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# Epidemiologic assessment of prevention of vertical transmission of HIV

Avaliação epidemiológica da prevenção da transmissão vertical do HIV

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## Keywords

Maternal-child nursing; Nursing care; Skilled nursing facilities; Vertical infectious disease transmission/prevention & control; HIV; Epidemiology

## Descritores

Enfermagem materno-infantil; Cuidados de enfermagem; Instituições de cuidados especializados de enfermagem; Transmissão vertical de doença infecciosa/prevenção & controle; HIV; Epidemiologia

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## Abstract

**Objective:** To assess actions directed toward prevention of vertical transmission of HIV.

**Methods:** Epidemiological and documental study with 1,364 seropositive pregnant women notified in the Notifiable Diseases Information System over ten years. Data were expressed as frequencies, and linear regression analysis was applied. The analysis was conducted by using the statistical software R, version 2.12.1.

**Results:** The number of notified cases of seropositive pregnant women increased during the 10-year period; 41.72% of women used antiretroviral therapy in the prenatal period and 84.53% of women did prenatal care. The prevalence of cesarean delivery was 63.12%; 67.01% of parturients used antiretroviral during labor and 71.48% of children started therapy within the first 24 hours of life.

**Conclusion:** Actions directed toward prevention of vertical transmission of HIV are partly effective because less than the half of infected pregnant women used antiretroviral therapy in the prenatal period.

## Resumo

**Objetivo:** Avaliar as ações direcionadas à prevenção da transmissão vertical do HIV.

**Métodos:** Estudo epidemiológico e documental constituído por 1364 gestantes soropositivas notificadas no Sistema de Informação de Agravos de Notificação no período de dez anos. Os dados foram expressos em frequências e uma análise de regressão linear foi aplicada. Utilizou-se para a análise estatística software R versão 2.12.1.

**Resultados:** Houve ascensão nos casos notificados de gestantes soropositivas no período; 41,72% usaram terapia antirretroviral no pré-natal; a cobertura pré-natal foi de 84,53%; houve 63,12% de prevalência de partos cesáreos; 67,01% das parturientes usaram antirretrovirais durante o parto e 71,48% das crianças iniciaram a terapia nas primeiras 24 horas de vida.

**Conclusão:** As ações direcionadas à prevenção da transmissão vertical do HIV são parcialmente efetivas porque menos da metade das gestantes infectadas usaram terapia antirretroviral no período pré-natal.

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Conflicts of interest: none reported.

## Introduction

The acquired immune deficiency syndrome is an important health priority throughout the world. Although significant progress has been made toward preventing new human immunodeficiency virus (HIV) infections and reduce annual deaths related to this disease, the number of individuals living with the virus continues to grow.

The growing number women infected with HIV is associated with such problems as a high number of infected women of reproductive age. In Brazil from 2000 to 2009, 66% of seropositive women were age 20 to 39 years, a statistic that reflects increased risks of vertical transmission of HIV.<sup>(1)</sup>

In Brazil, the prevalence of HIV infection among pregnant women is 0.41%, and it is estimated that 12,456 newborns are exposed to the virus each year. Vertical transmission can occur during gestation, labor, or delivery or in breastfeeding. Approximately 35% of vertical transmission occurs during gestation, and 65% occurs in labor; during breastfeeding, the risk increases from 7% to 22%.

<sup>(1)</sup> Vertical transmission is the main route for HIV infection in children and is responsible for 90% of HIV infections in children younger than age 13 years in Brazil.

The Brazilian Ministry of Health has developed measures to be taken prenatally, during delivery, and in the puerperium period among HIV seropositive women. When these measures are implemented in their entirety, they reduce the rate of vertical transmission of HIV from 25% to 1%–2%. The main measures are the use of antiretrovirals from the 14th week of gestation, use of zidovudine injection during labor, cesarean delivery, and, when indicated, the use of oral antiretrovirals for newborns exposed from birth through the 42nd day of life; the child should be formula-fed, not be breastfed, up to six months of age.

In this context, epidemiologic surveillance is considered an important way to control vertical transmission of HIV. Also needed are studies on this subject that investigate the dimension of the problem and the local reality over time; such studies can collect epidemiologic data that are

needed to perform directed preventive measures and plan new proposals to control the vertical transmission problem.

Considering this, it is relevant to assess actions directed toward the prevention of vertical transmission of HIV, verify frequencies of cases in seropositive women, and ascertain the sociodemographic and obstetric profile of vertical transmission cases. This epidemiologic study assessed actions for preventing vertical transmission of HIV in a state in northeast Brazil.

## Methods

This was an epidemiological, documental and descriptive study with a quantitative approach conducted in January 2011 in the Secretary of Health of the state. We included 1,364 seropositive pregnant women who were registered in the Notifiable Diseases Information System between 2000 and 2009 in a state in northeast Brazil.

The investigation period was chosen because reporting of cases of HIV infection in pregnant women and children became compulsory in Brazil in 2000. In addition, 2000 was the year in which the program of humanization during the prenatal period and birth was implemented; this is considered a milestone for implementation of policies directed to the health of mothers and children.

The change made in 2006 in the forms used by the Notifiable Diseases Information System concerning seropositive pregnant women and children exposed to HIV is important to highlight. The “notification/investigation of HIV-positive pregnant women and children exposed to HIV” form, used until 2006, was divided into two new forms: “notification/investigation of HIV infected pregnant women” and “children exposed to HIV.” These two forms are used currently. However, the latter is used only to notify and is not recorded in the Notifiable Diseases Information System; as a result, this information could not be obtained for our study.

Results are presented in tables and expressed as absolute and relative frequencies. A linear

regression analysis was applied to describe the behavior of the following data: frequencies of seropositive pregnant women for one year and the use of antiretrovirals in the prenatal period and after delivery in the state studied. Dispersed charts of these data were plotted.

To verify presupposed linearity and normality of the residues of linear regression, the Pearson correlation coefficient were calculated ( $r=0.9231$ ;  $p=0.0001$ ) and the Shapiro-Wilk test was used ( $W=0.9678$ ,  $p$  value =  $0.087020$ ). This statistic shows that two presuppositions were confirmed. For analysis of the adjusted model, the determination coefficient was calculated ( $R^2$ ). Analyses were conducted with the statistical software R version 2.12.1.

Development of this study followed national and international ethical and legal aspects of research in human subjects.

## Results

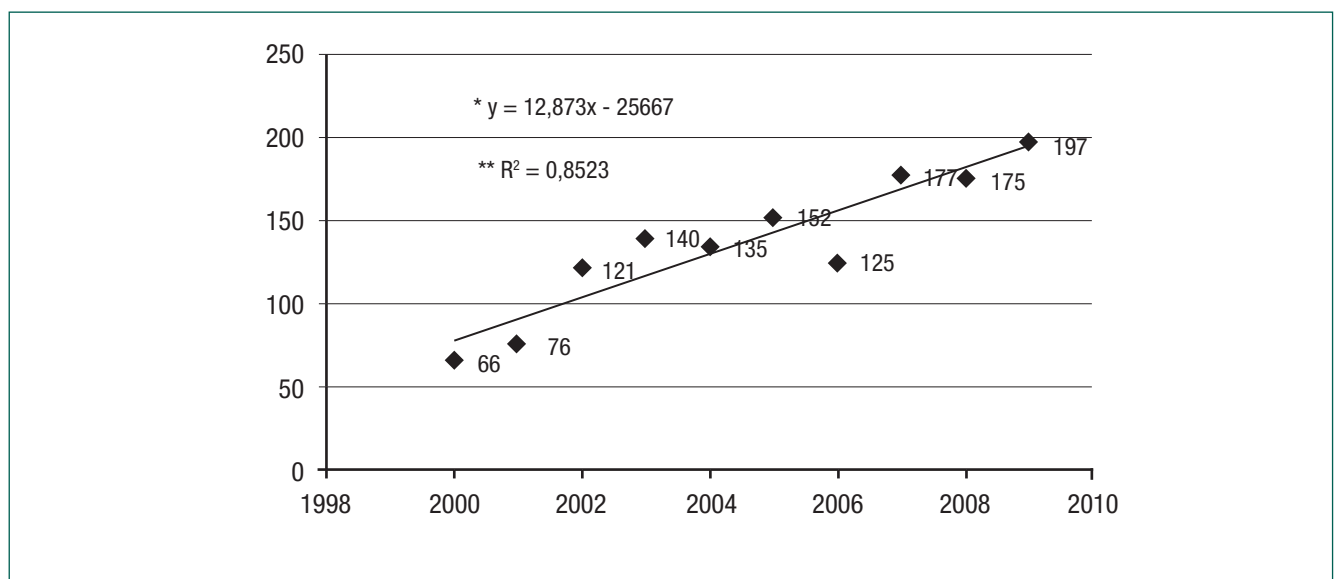
Between 2000 and 2009, this study identified 1,364 seropositive pregnant women in north-east state of Brazil. The most prevalent age of infection was 20 to 34 years (65.7%), and the duration of formal education among the infected women was 4 to 7 years (23.02%), with a total of

500 (37.32% of women) with up to seven years of study. Most of women were Pardo (mixed race Brazilians). It is important to emphasize the large number of items on the form that were ignored or left blank. The item on education was the ignored the most; almost half of participants left it blank (43.62%).

For the distribution of laboratory evidence of HIV in seropositive pregnant women in the state between 2000 and 2009, most confirmed diagnoses of HIV positivity in pregnant women occurred during the prenatal period, with 675 (49.49%) cases, followed by diagnosis before pregnancy, 406 (29.76%). Laboratory evidence after delivery was seen in 116 women (8.5%). A total of 108 women (7.92%) were diagnosed with HIV infection during labor; 59 (4.33%) ignored this item on the form or left it blank.

Most of pregnant women infected with HIV during the study period had cesarean delivery (861 of deliveries [63.12%]), followed by vaginal delivery (209 [21.33%]). A total of 212 women did not provide this information (15.54%).

This analysis showed a growing predominance of HIV-positive women who did prenatal care, totaling 1,153 women (84.53%). However, the number of women who did not conduct the prenatal is a concern: 70 (5.13%) (Figure 1).



$n=1,364$ ; linear regression model: \*intercept and inclination; \*\* coefficient of determination

**Figure 1.** Frequency of seropositive pregnant women

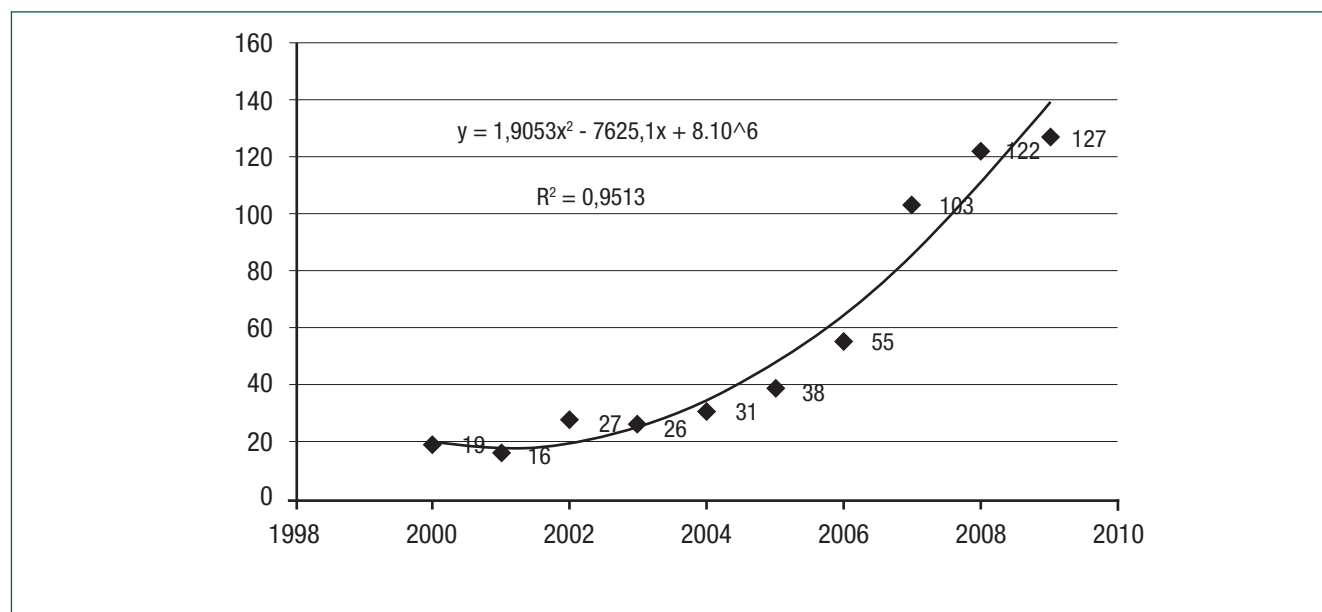
The absolute frequency of HIV-positive pregnant women in this northeast state of Brazil increased from 66 in 2000 to 197 in 2009. The adjusted linear regression model showed that for each unit of time, there was an increase of 12.873 in absolute frequency of seropositive pregnant women per year ( $r=0.3538$ ,  $t=1.0701$  gl=8,  $p=0.3158$ ). The coefficient of determination shows that 85.23% of absolute frequency range of seropositive women is explained by time variation. It is important to highlight that a weak linear correlation was identified between proportions of notified HIV-positive women during the study period.

Figure 2 shows that use of antiretroviral medicines in seropositive pregnant women showed a second-degree polynomial behavior, which reflected an important increase throughout the study period with regard to use of therapy. A total of 569 pregnant women (41.72%) used antiretroviral therapy. The adjusted linear regression model showed that for each unit of time, use of antiretrovirals during the prenatal period increased 1.90 per year ( $r=0.3538$ ,  $t=1,070$  1gl=8,  $p=0.3158$ ). The coefficient of determination showed that 95.13% of variations in the use of antiretroviral therapy is explained by time variation. Until 2005, the use of antiretroviral during the prenatal period was quite low, but from 2007 onward, use of these medicines

increased because of the 2007 launch of the National Plan for Reduction of Vertical Transmission of HIV and Syphilis.

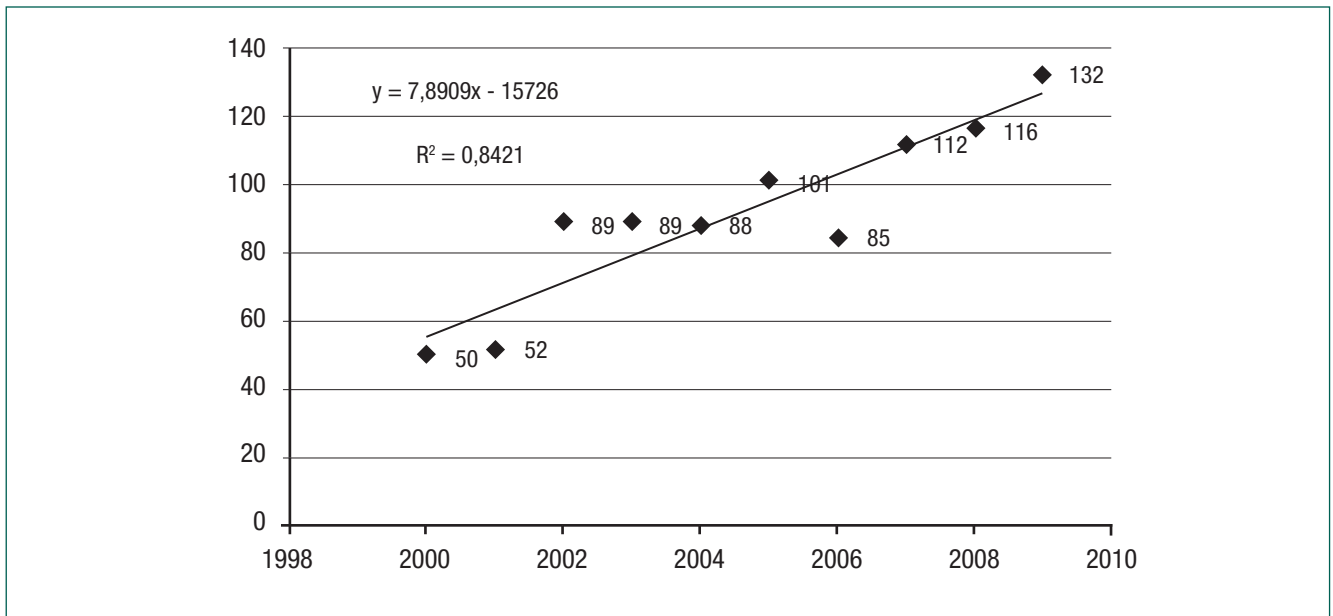
From figure 3 we can infer that 914 (67.01%) parturients had used antiretrovirals during labor and that use increased each year. The adjusted linear regression model showed that for each unit of time the use of antiretroviral therapy during labor increased 7.89 per year ( $r=0.3538$ ,  $t=1.0701$  gl=8,  $p=0.3158$ ). The coefficient of determination showed that 84.20% of the range of antiretroviral use during labor is explained by time variation. Figure 3 also shows the significant increase in antiretroviral therapy since 2007.

The data analysis showed that 975 (71.48%) children started antiretroviral prophylaxis within the 24 hours after birth, 24 children (1.76%) started it after 24 hours, 233 (17.08%) cases were ignored, 119 (8.72%) cases were notified and classified as non-applicable, and 13 (0.95%) children did not receive prophylaxis. The use of antiretroviral therapy within the first 24 hours was high throughout the period and higher than the other variables. In addition, data on prophylaxis in children were similar to those reported in figures 2 and 3 and reflected an increase in the percentage of antiretroviral therapy use since 2007.



n=1364; linear regression model: \*interception and inclination; \*\* coefficient of determination

**Figure 2.** Distribution of antiretroviral use by seropositive pregnant women during the prenatal period



n= 1,364; linear regression model: \*interception and inclination; \*\* coefficient of determination

**Figure 3.** Distribution of antiretroviral use by seropositive pregnant women during labor

## Discussion

Limitations of this study are related to the secondary source of the information; we could not verify the accuracy of the recorded data. In addition, the high number of items that were left blank compromised the assessment quality and reinforced the limitations of documental studies.

Despite these obstacles, the conduction of this type of epidemiologic research seems relevant, particularly because these studies can provide evidence of the local reality and enable health care professionals, such as nurses, to assess the problem and both plan and implement preventive measures. The enhancement of information provided by the database and the training of health professionals are essential to promote adequate assessment for prevention of vertical transmission of HIV.

According to Figure 1, we verified an increase in absolute frequency of seropositive pregnant women in northeast Brazil between 2000 and 2009. This increased during the study period shows the need to intensify the creation of strategies to prevent and reduce the increase of HIV infection among pregnant women; prevention is important because of the in-

creased risk for vertical transmission associated with infection during gestation.

However, this increase can also be explained by an improvement in notification of cases during the study years. In 2006, the single form for notification of HIV-positive pregnant women and children exposed to HIV was replaced with two separate forms for women and children. This may have improved the problem with under-notifications because from 2007 to 2009 a high absolute number of notified cases was observed.

However, the improvement could also reflect the contribution of programs that affected basic care in Brazil over the last ten years, such as the Family Health Strategy, the National Program of Humanization in Labor and Birth, the Birth Project, and the Operational Plan of Reduction of Vertical Transmission of HIV and Syphilis.

Most HIV-infected pregnant women were 20 to 34 years of age, an expected finding because this is the most prevalent age range for reproduction. These results reflect Brazil's general data; on average, 55% of notified cases occur in pregnant women aged 20 to 29 years.

The higher prevalence of registered cases occurred in women with less than seven years of edu-

cation (509 [37.32%]), a finding that shows a low formal education level. Previous studies have shown a proportionally inverse relation between the duration of education and the occurrence of HIV infection in pregnant women.<sup>(2,3)</sup>

Almost half (50.44%) of notified cases were in women of Pardo race; this is also a predictable result because this race predominates in the region in which this study took place. However, considering this item, the number of items left blank was high (32.04%). The great diversity concerning race in earlier studies reflects the aspect with higher ranging and inconsistency in studies among all regions of the country; entries on race are often ignored or omitted on notification forms.<sup>(3,4)</sup>

A high proportion of diagnoses of HIV infection among pregnant women was observed during prenatal visits (49.49%), a finding that corroborates results of other studies.<sup>(5,6)</sup>

An increase in the number of seropositive pregnant women during prenatal visits was observed throughout the years. This increase reveals important data because the prenatal visit is often one of the only times that the women present to health service. At that time they have the chance to be tested for HIV, thereby enabling appropriate measures to prevent vertical transmission.

Although prenatal visits among seropositive women of our study was high (84.53%), this number is within the range of coverage estimated at the national level (85%). This finding points out the need for improvement in basic health actions of this northeast state concerning stimulation of pregnant women to attend prenatal visits. In addition, other studies with seropositive women revealed a higher prenatal coverage than that found in our study, with percentages between 92.7% and 97.7%.<sup>(4,5)</sup>

The prevalence of cesarean deliveries found in our study is compatible with other studies. In such cases, professionals based the procedure on guidelines issued by the Brazilian Ministry of Health on elective labor; however, this type of delivery should not be a rule because seropositive women can also undergo vaginal delivery, depending on clinical and obstetric conditions of the case. Hence, a risk-benefit assessment of each type of labor should be taken

into account, and the wishes of the pregnant woman should be also considered.

One of main factors contributing to reduction of vertical transmission of HIV is the use of antiretroviral drugs according to recommendations for gestation, labor, and the exposed child. It is clear that massive and universal implementation of prophylactic actions has led to a progressive reduction in vertical transmission of HIV.

Figures 2 and 3 show an exponentially increase in the use of antiretroviral therapy since 2007 during the prenatal period and labor and among exposed children. This coincides with the launch of the Operational Plan for Reduction of Vertical Transmission of HIV and Syphilis, and perhaps is due to implementation of this plan.

This growth can be also associated with the fact that, in 2006, the notification form for HIV-positive pregnant women and exposed children was replaced by a notification form solely for HIV-infected pregnant women. This could explain the increase in notification indices and, consequently, in the numbers of women using antiretroviral therapy.

Despite the progress since 2007, figure 2 shows concerning data related to the reality of prenatal care delivery in the northeast state: less than half of pregnant women used antiretroviral prophylaxis in that occasion. Thus, the following question is raised: if more pregnant women are diagnosed during the prenatal period, according to results of our study, why did they not receive prophylaxis during that period?

Based on this assumption, some hypotheses can be raised, such as the lack of training for professionals who deliver care for seropositive women, the lack of initiation of antiretroviral therapy, the refusal of the pregnant woman to begin therapy, the unavailability of medicines, or even the bureaucracy of the specialized service to which these pregnant women were referred. This fact can make it difficult to follow up on and implement adequate treatment. These deficiencies in prenatal care are evident, and they compromise the quality of care delivery for these seropositive women and increases the risks of vertical transmission in the northeast state.

An important point to be emphasized concerns the use of antiretrovirals during the prenatal peri-

od. Such use is not sufficient, but for complete and efficacious prophylaxis, medicines must be used between 14 and 28 weeks of gestation, according to the Brazilian Ministry of Health<sup>(4)</sup>: the later the treatment is started the higher the risks of infection in the child. However, the assessment of such information was impossible after the implementation of the new form, because this information was removed from the current form.

Figure 2 shows that 67.01% of parturients used antiretrovirals during labor. This result is better than the percentage using antiretroviral therapy in the prenatal period; however, a significant number of parturients did not receive prophylaxis, a concerning finding given that labor is the most critical period and presents the greatest risks for vertical transmission. Moreover, it is unacceptable that such a high percentage of pregnant women did not receive antiretroviral therapy, especially because 87.17% of them discovered their serologic status during labor or before it.

Another problem of the notification form is the lack of questions on the starting time of intravenous zidovudine in the intrapartum period, given the fact that it is indicated at least three hours before cesarean delivery and as soon as labor begins in the case of vaginal delivery.<sup>(7)</sup>

Hence, the revision of the current form so that it reflects aspects relevant to vertical transmission, which currently are not covered, could improve assessment and provide higher-quality and more accurate surveillance.

We observed that antiretroviral prophylaxis in children born of seropositive women was started within 24 hours after birth in 71.48% of cases. This was the highest percentage of prophylaxis use when compared to prenatal and labor use. However, 13 (0.95%) children did not receive prophylaxis.

Although antiretroviral therapy use in children was high compared with other measures, we found that the percentage of children who used prophylaxis was lower than expected. This is especially relevant because another study conducted in the same region observed the possibility of wider coverage, corresponding to a 91% rate of antiretroviral syrup use within the 24 hours of newborn life.

For this reason, based on numbers found, there is still a long way to go concerning actions for preventing vertical transmission of HIV in the northeast state until it reaches ideal results. Preventive measures should be broadened, improved, and prioritized in order to decrease vertical transmission of HIV to undetectable levels.

Actions toward prevention of vertical transmission of HIV in the northeast state of Brazil in our study followed Brazilian Ministry of Health guidelines concerning serologic test to detect HIV in the prenatal period or as early as possible so that antiretroviral therapy can be used prenatally and during labor, as well as in children exposed within the first 24 hours of life. However, indices found were below what was expected. The most alarming finding was that less than half of pregnant women used the antiretroviral prophylaxis during the prenatal period, indicating the need for urgent intervention measures for effective prevention of vertical transmission of HIV.

## Conclusion

Actions toward prevention of vertical transmission HIV are partially effective because less than half of infected pregnant women used the antiretroviral therapy in the prenatal period.

## Acknowledgments

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## Collaborations

Costa Lima ACMACC contributed to the project design, conduction of the research, drafting the article, critical revision of the important intellectual content and final approval of the version to be published. Costa CC contributed to the project design, drafting the article, critical revision of the important intellectual content and final approval of the version to be published. Teles LMR; Dama-

sceno AKC and Oriá MOB contributed to analysis and interpretation of data, critical revision of the important intellectual content and final approval of the version to be published.

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