

# Declining Trend of HIV Seroprevalence in Pregnant Women: A Retrospective Observational Analysis of 12 Years' Experience at a Tertiary Care Hospital in Central India

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## ABSTRACT

**Introduction:** Human Immunodeficiency Virus (HIV) infection among antenatal women has been reported throughout the country, with a relatively high prevalence in the state of Maharashtra. Data on HIV seroprevalence in antenatal women serve as an indirect indicator of the HIV epidemic's burden in the general population and aid in predicting the same in young children. Diagnostic and treatment services for HIV are concentrated in selected states and districts with high seroprevalence, making it necessary to accurately calculate the prevalence of HIV.

**Aim:** To assess the effectiveness of Prevention of Parent-to-Child Transmission (PPTCT) services and to study the effectiveness of the National Acquired Immunodeficiency Syndrome (AIDS) Control Programme (NACP) in the functioning of PPTCT services.

**Materials and Methods:** A retrospective observational analysis of 12-year data, from January 2007 to December 2018, was conducted in the Department of Microbiology at the Government Medical College and Hospital, Nagpur, Maharashtra, representing Central India. Data collection took place from June 2019 to December 2019, and analysis occurred over the subsequent two months (January 2020 to February 2020). The total sample size was 101,865 patients. All pregnant women registered in the Antenatal Clinic (ANC) under the PPTCT Program were included

in the present study, and Strategy III of the National HIV testing algorithm was followed. The women's ages, their partners' serostatus, and records of babies born to HIV seropositive mothers were obtained and analysed. The statistical analysis of the data was performed using Stata (version 10.4.2009, STATA Corp., Texas, USA) and Epi Info 7 (version 7.1.06, 2012, CDC, Atlanta, USA), employing the Chi-square test for linear trend (Extended Mantel-Haenszel). A p-value <0.05 was considered significant.

**Results:** The seroprevalence of HIV infection among pregnant women was 1.04% in 2007, decreasing to 0.23% by 2017. In 2009, 88.9% of women were counselled, and 100% were tested for HIV, with pretest counselling steadily increasing to 100% by 2012. The trend in HIV testing, however, remained at 100% over the span of 10 years. Post-test counselling varied from 89.6% to 99.9%, whereas the trend of HIV testing among partners fluctuated from 50% to 94.44%. The overall HIV positivity among babies, after 18 months of follow-up, was 4.77%.

**Conclusion:** The HIV seroprevalence among the pregnant population is steadily declining. More and more women are availing themselves of the facilities at Integrated Counselling and Testing Centre (ICTC). Intensive health education and the availability of diagnostic and therapeutic services across the country have reduced the burden of the HIV/AIDS problem in the country.

**Keywords:** Acquired immunodeficiency syndrome, Human immunodeficiency virus, Infectious disease transmission vertical, Prevention of parent-to-child transmission

## INTRODUCTION

The technical report of the National AIDS Control Organisation (NACO) on HIV estimations 2017 in India shows that significant progress has been made in halting and reversing the epidemic. The total number of People Living with HIV (PLHIV) in India was estimated at 21.40 (15.90-28.39) lacs by the end of 2017 [1]. With 3.30 (2.531-4.353) lacs PLHIV, Maharashtra had the highest number of PLHIV, contributing 15% to the total PLHIV size in the country [1]. According to the recently released HIV estimation 2017 report of India, the national adult (15-49 years) HIV prevalence was estimated to be 0.22% (0.16-0.30) in 2017, with adult HIV prevalence estimated at 0.25% among males and 0.19% among females. Maharashtra has shown an estimated adult HIV prevalence of 0.33% (0.25-0.45), which is greater than the national prevalence. Children (<15 years) account for 0.61 (0.43-0.85) lac, approximately 3% of cases in India [1].

Though the incidence of infection, especially in the sexually active group, is the most sensitive marker to monitor the HIV epidemic, it is difficult to measure the incidence. However, the prevalence in young women is an indirect but useful tool [2]. Hence, the data on HIV from antenatal women is used to monitor the trends in the general population, and it also helps in predicting the seroprevalence in young children [3,4]. As cited in the HIV Annual Report of 2015-2016 by NACO, according to the HIV Sentinel Surveillance (HSS) 2014-15, in the Antenatal Clinic (ANC) attendees, the overall prevalence was found to be 0.29% [5]. Sangal B et al., (2018) studied the HIV prevalence rates from HSS during 2003-2015 and reported a significant decline in HIV seroprevalence from 0.93% in 2003 to 0.36% in 2015 ( $p < 0.001$ ) at the national level [6]. They also reported a significant rising trend of HIV seroprevalence in Northern India from 0.16% in 2003 to 0.33% in 2015, whereas reported significant declining trends from 0.43% in 2003 to 0.16% in 2015 from Central

India. They observed a similar declining trend in southern and western India [6]. The prevalence in Maharashtra is estimated to be 0.26% among the attendees of ANC in 2017 [7].

The burden of HIV in pregnant women and children reflects the overall HIV epidemic in India. The epidemic in India is concentrated in some states and districts; therefore, diagnostic and treatment services are concentrated in these areas [5]. These services are limited in the rest of the country; hence, it is necessary to accurately calculate the prevalence of HIV [8]. Various authors have studied and evaluated the utility of different surveillance methodologies used to estimate HIV prevalence [9-13]. The PPTCT of HIV program was launched under the NACP to prevent mother-to-child transmission of HIV, and it is the largest national antenatal screening program in the world [4]. The uniqueness of the study lies in assessing the data of 101,865 patients to demonstrate a declining rate of HIV seropositivity.

The present study is a retrospective analysis of 12 years of data reflecting the extensive work done on antenatal mothers, showing the efforts made under NACP III/IV and the resulting outcomes achieved after targeted interventions in the NACP. The analysis aimed to discern the data on HIV prevalence in and around Nagpur, representing Central India.

The study aimed to assess the effectiveness of PPTCT services and to study the effectiveness of the NACP in the functioning of PPTCT services. The primary objective was to determine the prevalence of HIV in pregnant women attending the Integrated Counselling and Testing Centre located in Nagpur, representing Central India, under the HIV (PPTCT) program. Also, a comparison of HIV seroprevalence India, Maharashtra State, and Nagpur was done. The secondary objective was to detect the HIV seropositivity of babies born to HIV seropositive mothers.

## MATERIALS AND METHODS

This retrospective observational analysis covers data from a 12-year period, from January 2007 to December 2018, in the Department of Microbiology at the Government Medical College and Hospital, Nagpur, Maharashtra, representing Central India, which includes both the phases of NACP-III (2007-2012) and IV (2012-2017). Institutional ethical clearance was obtained (No.1035/EC/Pharmac/GMC/NGP). The NACO guidelines of pre-test counselling, written informed consent, and post-test counselling were followed [14]. Data collection was conducted from June 2019 to December 2019 and was analysed over the following two months (January 2020 to February 2020). The sample size was not pre-determined as the data was taken from past records. The partners of those women who were seropositive were offered HIV testing.

**Inclusion criteria:** All attendees (pregnant women and partners of seropositive women) who gave consent for testing were included in the study. The babies of seropositive mothers were also included after obtaining consent from their guardians.

**Exclusion criteria:** All other HIV seropositive patients were excluded from the study.

### Study Procedure

All pregnant women registered in the ANC are routinely given group counseling for HIV testing under the PPTCT Program. The data of antenatal mothers attending the ANC were collected, comprising comprehensive data from 101,865 patients.

The purpose of NACO Strategy III is to diagnose HIV in asymptomatic individuals, such as antenatal women, for screening. The National HIV testing algorithm, Strategy III, was followed [5]. According to it, an antenatal woman with positive results in all three tests was labelled HIV seropositive. The record of the babies born to HIV seropositive mothers was obtained. All data parameters were

entered into Microsoft Excel to perform a descriptive analysis.

## STATISTICAL ANALYSIS

The statistical analysis of the data was conducted using STATA (version 10.4.2009, STATA Corp., Texas, USA) and Epi Info 7 (version 7.1.06, 2012, CDC, Atlanta, USA). The Chi-square test for linear trend (Extended Mantel-Haenszel) was used. A p-value <0.05 was considered significant.

## RESULTS

A total of 101,865 pregnant females were tested for the detection of HIV antibodies over a period of 12 years, from January 2007 to December 2018, among which 475 (0.47%; 95% CI, 0.43-0.51) tested positive for HIV antibodies. The seroprevalence of HIV infection among pregnant women was 79 (1.04%) in 2007, which decreased to 24 (0.23%) by 2017. [Table/Fig-1] shows the distribution of year-wise samples tested and the HIV positivity. HIV testing of ANC mothers comes under PPTCT services. The declining trend of HIV seropositivity among ANC mothers, as shown in [Table/Fig-1], reflects the effectiveness of the implementation of PPTCT services. This gradual decline in the positivity rate in the study period was statistically significant (Chi-square test of linear trend: p-value <0.0001).

Year	ANCs tested for HIV	ANCs with HIV positive status (%)	ANCs with HIV negative status (%)	95% CI for HIV positive (%)
2007	7632	79 (1.04)	7553 (98.96)	0.85-1.34
2008	8359	76 (0.91)	8283 (99.09)	0.72-1.14
2009	8140	69 (0.85)	8071 (99.15)	0.66-1.07
2010	7232	54 (0.75)	7178 (99.25)	0.56-0.97
2011	6757	34 (0.50)	6723 (99.50)	0.35-0.70
2012	7485	24 (0.32)	7461 (99.68)	0.21-0.48
2013	8039	20 (0.25)	8019 (99.75)	0.15-0.38
2014	9587	24 (0.25)	9563 (99.75)	0.16-0.37
2015	9215	18 (0.20)	9197 (99.80)	0.12-0.31
2016	9754	19 (0.19)	9735 (99.81)	0.12-0.30
2017	10220	24 (0.23)	10196 (99.77)	0.15-0.35
2018	9445	34 (0.36)	9411 (99.64)	0.25-0.50
Total	101865	475 (0.47)	101390 (99.53)	0.43-0.51

[Table/Fig-1]: Trend of ANC with HIV testing and HIV positivity. p-value<0.0001

The comparison of the various trends reported by the Sentinel Surveillance conducted by NACO at the national level, in Maharashtra state, and Nagpur region representing Central India, has been depicted in [Table/Fig-2].

Out of the 475, the maximum number of antenatal mothers were in the age group of 25-34 years, i.e., 230 (48.42%), followed by the age group 15-24 years, i.e., 223 (46.95%), with 22 (4.63%) cases in the 35-49 years age group [Table/Fig-3].

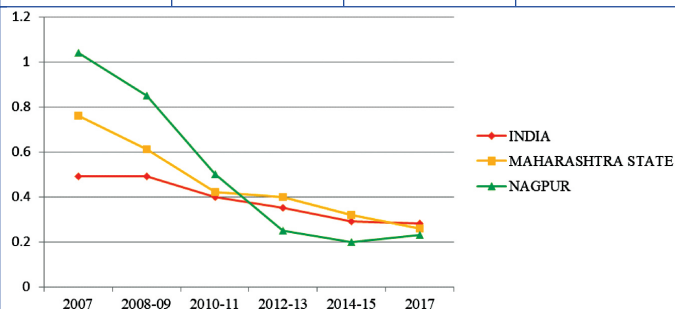
Around 88.9% of women were counselled, and 100% were tested for HIV in 2009, and the pretest counselling trend steadily increased to 100% by 2012. The HIV testing trend, however, remained at 100% throughout the last 10 years. Post-test counselling trends ranged from 89.6% to 99.9%.

Partners of HIV-positive mothers were also tested as part of contact tracing, and HIV testing among them fluctuated from 50% to 94.44% [Table/Fig-4].

Follow-up testing of babies born to HIV-positive mothers was conducted until 18 months, as per NACO guidelines, and the overall HIV positivity among them was 4.77% [Table/Fig-5].

The present study period includes both the phases of NACP-III (2007-2012) and NACP-IV (2012-2017). The maximum seropositivity

Year	India	Maharashtra	Nagpur
2007	0.49	0.76	1.04
2008-09	0.49	0.61	0.85
2010-11	0.40	0.42	0.50
2012-13	0.35	0.40	0.25
2014-15	0.29	0.32	0.20
2016-17	0.28	0.26	0.23



[Table/Fig-2]: Comparison of HIV seroprevalence in India, Maharashtra State, and Nagpur.

Year	Age groups			Total
	15-24 years	25-34 years	35-49 years	
2007	46 (58.23%)	30 (37.97%)	3 (3.80%)	79 (100%)
2008	45 (59.21%)	29 (38.16%)	2 (2.63%)	76 (100%)
2009	29 (42.03%)	38 (55.07%)	2 (2.90%)	69 (100%)
2010	30 (55.55%)	21 (38.90%)	3 (5.55%)	54 (100%)
2011	11 (32.35%)	22 (64.71%)	1 (2.94%)	34 (100%)
2012	9 (37.50%)	15 (62.50%)	0	24 (100%)
2013	8 (40%)	9 (45%)	3 (15%)	20 (100%)
2014	10 (41.67%)	14 (58.33%)	0	24 (100%)
2015	8 (44.44%)	10 (55.56%)	0	18 (100%)
2016	5 (26.32%)	14 (73.68%)	0	19 (100%)
2017	12 (50%)	10 (41.67%)	2 (8.33%)	24 (100%)
2018	10 (29.41%)	18 (52.94%)	6 (17.65%)	34 (100%)
Total	223 (46.95%)	230 (48.42%)	22 (4.63%)	475 (100%)

[Table/Fig-3]: Distribution of HIV-positive antenatal mothers according to age groups.

Year	ANCs positive	Spouse tested	Spouse positive n (%)	Spouse negative n (%)
2007	79	51 (64.56%)	39 (76.47)	12 (23.53)
2008	76	57 (75%)	45 (78.95)	12 (21.05)
2009	69	43 (62.32%)	34 (79.07)	9 (20.93)
2010	54	41 (75.93%)	27 (65.85)	14 (34.15)
2011	34	31 (91.18%)	24 (77.42)	7 (22.58)
2012	24	18 (75%)	14 (77.78)	4 (22.22)
2013	20	14 (70%)	11 (78.57)	3 (21.43)
2014	24	16 (66.67%)	10 (62.50)	6 (37.50)
2015	18	17 (94.44%)	10 (58.82)	7 (41.18)
2016	19	11 (57.89%)	04 (36.36)	07 (63.64)
2017	24	12 (50%)	09 (75.00)	03 (25.00)
2018	34	25 (73.53%)	17 (68.00)	08 (32.00)
Total	475	336 (70.74%)	244 (72.62)	92 (27.38)

[Table/Fig-4]: Proportional trend of ANCs with HIV positivity and partner's HIV status.

was seen in the year 2007, i.e., 1.04%, which gradually and steadily declined to 0.32% in the year 2012. The data from the year 2013 to 2016 showed a steady decline from 0.25% in 2013 to 0.19% in the year 2016. However, a steady increase in seroprevalence was seen in 2017 (0.23%) and 2018 (0.36%), which is indeed alarming. NACP IV targeted intensifying and consolidating prevention services with a focus on high-risk groups and vulnerable populations.

Year	Number of babies tested at 18 months	Number of babies found positive at 18 months n (%)	Number of babies found negative at 18 months n (%)
2007	28	04 (14.29)	24 (85.71)
2008	35	01 (2.86)	34 (97.14)
2009	35	01 (2.86)	34 (97.14)
2010	48	00 (0.00)	48 (100.00)
2011	17	00 (0.00)	17 (100.00)
2012	42	03 (7.14)	39 (92.86)
2013	48	03 (6.25)	45 (93.75)
2014	42	02 (4.76)	40 (95.24)
2015	29	02 (6.90)	27 (93.10)
2016	25	02 (8.00)	23 (92.00)
2017	51	03 (5.88)	48 (94.12)
2018	40	00 (0.00)	40 (100.00)
Total	440	21 (4.77)	419 (95.23)

[Table/Fig-5]: Proportional trend of HIV-exposed live birth cohort analysis.

## DISCUSSION

The seroprevalence of HIV in antenatal mothers serves as a surrogate marker to assess the HIV epidemic in the general population [5,7]. The present study demonstrates a gradual and steady decline in HIV seroprevalence among antenatal mothers from 2007 to 2012, coinciding with the NACP phase III program. This program aimed to halt and reverse the HIV epidemic in India over a five-year period by scaling up prevention efforts among high-risk groups and the general population, as well as integrating care, support, and treatment services. Sarkate P et al., reported a declining trend from 2008 to 2012, with an overall 0.88% seroprevalence rate from Mumbai [15]. Kulkarni S and Doibale M reported a significant decline in seropositivity from 1.58% in 2007 to 0.54% in 2011 [16]. In the present study, a comparison of HIV seroprevalence has been done between Nagpur, the entire state of Maharashtra, and India as a whole too. Maharashtra is a big state, and HIV prevalence varies in different districts of the state, so we compared the HIV prevalence of Nagpur to the entire state. Also, Nagpur receives a patient pool from the adjacent states of Madhya Pradesh and Chhattisgarh, so it is more representative of Central India. The declining trend in HIV seropositivity was consistent across all levels (national and state), and it aligns with the results of the present study, as depicted in [Table/Fig-2]. The seroprevalence of HIV in various regions of India has been listed in [Table/Fig-6] [16-26].

According to the HSS 2016-17 report, the observed HIV prevalence was 0.28% (95% CI: 0.26-0.29) among attendees of

Author and year of study	Location	Seroprevalence in %
Pawan MU et al., (2005) [19]	Nagpur, Maharashtra	1.38
Gupta S et al., (2007) [20]	AIIMS, New Delhi	0.88
Snehamay C et al., (2007) [21]	Kolkata, West Bengal	0.16
Parameshwari S et al., (2009) [22]	Namakkal, Tamil Nadu	0.77
Ashtagi GS et al., (2011) [18]	Belgaum, Karnataka	0.70
Kwatra A et al., (2011) [23]	Ahmednagar, Maharashtra	1.38
Devi A and Shyamala R (2012) [24]	Ranga Reddy Dist, Andhra Pradesh	0.45
Dash M et al., (2012) [25]	Behrampur, Orissa	0.66
Kulkarni S and Doibale M (2013) [16]	Nanded, Maharashtra	0.76
Mehta KD et al., (2013) [26]	Jamnagar, Gujarat	0.38
Sibia P et al., (2016) [17]	Patiala, Punjab	1.03
Present study (2018)	Nagpur, Maharashtra	0.47

[Table/Fig-6]: Seroprevalence of HIV across various regions of India [16-26].

ANC [7]. The overall prevalence in ANCs in India declined from 0.49% in 2007 to 0.35% in 2012-13, 0.29% in 2014-2015, and 0.28% in 2017 in the present study, indicating a decreasing trend in HIV seroprevalence among ANC attendees at the national level, including in states with previously high prevalence such as Tamil Nadu, Maharashtra, Andhra Pradesh, Karnataka, and Manipur, all of which recorded a prevalence of 0.25%-0.50% in 2017 [7]. Studies from Gujarat by Joshi U et al., and Patel BS et al., found the seropositivity of babies at 18 months to be 3.6% and 2% (3 babies out of 148), respectively, slightly lower than in the present study [27,28].

Critical epidemiological estimates such as adult HIV prevalence, HIV population size, HIV incidence, annual new HIV infections, annual AIDS-related deaths, and the need for PMTCT of HIV services are generated at national and state/Union Territory levels. Adult prevalence and HIV population estimates provide insight into the status of HIV in the geographic area: its level, trend, and overall burden of disease at the inter-state level.

The indicator of annual new HIV infections highlights the impacts of the prevention program and identifies areas where new infections are estimated to be increasing or not declining as rapidly as needed to achieve the targets of a 75% decline in annual new HIV infections from 2010-2020, which are areas of concern requiring scaled-up HIV prevention efforts. Estimates of AIDS-related deaths indicate the impact of treatment services and the need for increased efforts in this area. PMTCT need is also a critical indicator, and for India to achieve the national goal of eliminating mother-to-child transmission of HIV by 2020, 95% of pregnant women in need of PMTCT must be receiving treatment [29,30].

Screening pregnant women for HIV serostatus has many implications. Tracking HIV prevalence among pregnant women has been considered a good proxy for tracking the HIV/AIDS epidemic in the general population, as pregnant women are representative of the healthy population [5,7].

This allows for early initiation of treatment in the mother, resulting in the decrease of her viral load, thus minimising the probability of transmission to the child. It also enables early detection and intervention in case of transmission, thereby reducing the likelihood of the child developing the disease.

### Limitation(s)

While the present study was exhaustive, the authors encountered a few limitations. They were unable to trace the data of all the partners of the HIV-positive mothers and their babies.

### CONCLUSION(S)

A declining trend of HIV-positivity among pregnant women, along with an increasing number of women availing of ICTC services, is a welcome sign in our fight against AIDS. While success in high-prevalence pockets has been well-demonstrated, the same is not as evident in low-prevalence pockets, making it much more challenging to substantially reduce prevalence in these areas. However, as India aims to end the AIDS epidemic as a public health threat by 2030 as part of its sustainable development goals, the imminent need to scale up the current momentum of interventions in low-prevalence states cannot be underestimated. Furthermore, the heterogeneity in the national and regional epidemic scenario necessitates the implementation of tailored interventions to address the determinants of HIV, informed by the analysis of local risks operating at various levels.

**Conflicts of Interest:** The authors alone are responsible for the views expressed in this article and they do not necessarily represent the decisions, policies, or views of the NACO.

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