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Spatial and Temporal Analysis of HIV Prevalence in Manipur

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Abstract
HIV/AIDS has posed a persistent challenge to public health worldwide, with its prevalence and transmission patterns exhibiting significant regional disparities. Manipur, located in northeastern India, has been particularly affected by the HIV epidemic, with its unique socio-cultural and geographical characteristics influencing the spread of the virus. This article offers a detailed examination of the spatio-temporal trends of HIV prevalence in Manipur from 2003 to 2020, focusing on district-wise differentials and the distinctive dynamics between hill and valley regions.
Utilizing a robust dataset spanning several years, the study uncovers significant geographical and temporal variations in HIV prevalence. The findings reveal a complex interplay of socio-economic, cultural, and environmental factors contributing to these trends. Location of Manipur close to the Golden Triangle sharing with long international borders with Myanmar in the east which happens to be one of the main route of drugs and heroin trafficking makes the state generally vulnerable to not only drug trafficking but also associated HIV infections. Besides, Churachandpur district of Manipur also shares internal boundary with Mizoram, which is the highest HIV prevalent state in the country. Ethnic similarity has been responsible for the migration of people from the former into the latter.

Keywords: HIV/AIDS, Geographic mapping, Temporal trends

1. Introduction

HIV is a significant public health concern in Manipur. It has trapped the state since the early 1990s, with high prevalence rates reported and observed in certain areas and regions. In the early 1990s, Manipur experienced the first wave of the HIV epidemic among injecting drug users (IDUs), which peaked in the late 1990s. This was followed by a second wave, which peaked in the early 2000s, affecting mainly the injecting drug users (IDUs) and other high-risk groups (HRGs), including sex workers, men who have sex with men (MSM) and people who inject drugs.

The state of Manipur is reported to be a hard-hit epicenter of the HIV/AIDS epidemic in India (Sharma, Singh and Singh, 2018) [47]. The state ranks third among the most prevalent states in India. The current HIV situation in Manipur for the year 2020, as reported by NACO in 2021 (National AIDS Control Organization, 2021), reveals a prevalence of HIV among adults aged 15 to 49 years, with rates of 1.2% among males and 1.1% among females, resulting in an overall prevalence of 1.15%. This indicates the presence of an ongoing HIV challenge within the region. The total estimated number of people living with HIV in Manipur for the year 2020 stands at 28,381 individuals, comprising 14,898 males and 13,483 females. Additionally, there are 1,662 estimated children living with HIV in the region. Annually, Manipur witnessed a substantial number of new HIV infections in 2020, with 951 reported cases. This figure is divided between 487 males and 464 females. A concerning aspect of the HIV situation in Manipur is the annual AIDS-related deaths (ARD) in 2020, totalling 812 cases. Of these, 524 are males, while 288 are females.

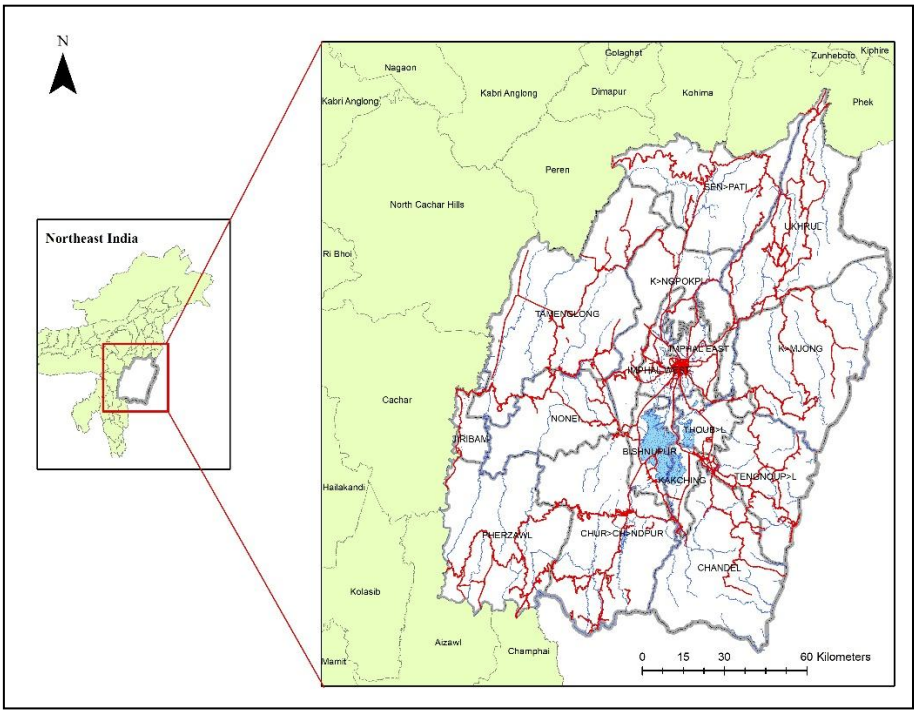
The HIV epidemic in Manipur has persisted for over three decades, posing a formidable challenge to containment efforts owing to a multitude of factors. Among these, injecting drug use stands out as a predominant catalyst, particularly prevalent among the youth in the region (Sharma, Singh, & Singh, 2019) [47] (Ganju, Ramesh, & Saggurt, 2016) [18].

This practice not only contributes significantly to the spread of the virus but also underscores the complex web of social, economic, and health-related issues that exacerbate the ongoing crisis.

The interplay of spatial factors, especially proximity to regions with high prevalence of HIV/AIDS and drug abuse, significantly impacts the spread of the disease. Unregulated migration of affected individuals, drug trafficking routes, displacement due to insurgency, and other similar circumstances increase vulnerability to HIV without adequate awareness.

Manipur's HIV Landscape: A Regional Comparison with Northeast India

Manipur shares inter-state boundary with Cachar district of Assam, Aizawl district and Champai district of Mizoram, Peren, Dimapur, Kohima, and Phek districts of Nagaland and international boundary with Myanmar and the "Golden Triangle" in the east. Being adjacent to the "Golden Triangle" Manipur is one of the drug trafficking routes from the Golden Triangle to India.



Source: Prepared by the Researcher using ArcGIS software.

Fig 1: Location of Manipur in Northeast India

In the context of HIV/AIDS, the northeastern states of India have been severely impacted by the virus, posing a major concern for the general population. Mizoram has the highest HIV prevalence, followed by Nagaland and Manipur. However, the neighbouring state of Assam, particularly the Silchar area in close proximity to Manipur, is now reporting an increasing number of cases. The landlocked nature of these states and the ethnic ties of their people cutting across national and international boundaries lead to the continuous movement of people and goods. For instance, there is extraordinary inter-state migration between Nagaland and Manipur, as people living in the northern parts of both states have strong ethnic links. Similarly, the southern part of Manipur, specifically the Churachandpur district, has strong ties with the Mizos living in the northern part of Mizoram. Although the continuous migration of people into Manipur from these districts does not necessarily mean transmission of the virus, it certainly contributes to the vulnerability to HIV/AIDS.

Table 1: Adult HIV Prevalence (15–49 Years) (in % of the total population), 2015–2020

States	2015	2016	2017	2018	2019	2020
Manipur	1.48	1.4	1.32	1.26	1.2	1.15
Meghalaya	0.53	0.54	0.54	0.54	0.53	0.53
Mizoram	2.19	2.24	2.29	2.34	2.36	2.37
Nagaland	1.42	1.42	1.42	1.43	1.43	1.44
Sikkim	0.06	0.06	0.07	0.07	0.07	0.07
Tripura	0.05	0.06	0.07	0.08	0.09	0.1
Arunachal Pradesh	0.05	0.05	0.06	0.06	0.06	0.087
Assam	0.08	0.08	0.08	0.08	0.08	0.08

Source: (National AIDS Control Organisation & ICMR-National Institute of Medical Statistics, 2022)

The trends reveal both stability and fluctuations in HIV prevalence rates across these regions. States like Manipur demonstrated a consistent decline in HIV prevalence, while Meghalaya maintained relatively stable rates. Meanwhile,

Mizoram and Nagaland experienced modest increases, signifying the need for ongoing vigilance in HIV prevention efforts. Sikkim exhibited consistently low HIV prevalence, and Tripura and Arunachal Pradesh saw upward trends, prompting further investigation. Finally, Assam reported a consistent HIV prevalence rate throughout the observation period.

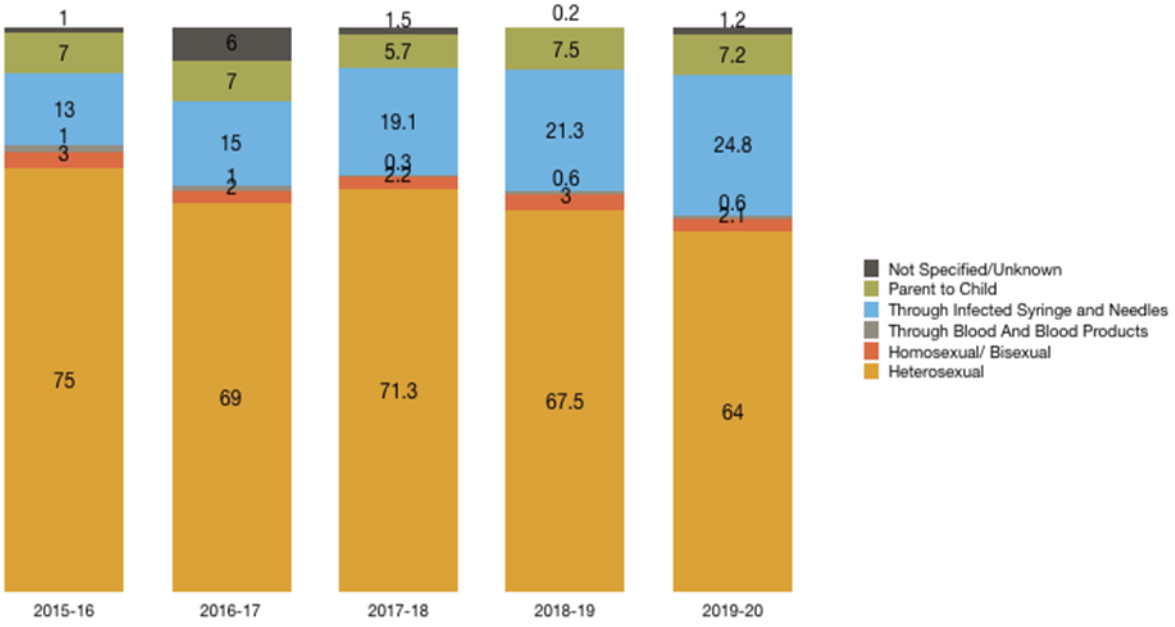
It is noteworthy that although there has been a substantial decrease in new HIV infections among adults in the "high-prevalence" states, a concerning upward trajectory of new infections is emerging in the "low-prevalence" states of north-eastern India(NACO, 2012-13). While the overall prevalence may remain relatively low in these "low-prevalence" states, the increasing trends and vulnerabilities necessitate a heightened programmatic focus that extends beyond the mere consideration of prevalence figures.

Mode of HIV Transmission in Manipur:

When the first case of HIV was detected in the state, it was found that the primary mode of transmission was through the use of unclean or contaminated syringes, which were commonly shared among people who inject drugs (IDUs). However, while this mode of transmission continues to be an important factor in the spread of HIV in the state, its relative importance has declined over time. This decline is not due to a reduction in the number of cases resulting from this mode of transmission but rather due to the increasing significance of other modes of transmission, particularly those related to sexual contact. In addition, HIV transmission through mother-to-child transmission, blood transfusions, and other modes have also become important factors in the spread of HIV in the state.

Heterosexual is the major route of transmission of HIV during 2015-2020, as shown in fig. 2., followed by through infected Syringe and needles, Parent to child transmission, Homosexual/Bisexual and through Blood to blood products & Not specified were very minimal (Manipur State AIDS Control Society (MACS), 2015-16) (National AIDS Control Organization, 2020).

Over the five-year period, the percentage of HIV cases attributed to heterosexual transmission has shown a declining trend, decreasing from 75% in 2015-16 to 64% in 2019-20. The percentage of HIV cases attributed to homosexual/bisexual transmission has remained relatively stable, with a slight variation, ranging from 2% to 3% over the five-year period. The percentage of cases attributed to transmission through contaminated blood and blood mode has varied but remained relatively low, ranging from 0.3% to 0.6% during the observed period. Parent-to-child transmission mode accounts for the percentage of HIV cases transmitted from an infected parent to their child, typically during childbirth or breastfeeding. The percentage has remained relatively stable, fluctuating around 7% over the five years. Not Specified/Unknown category includes cases where the mode of transmission is either not specified or unknown. The percentage in this category has shown minor variations, ranging from 0.2% to 1.5% during the specified period.



Sources: i) SIMS Annual Reports, 2015-16 & 2016-17
ii) National AIDS Control Organization (2020)

Fig 2: Proportional distribution of HIV positive cases by Route of Transmission (in%)

The NACO report stated that in Manipur, the main route of HIV transmission is through sexual contract, which is rising due to the changing behaviour among the youth. While there has been a declining trend in the percentage of transmission through sexual contracts, during 2015-2020, we can see a rising trend in the percentages of transmission through sharing infected syringes and needles i.e., from 13% in 2015-16 to 24.8% in 2019-20.

Spatio-Temporal Trends of HIV Prevalence: District-wise/Hill-Valley Analysis

Understanding the trends of HIV prevalence rates is crucial for effective public health planning and resource allocation. While overall HIV prevalence rates in a region can provide a broad picture of the disease burden, it is also important to examine trends at a more granular level in order to identify specific areas or populations that may be particularly affected. In this context, district-wise trends of HIV

prevalence provide a valuable tool not only for public health officials and researchers to gain insights into the spread of the disease and to develop targeted interventions, but also provides a clear understanding of the hill-valley distribution of the disease. Table 2. shows the district-wise HIV prevalence reported in cases per 10,000 persons in Manipur from 2003 to 2020.

Table 2: District-Wise HIV Prevalence (Reported Cases per 10,000 persons), 2003-2020

Year	Bishnupur	Chandel	Churachandpur	Imphal East	Imphal West	Senapati	Tamenglong	Thoubal	Ukhrul
2003	4.20	0.16	8.22	18.79	24.10	0.00	0.00	1.04	0.00
2004	3.69	0.95	14.64	22.41	42.76	0.00	0.67	1.97	3.58
2005	6.05	3.73	8.89	15.67	24.59	0.22	0.41	2.30	5.88
2006	5.74	4.42	12.07	18.50	23.49	0.92	0.79	3.43	14.66
2007	4.96	13.00	14.24	21.04	19.81	2.05	0.47	6.64	12.72
2008	2.06	1.10	7.80	4.34	10.89	0.69	0.61	1.75	4.68
2009	3.89	3.31	12.31	6.76	14.84	1.64	1.11	1.58	3.82
2010	3.84	3.25	12.10	6.67	14.63	1.57	1.09	1.56	3.73
2011	2.02	2.64	10.51	4.01	10.54	0.67	0.64	2.04	2.34
2012	2.16	1.50	6.64	4.11	8.20	0.86	0.77	1.33	3.35
2013	2.26	3.08	5.40	5.66	8.84	0.48	6.28	1.38	3.32
2014	3.49	2.96	5.35	4.83	8.45	0.78	1.00	1.16	3.35
2015	1.53	2.72	5.30	6.12	8.72	0.61	0.59	1.12	2.83
2016	1.23	1.91	5.52	4.87	7.34	0.47	0.71	0.95	3.06
2017	1.14	2.76	5.07	5.94	6.89	0.45	0.70	0.92	6.48
2018	0.74	2.71	7.11	4.37	6.61	0.70	0.43	0.82	2.94
2019	1.30	2.67	5.88	4.16	6.07	0.46	0.67	1.00	2.20
2020	1.82	2.51	5.19	2.82	2.54	0.75	0.78	0.42	2.20

Source: Manipur State AIDS Control Society (MACS) (Computed)

The table provides data on the prevalence of HIV in nine districts of Manipur, namely Bishnupur, Chandel, Churachandpur, Imphal East, Imphal West, Senapati, Tamenglong, Thoubal, and Ukhrul.

The data shows that HIV prevalence varies across districts and over time. In 2003, the highest HIV prevalence was reported in Imphal West (24.10), followed by Churachandpur (8.22) and Bishnupur (4.20). In 2020, the highest HIV prevalence was reported in Bishnupur (1.82), followed by Churachandpur (5.19) and Imphal East (2.82)

Overall, there seems to be a decreasing trend in HIV prevalence in most districts over time. However, there are some fluctuations in prevalence, especially in Chandel, Imphal East, Imphal West, Senapati, Tamenglong, and Thoubal. It is important to note that the reported cases might not represent the actual prevalence as they only include those tested and reported.

The spatio-temporal pattern in HIV prevalence in Manipur is presented in Fig. 3. (a, b & C). The maps showing HIV reported cases per 10,000 persons were prepared based on the integrated counseling and testing centers (ICTCs) data (reported HIV cases) and the estimated population for each of the districts. The maps show that no district in the state is free from the incidence of HIV reported cases. It is evident from the spatial pattern in the prevalence of HIV/AIDS that the distance from the international border results in decline in HIV cases. It can be seen from the maps that the districts, which share international border with Myanmar shows more HIV prevalence as compared to those which do not share the international boundary.

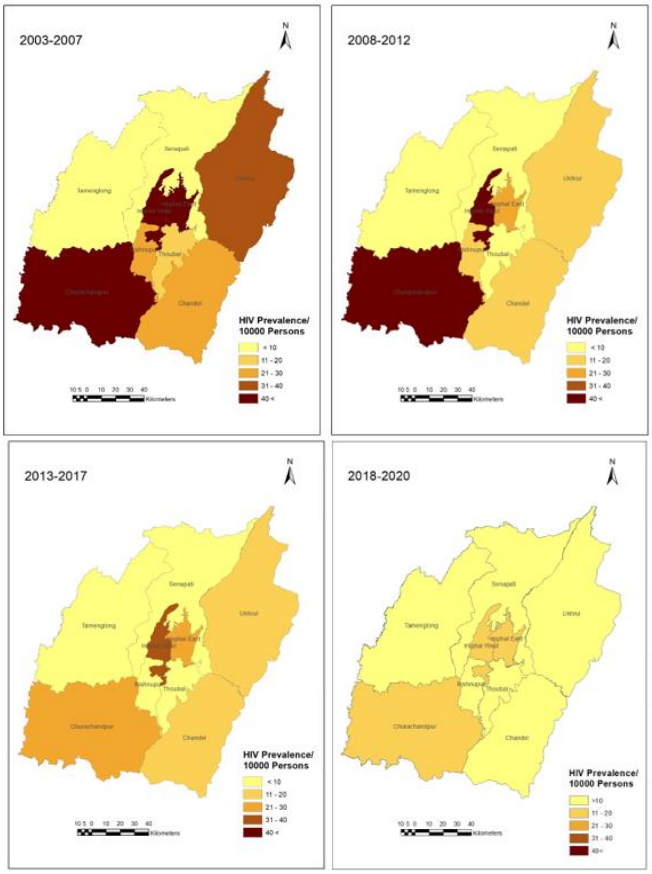
During the period of 2003-2007, Imphal West showed the highest no. of positive persons per ten thousand persons i.e., 130.58 positive cases/10,000 persons, followed by the Imphal East district and Churachandpur district with 93.67 positive cases/10,000 persons and 56.13 positive cases/10,000 persons respectively. Tamenglong district was the least prevalent district with only 2.25 positive cases/10,000 persons followed by Senapati district (3.12 positive cases/10,000 persons). Rest of the districts also recorded a high prevalence of more than 15 positive cases/10,000 persons.

Sexual risk behaviors signal the potential for sexual transmission of infectious disease to non-injecting partners. In Bishnupur district, 44% of IDUs had never passed a needle/syringe to others and 43% of IDUs had never injected with a needle/syringe after others injected with it (National Interim Summary Report - India, 2007). It has been reported that very few IDUs (7%) have received counseling during the round 1 of the IBBA. According to the same report, 14% of IDUs had sex with a female sex worker, of which 82% of them used condoms. It had also been reported that 6% of IDUs had sex with other non-paid regular partner where 70% of them used condoms. 9% of IDUs are reported to have ever had sex with a male partner.

In Churachandpur, around 20% of IDUs had neither pass a needle/syringe to others nor inject with a used needle/syringe by others (National Interim Summary Report - India, 2007). Only 19% of them have taken counselling. 6% of IDUs are reported to have had sex with FSW in the past year prior to the IBBA Round 1 survey. The report also showed that 32%of IDUs had sex with non-paid regular female partners; of them, only 36% used condoms.

The prevalence of HIV-positive cases in Imphal East dropped significantly from 93.67 positive cases/10,000 persons in 2003-2007 to 25.16 positive cases/10,000 persons in 2008-2012, making it the district with the highest prevalence decline during the period. Many of the districts, including Imphal West, etc., have witnessed a remarkable decline in HIV prevalence, with a reduction of approximately 50%, during 2008-2012. Churachandpur district (with 47.64 positive cases/10,000 persons) has moved to second place in terms of the highly prevalent districts in Manipur after Imphal West (57.32 positive cases/10,000) in 2008-2012. However, there has been an increase in the prevalence of HIV in the least prevalent districts of Tamenglong (from 2.25 positive cases/10,000 persons to 4.04 positive cases/10,000 persons)

and Senapati district (4.97 positive cases/10,000 persons).



Source: Prepared by the researcher using QGIS Software.

Fig 3.a, b, c & d: Spatio-temporal distribution of HIV prevalence per 10000 persons in Manipur

Tamenglong further increased to 8.73 cases/10,000 persons in 2013-2017. Though there has been a significant decline in the prevalence, Imphal West still remained first place with 39.12 cases/10,000.

In Chandel District, as per the Integrated Biological and Behavioural Survey (IBBS), 53% of the IDUs reported having a regular female partner and among them, only 23.7% reported using consistent condoms 12 months prior to the survey. And 18% of them have ever had a paid partner, of which 44.1% reported using condoms consistently (National AIDS Control Organisation, 2017).

In Imphal East, 5.5% of IDUs reported sharing needles/syringes. During 2014-15, 63.9% of them reported having a regular female partner, and only 16.9% used condoms consistently. 25.6% of them have ever had a paid female partner, of which 65% reported using condoms consistently.

In Senapati, 14.8% of IDUs reported sharing needles/syringes. 55.7% of them have a regular female partner, of which only 6.5% have reported using condoms consistently. 15% of them have ever had a paid female partner, of which 29.7% of them used condoms consistently.

In Thoubal, 9.9% of IDUs reported sharing needles/syringes. 73.6% of them had a regular female partner, and among them, 18.5% reported that they use condoms consistently. 24% of IDUs have ever had a paid female partner, of which 37.5% reported using condoms consistently.

In 2018-2020, Churachandpur district became the highest prevalent district with 17.89 positive cases/10,000 persons, followed by Imphal West (14.97 cases/10,000), Imphal East (11.20 positive cases/10,000) and so on.

Among those who had sex in the past year to the NFHS-3 survey (2005-06), 0.3% of women and 3% of men reported having had higher-risk sex during the year. High-risk sex is sexual intercourse with someone who is neither a spouse nor a cohabiting partner. While 1% of male respondents reported having multiple sex partners during the same year. Among men reporting higher-risk sex in the past 12 months, 49% reported not using a condom the last time they had higher-risk sex. As per NFHS-4 (2015-16), there was only 47.3% of youth (15-24 yrs) had comprehensive knowledge about HIV/AIDS (National AIDS Control Organization, 2017). Among the sexually active adults (15-49) having higher-risk sexual behaviour (3.8%), more than 70% reported not having condoms during the last higher-risk intercourse. It was also reported that a significant proportion of youth (15-24 yrs) (18.4%) had higher-risk sexual behaviour, and around 65% of them reported not using condoms during their last higher-risk intercourse (National AIDS Control Organization, 2017).

Conclusion

Location of Manipur close to the Golden Triangle, sharing long international borders with Myanmar in the east, which happens to be one of the main routes of drugs and heroin trafficking, makes the state generally vulnerable to not only drug trafficking but also associated HIV infections. Besides, Churachandpur district of Manipur also shares internal boundary with Mizoram, which is the highest HIV prevalent state in the country. Ethnic similarity has been responsible for the migration of people from the former into the latter.

Manipur has entered the generalized epidemic category from a stage when HIV was concentrated among IDUs only. The state is placed higher than the national average in HIV infected persons among ANC attendees and among FSWs when compared with the national average.

The spatial pattern of HIV pattern reveals wider spread of across the state though there is important regional variation. Urbanization and the location of the districts in proximity to international border and national highway appear to be most significant correlates of HIV prevalence creating spatial variation across the districts.

IDU continues to be an important mode of transmission, though its relative importance is on a decline not so much due to fall in absolute numbers, but due largely to increase in importance of other modes of transmission particularly after its shift to sexual transmission and still later through modes like mother-child, blood transfusion etc.

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