size), the Fisher exact test was used as a measure of any significant associations. Where differences exist between groups, logistic regression models were fitted to obtain odds ratios.

**RESULTS**

We analysed data from 206 mother-infant pairs. The mean age of mothers was 28 years (SD±5.7) with the age range of 16-42 years, while all infants assessed were aged 6 weeks at the time of DNA PCR test. The majority of mothers was between 21 and 30 years of age (58.7%), single (76.7%) and unemployed (67.3%). The rate of mother to child transmission of HIV was 4.9% (10/206) among the HIV exposed infants. About a quarter (24.8%) had CD4 count <200 cells/mm3. Only 19.1% had their first antenatal visit before 20 weeks and 25.7% were delivered by caesarean section. Two-thirds of mothers exclusively breast fed their infants (66%), while most were on intra-partum PMTCT prophylaxis (96.6%). Close to three quarters were on antiretroviral dual therapy of AZT and Nevirapine (74.2%) (Table 1).

**Table 1. Baseline characteristics of mothers (N꞊206)**

|  |  |
| --- | --- |
| **Variables** | **N(%)** |
| Ages (Years) |  |
| <21 | 18(8.7) |
| 21-30 | 121(58.7) |
| >30 | 67(32.5) |
| Marital status |  |
| Married | 48(23.3) |
| Single | 158(76.7) |
| Employment status |  |
| Unemployed | 138(67.3) |
| Employed | 67(32.7) |
| CD4 Count |  |
| <200 | 51(24.8) |
| 200-349 | 68(33.0) |
| ≥350 | 87(42.2) |
| First Antenatal Visit (weeks) |  |
| <19 | 38(19.1) |
| 20-30 | 149(74.9) |
| >30 | 12(6.0) |
| Mode of delivery |  |
| C/S | 53(25.7) |
| NVD | 153(74.3) |
| Infant Feeding Choice |  |
| Exclusive formula feeding | 70(34.0) |
| Exclusive breast feeding | 136(66.0) |
| Intra-partum PMTCT Prophylaxis |  |
| Yes | 198(96.6) |
| No | 7(3.4) |
| Antenatal Treatment |  |
| HAART | 53(25.8) |
| Dual Therapy | 152(74.2) |

C/S=Caesarean section, NVD=Normal vaginal delivery, HAART=highly active antiretroviral therapy

The statistical relationship between maternal baseline characteristics and infants HIV PCR results was assessed. The mean age of mothers with HIV transmission to their infants was slightly higher than those without transmission (29 vs. 28; p-value=0.424). However, maternal baseline CD4 count (χ2 =7.8, p=0.019) and intra-partum PMTCT prophylaxis (χ2 =8.7, p= 0.003) were statistically significant. The mean CD4 count of mothers with MTCT of HIV was lower (193 cells/μl, SD±190; range 18-657) than those without MTCT (351 cells/μl SD±196; range 10-1004). The maternal age, marital status, employment status, gestational age at booking, antenatal treatment, mode of delivery, feeding choice had no statistical significant effect on MTCT of HIV (Table 2).

**Table 2. Bivariate analysis of the associated factors of MTCT (N꞊206)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Variables** | **DNA PCR Negative N(%)** | **DNA PCR Positive N(%)** | **χ2** | **p-value** |
| Maternal Age (Years) |  |  |  |  |
| <21 | 17(94.4) | 1(5.6) | 0.336 | 0.845 |
| 21-30 | 116(95.9) | 5(4.1) |  |  |
| >30 | 63(94.0) | 4(6.0) |  |  |
| Marital status |  |  |  |  |
| Married | 46(95.8) | 2(4.2) | 0.064 | 0.800 |
| Single | 150(94.9) | 8(5.1) |  |  |
| Employment status |  |  |  |  |
| Unemployed | 131(94.9) | 7(5.1) | 0.034 | 0.800 |
| Employed | 64(95.5) | 3(4.5) |  |  |
| Maternal CD4 |  |  |  |  |
| <200 | 45(88.2) | 6(11.8) | 7.887) | 0.019 |
| 200-349 | 65(95.6) | 3(4.4) |  |  |
| ≥350 | 86(98.9) | 1(1.2) |  |  |
| Maternal CD4 |  |  |  |  |
| ≥350 | 86(98.9) | 1(1.2) | 4.476 | 0.034 |
| <350 | 110(92.4) | 9(7.6) |  |  |
| Gestational age at booking (weeks) |  |  |  |  |
| <19 | 38(100) | 0 | 3.533 | 0.171 |
| 20-30 | 139(93.3) | 10(6.7) |  |  |
| >30 | 12(100) | 0 |  |  |
| Mode of delivery |  |  |  |  |
| C/S | 50(94.3) | 3(5.7) | 0.100 | 0.751 |
| NVD | 146(95.4) | 7(4.6) |  |  |
| Intra-partum prophylaxis |  |  |  |  |
| Yes | 190(96.0) | 8(4.0) | 8.768 | 0.003 |
| No | 5(71.4) | 2(3.3) |  |  |
| Ante-natal Treatment |  |  |  |  |
| HAART | 48(90.6) | 5(9.4) | 3.197 | 0.074 |
| Dual Therapy | 147(96.7) | 5(3.3) |  |  |
| Choice of infant feeding |  |  |  |  |
| EFF | 65(92.9) | 5(7.1) | 1.202 | 0.273 |
| EBF | 131(96.3) | 5(3.7) |  |  |

χ2=Pearson Chi square, DNA=Deoxyribonucleic acid, PCR=Polymerase chain reaction, N=Frequency, EFF=Exclusive formula feeding, EBF=Exclusive breast feeding, HAART=highly active antiretroviral therapy

In the multivariate analyses, after adjusting for confounding factors, only maternal CD4 count ≥200 and intrapartum prophylaxis were the independent determinants of MTCT of HIV. Mothers who had intrapartum prophylaxis were 9.5 times less likely to transmit HIV to their infants (Table 3).

**Table 3. Logistic regression (LR method) analysis of MTCT (N꞊206)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Variables | SE | OR | 95% CI | p-value |
| Ages (Years) |  |  |  |  |
| >30 | 1.24 | 1.08 | 0.113-10.300 | 0.947 |
| 21-30 | 0.824 | 0.73 | 0.081-6.656 | 0.782 |
| <21 |  | 1 |  |  |
| Marital status |  |  |  |  |
| Married | 0.991 | 1.23 | 0.251-5.981` | 0.800 |
| Single |  | 1 |  |  |
| Employment status |  |  |  |  |
| Employed | 0.620 | 0.88 | 0.220-3.504 | 0.853 |
| Unemployed |  | 1 |  |  |
| Maternal CD4 |  |  |  |  |
| ≥350 | 0.096 | 0.09 | 0.010-0.747 | 0.026 |
| 200-349 | 0.254 | 0.35 | 0.082-1.457 | 0.148 |
| <200 |  | 1 |  |  |
| Maternal Prophylaxis at Delivery |  |  |  |  |
| Yes | 8.656 | 9.50 | 1.593-56.662 | 0.013 |
| No |  | 1 |  |  |
| Maternal Ante-natal Treatment |  |  |  |  |
| HAART | 0.214 | 0.33 | 0.096-1.176 | 0.087 |
| Dual Therapy |  | 1 |  |  |

SE=Standard error, OR=Odd ratio, CI=Confidence intervals, HAART=Highly active antiretroviral therapy

**DISCUSSION**

The rate (4.9%) of MTCT of HIV at Levai Mbatha CHC is similar to the National (3.5%) MTCT of HIV at Six Weeks Postpartum in South Africa during 2010 and different provinces ranged from 1.4% to 5.9%.4 The result is comparable with the target (less than 5%) of the National HIV & AIDS and STI strategic Plan for South Africa, 2007-2011.8 The outcome at Levai Mbatha CHC may be an indication of improvement in PMTCT outcomes within the South African public health system. It also points to the fact that the public health policies of government are yielding positive results, even in a semi-rural setting like Levai Mbatha CHC.

Though the MTCT rate is higher than what has been reported, the rate obtained at Levai Mbatha CHC was comparable with findings in different districts in the Western Cape Province of South Africa where the MTCT rates were found to be between 3.6% and 7.5%.6 The outcome of this research demonstrates significant improvement compared to 20.6% that was previously obtained in Kwazulu-Natal.6 The significant progress made justifies government’s policy that led to the introduction of dual therapy for HIV-infected pregnant women. Looking into the future, this study supports the current policy framework of WHO Option B+, which stipulates that HAART should be made available to all HIV positive pregnant women irrespective of CD4 count. The results are bound to be better with regards to reduction of MTCT rates as well as mortality in infants of HIV-infected pregnant women.

**CD4 Count**

The study revealed that mothers with CD4 count below 200cells/µl are at increased risk of vertically transmitting HIV to their infants. The outcome justifies the commencement of antiretroviral therapy (ART) in HIV-infected pregnant women with low CD4 count. This finding is in tandem with what previous researches have shown; the lower the CD4 count of the mother, the higher the rate of vertical transmission of HIV infection.9 Although, the risk was low for vertical transmission of HIV when maternal CD4 count is above 200 but there is still a chance of MTCT. The eligible criteria for WHO Option-B is too complex for mothers enrolled in the PMTCT programme at Primary Health Care (PHC) level especially in the settings where there are poor access to CD4 Count. Since the decentralization of ART programme in South Africa, WHO Option-B+ has been the best choice for elimination of MTCT of HIV. WHO Option-B+ can easily be integrated as “One size fits for all” at every PHC level. This option provides better protection and greater reduction of MTCT of HIV (UNICEF, 2012).10

**Prophylaxis in labour**

Antenatal prophylaxis in labour was found to be significantly associated with peripartum transmission of HIV. Mothers who received prophylaxis during labour were found to have a significant reduction in MTCT rates among their children compared to those that did not receive prophylaxis in labour. Antiretroviral prophylaxis to the mothers in labour and to the infants post-delivery significantly reduces both intrapartum and postpartum transmission of HIV from mothers to their infants. The antenatal phase has been identified as the most important antiretroviral component of MTCT programmes based on the fact that it provides the most opportunity for intervention.11 In congruence with this view is the fact that CD4 count at booking significantly impact on the DNA PCR result of the infants of the HIV-infected mothers.

**Choice of antenatal prophylaxis**

Based on DNA PCR results of the infants after birth, the study showed that there was no difference between the women who received HAART and those who received dual therapy in a similar setting. This is consistent with the finding of a study conducted in Abidjan, Cote d’Ivoire which showed no difference between HAART and dual therapy outcomes among HIV infected women.12

Van der Merwe et al13 reported the MTCT rate of 10.7% in mothers who received dual therapy while those that received HAART had MTCT rate of 4.3%. The current programme at Levai Mbatha CHC combines the use of dual therapy as well as HAART and the MTCT rate is similar to the rate reported by van der Merwe et al.13 The rate of MTCT at Levai Mbatha CHC, Evaton was 4.9%, while in similar settings within SA a rate of 11% was observed at Khayelitsha, Western Cape province.11 These rates were based on regimens containing dual antiretroviral therapy (AZT from 28weeks and sd-NVP in labour) and Zidovudine-based pilot study, respectively.11

Based on the above findings, both HAART and dual therapy if appropriately utilized, are effective in reducing MTCT rate but neither of the two factors significantly influenced the outcome of this research. The current WHO Option B and B+ is providing a wide range of protection and it is a suitable approach for elimination of MTCT of HIV even in resource limited settings.10

**Choice of infant feeding**

Choice of infant feeding is often reported as a factor associated with MTCT of HIV infection. The impact on MTCT varies depending on the mother’s choice. Infant feeding was identified as a major source of infection, but strategies have been put in place for both mothers and children in order to reduce HIV transmission rates.14 The transmission of HIV through breastfeeding is estimated to be about 10% but when extended prophylaxis with 6 weeks of NVP is given, this transmission rate can be reduced by half.15

Thior et al16 in the Mashi Study also reported that breastfeeding with antiretroviral prophylaxis is not as effective as formula feeding with similar intervention in curtailing post-natal HIV transmission but it reduces mortality in infants of HIV-infected mothers at 7 months. However, this study revealed there was no difference in the DNA PCR results between mothers who chose to exclusively breastfeed (EBF) and those that opted for exclusive formula feeding (EFF).

This study observed that two third of mothers opted for EBF instead of EFF. The finding is expected in a resource-limited setting like Levai, CHC where mothers cannot afford EFF for their babies. However, the National Report of the PMTCT programme showed that two-third of mothers preferred EFF in 2010. The WHO’s infant feeding recommendation gives preference to EBF for the first six months and then complementary feeding from six months but an alternative option of EFF method was recommended if formula was acceptable, feasible, affordable, sustainable and safe.17 In line with this reality, the WHO Option B and B+ approach for PMTCT Programme provides greater reductions of MTCT of HIV among women who choose EBF. The South African government promotes EBF in order to prevent malnutrition in HIV-exposed infants.

**Gestational age at booking**

The study revealed that MTCT rates were highest when mothers book between 20 and 30 weeks which was the period during which most of the mothers enrolled at Levai Mbatha CHC were booked. It has been shown that mothers who book their pregnancy late often miss the opportunity for early diagnosis and intervention to prevent MTCT of HIV during antenatal period. According to WHO Option B and B+, HIV positive mothers who received ART as early as 14 weeks of gestation had greater reduction of vertical transmission of HIV.10 A study conducted in Johannesburg, South Africa indicated that advanced gestational age at treatment initiation and loss to follow-up are some of the major challenges affecting PMTCT programme at integrated antenatal and HIV clinics.18

**Age of mother**

This study showed that mothers in the higher age group had more infants with positive DNA PCR results; maternal age did not predict infants HIV status. A similar study by Coetzee et al9, though in an urban setting in South Africa, had shown that maternal age greater than 25 years was the only significant risk factor associated with MTCT. In the Coetzee et al9 study, zidovudine was provided to the HIV-infected mothers from 34 weeks gestation as opposed to 28 weeks at Levai Mbatha CHC

**Marital status**

The fact that documentation regarding support structure is hardly found in antenatal records, marital status has been used as a proxy indicator to assess the availability of support structure to women attending antenatal clinics. It has been shown that the family plays a significant role in the prevention of MTCT of HIV infection to unborn children.19

In our study, marital status of the mothers was not associated with the DNA PCR results of their infants. However, in a study conducted by Meyers et al in Johannesburg, lack of support for HIV-infected mothers is one of the factors identified as worsening MTCT outcomes.20 However, it was not the focus of our study to explore whether or not marital status had any relationship with the support received by an HIV-infected mother from her spouse.

## Limitations of the study

The study did not measure adherence to prophylactic treatment in the infants. The lack of data on co-morbidities in HIV-infected pregnant women is a drawback to our study. In addition, only booking CD4 count was obtained for analysis in this study; whether the peri-partum CD4 count will yield significant association with the rate of MTCT of HIV remains uncertain. Self-reporting of relevant data might introduce bias to our findings on choice of infant feeding. We were unable to confirm if the infants had received the choice of feeding documented in the medical records of each participants. We were unable to obtain data on adherence to dual or HAART in the mothers and their infants.

## Strengths of the study

The evaluation of PMTCT programme provided potential indicators of MTCT of HIV as well as better understanding of the field performance of these interventions. The study finding is meant to further strengthen the implementation of PMTCT programme at PHC level in public health system. The study also guide the appropriateness of antenatal, intrapartum and postpartum prophylaxis therapy from WHO Option A, B and B+ for elimination of MTCT of HIV.

## Conclusion

The rate of MTCT of HIV at Levai Mbatha CHC was reduce by six times from the approximately 30% without intervention to 4.9% with implementation of PMTCT programme. The PMTCT programme at Levai CHC is relatively effective and has achieved outcomes comparable to what is obtainable from similar settings. The success of the PMTCT programme at Levai Mbatha CHC is within the policy framework of the South African Department of Health (SADoH). The study demonstrates the capabilities of well-coordinated CHCs in a semi-rural setting to deliver effective and successful PMTCT programme. Low CD4 count and prophylaxis in labour among HIV-infected mothers as the two significant factors associated with the MTCT of HIV. The implementation of WHO Option B+ approach by SADoH for public health system will further strengthening the PMTCT programme and it is a step ahead towards elimination of MTCT of HIV.

**Conflict of interests**

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