

# **Analysis of India's Rural Healthcare System**

Plaksha University

Fundamentals of Computational Thinking

FM111

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## 1. Introduction

The rural healthcare system in India has been neglected time and time again, which has led to its insufficiency in providing basic medical treatment to all citizens. A new analysis published by The Lancet shows that 1.6 million deaths in India occur due to inadequate healthcare. Even though the present infrastructural setup for providing health care in rural India is on the right track, the qualitative and quantitative availability of primary health care facilities is far less than the defined norms by the World Health Organization. The population through years rose exponentially, and the number of doctors is not closed to being at part.

The Primary Health Care Infrastructure of India has been developed as a three-tier system with Sub Centre, Primary Health Centre (PHC) and Community Health Centre (CHC) being the three pillars of this system.

Even though the present infrastructural setup for providing health care in rural India is on the right track, the qualitative and quantitative availability of primary health care facilities is far less than the defined norms by the World Health Organization. Union Ministry of Health and Family Welfare figure of 2005 suggests a shortfall of 12% for sub centres (existing 146,026), 16% of Primary Health Centres (PHCs) (existing 23,236) and 50% Community Health Centres (CHCs) (existing 3346).

Through this project, we aim to shed light on the rural health infrastructure of India which is overburdened and strained. We will analyse and do a comparative study for the years 2005 and 2019 to see the overall development of healthcare facilities in each state.

## 2. Dataset

We collected our datasets from government resources, namely the Ministry of Health and Family Welfare (MoHFW), Government of India. We acquired data for the state-wise numbers of doctors, nursing staff and healthcare workers as well as number of PHCs, CHCs and SCs functioning each year for the years 2005 and 2019 from the Rural Health Statistics, which is released annually by the MoHFW. Being a government resource, it has high credibility, and there is no doubt about the accuracy of the data.

We used the census data from the official website, released by the [Ministry of Home affairs](#) for rural population.

We clearly laid out what we require for our project and thus we were able to sort through the massive amount of data with ease, systematically extracting it to excel files. Combining data from multiple sources was effortless as we took an orderly approach to refining and documenting our data.

[Analysis 2005](#) , [Analysis 2019](#)

### 3. Methodology

To spot anomalies and discover patterns between available data we used an excel sheet for the preliminary investigation before applying any data analysis technique. Then, we used pandas to categorize the data under different parameters such as:

- Doctors = Doctors + Specialist
- HealthCare Centres = Sub Centres + PHCs + CHCs
- HealthCare & Nursing Staff = Nursing Staff+ ANM/Health Worker Female
- Second-line HealthCare Centres = Radiographers + Pharmacists + Lab Technicians

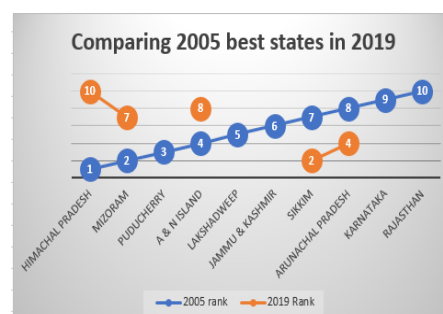
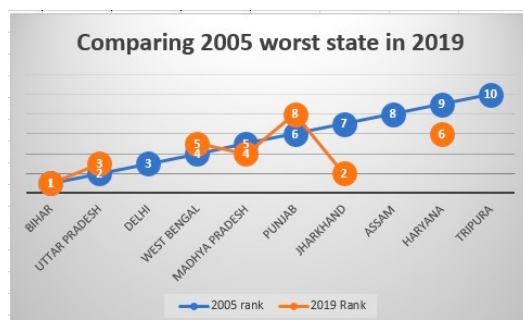
We then used matplotlib, plotly as well as seaborn library to plot the four parameters given below onto the map of India for the years 2005 and 2019:

- Rural population to doctor and specialist ratio
- Rural population to healthcare and nursing staff ratio
- Rural population to primary healthcare centres ratio
- Rural population to second line healthcare workers ratio which include radiographers, pharmacists and lab technicians

We will then select the top ten and the worst ten states under each parameter for the years 2005 and 2019. Thereafter, we used the formula mentioned below to rank the states in overall healthcare facility.

$$\text{Final Rank of the state} = \frac{\text{Sum of rank in all the parameters/}}{\text{Number of times states appeared in the parameters}}$$

After finding out the final ranks of the state we plotted a line chart graph to compare the improvement of worst and best states from 2005 to the year 2019.



## 4. Results and discussion

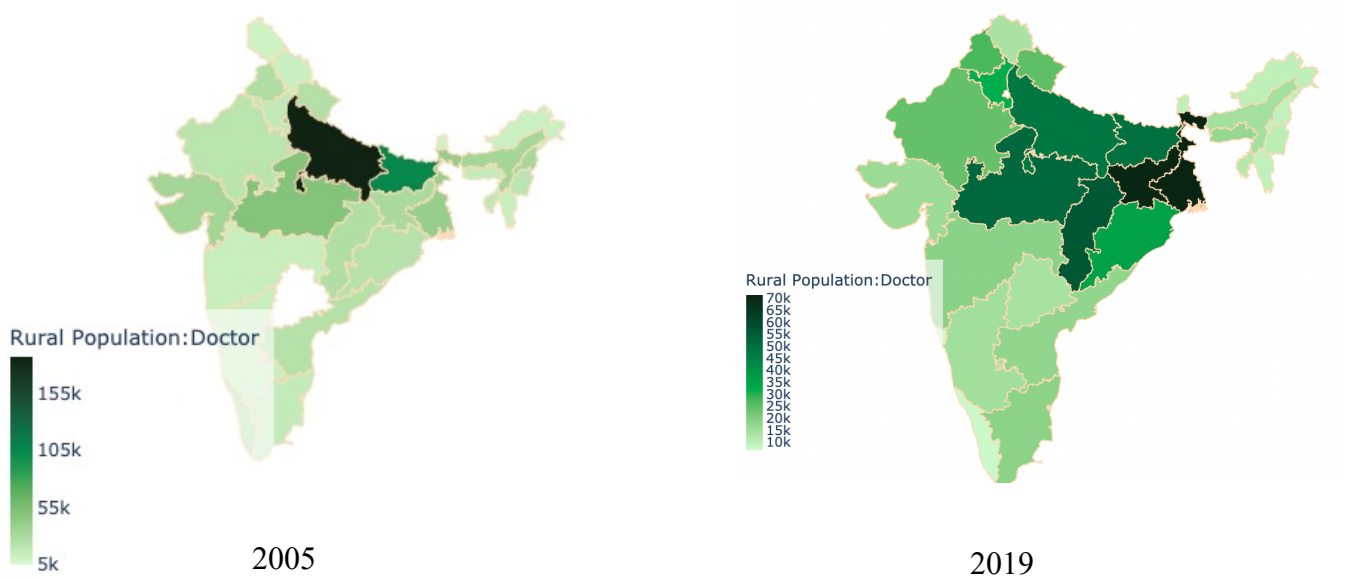


Fig. 1 *Rural Population to Doctors ratio 2005 vs 2019*

In 2005, we see that the condition of central-northern India was worse with an average ratio of 1 doctor for 187k people in Uttar Pradesh, and in 2019, the eastern states were worse off with a ratio of 1 doctor for 70k people in West Bengal.

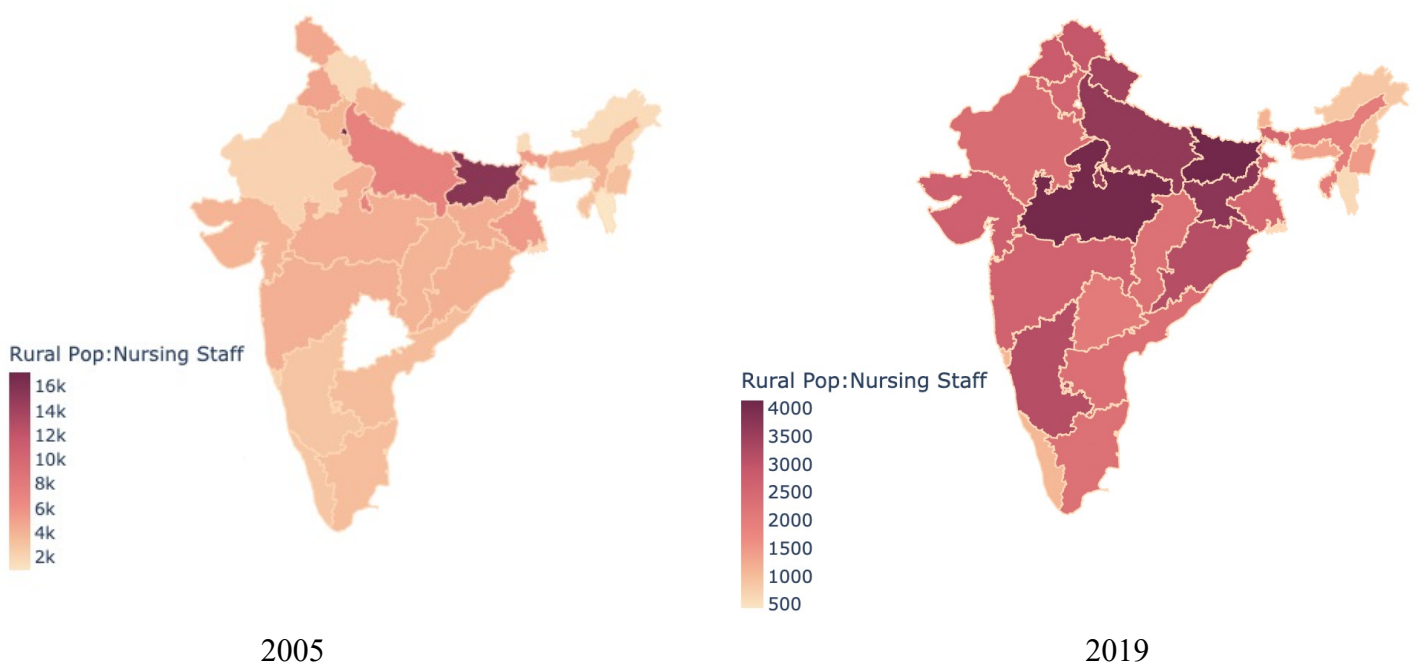


Fig. 2. *Rural Population to HealthCare and Nursing Staff Ratio 2005 vs 2019*

In 2005, Bihar had a ratio of 1 nursing staff in 16k people as opposed to a ratio of 1 in 4k people in 2019, which shows drastic improvement.

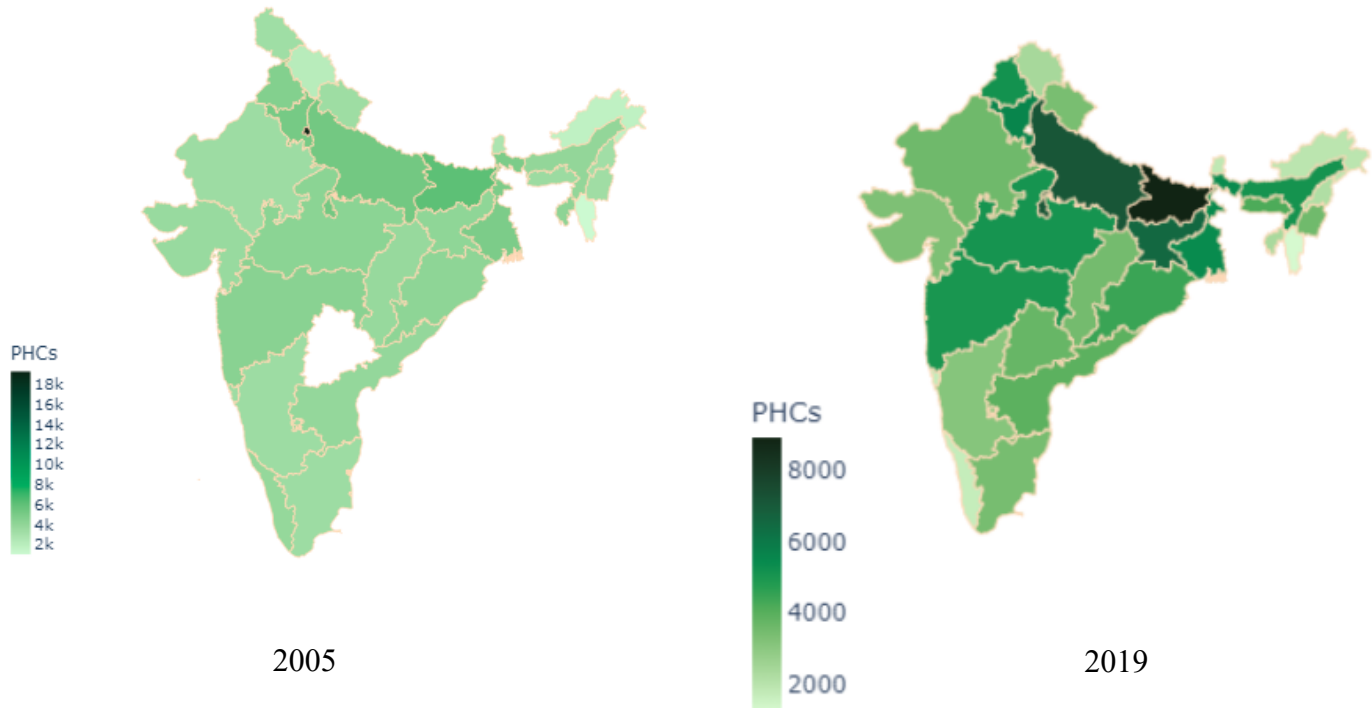


Fig. 3. *Rural Population to Primary Healthcare Centres Ratio 2005 vs 2019*

From these two maps, we inferred that the increase in the number of PHCs is not at par with the rise in population.

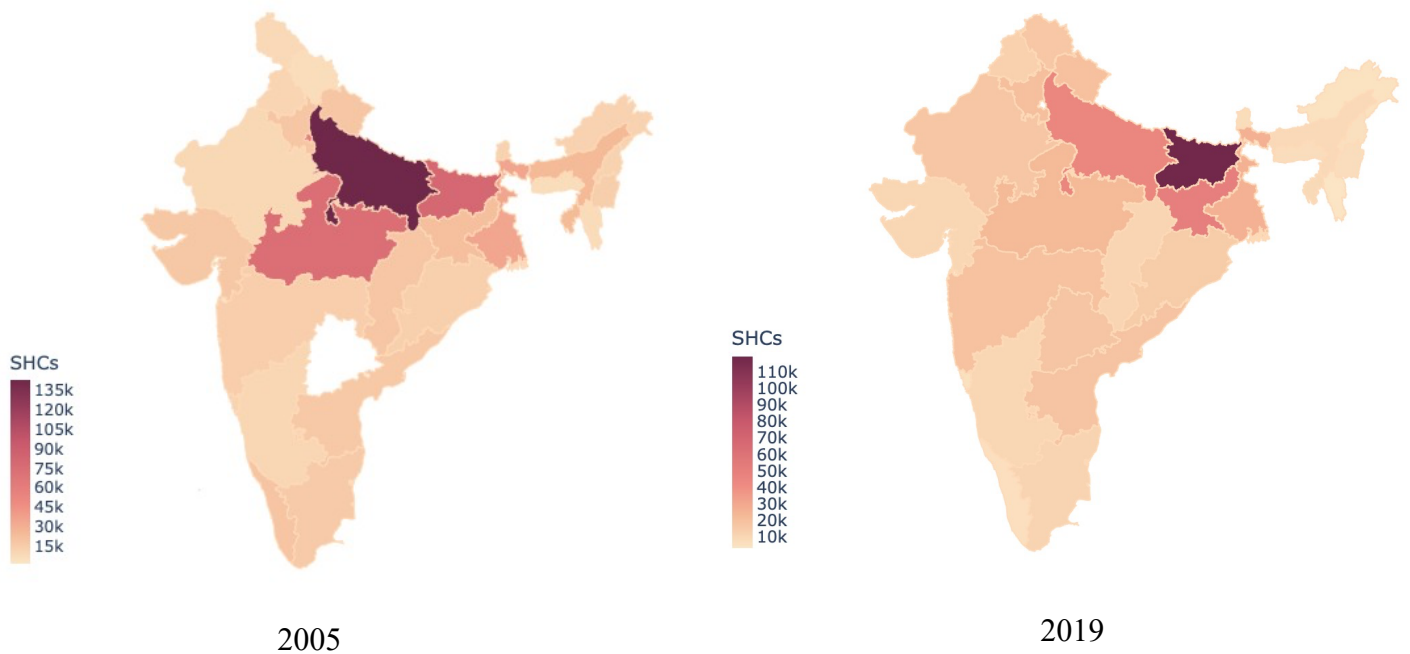


Fig. 4. *Rural Population to Primary Healthcare centres Ratio 2005 vs 2019*

In 2005, Uttar Pradesh had 1 second-line healthcare worker in 140k people, and in 2019, it showed an upgrade to 1 in 44k people. On the other hand, we see that Bihar showed a decline from a ratio of 1 in 80k people in 2005 to a ratio of 1 in 110k people in 2019.

## 5. Conclusion

After ranking the states based on the four parameters mentioned above and comparing the findings between the years 2005 and 2019, we came across some very interesting observations:

States with the worst healthcare facilities:

- Bihar remains the worst state overall
- Uttar Pradesh appears in the top 3 worst states in both the years
- Delhi, Assam and Tripura have shown overall improvement and have been replaced by Uttarakhand, Odisha and Maharashtra in the list of top 10 worst states

States with the best healthcare facilities:

- Tripura has emerged at the top of the list in 2019 and Sikkim has moved up 4 places
- Himachal Pradesh has fallen to the 10<sup>th</sup> position in 2019 from the 1<sup>st</sup> position in 2005
- Rajasthan, Puducherry, Lakshadweep and Karnataka have been replaced by Nagaland, Goa, Kerala and Manipur in the list of top 10 best states

From the observations made above, we can infer that states are not consistently performing well. On one hand, there has been a decline in the healthcare situation in some states like Uttarakhand, Odisha and Maharashtra, and on the other hand, some states have shown tremendous progress like Tripura and Sikkim.

One of the biggest limitations of our project lies in the technique/formula used in predictive modelling. Our model accuracy would have increased if we had used Friedman's test i.e. the procedure which involves ranking each row (or *block*) together, then considering the values of ranks by columns. Given our limited knowledge about this statistical tool we couldn't implement the same.

While the scope of our report is to analyse the rural healthcare system, we believe the above-mentioned parameters are not the only variable that affects the healthcare system of states. Besides infrastructure and manpower there are various other factors that should be taken into consideration such as affordability, accessibility, management system as well as the quality and efficiency of the manpower employed. So, a further study can be done based on these factors for a better understanding of the Primary Healthcare System of India.

## 6. References

1. [Rural Health Care System in India](#). (2020, March 12). Vikaspedia.In. Retrieved January 30, 2022.
2. [Rural Health Care System in India](#). (2012, April 9). Nhm.Gov.In. Retrieved January 30, 2022.
3. [Health care in rural India: A lack between need and feed](#). (2014, April 15).
4. [Rural Health Care System in India](#). (2012, April 9). Ministry of Health and Family Welfare, Government of India. Retrieved February 7, 2022
5. [Notebooks and other graphs](#)

## 7. Appendix

```
d2=pd.read_csv('2019.csv')
d2.drop([29,30,31,32,34,37,33,35,36],inplace=True)
d2.reset_index(drop=True,inplace=True)
#addition
d2['HealthCare Centers'] = d2['SubCenters'].astype(int) +d2['PHCs'].astype(str).astype(int)+d2['CHCs'].astype(str).astype(int)
d2['Doctor'] = d2['Doctors'].astype(str).astype(int) +d2['Specialists'].astype(str).astype(int)
d2['HealthCareNursing Staff'] = d2['ANM/Health_Worker_Female'].astype(str).astype(int) +d2['NursingStaff'].astype(str).astype(int)
d2['Secondline HealthCare Centers'] = d2['Radiographers'].astype(str).astype(int) +d2['Pharmacists'].astype(str).astype(int)+d2['LabTechnicians'].astype(str).astype(int)
#dropping
d2.drop(['SubCenters','PHCs','CHCs','ANM/Health_Worker_Female','Doctors','Specialists','Radiographers','Pharmacists','LabTechnicians','NursingStaff'],axis=1,inplace=True)
#mean
d2['Doctor']=d2['Doctor'].replace(0,d2['Doctor'].mean())
d2['HealthCareNursing Staff']=d2['HealthCareNursing Staff'].replace(0,d2['HealthCareNursing Staff'].mean())
pl=pd.read_csv('2019_population.csv')
pl.drop(['Urban_Population','Urban_Population_Density','Total_Population_Density','Rural_Population_Density','Rural_Population_%'],axis=1,inplace=True)
pl.drop([29,30,31,32,34],inplace=True)
pl.reset_index(drop=True,inplace=True)
d2['Rural_Population']=pl['Rural_Population']
d2['Rural Pop to Doc Ratio']=d2['Rural_Population']/d2['Doctor']
d2['Rural Pop to HealthCare Staff Ratio']=d2['Rural_Population']/d2['HealthCareNursing Staff']
d2['Rural Pop to HealthCare Centers Ratio']=d2['Rural_Population']/d2['HealthCare Centers']
d2['Rural Pop to Secondline HealthCare Centers Ratio']=d2['Rural_Population']/d2['Secondline HealthCare Centers']
d2.head(2)
```

[illegible]

```
d1.read_csv('2005.csv')
d1.drop([23,34,37,39],inplace=True)
d1.fillna(value=0,inplace=True)
d1['HealthCare_Centers'] = d1['SubCenters'].astype(str).astype(int) +d1[['PHCs'].astype(str).astype(int)+d1['CHCs'].astype(str).astype(int)
d1['Doctor'] = d1['Doctors'].astype(str).astype(int) +d1['Specialists'].astype(str).astype(int)
d1['HealthCareNursing Staff'] = d1['AMM/Health_Worker_Female'].astype(str).astype(int) +d1['NursingStaff'].astype(str).astype(int)
d1['SecondLine HealthCare Centers'] = d1['Radiographers'].astype(str).astype(int) +d1['Pharmacists'].astype(str).astype(int)+d1['LabTechnicians'].astype(str).astype(int)
d1.drop(['SubCenters','PHCs','CHCs','AMM/Health_Worker_Female','Doctors','Specialists','Radiographers','Pharmacists','LabTechnicians','NursingStaff'],axis=1,inplace=True)
d1.reset_index(drop=True, inplace=True)
d1['Doctor']=d1['Doctor'].replace(0,d1['Doctor'].mean())
d1['HealthCareNursing Staff']=d1['HealthCareNursing Staff'].replace(0,d1['HealthCareNursing Staff'].mean())
d1['SecondLine HealthCare Centers']=d1['SecondLine HealthCare Centers'].replace(0,d1['SecondLine HealthCare Centers'].mean())
Rural_Pop_2005=[5540100, 87000, 23216000, 74314000, 16648000, 677000, 31741000, 15029000, 5482000, 20952000, 34899000, 23574000, 44381000, 55778000, 1718000, 1865000, 448800, 31287000,
d1['Rural_Pop']=Rural_Pop_2005
d1['Rural_Pop to Doc Ratio']=d1['Rural_Pop']/d1['Doctor']
d1['Rural_Pop to HealthCare Staff Ratio']=d1['Rural_Pop']/d1['HealthCareNursing Staff']
d1['Rural_Pop to HealthCare Centers Ratio']=d1['Rural_Pop']/d1['HealthCare Centers']
d1['Rural_Pop to SecondLine HealthCare Centers Ratio']=d1['Rural_Pop']/d1['SecondLine HealthCare Centers']
d1.head()
```