Determining the Spatial and Risk Heterogeneity in HIV Prevalence among IDUs in India: Analysis Based on the Data from Integrated Biological and Behavioural Surveillance (IBBS), 2014-15

Santhakumar Aridoss  
National Institute of Epidemiology

Joseph David  
National Institute of Epidemiology

Nagaraj Jaganathasamy  
National Institute of Epidemiology

Malathi Mathiyazhakan  
National Institute of Epidemiology

Ganesh Balasubramanian  
National Institute of Epidemiology

Manikandan Natesan  
National Institute of Epidemiology

V.M. Padmapriya  
National Institute of Epidemiology

Pradeep Kumar  
National AIDS Control Organisation

Shobini Rajan  
National AIDS Control Organisation

Elangovan Arumugam  
elangovan@nie.gov.in  
National Institute of Epidemiology

Research article

**Keywords:** Injecting Drug User, behaviour, risk-structure, HIV prevalence, India

**DOI:** https://doi.org/10.21203/rs.3.rs-89506/v1

**License:** ©  This work is licensed under a Creative Commons Attribution 4.0 International License.  Read Full License
Abstract

**Background:** Spatial and risk-related heterogeneity among high-risk HIV populations marks the prevalence, dynamics, and management of HIV. Identifying the spatial heterogeneity of disease prevalence and risk heterogeneity at a specific location is crucial for fine-tuning the strategic interventions. On this background, we analysed the behavioural data and HIV prevalence of IDUs, in a state-specific manner.

**Objectives:** To structure the IDU population based on their risk of infection and location, and to determine the HIV prevalence for each of the IDU subpopulation based on their spatial distribution and risk profile.

**Methods:** We analysed the behavioural data and HIV prevalence obtained from the National Integrated Biological and Behavioural Surveillance (IBBS), a nationwide cross-sectional community-based study conducted in 2014-2015. We included the data obtained from 19,902 IDUs across 53 domains in 29 states of India for analysis. We grouped the IDUs into different categories, based on their risk profile, and analysed the corresponding HIV prevalence among IDUs in each category for all states.

**Results:** State-specific analysis of HIV prevalence among the IDUs exhibiting safe and high-risk characteristics revealed that the HIV prevalence was the highest in Uttar Pradesh irrespective of the risk-structure of the state. HIV infection was highly prevalent in the Central and most Northern states, and in a few East and North-Eastern Indian states. HIV Prevalence was predominantly higher among those IDUs self-reporting presence of at least one STI symptom, following unsafe injecting practices, IDUs with inconsistent condom usage with sexual partners (other than regular partners), and those with inadequate knowledge of HIV /AIDS.

**Conclusion:** Stratified, region-specific interventions based on geographic risk-structure and combination-approaches are recommended to prevent HIV transmission among IDUs. Implementing measures to generate adequate awareness of STI, HIV, and injecting behaviours, specifically among IDUs in the Central and Northern states of India and advocating safe sexual practises among all IDUS will have a positive impact on HIV prevention measures among IDUs.

Background

HIV prevalence in India is highly heterogeneous with varying disease burden across and within states, with potential vulnerabilities and risk-behaviours differing by geography and by subpopulation. Hence, considering such heterogeneities for the epidemiological setting of HIV interventions in India will improvise the planning and implementation of targeted interventions [1]. The Integrated Biological and Behavioural Surveillance (IBBS) conducted in 2014-15, collected the behavioural data among the high-risk groups (female sex workers (FSW), men having sex with men (MSM), injecting drug users (IDU), and transgender (TG) along with their biological samples. Apart from the sexual route, HIV transmission through injecting drug use contributes significantly to the increase in HIV prevalence, thus placing injecting drug users (IDU) among the third largest high-risk HIV population in India. In a recent study, the estimated size of the IDU population in India is about 0.39 million in 2019 [2]. The HIV prevalence among IDUs in 2015, based on IBBS, was 9.9%; with Uttar Pradesh recording the highest prevalence of 29% [3]. Reports show a considerable increase in new HIV infections in the north-eastern states in 2015 [3, 4], which could be attributed to the widely prevalent injecting drug use in the region, given its proximity to Myanmar [5]. Accordingly, the HIV Sentinel Surveillance (HSS) conducted in 2017 reports the estimated HIV prevalence to be 6.26% in 2017, with Mizoram recording the highest prevalence of 19.81% [4].

IBBS, with its behavioural components, presents the actuality of risk-structure and disease confinement at different geographical locations within India that affects the dynamics of HIV prevalence and transmission. For instance, within the IDU meta-population, the risk-structure varies, resulting in subpopulations of different risk-groups based on their sexual and injecting behaviours. Lack of awareness or adequate knowledge on HIV/AIDS, presence of STI symptom,
unsafe injecting behaviours, and inconsistent condom usage are most commonly associated with higher infection risk [6]. The transmission might occur at a much higher rate within the high-risk subpopulations leading to confined disease transmission. Identifying the heterogeneity of HIV infection and the underlying disease confinement, and implementing improvised decentralised targeted interventions are essentially needed to prevent HIV transmission. Such structuring of the population will have profound effects on interventional outcomes. Hence, the objective of this study is to structure the IDU population based on their risk of infection and location, and to determine the HIV prevalence for each of the IDU subpopulation based on their spatial distribution and risk profile.

Methods

This study analyses the behavioural data and HIV prevalence obtained from the National Integrated Biological and Behavioural Survey conducted in 2014–2015 among IDUs across 53 domains in 29 states of India [3]. The inclusion criteria for IDU were men, aged 15 years or more, who had used any psychotropic (addictive/mind-altering) substance or drug for recreational or non-medical reasons through injections, at least once in the last three months. IBBS followed a probability-based study design with a fixed sample size of 400 for each domain. The respondents were recruited based on cluster sampling; by employing both conventional cluster sampling (CCS) and time-location cluster sampling (TLCS) methods, wherever appropriate. Blood samples were collected from all consented respondents following the pre-validated standard questionnaire administration. IBBS followed an unlinked anonymous testing (UAT) approach, with informed consent for sample and data collection, and the standard two-test protocol for HIV testing. The detailed methodology for sample and data collection are reported elsewhere [3].

For IDUs, data on basic demographics, injecting and sexual behaviours, partner types, knowledge of STI, HIV, ART, and details on violence-episodes were collected. Here we analyse a part of the data from the entire questionnaire, which are deemed as potential behavioural characteristics attributing to high risk of disease transmission among IDUs. The behavioural data considered for analysis were having one or more symptoms of sexually transmitted infections (STIs), unsafe injecting practices such as sharing needles/syringes, having inadequate knowledge or misconceptions about HIV/AIDS, inconsistent condom usage with regular female partners, inconsistent condom usage with sexual partners (other than regular female partners) such as paid or casual female partners or male or transgender partners.

The respondents who had self-reported to have at least one of the following three STIs; namely genital ulcer/sore, urethral discharge or genital warts were considered to have symptoms of STIs. An IDU was considered to have adequate awareness and knowledge on HIV/AIDS, if he had given correct answers to all questions on awareness, modes of transmission and HIV preventive measures, that were included in the survey. An IDU was considered to have unsafe injecting practices if he had shared used needles or syringes in any of the injecting episodes in the last 3 months of the survey. An IDU was considered to have consistent condom usage practice if he had consistently used condoms during sex act in the last 12 months of the survey, with his sexual partners. Under each of the risk-categories, HIV prevalence among IDUs with and without risk characteristics was determined, based on the state-weight. Chi-square test was done to establish an association between HIV prevalence among IDUs in each state. Spatial analysis was done using Q-GIS software (Version 3.12). All statistical analysis was done using SPSS software (Version 26.0).

Results

All valid samples of consented IDUs were included in the analysis, accounting to 19902 respondents. Among all IDUs, the highest HIV prevalence was recorded in Uttar Pradesh (29.6%), followed by NCT of Delhi (22.4%), Madhya Pradesh (15.7%), Uttarakhand (13.2%) and Manipur (12.1%). The states Chandigarh, West Bengal, and Mizoram recorded a prevalence of over 10%, while it ranged between 7 and 10% in Punjab, Haryana, and Chhattisgarh (Table 1, Fig. 1A).
| State                  | n    | Age Median (IQR) | HIV Prevalence (%) | Have STI Symptom (%) (At least 1) | Inadequate HIV knowledge (%) | Unsafe Injection Practice (%) (At least 1) | Inconsistent Condom Usage with RFP (%) | Inconsistent Condom Usage with OP (%) |
|-----------------------|------|------------------|--------------------|-----------------------------------|-------------------------------|------------------------------------------|---------------------------------------|--------------------------------------|
| Andhra Pradesh        | 768  | 30 (26-34)       | 3.1                | 17.7                              | 32.4                          | 18.0                                     | 86.8                                  | 48.3                                 |
| Arunachal Pradesh     | 397  | 25 (22-28)       | 0.0                | 4.7                               | 72.8                          | 23.9                                     | 82.7                                  | 65.4                                 |
| Assam                 | 805  | 28 (24-31)       | 2.3                | 4.4                               | 64.3                          | 22.2                                     | 90.1                                  | 52.1                                 |
| Bihar                 | 288  | 28 (23-34)       | 2.2                | 19.1                              | 72.6                          | 18.8                                     | 92.7                                  | 70.1                                 |
| Chandigarh            | 401  | 30 (28-36)       | 11.8               | 17.0                              | 33.7                          | 13.7                                     | 84.7                                  | 52.2                                 |
| Chhattisgarh          | 764  | 26 (23-31)       | 7.4                | 19.4                              | 54.8                          | 18.6                                     | 76.5                                  | 38.3                                 |
| Goa                   | 380  | 28 (23-33)       | 1.4                | 19.0                              | 84.5                          | 60.3                                     | 52.1                                  | 65.5                                 |
| Gujarat               | 394  | 35 (29-40)       | 2.7                | 39.4                              | 85.3                          | 65.0                                     | 53.8                                  | 30.1                                 |
| Haryana               | 1437 | 29 (25-35)       | 8.0                | 27.3                              | 73.3                          | 34.8                                     | 84.8                                  | 60.4                                 |
| Himachal Pradesh      | 403  | 27 (23-34)       | 3.8                | 14.7                              | 71.2                          | 54.3                                     | 82.5                                  | 71.8                                 |
| Jammu Kashmir         | 359  | 30 (26-38)       | 0.4                | 27.3                              | 72.1                          | 32.6                                     | 91.5                                  | 76.5                                 |
| Jharkhand             | 393  | 28 (23-35)       | 0.7                | 2.5                               | 70.7                          | 8.9                                      | 82.6                                  | 41.5                                 |
| Karnataka             | 364  | 27 (22-33)       | 1.1                | 17.2                              | 49.5                          | 50.0                                     | 90.0                                  | 70.5                                 |
| Kerala                | 1113 | 31 (26-40)       | 0.2                | 10.0                              | 41.8                          | 23.5                                     | 96.1                                  | 70.7                                 |
| Madhya Pradesh        | 1175 | 28 (24-35)       | 15.7               | 15.4                              | 58.1                          | 33.6                                     | 72.0                                  | 63.4                                 |
| Maharashtra           | 383  | 31 (28-36)       | 0.6                | 8.4                               | 77.5                          | 49.1                                     | 83.5                                  | 72.5                                 |
| Manipur               | 1594 | 32 (27-37)       | 12.1               | 11.3                              | 38.0                          | 25.6                                     | 83.0                                  | 53.4                                 |
| Meghalaya             | 396  | 26 (23-29)       | 3.2                | 2.7                               | 77.0                          | 33.1                                     | 77.2                                  | 68.7                                 |
| Mizoram               | 1084 | 25 (23-30)       | 10                 | 7.2                               | 39.8                          | 37.7                                     | 89.7                                  | 74.9                                 |
| Nagaland              | 1198 | 33 (28-32)       | 3.2                | 18.5                              | 66.6                          | 21.6                                     | 80.4                                  | 63.4                                 |
| State             | IDUs | Median Age (Range) | HIV Infected | STI Infected | HIV Prevalence | STI Prevalence |
|-------------------|------|-------------------|-------------|--------------|---------------|---------------|
| NCT Of Delhi      | 790  | 30 (25-35)        | 22.4        | 34.9         | 48.7          | 20.5          |
| Orissa            | 391  | 27 (24-33)        | 1.4         | 12.8         | 47.3          | 16.4          |
| Punjab            | 1087 | 26 (23-31)        | 9.6         | 23.1         | 65.8          | 34.5          |
| Rajasthan         | 273  | 34 (28-40)        | 1           | 15.1         | 72.9          | 19.4          |
| Sikkim            | 385  | 24 (21-28)        | 0.2         | 15.9         | 47.8          | 30.9          |
| Tripura           | 286  | 28 (25-33)        | 0.6         | 6.1          | 68.2          | 15.0          |
| Uttarakhand       | 411  | 30 (26-35)        | 13.2        | 40.7         | 60.3          | 23.8          |
| West Bengal       | 596  | 30 (24-37)        | 10.8        | 13.7         | 66.9          | 22.8          |

HIV- Human Immunodeficiency Virus;
STI – Sexually Transmitted Infections (*Had at least one STI symptom during the past 12 months (Vaginal discharge/lower abdominal pain without diarrhea or menses/Genital ulcer or sores);
RFP – Regular female partners; OP – Other sexual partners (including paid or casual female partners, male or transgender partners)

About one-fourth to two-fifths IDUs reported the presence of one or more STI symptoms; the highest in Uttarakhand followed by Gujarat, NCT of Delhi, Haryana, Jammu & Kashmir, and Punjab. (Fig. 1B). Accordingly, in most of the high prevalence states, a positive association was significantly established between the presence of STI symptoms and HIV prevalence. A reverse association was significant in Chandigarh and Chhattisgarh; whereas, irrespective of the presence or absence of STI symptoms, HIV prevalence was invariably high among IDUs in Uttar Pradesh (Table 2).
Table 2
Comparison of HIV Prevalence among IDU subgroups based on risk-characteristics

| High Risk Behaviours | Presence of any one STI symptoms | Injecting Practice | Aware of HIV transmission | Consistent Condom Usage (Regular partner) | Consistent Condom Usage (Other Partners) |
|----------------------|----------------------------------|--------------------|---------------------------|------------------------------------------|-----------------------------------------|
|                      | No | Yes | Safe | Unsafe | Yes | No | Yes | No | Yes | No | Yes | No |
| Andhra Pradesh       | 3.3 | 1.5 | 3.7  | 0.7   | 2.1 | 5.2 | 5.3 | 2.1 | 3.5 | 2.4 |
| Arunachal Pradesh    | 0  | 0   | 0    | 0     | 0   | 0   | 0   | 0   | 0   | 0   |
| Assam                | 2.3 | 2.8 | 2.4  | 2.2   | 2.4 | 2.3 | 2.8 | 1.5 | 0   | 0   |
| Bihar                | 2.1 | 1.8 | 2.6  | 0     | 3.8 | 1.4 | 6.7 | 2.6 | 2.2 | 1.9 |
| Chandigarh           | 13.5 | 2.9* | 11.8 | 10.9 | 9   | 17.0* | 4.3 | 7.1 | 3.9 | 6   |
| Chhattisgarh         | 8.5 | 2.7* | 3.9  | 22.5*** | 4.1 | 10.0** | 4.2 | 8.9 | 3.3 | 3.5 |
| Goa                  | 0.6 | 5.5** | 0.7  | 1.7   | 0   | 1.6 | 3.6 | 5   | 0   | 0   |
| Gujarat              | 0.8 | 5.2* | 1.4  | 3.5   | 3.4 | 2.7 | 6.6 | 1.4 | 3.8 | 2.9 |
| Haryana              | 6.1 | 12.8** | 6.9  | 9.8   | 9.1 | 7.5 | 8.4 | 9.3 | 15.6 | 8.7** |
| Himachal Pradesh     | 4.4 | 0    | 7.1  | 0.9*** | 1.7 | 4.5 | 0   | 1.1 | 1.4 | 5.3 |
| Jammu & Kashmir      | 0.4 | 0    | 0    | 0.9   | 0   | 0.4 | 0   | 0.6 | 0   | 1.3 |
| Jharkhand            | 0.8 | 0    | 0.6  | 2.9   | 0   | 1.1 | 0   | 1.2 | 0   | 0   |
| Karnataka            | 1   | 1.6 | 2.2  | 0.5   | 2.2 | 0.6 | 0   | 0.7 | 2.6 | 1.1 |
| Kerala               | 0.2 | 0    | 0    | 0.8*  | 0   | 0.4 | 0   | 0.2 | 0   | 0.4 |
| Madhya Pradesh       | 16.2 | 13.3 | 15   | 17    | 14.6 | 16.5 | 10.3 | 14.9 | 13.9 | 11.7 |
| Maharashtra          | 0.6 | 0    | 0.5  | 0.5   | 0   | 0.7 | 0   | 0.4 | 1.5 | 0   |
| Manipur              | 12.6 | 8.3 | 11.8 | 13.2 | 13.8 | 9.4* | 16.7 | 7.7** | 8.2 | 10 |
| Meghalaya            | 3.1 | 9.1 | 2.6  | 3.8   | 2.2 | 3.6 | 11.5 | 1.1* | 7.3 | 2.2 |
| Mizoram              | 8.3 | 31.6*** | 10.5 | 9.3   | 11.5 | 7.7* | 6   | 10.3 | 5.6 | 15.0* |
| Nagaland             | 2.9 | 4.5 | 3.1  | 3.9   | 5.3 | 2.1** | 2.3 | 3.1 | 1.2 | 4.7* |
| NCT Of Delhi         | 18.3 | 30.1*** | 19.6 | 32.7*** | 11.6 | 33.6*** | 6.7 | 21.4*** | 8.1 | 30.9*** |
| Orissa               | 1.5 | 0    | 1.2  | 1.6   | 1.5 | 1.1 | 0   | 1   | 1   | 2.6 |
| Punjab               | 7.8 | 15.9*** | 11   | 7.2*  | 6.7 | 11.1* | 17.3 | 6.3*** | 4.9 | 7.1 |
| Rajasthan            | 1.3 | 0    | 1.4  | 0     | 2.7 | 0.5 | 0   | 1.1 | 4.8 | 0   |
| Sikkim               | 0.3 | 0    | 0.4  | 0     | 0.5 | 0   | 0   | 0.6 | 0   | 0.6 |
| Tripura              | 0.7 | 0    | 0.8  | 0     | 0   | 1   | 0   | 0   | 0   | 0   |
| Uttar                | 28.8 | 34.8 | 25.3 | 34.2*** | 30.4 | 29.4 | 40   | 24.9* | 27.1 | 27.8 |
| Pradesh       | 11.5 | 15.5 | 12.1 | 16.3 | 12.9 | 13.3 | 44.4 | 10.2** | 10.2 | 9    |
|--------------|------|------|------|------|------|------|------|--------|------|------|
| Uttarakhand  |      |      |      |      |      |      |      |        |      |      |
| West Bengal  | 8.4  | 25.6***| 7   | 23.5***| 6.6  | 13.0* | 21.9 | 6.5**  | 7.8  | 11.1 |

* Significantly differed at *5% level (P<0.05); **0.5% level (P<0.005); ***0.1% level (P<0.001)

While the overall awareness of HIV among IDUs in India was around 96%, nearly 10% of the IDUs in Uttar Pradesh and Delhi were unaware or unheard of HIV. Nearly one-third or more IDUs lacked adequate awareness of HIV/AIDS across India, with the highest proportions in Goa and Gujarat (Table 1). Higher the rate of lack of awareness higher was the rate of unsafe injecting practices in most states, HIV prevalence was predominantly higher among IDUs with inadequate knowledge of HIV/AIDS, which was significant in the states of Delhi, Haryana, Chandigarh, Punjab, West Bengal, Chhattisgarh, and Andhra Pradesh (Fig. 1C).

Nearly, one-third or more respondents reported unsafe injecting practices, in the states of Gujarat, Goa, Himachal Pradesh, Karnataka, Maharashtra, Uttar Pradesh, Mizoram, Haryana, Punjab, and Madhya Pradesh (Table 1). In most states, HIV prevalence was higher among IDUs with unsafe injecting practices as compared to those with safe injecting practices in most states (Table 2, Fig. 1D). The unsafe injecting practice was significantly associated with higher HIV prevalence in Uttar Pradesh, NCT of Delhi, West Bengal, Chhattisgarh, and Kerala; whereas a reverse association was observed in Punjab and Himachal Pradesh (Table 2).

Inconsistent condom usage with regular female partners was associated with slightly higher HIV prevalence in most states, however, the association was significant only in NCT of Delhi. Further, a significant reverse association was found in Meghalaya, Manipur, Punjab, West Bengal, Uttar Pradesh, Uttarakhand. Likewise, a reverse association was established with consistent condom usage with sexual partners (other than regular female partners) casual or paid partners and HIV prevalence in most states, which however was significant only in Haryana. Nevertheless, inconsistent condom usage with casual or paid partners was significantly associated with higher HIV prevalence in Delhi, Mizoram, and Nagaland (Table 2).

**Discussion**

The regions of higher HIV prevalence among IDU was concentrated in the North and Central India, and few states of the East and North-East India. Accordingly, the states, Uttar Pradesh, Delhi, Punjab, Manipur, and Nagaland have the highest number of estimated IDUs [2]. The analysis shows that unsafe injecting practices were more prevalent in the Western and Central India, whereas unsafe sexual behaviours were widespread among most states. IDUs with unsafe injecting practices and sexual practices had a significantly higher prevalence. Higher HIV prevalence was also significantly associated with inadequate knowledge or misconceptions about HIV/AIDS.

Awareness and adequate knowledge of HIV/AIDS is the key to HIV prevention and management [7, 8, 9]. IDUs with inadequate knowledge or misconceptions about HIV/AIDS are more likely to be involved in high-risk behaviours. In India, 26.1% of the IDUs had misconceptions about the transmission routes or had inadequate knowledge of preventive measures and 42.6% IDUs lacked comprehensive knowledge of HIV/AIDS. IEC activities aim to create awareness on HIV/AIDS among all IDUs in India, which is of utmost importance to prevent disease transmission. However, in India, only 58.2% of the IDUs had received IEC services, representing a knowledge gap to be addressed for effective HIV management [10, 11]. While it is essential to educate the IDUs on HIV prevention and management, it is necessary not to foster unintended, false assumptions. For instance, evidence suggests that awareness of ART led to misconceptions of considering HIV as a non-communicable or curable disease [12].

Among IDUs, safe injecting practices mainly prevents HIV transmission [13, 14]. Various social-structural contextual factors lead to unsafe injection practices. Social networks, peer pressure, fear of harassment, inaccessibility to sterile needles or syringes are some of them [15, 16]. Reports show that HIV-positive IDUs follow certain strategies to reduce transmission risks such as ‘being the last receiver’, sharing with HIV positive IDUs, and washing the needles/syringes before sharing. These practices further increase their risk of acquiring other infections such as HCV, HBV [15, 17]. These factors, however, cannot be generalized, and region and state-specific contextual factors need to be identified and addressed.

Reports show that the HIV prevention interventions among IDU focus on propagating safer injection practices and emphasizing condom use with high-risk partners such as paid partners [18]. Among all HRGs, more than 50% of the participants have reported having consistent condom usage among all partner types other than regular partners, the exception being IDUs. Nationwide, the proportion of IDUs having female partners is 80.2% of which 15.9%, 29.2% and 50.0% had consistent condom usage with regular, casual and paid partners respectively. While 37.4% of them had male/TG partners, only 35.9% reported consistent condom usage [3]. Subsequently, a significant positive association between HIV prevalence and inconsistent condom usage in high prevalence states such as Delhi and Mizoram, suggests the need to emphasize safe sexual practices in IDU interventions. Several studies have documented the unsafe sexual behaviours of IDUs and transmission risk from IDU to their non-injecting partners, specifically the regular partners [19, 20]. Various factors affect condom usage with sexual partners of IDU, such as non-disclosure of risk-behaviours due to fear of rejection, social stigma, or discrimination. In some cases, HIV sero-concordant and concordant HIV-negative relationships may significantly affect the consistent use of condoms. Nevertheless, condom usage reduces transmission risks as well as resistance to ART [21, 22]. On the other hand, drug-intake during or before sex is often associated with unsafe sexual behaviour, due to its physiological impact on the drug user. Negotiating condom usage under such circumstances is difficult, which poses risks of disease transmission at a much higher rate among the high-risk population. Hence, advocating consistent condom usage among IDUs with all sexual partners, and provision of necessary psychological support and counselling ensures safe sexual practices in IDUs [18].

Untreated STIs increases HIV infection risks, therefore, HIV interventions in India include regular screening and treatment for STIs, despite which only 76.1% IDUs had heard of STIs as against 96% of HIV/AIDS. A predominantly, significant association between the presence of self-reported STI symptom and high HIV prevalence calls for appropriate interventions. Apart from personal hygiene, drug abuse and sexual encounters; studies also report an association between Needle Syringe Exchange Programme (NSEP) accessibility and HCV prevalence [23]. Identifying and addressing such programmatic gaps is crucial to reduce infection risks.

Various individual and socio-structural contextual factors such as the age of the IDUs, age at initiation of the drug use or duration of IDU behaviour, stigma, violence-victimization, unavailability or inaccessibility of interventional services, influence the risk behaviours of the IDUs, and hinder the utilization of HIV services by the IDUs [24]. The researchers highlight the need of high coverage and combined approaches for HIV prevention, and they recommend social and structural changes for effective outcomes [25]. Stratified, region-specific interventions based on geographic risk-structure and combination-approaches are recommended to prevent HIV transmission among IDUs.

**Conclusion**

Ensuring adherence to safe injecting and safe sexual practices under the influence of drugs by IDUs is a major challenge for HIV preventive and control measures. Addressing this situation through intensified, decentralised, region-specific strategies, with high coverage and outreach, is recommended for optimal and effective program response.

**Limitations**
IBBS does not include any female IDUs, hence the data analysed in this paper are limited to male IDUs alone. The variables selected for this particular analysis were selected to identify the behavioural risk-structure, hence the underlying socio-demographic factors such as age, education, age at initiation of the drug use or occupation, and violence-victimization, were not considered.

**Abbreviations**

HIV  Human Immunodeficiency Virus
AIDS  Acquired Immunodeficiency Syndrome
STI  Sexually Transmitted Infection
FSW  Female sex workers
MSM  Men having sex with men
IDU  Injecting drug users
TG  Transgender
IBBS  Integrated Biological and Behavioural Surveillance
CCS  Conventional Cluster Sampling
TLCS  Time Location Cluster Sampling
UAT  Unlinked Anonymous Testing
ART  Anti-Retroviral Treatment
Q-GIS  Quantum-Geographic Information System
SPSS  Statistical Package for Social Science
NCT  National Capital Territory
IEC  Information, Education and Communication
HCV  hepatitis C Virus
HBV  hepatitis B Virus
NSEP  Needle Syringe Exchange Programme
ICF  Informed Consent Form

**Declarations**

**Ethics approval and consent to participate:**

All respondents were clearly informed about the details of the survey and the voluntary nature of the participation. A written informed consent was obtained through informed consent form (ICF). The study approved by the Institutional
Ethical Committee of ICMR - National Institute of Epidemiology, Chennai. Approval number is NIE/IHEC/20138/04.

**Consent for publication:**

Not applicable

**Availability of data and materials:**

The datasets generated and/or analysed during the current study are not publicly available due to National AIDS Control Organisation's data sharing policy, but are available from Head, Strategic Information and Management Unit or Programme Officer Surveillance or Director General, National AIDS Control Organisation Department of Health & Family Welfare, Chanderlok Building Janpath New Delhi, on reasonable request in prescribed format. ([http://www.naco.gov.in/nacos-data-sharing-guidelines-december-2018](http://www.naco.gov.in/nacos-data-sharing-guidelines-december-2018)).

**Competing Interest:**

The author(s) declared that no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

**Funding:**

The Study was funded by National AIDS Control Organization. Government of India. Grant No. T-11020/36/09-NACO (Surveillance). The views expressed herein are those of the authors and do not necessarily reflect the official policy or position of National AIDS Control Organization.

**Author’s contributions:**

Conceptualization: AS, AE. Data curation: AS, JKD. Data Analysis and Spatial mapping: NJ, AS. Writing: MM AE. Review & editing: AS, PK,SR, BG, MN, VMP. All authors have read and approved the manuscript.

**Acknowledgments:**

The authors wish to thank the project directors of state AIDS control societies for their support in completing the surveillance activities in a timely manner. The authors also express their gratitude to the concerned referral laboratories, state surveillance team members, and sentinel site personnel. Our special thanks to Dr. Sanjay Madhav Mehendale, Former Director, and Dr. Manoj Murhekar, Director, ICMR – National institute of Epidemiology, Chennai for their immense contribution and technical inputs towards successful completion of the HIV surveillance.

**References**

1. Paranjape RS, Challacombe SJ. HIV/AIDS in India: An overview of the Indian epidemic. Oral diseases. 2016; 22:10-4.
2. Arumugam E, Kangusamy B, Sahu D, Adhikary R, Kumar P, Aridoss S. Size Estimation of high-risk groups for hiv infection in india based on data from national integrated bio-behavioral surveillance and targeted interventions. Indian J Public Health 2020;64(Suppl S1):39-45.
3. National AIDS Control Organisation, NACO. National Integrated Biological and Behavioural Surveillance (IBBS) 2014-15. New Delhi: NACO, Ministry of Health and Family Welfare, Government of India, 2015. http://naco.gov.in/sites/default/files/IBBS%20Report%202014-15.pdf

4. National AIDS Control Organisation, NACO. India HIV estimations 2017. New Delhi: NACO, Ministry of Health and Family Welfare, Government of India, 2017. http://naco.gov.in/sites/default/files/HIV%20Estimations%202017%20Report_1.pdf

5. Ganju D, Ramesh S, Saggurti N. Factors associated with HIV testing among male injecting drug users: findings from a cross-sectional behavioural and biological survey in Manipur and Nagaland, India. Harm reduction journal. 2016;13(1):21.

6. Ganesh B, Mosoniro K, Vasna J, Elangovan A, Santhakumar A, Shobini R. Factors associated with human immunodeficiency virus infection and self-assessed risk to human immunodeficiency virus among injecting drug users in Manipur, India. Indian J Public Health 2020;64(Suppl S1):61-6.

7. De Souza NJ, Kolipaka RP, Kumar J, Hegde AM. Knowledge, attitude, and practice toward human immunodeficiency virus/acquired immune deficiency syndrome: A questionnaire study among students, teachers, and parents in Mangalore, India. J Indian Assoc Public Health Dent 2019;17:70-5.

8. Dokubo EK, Shiraishi RW, Young PW, Neal JJ, Aberle-Grasse J, Honwana N, Mbofana F. Awareness of HIV status, prevention knowledge and condom use among people living with HIV in Mozambique. Plos one. 2014;9(9):e106760.

9. Nketiah-Amponsah E, Afful-Mensah G. A review of HIV/AIDS awareness and knowledge of preventive methods in Ghana. African journal of reproductive health. 2013;17(4):69-82.

10. Zaman FA. Impact assessment of IEC intervention on knowledge attitude and practice (KAP) of HIV/AIDS in Assam. Ann Trop Med Public Health 2013;6:644-8.

11. Imran M, Madhusudan M. Role of IEC in Improvement of Knowledge and Attitude about HIV/AIDS among College Students. Indian Journal of Public Health Research & Development. 2014;5(4):221-6.

12. Lange Joep MA, Perriens Jos, Kuritzkes Dan, Zewdi Debreworkd. What policymakers should know about drug resistance and adherence in the context of scaling-up treatment of HIV infection, AIDS. 2004;18:S69-S74.

13. Noroozi M, Noroozi A, Mirzazadeh A, Hajeibi A, Mehrabi Y, Hashemi SS, et al. Impact of needle and syringe program coverage on HIV incidence in people who inject drugs. Int J High Risk Behav Addict. 2017;6(1):e28929.

14. Wodak A, McLeod L. The role of harm reduction in controlling HIV among injecting drug users. AIDS (London, England). 2008;22(Suppl 2):S81.

15. Chakrapani V, Newman PA, Shunmugam M, Dubrow R. Social-structural contexts of needle and syringe sharing behaviours of HIV-positive injecting drug users in Manipur, India: a mixed methods investigation. Harm Reduction Journal. 2011;8(1):9.

16. De P, Cox J, Boivin JF, Platt RW, Jolly AM. The importance of social networks in their association to drug equipment sharing among injection drug users: a review. Addiction. 2007;102(11):1730-9.

17. Latkin CA, Buchanan AS, Metsch LR, Knight K, Latka MH, Mizuno Y, et al. Predictors of sharing injection equipment by HIV-seropositive injection drug users. Journal of acquired immune deficiency syndromes (1999). 2008;49(4):447.

18. Sharma V, Tun W, Sama A, Saraswati LR, Pham MD, Thior I, Luchters S. Prevalence and determinants of unprotected sex in intimate partnerships of men who inject drugs: findings from a prospective intervention study. International journal of STD & AIDS. 2019;30(4):386-95

19. Pisani E, Sucahya PK, Kamil O, Jazan S. Sexual behavior among injection drug users in 3 Indonesian cities carries a high potential for HIV spread to noninjectors. JAIDS Journal of Acquired Immune Deficiency Syndromes. 2003;34(4):403-6.
20. Panda S, Kumar MS, Saravanamurthy PS, Mahalingam P, Vijaylakshmi A, Balakrishnan P, et al. Sexually transmitted infections and sexual practices in injection drug users and their regular sex partners in Chennai, India. Sexually transmitted diseases. 2007;34(4):250-3.

21. Eaton LA, West TV, Kenny DA, Kalichman SC. HIV transmission risk among HIV seroconcordant and serodiscordant couples: dyadic processes of partner selection. AIDS and Behavior. 2009;13(2):185.

22. Jones D, Kashy D, Villar-Loubet O, Weiss S. Enhancing acceptability and use of sexual barrier products among HIV concordant and discordant couples. AIDS and Behavior. 2013;17(6):2185-93.

23. Sogarwal R, Madge V, Bishi P, Woleng A, Garg R. Predisposing, enabling, and need factors associated with utilization of HCV testing services among PWID in two settings in India. Hepatology, medicine and policy. 2016;1(1):1.

24. Panda S, Kumar MS. Injecting drug use in India and the need for policy and program change. Int J Drug Policy. 2016;37:115-6.

25. Degenhardt L, Mathers B, Vickerman P, Rhodes T, Latkin C, Hickman M. Prevention of HIV infection for people who inject drugs: why individual, structural, and combination approaches are needed. The Lancet. 2010;376(9737):285-301.