Vertical transmission of HIV, Where do we stand? Study done in PPTCT center – in a tertiary level of hospital of Western Rajasthan

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Abstract

Background: Human immunodeficiency virus (HIV) infection in pregnant women has an important role in its spread to the pediatric population through vertical transmission. Effective utilization of Prevention of Parent to Child Transmission (PPTCT) services can reduce this spread. This study aims to determine the vertical transmission of HIV, the seroprevalence of HIV in antenatal women, demographic factors of seropositive women, and utilization of PPTCT services to minimize the risk of mother-to-child transmission.

Methods: This study was conducted to assess vertical transmission of HIV in the newborn of HIV pregnant women attending antenatal clinic (ANC) of a tertiary care hospital from August 2014 to December 2020. Pretest counseling, HIV testing, and posttest counseling were done as per National AIDS Control Organization (NACO) guidelines. Antiretroviral prophylaxis was given to seropositive women and their children. Analysis of demographic data of seropositive women and assessment of the utilization of PPTCT services were done according to available records.

Results: In the study time, 139,619 new antenatal registrations were there, 68.21% of women attended pretest counseling and of them, 95.28% gave consent for HIV testing. Out of which, 0.14% were reported as HIV seropositive in PPTCT (tested according to NACO guidelines). In the study time, a total of 188 HIV-positive deliveries were conducted in our institute. Out of which, 144 (76.6%) were ANC-booked patients and 44 (23.4%) were unbooked patients and directly came in labor, deliveries were conducted according to NACO guidelines and all newborns were given nevirapine syrup. All newborns were followed up until 18 months and in study time, 78 dry blood samples (DBSs) were sent for DNA polymerase chain reaction (PCR) detection and all were reported negative by the reference laboratory at AIIMS, New Delhi. Conclusions: Adherence to testing, treatment, and follow-up in the antenatal and postnatal period can minimize the risk of HIV transmission from mother to child.

Keywords: ANC, ART, DBS, EID, HIV, ICTC, NACO guidelines, PPTCT

Introduction

In India, the Prevention of Parent to Child Transmission of HIV/AIDS (PPTCT) program was started in 2002. Currently, there are more than 4,000 integrated counseling and testing centers (ICTCs) in the country.[1]

Transmission of HIV infection is primarily the result of risk behavior. Hence, the National AIDS Control Program (NACP) emphasizes risk reduction—through Information, Education, and Communication (IEC)—within the general population and through targeted intervention (TI) programs among high-risk groups.

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The HIV status of an infected individual can be reliably determined only by laboratory testing. The National HIV testing strategies are defined by the national program and are aimed at obtaining an accurate result.\[2\]

The National AIDS Control Organization (NACO) has established a network of laboratories, which includes ICTCs, SRLs, NRLs, and PPTCT. Designated National Reference Laboratories (NRLs) and State Reference Laboratories (SRLs) will be responsible to confirm the presence of HIV-2 infection. Laboratories (NRLs) and State Reference Laboratories (SRLs) established a network of laboratories, which includes ICTCs, SRLs, NRLs, and PPTCT. Designated National Reference Laboratories (NRLs) and State Reference Laboratories (SRLs) will be responsible to confirm the presence of HIV-2 infection. NACP launched PPTCT of HIV in the year 2001–2002. PPTCT program aimed to prevent perinatal transmission by interruption at different levels. This access to HIV testing services to all pregnant women enrolled for antenatal care (ANC) with provision of drug antiretroviral therapy (ART) prophylaxis with nevirapine in a single dose at the time of delivery led to the decline in pediatric HIV seropositivity.

Patients with an HIV-positive report must be referred to the nearest ART center for care, support, and treatment by the ICTC or PPTCT. This would help to provide early protection against mother-to-child transmission (MTCT) for future pregnancy and also it can reduce HIV risk in discordant couples and improve health. Counseling and screening are a must to detect HIV infection and to improve access to HIV awareness.\[2\]

**Aim of Study**

1) To study the vertical transmission of HIV in newborns delivered at a tertiary level hospital.

2) To study follow-up HIV testing of all newborns up to 18 months.

**Method**

This was a hospital-based prospective study done from August 2014 to 2020 at a PPTCT center in a tertiary level hospital. In study time, a total of 139,619 pregnant women attended ANC. Their pretest, posttest counseling, and HIV test were done according to NACO guidelines after taking written consent and all HIV-positive females were linked to ART for further management and were advised institutional delivery. All newborns were given nevirapine syrup till 6 weeks of age. After 6 weeks, dry blood samples (DBSs) were taken according to NACO guidelines and were sent to AIIMS, New Delhi for HIV DNA PCR testing. Follow-up of all newborns was done up to 18 months and at 6, 12, and 18 months, a repeat HIV testing was done according to NACO guidelines.\[2\]

**Testing procedures**

HIV testing facilities are being provided free of cost by NACO and Rajasthan State AIDS Control Society (RSACS) at ICTCs. The commonest method to diagnose HIV infection is by detection of the presence of antibodies to HIV in the blood of an HIV-infected person.

Rapid tests used to diagnose HIV infection provide quick results. A variety of rapid tests are available and employ different principles. NACO recommends the use of rapid HIV test kits, which provide results within 30 min. Rapid test kits with a detection rate >99.5% of all HIV-infected individuals and false positive results in <2% of all those who are tested are recommended for general use. Testing is done free of cost in ICTCs in the government health sector in all stand-alone facilities providing ICTC supported by RSACS.

A person who has a negative result in one test is declared to be HIV-negative. A person is declared to be HIV-positive when the same blood sample is tested three times using kits with different antigens/principles and the result of all three tests is positive.\[3\] Emergency testing is done for women with an unknown HIV status and in labor, the labor room nurses, resident doctors, or medical officer provides basic information on HIV/AIDS and about HIV testing. Thereafter, a single HIV test will be offered to determine the HIV status of the pregnant woman and requirements for antiretroviral prophylaxis to prevent MTCT. A repeat sample is collected and tested on the next working day at ICTC to confirm the HIV status.

HIV pretest information/education/counseling involves providing basic information on HIV and risk assessment to pregnant women attending ICTC. HIV posttest counseling helps pregnant women to understand and cope with the HIV test result:

In case of a negative test result, the counselor reiterates basic information on HIV and educates to adopt behavior that reduces the risk of getting infected with HIV in the future. In case the pregnant woman is in the window period, a repeat test is recommended.

In case of a positive test result, the ICTC counselor assists and educates to understand the implications of the positive test result and helps in coping with the test result. The counselor also ensures access to treatment and care and supports disclosure of the HIV status to the spouse.

Follow-up counseling includes reemphasis on the adoption of safe behavior to prevent transmission of HIV infection to others. Follow-up counseling also includes establishing linkages and referrals to services for care and support including antiretroviral therapy, nutrition, home-based care, and legal support.\[4\]

**Results**

In study time 139,619 pregnant females attended ANC clinic [Table 1]. Out of which, 9529 (68.21%) pregnant females were precounseled, and after consent HIV test was done in 90,738 (95.28%) females. Out of 90,738 pregnant females, 135 (0.14%) females were reported HIV-positive in PPTCT center [Table 2]. In our hospital, 188 (0.13%) HIV-positive deliveries were conducted, of which 144 (76.6%) were ANC-booked patients and 44 (23.40%) patients came directly
Table 1: Showing spectrum PPTCT data in study time

| Data                  | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | Total | % |
|-----------------------|------|------|------|------|------|------|------|-------|---|
| Total ANC             | 12,561 | 29,304 | 26,273 | 17,624 | 18,875 | 17,563 | 17,419 | 13,961 | 60.00 |
| Counseling            | 6451 | 11,548 | 15,854 | 14,364 | 14,936 | 15,768 | 16,308 | 9,5229 | 68.21 |
| Testing               | 5950 | 9,461 | 14,225 | 14,335 | 14,881 | 15,760 | 16,126 | 9,0738 | 95.28 |
| Wrong address         | 0    | 0    | 0    | 0    | 3    | 1    | 1    | 5     | ---- |
| HIV positive          | 0    | 25   | 27   | 15   | 23   | 15   | 17   | 135   | 0.14 |
| ART                   | 18   | 25   | 27   | 15   | 23   | 15   | 10   | 133   | ---- |
| Refuse ART            | 2    | 0    | 0    | 0    | 0    | 0    | 0    | 2     | ---- |
| Total HIV Positive Delivery | 37   | 20   | 19   | 32   | 29   | 19   | 32   | 100 N/R | 100.00 |
| Booked                | 34   | 15   | 9    | 21   | 23   | 13   | 29   | 144   | 76.6 |
| Unbooked              | 3    | 5    | 10   | 11   | 6    | 6    | 3    | 44    | 23.40 |
| Live                  | 37   | 16   | 19   | 32   | 27   | 14   | 32   | 177   | ---- |
| Dead                  | 0    | 4    | 0    | 0    | 2    | 1    | 0    | 7     | ---- |
| Follow-up             | ------ | ------ | ------ | ------ | ------ | ------ | ------ | ------ | ---- |
| Lost to follow-up     | ------ | ------ | ------ | ------ | ------ | ------ | ------ | ------ | ---- |
| 18 months             | ------ | ------ | ------ | ------ | ------ | ------ | ------ | ------ | ---- |

Table 2: Showing spectrum of HIV Positivity in study time

| Year | Total testing of HIV | HIV-positive | Percentage (%) |
|------|----------------------|--------------|----------------|
| 2014 | 5950                 | 20           | 0.33           |
| 2015 | 9461                 | 25           | 0.26           |
| 2016 | 14,225               | 27           | 0.1            |
| 2017 | 14,335               | 15           | 0.10           |
| 2018 | 14,881               | 23           | 0.15           |
| 2019 | 15,760               | 15           | 0.09           |
| 2020 | 16,126               | 10           | 0.06           |
| Total | 90738               | 135          | 0.15           |

Over the years, HIV has spread rapidly from urban to rural areas in India and from high-risk groups to the general population and is heterogeneous in its spread.[6,7]

The NACO Technical Estimate Report (2015) estimated that out of 29 million annual pregnancies in India, 35,255 occur in HIV-positive pregnant women. In the absence of any intervention, an estimated (2015) cohort of 10,361 infected babies will be born annually.[8]

The PPTCT program aims to prevent the perinatal transmission of HIV from an HIV-infected pregnant mother to her newborn baby.[9]

In the present study, the total number of ANC tested for HIV infection was decreasing continuously from August 2014 to 2020. The overall seroprevalence of HIV infection in pregnant women is 0.14% (135/90738). Pretest and posttest counseling was improved from 33853 (2014–2016) to 61376 (2017–2020). This may be due to increased awareness and availability of HIV testing in various centers (like PPTCT, ICTC) and counseling for institutional deliveries.

In a study by Kwatra et al.[10], a total of 12,719 pregnant women attending the antenatal clinic, 10,491 (82.48%) were accepted for pretest counseling and HIV testing. A total of 145 women were found to be seropositive with a seroprevalence rate of 1.38%. Although a study done by Gupta et al. in north India revealed that the prevalence of HIV was found to be 0.88%.[10]

Similarly, Mehta et al.[11] study indicates a lower trend of HIV prevalence. In his study seropositivity of HIV was 0.38%.

Different authors have reported different seropositivity rates, ranging from 0.1% to 2.3%. Maitra et al.[12] reported seropositivity of 0.4–1.09% in Gujarat. Parmeshwari et al.[13] reported a seroprevalence of 1.14% (2002) and 0.7% (2007) among antenatal women. Joshi U et al. reported a seroprevalence of 0.35% (2006–2007).

Discussion

India’s socioeconomic status, traditional social ills, cultural myths on sexuality, and people who are excluded from mainstream social, economic, and cultural life make it extremely vulnerable to HIV/AIDS.[5]
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Table 3: Status of HIV Positive pregnant females and their pregnancy outcome

| Year          | HIV-positive delivered | Booked | Unbooked |
|---------------|------------------------|--------|----------|
|               | Live child delivered   |        | Dead child |
| August 2014   | 37                     | 37     | 0        | 34        | 3 |
| 2015          | 20                     | 16     | 4        | 15        | 5 |
| 2016          | 19                     | 19     | 0        | 9         | 10 |
| 2017          | 32                     | 32     | 0        | 21        | 11 |
| 2018          | 29                     | 27     | 2        | 23        | 6  |
| 2019          | 19                     | 14     | 1        | 13        | 6  |
| 2020          | 32                     | 32     | 0        | 29        | 3  |
| 7 years (Total)| 188                    | 177    | 7        | 144       | 44 |

Table 4: Showing follow up description of HIV positive pregnant patients and their treatment seeking behaviour

| Year          | HIV-positive in ANC | Status of spouse | HIV-positive delivered | ART linked | ART refused | Wrong addresses |
|---------------|---------------------|------------------|------------------------|------------|-------------|-----------------|
|               | registered booked   | Positive | Negative |
| August 2014   | 20                  | 1       | 6     | 37         | 18        | 2              | 0               |
| 2015          | 25                  | 0       | 2     | 20         | 25        | 0              | 0               |
| 2016          | 27                  | 0       | 7     | 19         | 27        | 0              | 0               |
| 2017          | 15                  | 0       | 6     | 32         | 15        | 0              | 0               |
| 2018          | 23                  | 0       | 5     | 29         | 23        | 0              | 3               |
| 2019          | 15                  | 10      | 5     | 19         | 15        | 0              | 1               |
| 2020          | 10                  | 5       | 5     | 32         | 10        | 0              | 1               |
| 7 years (Total)| 135                 | 16      | 36    | 188        | 133       | 2              | 5               |

Table 5: Follow up study of HIV Testing in Newborns up to 18 months

| Year     | Total sample sent for DBS | DBS result | 6 months follow-up | 12 months follow-up | 18 months follow-up | Final result |
|----------|---------------------------|------------|--------------------|---------------------|---------------------|--------------|
| August 2014 | ------------------------- |    |      |        |        |             |              |
| 2015     | ------------------------- | N/R        |        |        |        |             |              |
| 2016     | ------------------------- | N/R        |        |        |        |             |              |
| 2017     | ------------------------- | N/R        |        |        |        |             |              |
| 2018     | 30                        | N/R        | 30     | 18     | 8      | N/R         |
| 2019     | 25                        | N/R        | 23     | 20     | 28     | N/R         |
| 2020     | 23                        | N/R        | 22     | 20     | 16     | N/R         |
| 7 years (Total) | 78                  | N/R        | 75     | 58     | 52     | N/R         |

among antenatal women. The Rajasthan State AIDS Control Society (RSACS) reported 0.1%–0.2% seropositivity for 5 years (2006–2010). A Tamil Nadu Sentinel Surveillance showed that a median positivity rate of HIV infection among antenatal women was 0.65% in 2004 and 0.5% in 2005. HIV Sentinel Surveillance conducted by Maharashtra State AIDS Control Society (MSACS) revealed a decline in seropositivity among antenatal women from 1.25% (2005) to 0.75% (2006–2007) in urban areas.

These findings have significance as per the official data obtained from India’s NACO. The possible reason for ignorance about HIV infection could be a lack of knowledge about HIV infection. The risk of vertical transmission of HIV infection from mother to child during pregnancy, delivery, or breastfeeding is responsible.

Most of the deliveries occurred before the introduction of a triple-drug ART regimen for all pregnant women under the PPTCT program in India. In a study by Potty, the prevalence of pediatric HIV be 7.8% in maternally HIV-exposed children by age of 24 months.

Earlier, an overall MTCT rate of 18.6% was identified by the age of 18 months among HIV-exposed children born during 2005–2007 in West Bengal.

In a study conducted in the Ananthapur district, where all HIV-infected pregnant women were given triple ART regardless of the CD4 lymphocyte count, the MTCT rate reported was 3.7%. Studies conducted in Delhi and Ahmedabad found an overall MTCT rate of 8.3% and 8.5% among exposed children by 18 months of age, respectively.

The difference in results of MTCT in the studies mentioned above is probably related to the coverage of ART among HIV-positive pregnant women. The studies conducted in Delhi and Ahmedabad reported an ART coverage of 58% and 32%,
respectively, among mothers before delivery. However, the study in Anantapur included only the mothers who were on ART before delivery.[20-22]

In India, the PPTCT program was started in 2002 and the declining trend of seropositivity is seen afterward. This may be due to the success of the PPTCT program in the state. Initially in this program, HIV-positive pregnant women were given a single dose of NVP tablet at the time of labor; their newborn babies also get a single dose of syrup NVP within 72 h after birth to prevent transmission of HIV from mother to child, but recently according to newer guidelines (December 2013), syrup NVP to the infants should be continued for a minimum of 6 weeks after birth.[23] Among the babies of HIV-positive mothers who received full coverage of the PPTCT program, 85% HIV-negative status was achieved that indicated the protective role of NVP in vertical transmission.[24-26]

The main determinant of pediatric HIV infection is the scale and magnitude of adult HIV infection. There is an overall reduction of 57% in the new HIV infections per year among the adult population from 2.74 lakh in 2000 to 1.16 lakh in 2011, which demonstrates the impact of various preventive strategies under the NACP.[27]

Overall, in our study, 0.14% of pregnant women had been initiated on ART. In this study, vertical transmission of HIV infection in newborns who were regular in follow-up up to 18 months was zero. However, in our study as DNA PCR testing was not done in stillbirth deliveries.

As a protocol and NACO guidelines all newborn were given Nevirapine syrup. Mothers were advised to come for follow up HIV testing of Newborns up to 18 months.

According to NACO,[25] the transmission rate is 15%–35% if no intervention is undertaken, but if nevirapine is used it may reduce to 10%. MTCT (perinatal transmission) in a study by Khokher et al.[28] is 16.0%. Similar results have been reported by Vyas et al., Hooja et al., and Singal et al.[29] in their study (from 5.6%–12%). Parmeshwari et al., Diana et al., and Mary et al. (2008)[30] in their study have reported this transmission as 15%.

Recommendation and Conclusion

1. Mandatory HIV testing and counseling in all-new ANC should be done.
2. HIV tests of all pregnant females should be done at the level of CHC, PHC, Anganwadi, etc., Moreover, all HIV-positive pregnant females should be linked to ART centers for further management.
3. There should be 100% adherence for HIV treatment and follow-up. Institutional deliveries should be advised to minimize vertical transmission of HIV.
4. All newborns should be given HIV prophylactic treatment after birth. There should be 100% adherence for HIV treatment and follow-up. For emergency management availability of drugs should be ensured.
5. All positive females should continue their ARV therapy irrespective of CD4 count.

Limitation of the study

In our institute, DBS testing was done from 2018 hence DNA PCR test results of 104 newborns were not available. DBS testing was done only for those patients who came for follow-up.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Conflicts of interest

There are no conflicts of interest.

References

1. Sinha A, Roy M. An ICMR task force study of Prevention of parent to child transmission (PPTCT) service delivery in India. Indian J Public Health 2008;52:200-2.
2. NACO Updated Guidelines For Prevention of Parent to Child Transmission of HIV using Multidrug Antiretroviral Therapy in India; by National AIDS Control Organization Ministry of Health and Family Welfare Government of India 2017.
3. Government of India. National AIDS Control Organization, Department of AIDS Control, Ministry of Health and Family Welfare. Guidelines for HIV testing, March by National AIDS Control Organization Ministry of Health and Family Welfare Government of India 2007.
4. Government of India. National AIDS Control Organization, Department of AIDS Control, Ministry of Health and Family Welfare, Operational Guidelines for Integrated Counseling and Testing Centers, July 2007 by National AIDS Control Organization Ministry of Health and Family Welfare Government of India.
5. Singh S. Food crisis and AIDS: Indian perspective. Lancet 2003,362:1938-9.
6. UNAIDS-AIDS Epidemic Update: December 2006 [http://www.data.unaids.org]. [Last accessed on 2007 Jan 10].
7. Srikantn P, John TJ, Jayakumar H, Babu PG, Mathai D, Jacob M, et al. Epidemiological features of acquired immunodeficiency syndrome in Southern India. Indian J Med Res 1997;105:191-7.
8. Department of AIDS Control. Ministry of Health and Family Welfare. NACO Annual Report 2015-2016.
9. Kwatra A, Bangal VB, Shinde K, Padaliva K. HIV seroprevalence among the pregnant population and utilisation of integrated counselling and training centre facilities at a
teaching hospital in Rural Maharashtra. Australas Med J 2011;4:566-70.

10. Gupta S, Gupta R, Singh S. Seroprevalence of HIV in pregnant women in North India: A tertiary care hospital based study. BMC Infect Dis 2007;7:133.

11. Mehta KD, Antala S, Mistry M, Goswami Y. Seropositivity of hepatitis B, hepatitis C, syphilis, and HIV in antenatal women in India. J Infect Dev Ctries 2013;7:832-7.

12. Maitra N, Kavishvar AB, Dinkar A, Desai VA. Antenatal HIV testing. J Obstet Gynecol India 2006;56:36-8.

13. Parameshwari S, Jacob MS, Vijayakumari JJ, Shalini D, Sushi MK, Sivakumar MR. A program on prevention of mother to child transmission of HIV at government hospital, Tiruchengode taluk, Namakkal district. Indian J Community Med 2009;34:261-3.

14. Joshi Urvis, Kadri Anummadin, Bhojya S. Prevention of parent to child transmission services and interventions-coverage and utilization: A cohort analysis in Gujarat, India. Indian J Sex Transm Dis AIDS 2010;31:92-8.

15. Rajasthan State AIDS Control Society. sentinel surveillance report 2006-2010. Available from: http://www.rsacs.in/ICTC and PPTCT.html.

16. Tamil Nadu State AIDS Control Society. Sentinel surveillance report. Available from: http://www.aidsfreetn.com/output/antenatalclinic attendees.pdf.

17. HIV sentinel surveillance Maharashtra (2006-2007). Available from: http://www.mahaarogya.gov.in/programmes/nhp/aids/activities.htm.

18. Potty RS, Sinha A, Sethumadhavan R, Isaac S, Washington R. Incidence, prevalence and associated factors of mother-to-child transmission of HIV, among children exposed to maternal HIV, in Belgaum district, Karnataka, India. BMC Public Health 2019;19:386.

19. Mukherjee S, Ghosh S, Goswami DN, Samanta A. Performance evaluation of PPTCT (prevention of parent to child transmission of HIV) programme: An experience from West Bengal. Indian J Med Res 2012;136:1011-9.

20. Alvarez-Uria G, Midde M, Pakam R, Bachu L, Naik PK. Effect of formula feeding and breastfeeding on child growth, infant mortality, and HIV transmission in children born to HIV-infected pregnant women who received triple antiretroviral therapy in a resource-limited setting: Data from an HIV cohort study in India. ISRN Pediatr 2012; 2012:763591.

21. Gupta A, Singh G, Kaushik P, Joshi B, Kalra K, Chakraborthy S. Early diagnosis of HIV in children below 18 months using DNA PCR test—assessment of the effectiveness of PMTCT interventions and challenges in early initiation of ART in a resource-limited setting. J Trop Pediatr 2013;59:120-6.

22. Joshi U, Oza U, Solanki A, Vyas S, Modi H. Early infant diagnosis of HIV in India—early results and sero-positivity determinants. Open J Prev Med 2012;2:318-25.

23. NACO guidelines PPTCT, December 2013. Available from [Last accessed on 2015 Nov 30].

24. Mandal S, Bhattacharya RN, Chakraborty M, Pal PP, Roy SG, Mukherjee G. Evaluation of the prevention of parent to child transmission program in a rural tertiary care hospital of West Bengal, India. Indian J Community Med 2010;35:491-4.

25. Doherty T, Basser M, Donohue S, Kamoga N, Stoop N, Williamson L, et al. An evaluation of the Prevention of mother-to-child transmission (PMTCT) of HIV initiative in South Africa: Lessons and key recommendations. Health Systems Trust 2003:27 of 80. Available from: http://www.childrencount.ci.org.za/uploads/NSP-PMTCT-accesssto-HIV-testing-inpregnant-women.pdf. [Last accessed on 2015 Nov 30].

26. Welty TK, Bulterys M, Welty ER, Tih PM, Ndikintum G, Nkuoh G, et al. Integrating prevention of mother-to-child HIV transmission into routine antenatal care: The key to program expansion in Cameroon. J Acquir Immune Defic Syndr 2005;40:486-93.

27. Annual Report 2013-14 English — NACO | National AIDS, National AIDS Control Organisation (NACO), Department of AIDS Control (DAC), Ministry of Health and Family Welfare (MoHFW) - India

28. Khokher S, Dhaka VK, Singh HV. To determine the vertical transmission rate of HIV in the PPTCT programme since its initiation in 2005 in Umaid Hospital, Jodhpur (Rajasthan). Asian J Med Res 2018;8:0G10-4.

29. Vyas N, Hooja S, Sinha P, Mathur A, Singhal A, Vyas L. Prevalence of HIV/AIDS and prediction of future trends in North-West region of India. Indian J Community Med 2009;34:212-7.

30. Srijayanth Parameshwari, Mini S Jacob, JJ Vijayakumari, 1 Diana Shalini, 2 Mary K Sushi, and MR Sivakumar A Program on Prevention of Mother to Child Transmission of HIV at Government Hospital, Tiruchengode Taluk, Namakkal District Journal List Indian J Community Med v.34(3); 2009 JulPMC2800912.