

AIDS in India



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Certificate of Originality

This is to certify that the work done in '**AIDS in India**' has been carried out by Yatharth Rai, Ravikesh Yadav, Akash Yadav and Rishabh Jain in the name of the organization - Cluster Innovation Centre. I declare that the work done in the following project is free from plagiarism.

The work submitted is original, and has not been submitted earlier to any institute or organization.

Yatharth Rai

Abstract

India is the 2nd most populous country in the world, with a population of over 1.3 billion, there are over 2 million people infected with HIV. India ranks 80th when it comes to the ratio of infected to the total population, but in terms of HIV infected populace, India ranks 3rd. The numbers are not large when compared with the entire country, with statistics showing the prevalence of 0.31% (*2009 estimates*), but even then, the risk of the disease becoming a mass epidemic is also probable due to the high density of people. The project aims to,

- Assess the risk of AIDS in India.
- Compare India with other African countries.
- Evaluate success of Government policies.
- Provide prediction of future trends.
- Study the condition of AIDS in India.

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1. Introduction

AIDS is a viral disease caused by Human Immunodeficiency Syndrome, HIV for short. The disease was first identified in 1983 in Africa. Several studies show that AIDS existed prior to its identification in Kinshasa¹. Despite the low prevalence of AIDS in India, there are still over 2 million people infected with HIV². In India, AIDS was first identified in 1986³ in six female sex workers in Chennai. The Indian authorities were aware of AIDS, but the risk of the disease reaching India from the west was thought to be improbable due to several reasons, with a majority of them being due to a conservative mindset of the people. Suniti Solomon and Sellappan Nirmala were two doctors who discovered AIDS in India. First identification of the disease does not mean the first case, like HIV existing years before in Kinshasa. There was an influx of westerners in India before the first identification, and therefore, the probability of HIV existing in India and spreading before the first identification is highly probable. The international data for the study was obtained from [UNAids](https://aids.unaids.org/), with estimates from 1990 to 2016. For the domestic, state-wise study from data.gov.in.

¹ (n.d.). Where did HIV come from? | The AIDS Institute. Retrieved April 13, 2018, from <http://www.theaidsinstitute.org/node/259>

² (2017, December 5). HIV and AIDS in India | AVERT. Retrieved April 13, 2018, from <https://www.avert.org/professionals/hiv-around-world/asia-pacific/india>

³ "The woman who discovered India's first HIV cases - BBC News." 30 Aug. 2016, <http://www.bbc.com/news/magazine-37183012>. Accessed 14 Apr. 2018.

2. Methodology

2.1 Data Cleaning

The data provided was in an unreadable format for the Python language, and therefore, required to be parsed through several methods to ensure its readability and ease of access. For the task, a library, called Pandas was used which offered a data manipulation object called DataFrame.

These DataFrames are responsible for storing the data in a tabular format, and provide an array of functionalities.

The function, `clean_data` was responsible to replace the unusable, redundant data with NumPy's NaN variable, and also convert the string stored numbers into float datatype -

```
def clean_data(x):
    x = x.replace(' ', '')
    if( x.isalpha() == True):
        return x
    if (x.isnumeric() == False):
        return numpy.NaN
    else:
        return int (x)
```

The other function, `filter_data` was responsible to drop the countries which were not to be included in the study, as well as drop the columns which were not to be used for the same -

```
def filter_data(source, start, end):
    data = pandas.read_csv("Data\\" + source)
    data = data.rename(str.strip, axis = 'columns')
    data = data.set_index('Country')
    for colname in data.columns:
        if not (colname.isnumeric()):
            data = data.drop( columns = colname )
    # Let's clean the data
    data = data.applymap(clean_data).dropna().transpose()
    data = data.truncate(start, end)
    return data
```

2.2 Data Analysis

To analyze the data and draw conclusions, a code was written, which recorded the relative rate of change every year. When deriving the gradient of the graphs, it posed problems since the countries had a varying population. For example, the increase in HIV infected population of India exceeded much more than Zimbabwe and other countries, therefore, to provide a common platform, the relative change was adopted -

The function *delta_percentage* calculated the relative change each year, and the function *steps* arranged the data country-wise, and recorded the changes.

```
def delta_percentage(data, country):
    x = []
    for year in range(1990, 2016):
        x.append( ( ( data[country][str(year + 1)] - data[country][str(year)] ) / data[country][str(year)] ) )
    return x

def steps(data_gradient):
    initial = 100
    pop_year = []
    for change in data_gradient:
        pop_year.append(initial)
        initial = initial + initial*(1 + change)
    return pop_year
```

For predictive modelling, NumPy was used. The two modules used were *numpy.polyfit* and *numpy.poly1d*. Polyfit module reads the data, and stores it into an n^{th} degree polynomial equation. The polyfit module models an equation of the selected degree, then with the in-built algorithm finds the best fit using constants which give the closest value to the original values.

Using the *steps function*, we assessed the risk and spread of AIDS in India. An initial starting point was allotted to the African countries in study and India, which was a value of 100. This value experienced the relative changes.

2.3 Data Plotting

A web-based Python library, called PlotLy was used. This library provides interactive web visualizations which can be easily embedded into web pages. The link to these visualizations will be available in the appendix section. For the predictive model plotting, Matplotlib was used.

3. Analysis

3.1 Government Policies

There have been a number of government policies⁴. India's National AIDS Control Programme, called NACP covers prevention, testing and treatment services across the country. NACP launches phases, each phase with a duration of 5 years.

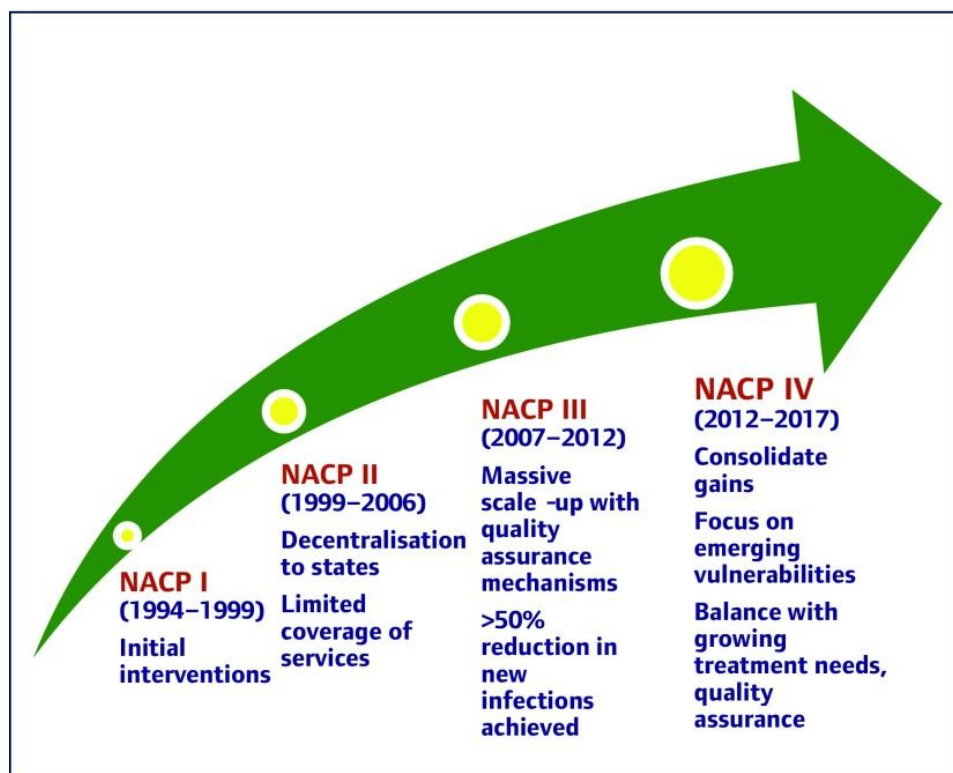


Fig 3.1A - Phases of NACP⁵

⁴ "India's HIV programme: successes and challenges - NCBI - NIH." 28 Nov. 2016, <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5337408/>. Accessed 14 Apr. 2018.

⁵ "India's HIV programme: successes and challenges - NCBI - NIH." 28 Nov. 2016, <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5337408/>. Accessed 14 Apr. 2018.

NACP has also launched focused campaigns on the most vulnerable communities.



Fig 3.1A -Estimates of vulnerable communities⁶

As stated by NACP, there should be a decrease in total number of new infections from 2007-2012, with the total number of infected population remaining constant or reducing. The healthcare has also been improved, therefore the deaths caused by AIDS must also fall.

3.2 India's Total HIV Population

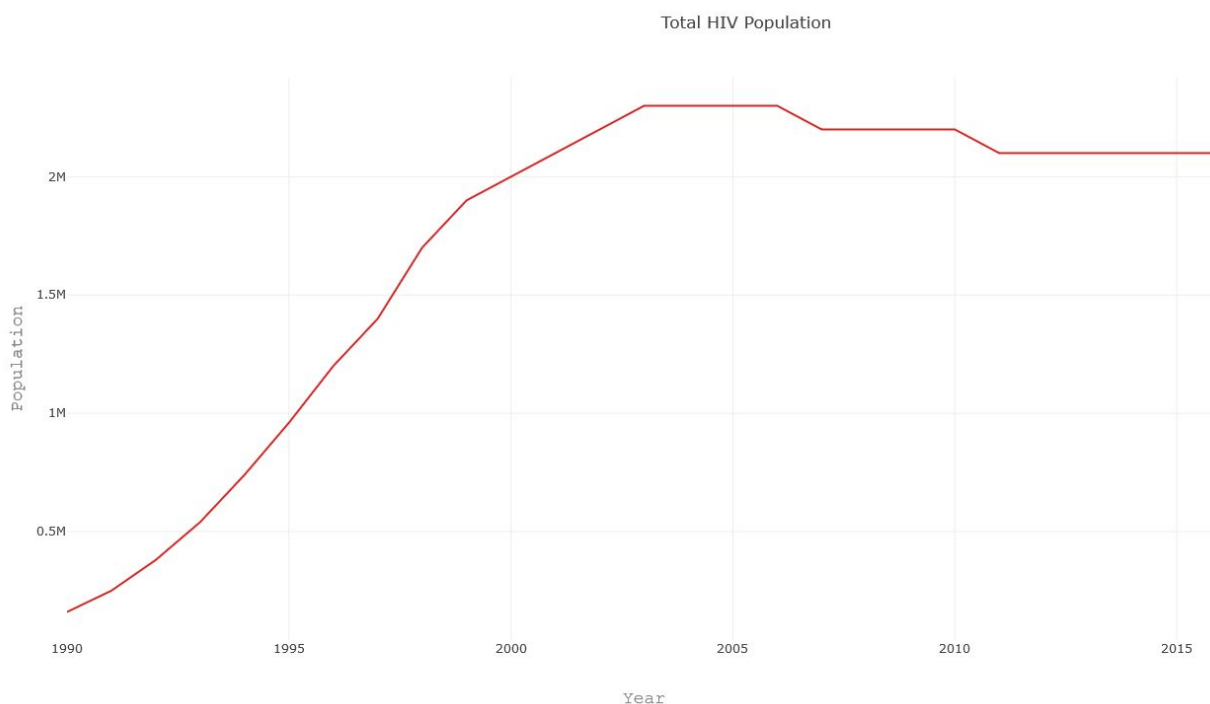


Fig 3.2A - Total HIV Population in India (Year vs Population)

⁶ "India's HIV programme: successes and challenges - NCBI - NIH." 28 Nov. 2016, <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5337408/>. Accessed 14 Apr. 2018.

The following is a plot of how the total number of people infected with HIV in India varied with time. From the above plot, it is visible that there was an increase in the total population from the year 1990, **peaking during the years from 2003 to 2006** with a population of 2.3 million. The population declined by a marginal amount of 4% and remaining constant until the year 2010, and dropping again by 4% to 2.1 million, and again, remaining constant.

3.3 India's New HIV Infections

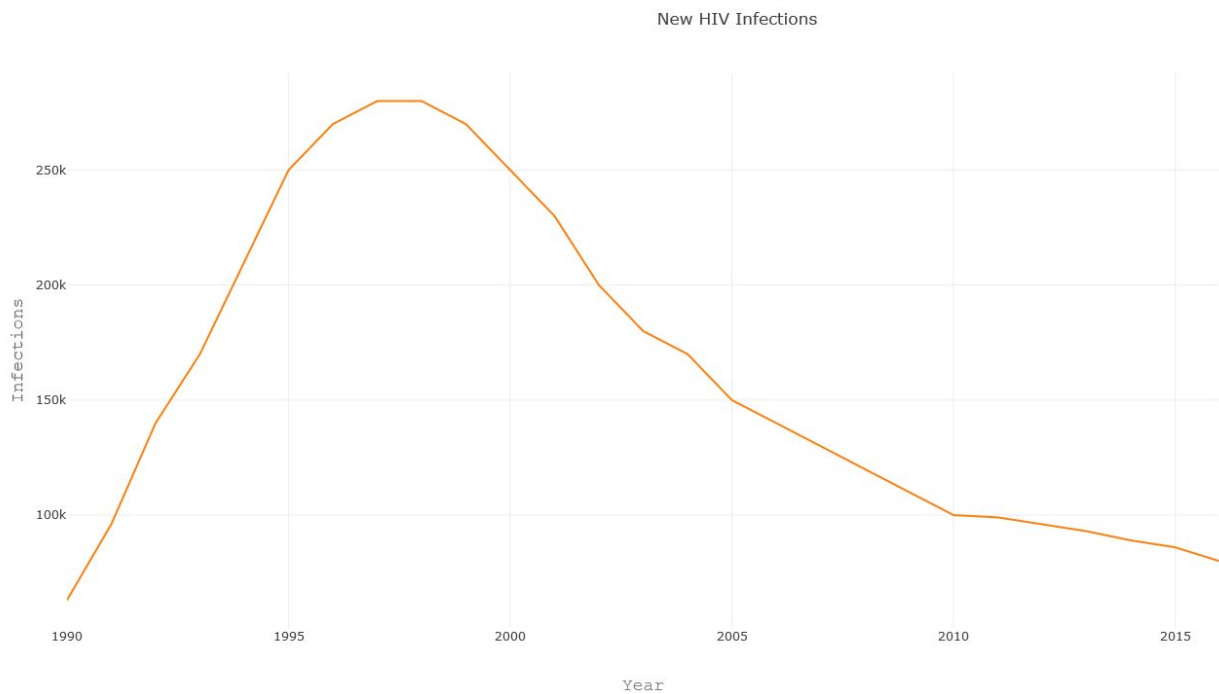


Fig 3.3A - New HIV Population in India (Year vs Infections)

Following is the plot of new infections recorded with respect to time. There is a continuous increase in the number of HIV infected, **peaking during 1997 and 1998**, with an estimated 280,000 people. **This number steadily declined**, and has been continuously declining, from the peak of 280,000 new infections a year to 80,000 new infections a year in 2016.

3.4 India's Deaths caused by AIDS

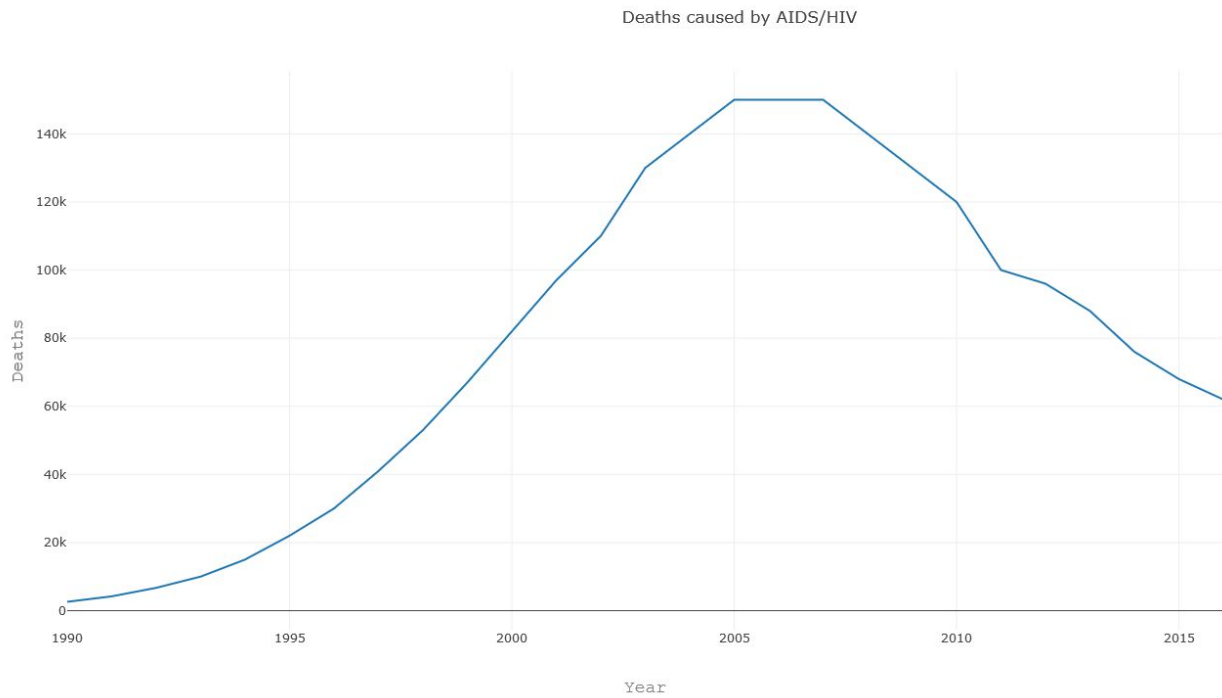


Fig 3.4A - Total HIV Deaths in India (Year vs Population)

The following is the plot of deaths caused due to AIDS / HIV. The graph **peaks in 2005**, and stays the same till 2007, before steadily falling, and in 2016, the deaths were reduced from the **peak of 150,000 to 62,000 in 2016**.

3.5 AIDS in India and other African Countries

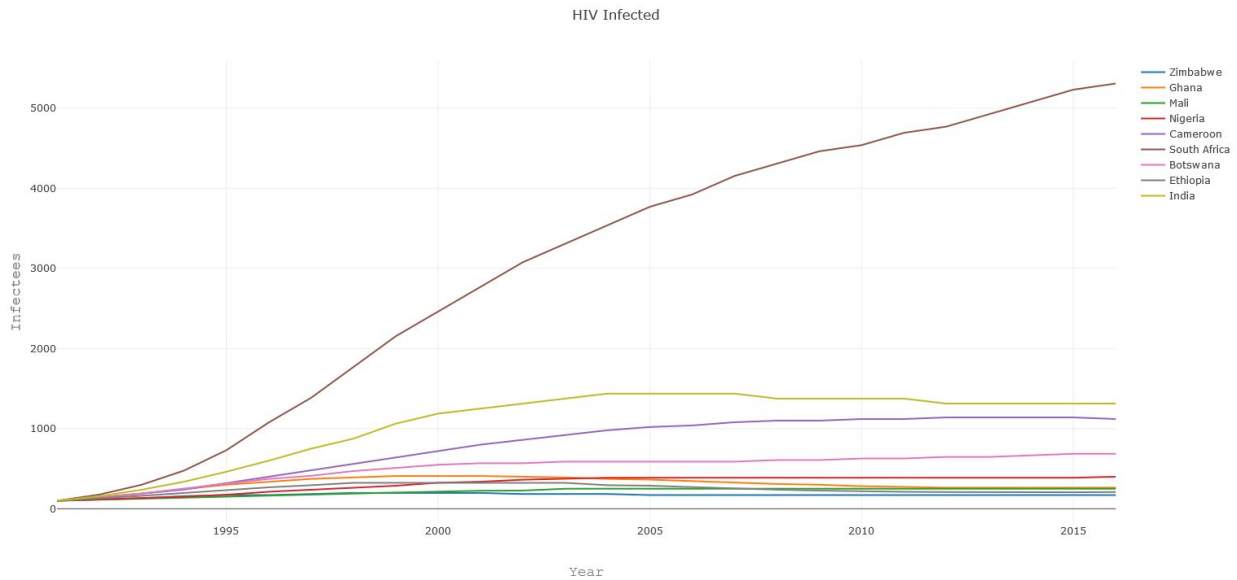


Fig 3.5A - AIDS in India and other African Countries

Following is the plot of India compared with other African countries.

The following plot was defined through *steps* function. The relative change of each country was recorded against time. Each country was then provided with an initial value of 100, and then, the relative change each year was applied to the initial value.

4. Conclusion

The condition in the India reached the level of epidemics during the initial years, with the new infections rising, and peaking to 280,000 individuals. Even the peak population of India's HIV population is over 2 million. The rate of new infections happening declined, but reached a peak in 1997 and 1998, but then experienced a continuous decline.

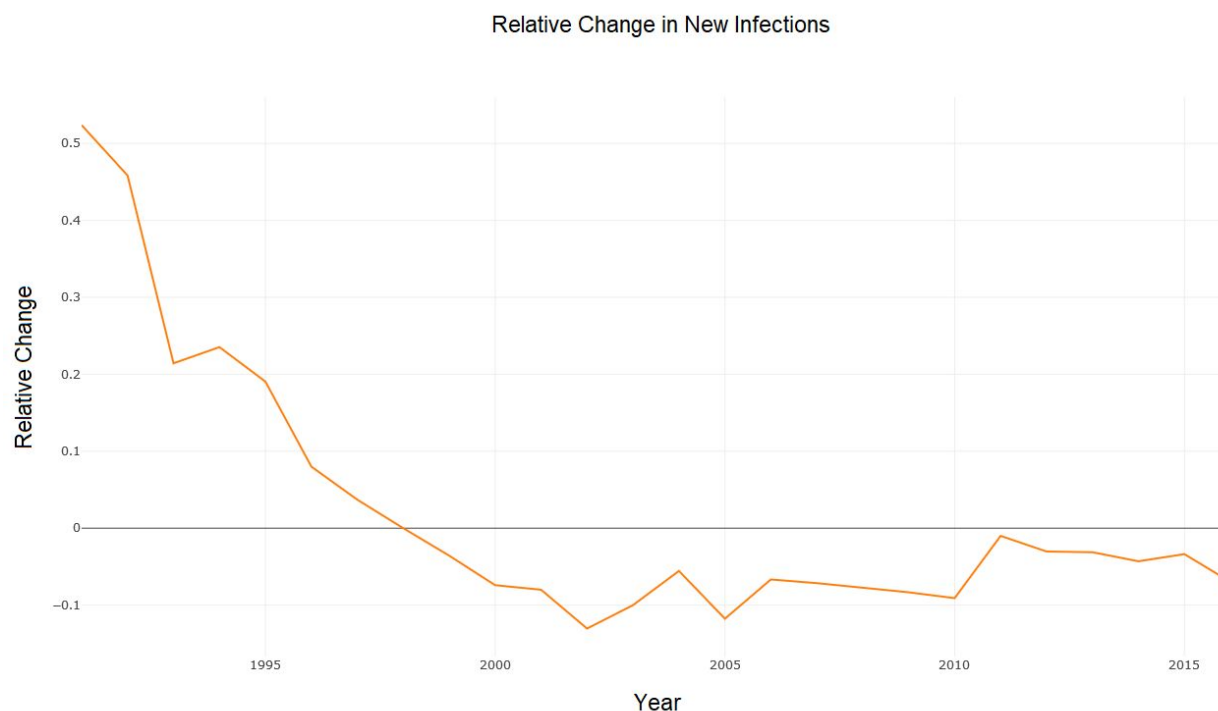


Fig 4A - New Infections relative change each year

The relative change each year declined, before finally experiencing a constant decline after 1998. This can be linked with the NACP's policies. The policies began showing their success right after 1998, when the numbers began to decline. The deaths caused by HIV has also reduced. The deaths peaked in the period 2005 to 2007, and constantly declined thereafter. This shows that healthcare for HIV infected patients has improved significantly.

AIDS in India, when compared to other African countries, shows striking similarity, which points to the fact that the risk of AIDS in India is still as high as other at-risk countries, albeit the infections were concentrated, thus, it was not as widespread as other African countries.

Upon running the curve fitting algorithms, the following graph was obtained,

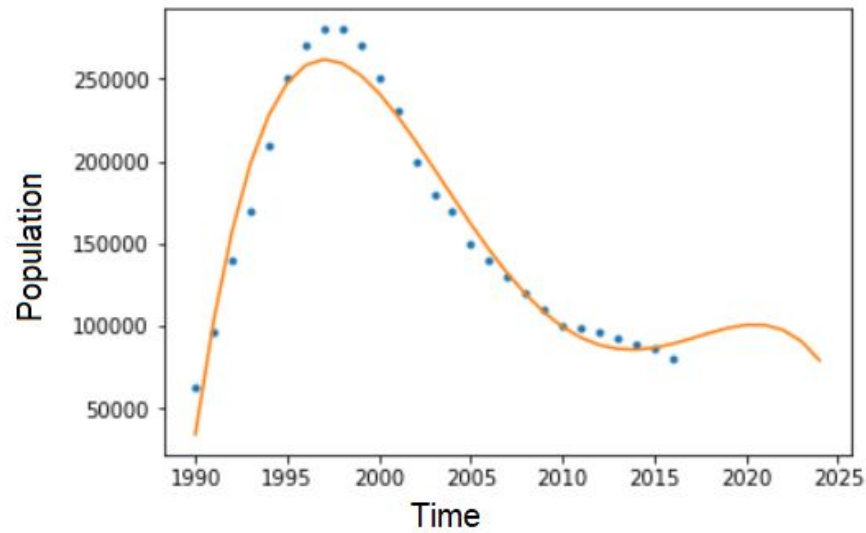


Fig 4B - Prediction of Total Population

There will continue to be a total decline in HIV infected populace in the future, and according to the factors, if they continue to remain the same, HIV will be eradicated in India by 2028.

5. References

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6. Appendix

Codes

https://github.com/abotiamnot/data_experiments/

Graphs

[Fig 3.2A - Total HIV Population in India \(Year vs Population \)](#)

[Fig 3.3A - New HIV Population in India \(Year vs Infections \)](#)

[Fig 3.4A - Total HIV Deaths in India \(Year vs Population \)](#)

[Fig 3.5A - AIDS in India and other African Countries](#)

The unused graphs which were made but not used are available on Plot.ly

<https://plot.ly/~abotiamnot/>

Citations have been included in the footers of the pages.