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Statistical Analysis of State wise HIV/ AIDS Data in India.

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ABSTRACT

HIV/ AIDS is a global outbreak infection which is quite predominant in India also. According to the reports of 2013, its prevalence in India is 0.27, down from previous year's 0.41. The article has tried to come up with a concise detailing of HIV/ AIDS infection, its mechanism, its drugs and their specific targets, its databases and the drug resistance mutations. Information is also collected on clinical data from different states in India, comprising of HIV Positive pregnant women identified in India, Estimated number of HIV infected persons, Estimated number of people (Above 15 years) with HIV infection, Status of Targeted Interventions in National AIDS Control Program and Total Targeted Intervention Projects. The article tries to correlate the number of cases detected and number of deaths to the lifestyle and medical facilities observed in the respective regions. With the help of Graphical and Visual tools like tables, graphs and images, the article tries to study the trends in Indian HIV scenario in proper detail. The article concludes that the main cause of HIV not getting detected in the non-urban areas is due to lack of proper diagnostic and detection infrastructure.

Keywords: HIV/ AIDS, NACP, Targeted interventions, Diagnostic, Detection, Infrastructure

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INTRODUCTION

Human Immunodeficiency Virus Infection or Acquired Immuno Deficiency Syndromeis a disease of the human immune system caused by infection with *Human Immunodeficiency Virus (HIV)* [1]. The term HIV/AIDS represents the entire range of disease caused by the human immunodeficiency virus from early infection to late stage symptoms. During the initial infection, a person may experience a brief period of influenza-like illness. This is typically followed by a prolonged period without symptoms. As the illness progresses, it interferes more and more with the immune system, making the person much more likely to get infections, including opportunistic infections and tumors that do not usually affect people who have working immune systems.

According to National AIDS Control Organization of India, the prevalence of AIDS in India in 2013 was 0.27, which is down from 0.41 in 2002 [2]. While the National AIDS Control Organization estimated that 2.39 million people live with HIV/AIDS in India in 2008–09 [3], a more recent investigation by the Million Death Study Collaborators in the British Medical Journal (2010) estimates the population to be between 1.4–1.6 million people [4].

The last decade has seen a 50% decline in the number of new HIV infections [5]. According to more recent National AIDS Control Organization data, India has demonstrated an overall reduction of 57 percent in estimated annual new HIV infections (among adult population) from 0.274 million in 2000 to 0.116 million in 2011, and the estimated number of people living with HIV was 2.08 million in 2011 [6].

A lot of awareness campaigns have been started in India, notably through print and social media, which has contributed a lot in bringing down the deaths due to HIV [7]. Southern states and North Eastern top the charts in terms of awareness related to HIV [8].

Drugs Available

ART (antiretroviral treatment) improved a lot in the recent year. In the 2011, eight million infected people were receiving ART in the developing countries which have low income or middle income. ART works by keeping patient healthy. It works when virus is not resistant against the drugs used [9].

The most widely used drug for AIDS is ATRIPLA (oral). This product contains 3 different medications: efavirenz, emtricitabine, and tenofovir. It is used alone or with other HIV medications to help control HIV infection. It helps to decrease the amount of HIV in the patient's body so their immune system can work better. This lowers the chance of getting HIV complications (such as new infections, cancer) and improves the quality of life. Efavirenz belongs to a class of drugs known as non-nucleoside reverse transcriptase inhibitors (NNRTIs). Emtricitabine and tenofovir belong to a class of drugs known as nucleoside reverse transcriptase inhibitors (NRTIs).

But it comes with its share of side effects. Dizziness, trouble sleeping, drowsiness, unusual dreams, and trouble concentrating may frequently occur. The side effects may begin 1-2 days after starting this medication and usually go away in 2-4 weeks. They are also reduced by taking this medication on an empty stomach at bedtime [10].

Targets Available

HIV targets $CD4^+$ T cells by binding to the *CD4* molecule on the cell surface, as well as a chemokine co-receptor – usually CCR5 or CXCR4. Transmission and the early phases of infection, are usually dominated by CCR5-tropic variants, which can bind *CD4*-expressing antigen-presenting cells, such as macrophages, as well as activated $CD4^+$ T cells. In about 50% of infected people, the later stages of infection are characterized by *CXCR4*-tropic variants, which bind naive *CD4* T cells.

NKT cells are likely to be an important target of HIV. Studies demonstrate that Vα24/Vβ11 NKT cells are depleted from the peripheral blood of HIV-infected individuals when compared with healthy donors. Most of the depletion appears to occur within the first year of seroconversion, and is out of proportion with the loss of conventional $CD4^+$ T cells over this period. While other possibilities exist as to the fate of NKT cells in HIV-

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infected patients, several convincing pieces of data support the idea that NKT cells are directly infected by HIV early in the course of the disease and could therefore play a role in establishing HIV infection [11].

Mechanism of Action:

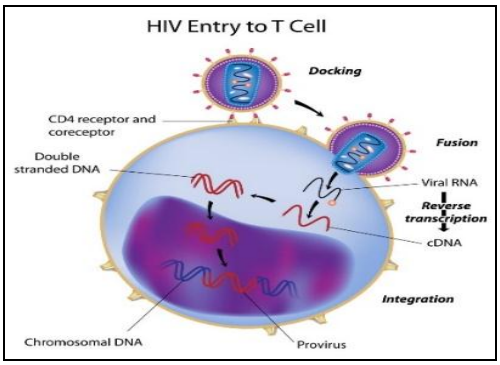

Figure 1: HIV's Entry into T-Cell (Source: http://www.interactive-biology.com/3574/aids-and-mechanism-of-hiv-infection)

HIV is only able to infect certain specific cells – those that display *CD4* protein on their surface. While this clearly includes *CD4* cells themselves, other blood cells such as macrophages and *CD8* cells are also susceptible to infection, as are specific cells in the lungs, the brain, the gastrointestinal tract and the kidneys.

HIV can only be transmitted and cause infection if it gets into the body via a route where these vulnerable cells are plentiful. Figure 1 shows the entry of HIV into a T-cell. Intact, undamaged skin forms a very effective barrier to infection, as skin itself contains no cells that are susceptible to HIV infection. For infection to occur, the virus must enter the body directly via the bloodstream, or via the mucous membranes [12].

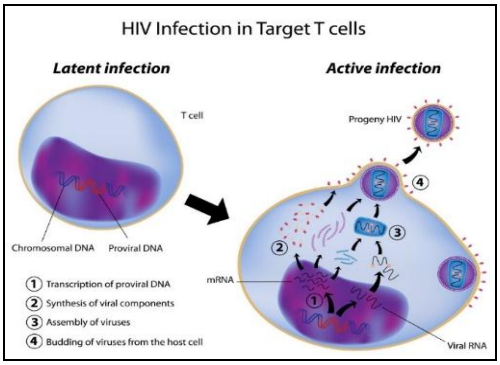

Figure 2: HIV Infection in Target Cells (Source: http://www.interactive-biology.com/3574/aids-and-mechanism-of-hiv-infection)

Figure 2 shows how HIV infects the target cells in the body. The provirus DNA, when activated, starts producing virus until it bursts due to the sheer number of virus inside it, hence leading to two things:

1. Destruction of the cell and;
2. Large number of newly produced HIV viruses which repeat the process all over again and thus spreading infection [12].

Stages of HIV AIDS:

HIV infection has a well-documented progression. If treatment is not provided on time, HIV will eventually overwhelm the immune system. This will lead to the patient being diagnosed with Acquired Immune Deficiency Syndrome (AIDS).

Acute Infection Stage

During this early period of infection, large amounts of virus are being produced in the body. The virus uses *CD4cells*to replicate and destroys them in the process. Because of this, the*CD4count* can fall rapidly. Eventually the immune response begins to bring the level of virus in the body back down to a level called a *viral set point,* which is a relatively stable level of virus in the body. At this point, the*CD4* count begins to increase, but it may not return to pre-infection levels. It may be particularly beneficial to the patient's health to begin ART during this stage [13].

Clinical Latency Stage

After the acute stage of HIV infection, the disease moves into a stage called the "clinical latency" stage. "Latency" means a period where a virus is living or developing in a person without producing symptoms. During the clinical latency stage, people who are infected with HIV experience no HIV-related symptoms, or only mild ones. (This stage is sometimes called "asymptomatic HIV infection" or "chronic HIV infection.") [13].

AIDS

This is the stage of HIV infection that occurs when the immune system is badly damaged and the patient becomes vulnerable to infections and infection-related cancers called opportunistic infections. When the number of *CD4* cells falls below 200 cells per cubic millimeter of blood (200cells/mm^3), the patient is considered to have progressed to AIDS. (In someone with a healthy immune system, *CD4* counts are between 500 and 1,600 cells/mm^3.) The patient is also considered to have progressed to AIDS if he/she develops one or more opportunistic illnesses, regardless of the*CD4* count.

Without treatment, people who progress to AIDS typically survive about 3 years. Once the person has a dangerous opportunistic illness, life-expectancy without treatment falls to about 1 year. However, if he is taking ART and maintain a low viral load, then he may enjoy a near normal life span. He will most likely never progress to AIDS [13].

HIV Databases

Various databases are available for HIV studies. But the most noted and commonly used is HIV Databases (http://www.hiv.lanl.gov/content/sequence/HIV/mainpage.html). The **HIV databases** contain data on HIV genetic sequences, immunological epitopes, drug resistance-associated mutations, and vaccine trials. The website also gives access to a large number of tools that can be used to analyze these data. This project is funded by the Division of AIDS of the National Institute of Allergy and Infectious Diseases (NIAID), a part of the National Institutes of Health (NIH). The databases are:

1) Sequence Database
2) Vaccine Database
3) Immunology Database
4) Database of other viruses

Drug Resistance

Mutation is a process which is uncontrollable as far as organisms in viral sizes are concerned. Thesesometimes leads to development of drug resistance in HIV. Hence, the research that is conducted goes in vain. The mutations listed are those that have been identified by 1 or more of the following criteria: (1) in vitro passage experiments or validation of contribution to resistance by using site-directed mutagenesis; (2) susceptibility testing of laboratory or clinical isolates; (3) nucleotide sequencing of viruses from patients in whom the drug is failing; (4) association studies between genotype at baseline and virologic response in patients exposed to the drug [14].

The following mutations have been listed: The M230L mutation in HIV-1 reverse transcriptase (RT) is associated with resistance to first-generation nonnucleoside reverse transcriptase inhibitors (NNRTIs).

Phenotyping assays with TZM-bl cells confirmed that M230L conferred various degrees of resistance to each of the NNRTIs tested. Recombinant viruses containing M230L displayed an 8-fold decrease in RC compared to that of the parental wild-type (WT) virus. Recombinant HIV-1 WT and M230L mutant RT enzymes were purified; and both biochemical and cell-based phenotypic assays confirmed that M230L conferred resistance to each of EFV, NVP, and ETR. RT that contained M230L was also deficient in regard to each of minus-strand DNA synthesis, both DNA- and RNA-dependent polymerase activities, processivity, and RNase H activity, suggesting that this mutation contributes to diminished viral replication kinetics [14].

The ability of HIV to mutate and reproduce itself in the presence of antiretroviral drugs is called HIV drug resistance (HIVDR). The consequences of HIVDR include treatment failure, need to start more costly second- and third- line treatments, increased health costs associated with these, spread of drug resistant HIV, and need to develop new anti-HIV drugs [15]. Dolutegravir is being evaluated in clinical trials for both initial HIV therapy and for use by treatment-experienced patients. It is available in an expanded access program and has been designated for priority review by the US FDA for treatment-experienced patients with detectable viral load who have documented HIV-1 resistance to raltegravir or elvitegravir.

Statistical Data

The data obtained from India Stat [16] are presented graphically.

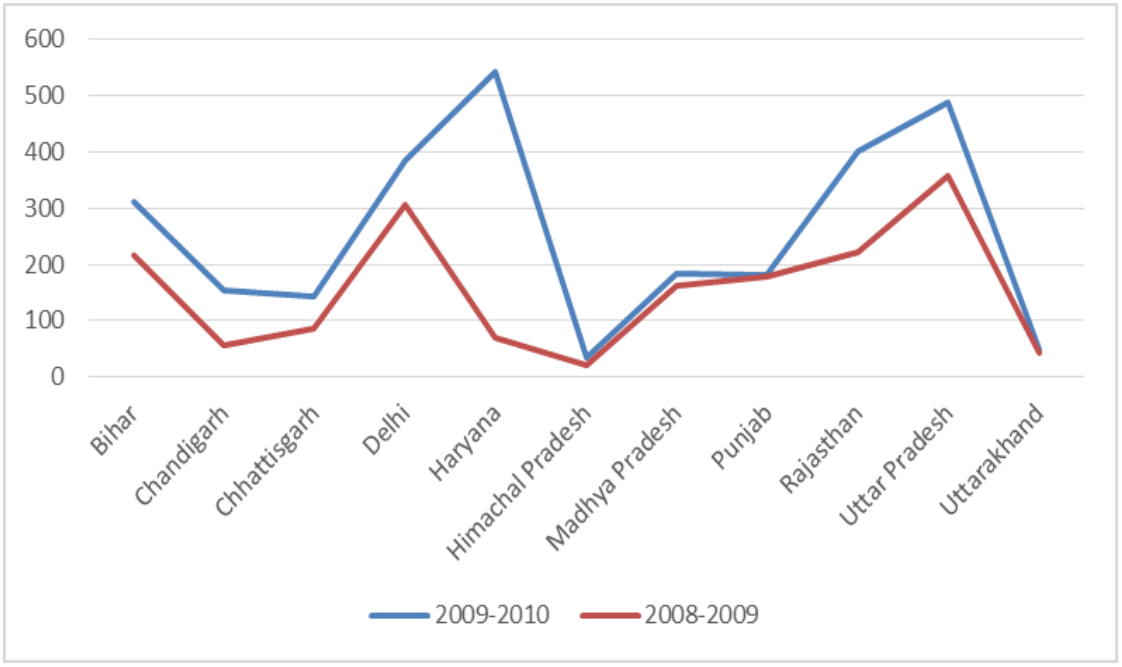

Figure 3: Selected Statewise Number of HIV Positive Pregnant Women Identified in India (2008-2009 and 2009-2010)

Drastic Changes observed in Haryana where the numbers went up 8-fold during a year. Rajasthan and Uttar Pradesh also reported rises in number, but lesser in magnitude. Himachal Pradesh, Madhya Pradesh, Punjab and Uttarakhand reported a no rise, constant scenario.

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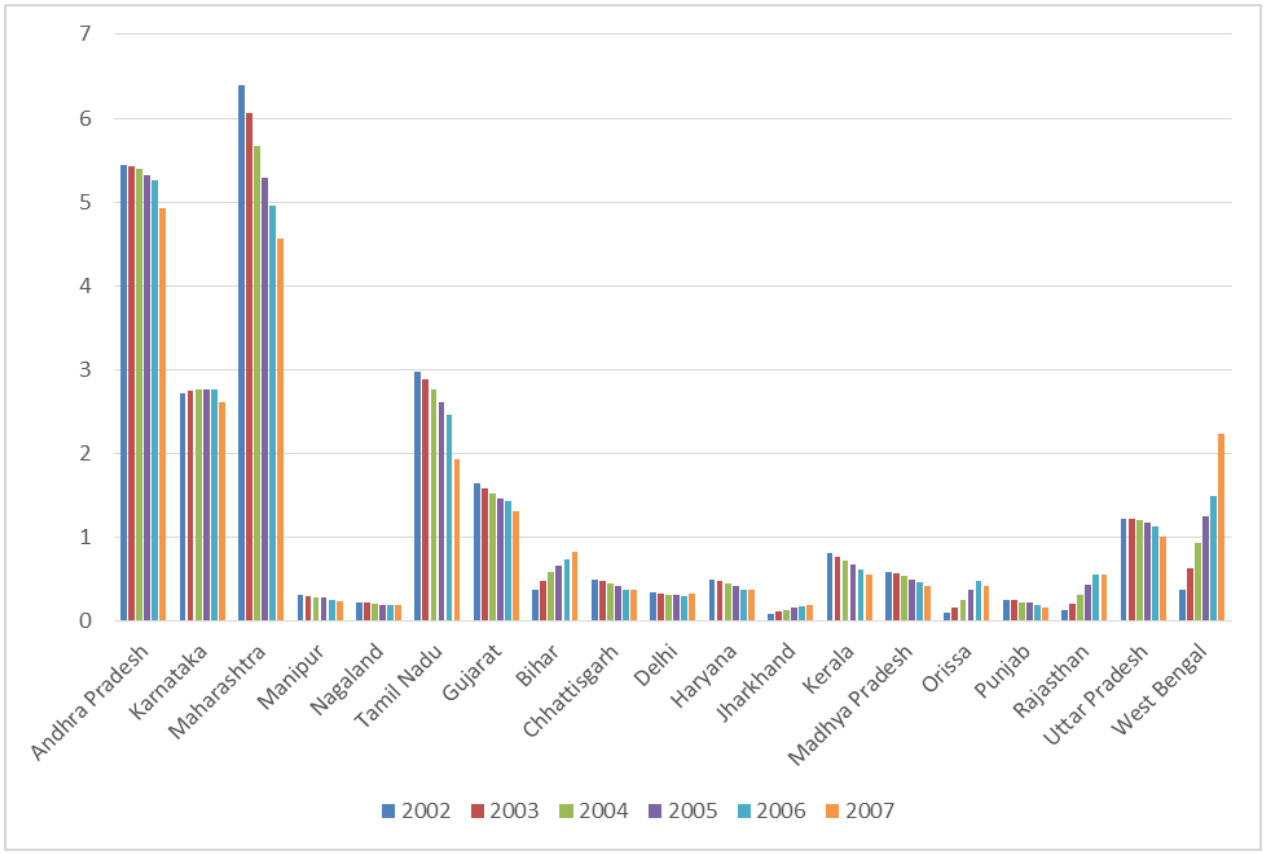

Figure 4: Selected State-wise Estimated Number of HIV Infected Persons in India (2002-2007)

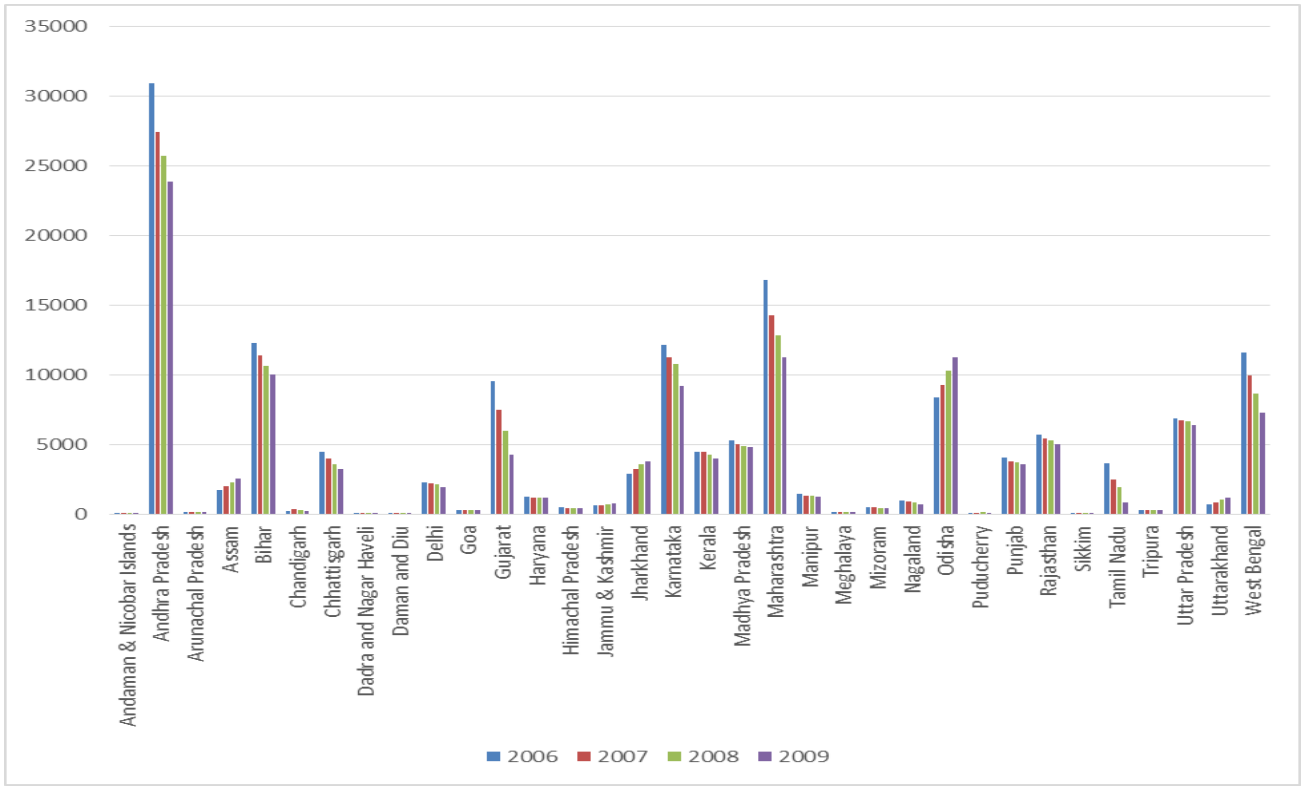

Figure 5: State-wise Estimated Number of People (Above 15 years) of HIV Infected in India (2006-2009)

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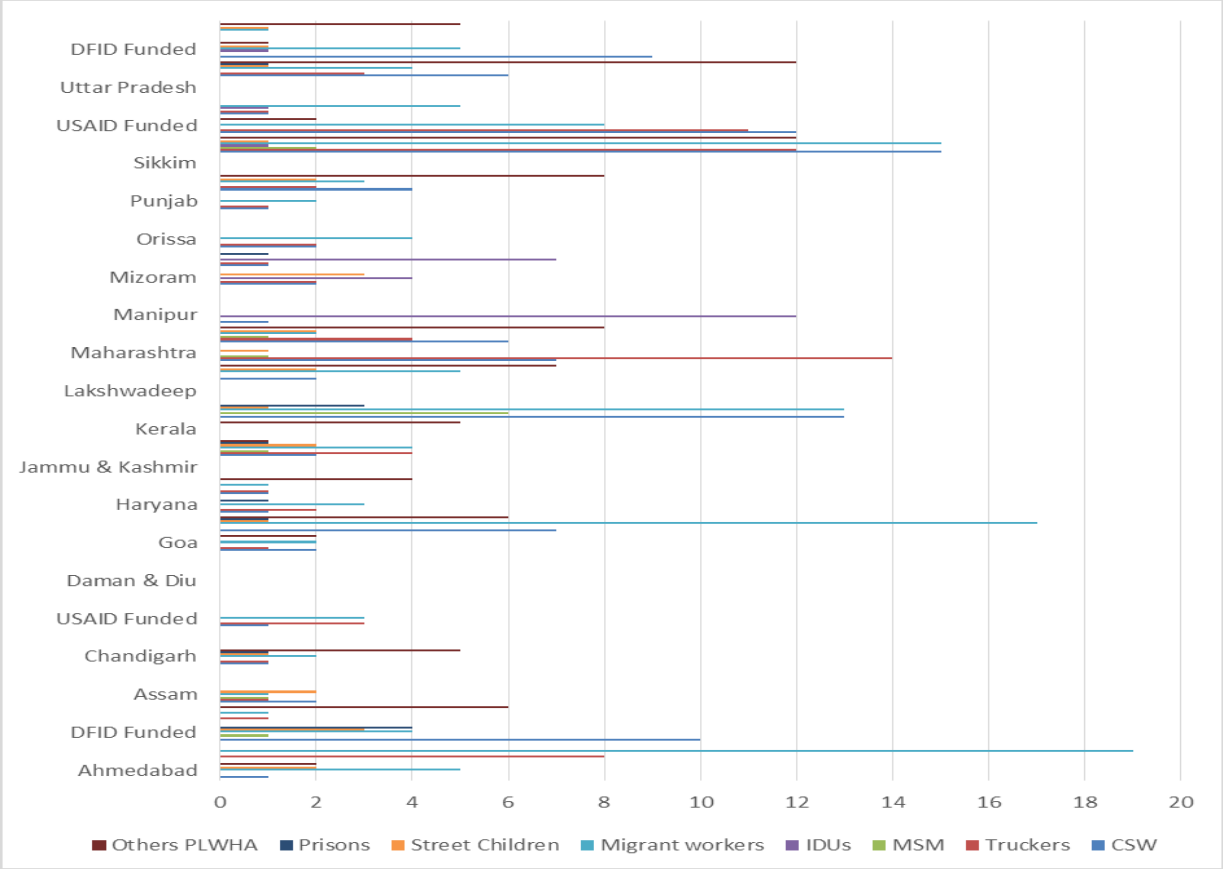

Figure 6: Status of Targeted Interventions in NACP

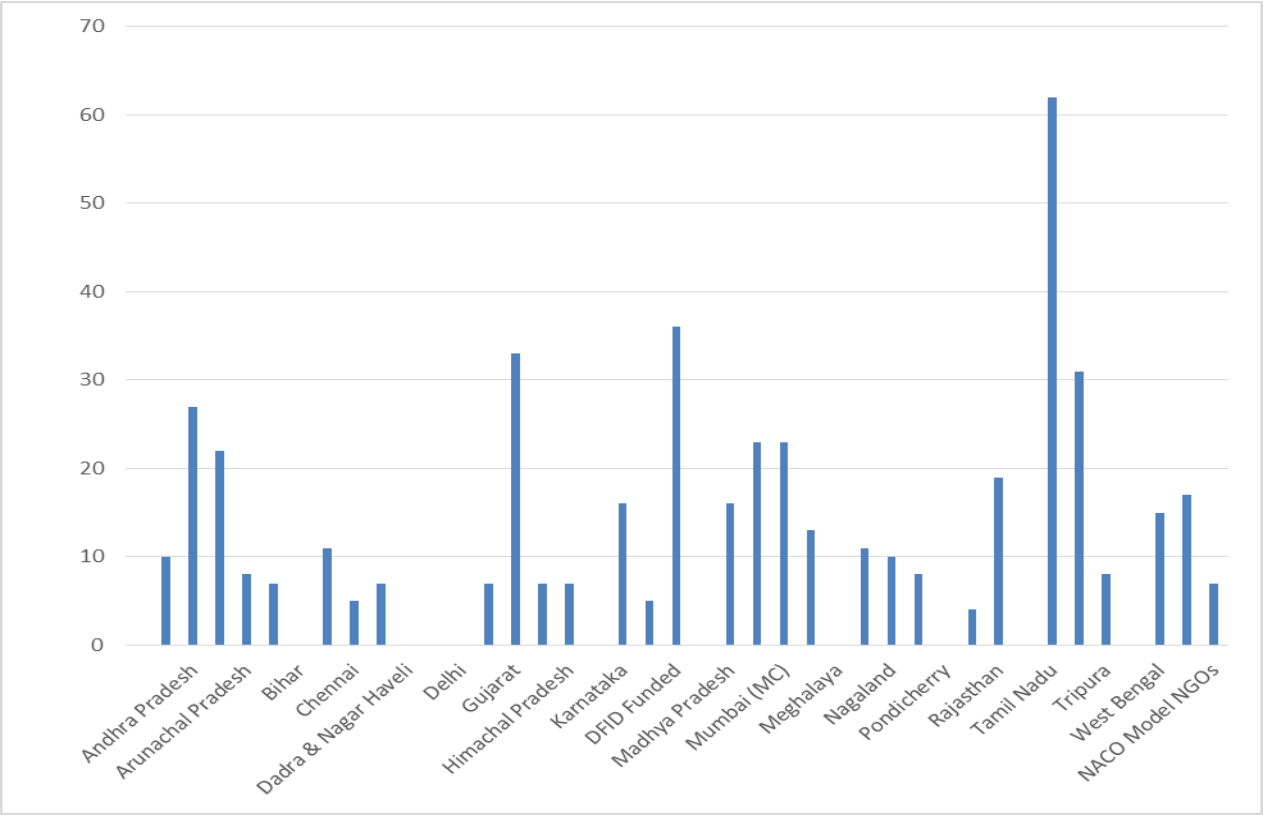

Figure7: Total TI Projects

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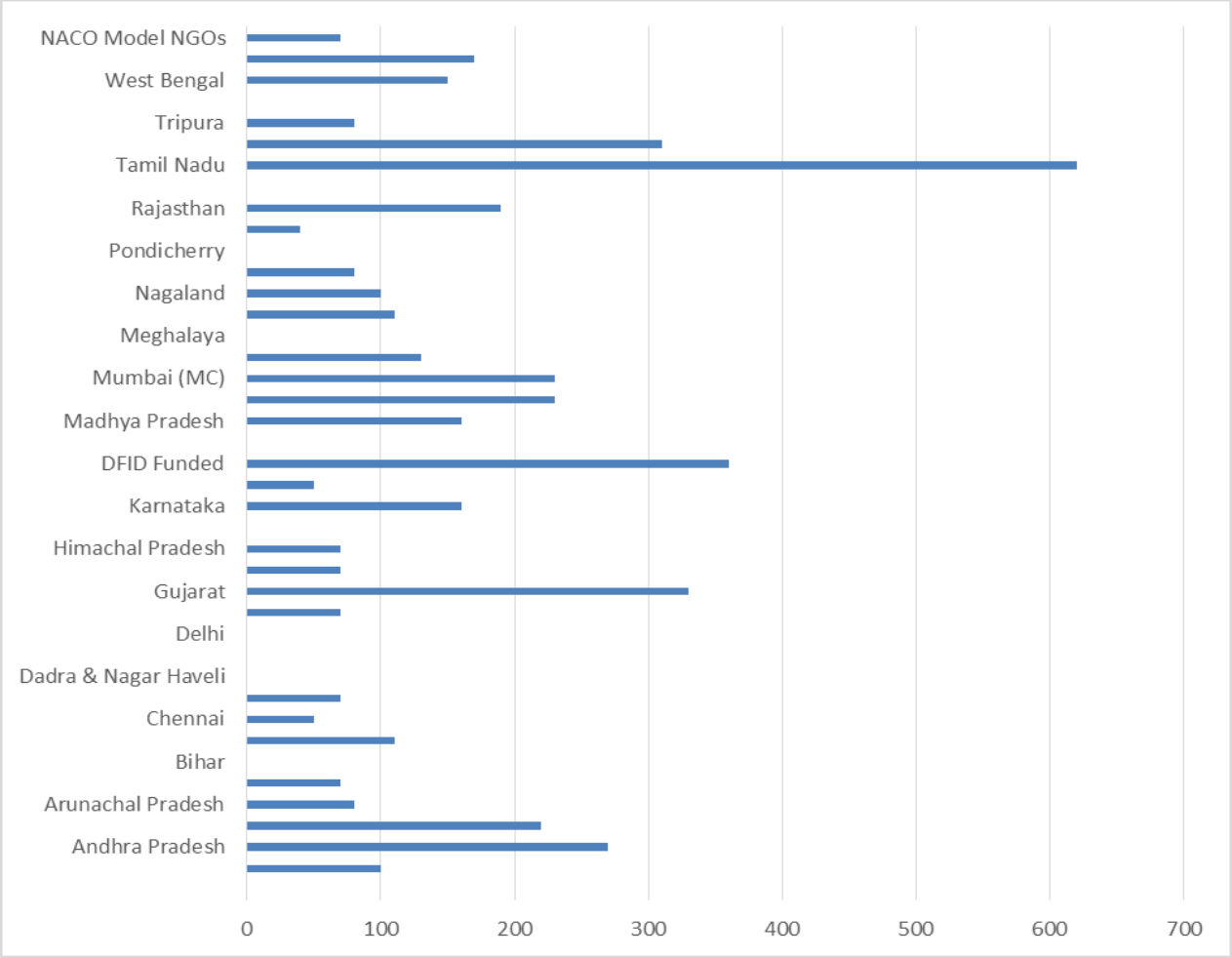

Figure 8: Money Released (in lakhs)

RESULTS AND DISCUSSIONS

Drastic Changes observed in Haryana where the number of HIV Positive pregnant women went up 8-fold during a year. Rajasthan and Uttar Pradesh also reported rises in number, but lesser in magnitude. Himachal Pradesh, Madhya Pradesh, Punjab and Uttarakhand reported a no rise, constant scenario. Technologically sound states such as Maharashtra, Karnataka and Andhra Pradesh lead in number of HIV detections, both in case of adults or ages above 15 years. National AIDS Control Program concentrated most of the projects in the isolated North East regions of India, and most of the financial funds are diverted there.

In a diverse country like India, a state-wise projection of infections is highly desirable for the following reasons:

a) Infections are not uniformly distributed over the states.
b) There is a large variation in the HIV-related population characteristics among the states.
c) Data are available state-wise.
d) Separate projection allows effective implementation of intervention strategies, depending on the local conditions.
e) An aggregation over states produces a national estimate as a corollary.

CONCLUSIONS

The state-wise strata sizes of the population can be obtained from census reports. Though the adults are at a greater risk of HIV infection, the exposure may not be the same for all the ages in the range (15–49) years. Thus a stratification by age or marital status may further improve the projection.

The above data shows that HIV AIDS is more prevalent in the developed states, mainly states like Tamil Nadu, Gujarat, Maharashtra, Karnataka and West Bengal. The most common reasons for these can be:

1) Due to their busy schedules and over occupied life, the residents here tend to neglect the basic causative factors for HIV AIDS. Apart from these, West Bengal and Maharashtra have large chains of government legalized prostitution centers. But as of today, the government does not enforce the use of any specific protection method. This can explain the rise in numbers in these states.

2) The second reason, and quite possibly the main reason is that the medical and diagnosis facilities in these states are more developed than the north-eastern India. So, most of the cases that are diagnosed in India belong to these states, which in turn clearly explains their major share in number of deaths. When the first case of HIV was reported in India beginning April 1986, specifically from Mumbai and adjoining areas, there was a sense of complacency in the North Eastern States, that being geographically isolated as they were from mainland India, and with small isolated tribal communities, they were safe from HIV**.**

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