Task1:

*Clean, structure, and prepare the data for analysis, so that you can compare all the files together.*

This task was done by using Excel techniques. First, I defined the labelled data and later just extracted numerical data after cleaning and I pasted the numerical data to respective blocks of the files and finally I combined all the files for better analyzation. This can be explained and visualized below by using python environment.

There are about 13 sub-districts in Nagpur. Nagpur is one of them and Bhiwapur, Hingna, Kalameshwar, Kamptee, Katol, Kuhi, Mauda, Narkhed, Parseoni, Ramtek, Savner, Umred etc. are other sub-districts in Nagpur.There are about 150 villages in Nagpur sub-districts.
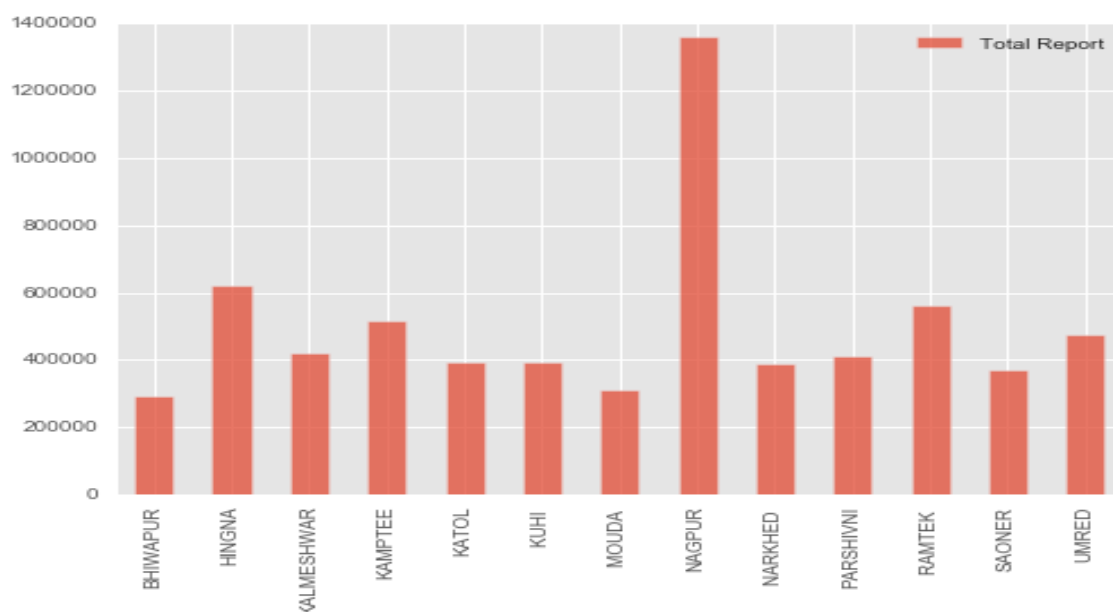
Health Care System – the structure and scenario

According NHRM the sub-districts of Nagpur has termed as blocks per assigning health facilities.

The total reports of the blocks from Apr-2015 to Mar-2016 is shown below:
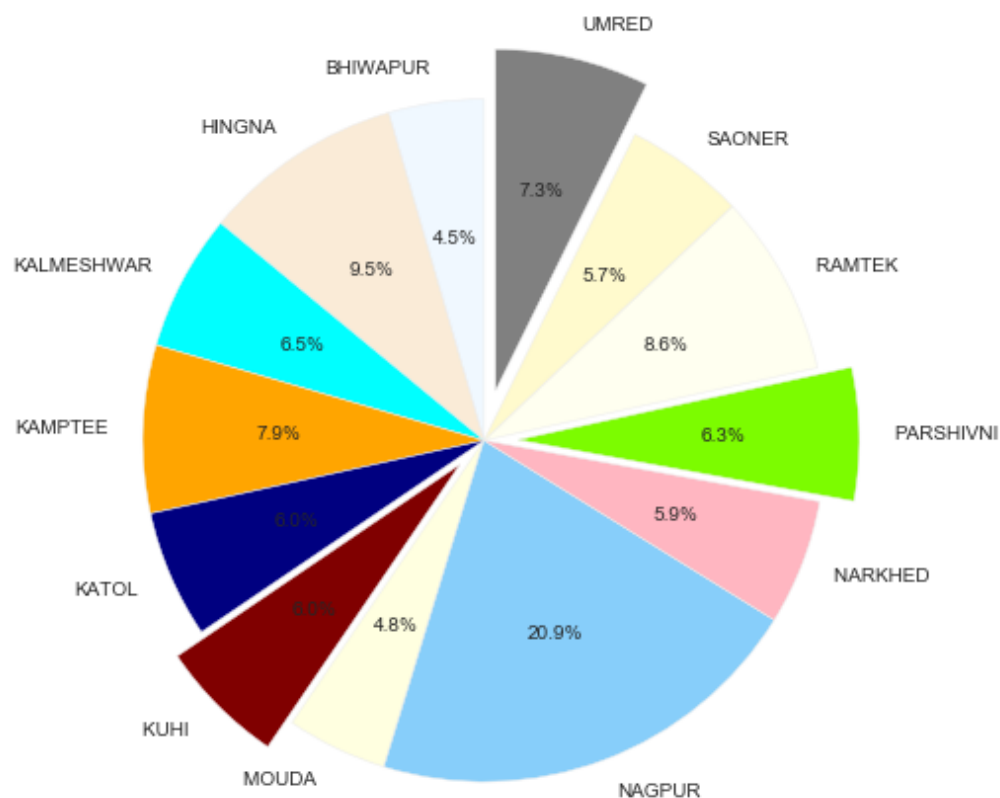
Another way of visualization is:

Further blocks are classified into 3 types of health facilities based on population norms of villages. Clearly the health care infrastructure in rural areas has been developed as a three tier system (see *Chart 1*) and is based on the following population norms:

Centre	Plain Area	Hilly/Tribal/Difficult Area
Sub Centre	5000	3000
Primary Health Centre	30,000	20,000
Community Health Centre	1,20,000	80,000

Later, I derived the data, based on the decentralized healthcare scenario, Sub centre makes the lowest division, followed by PHC and then block level hospitals (or RH).

So, each block has 3 types of health facilities those are Block level hospitals, Primary health centres(PHC) and Sub centres(SC) and Block level hospitals further classified into RH/WH/RH-SDH etc .Each Health facility or centre has the type of the facility in it and each type of the facility has the Name of the facility in it based on population norms. The visualisation of this total report from Apr-2015 to Mar-2016 is:
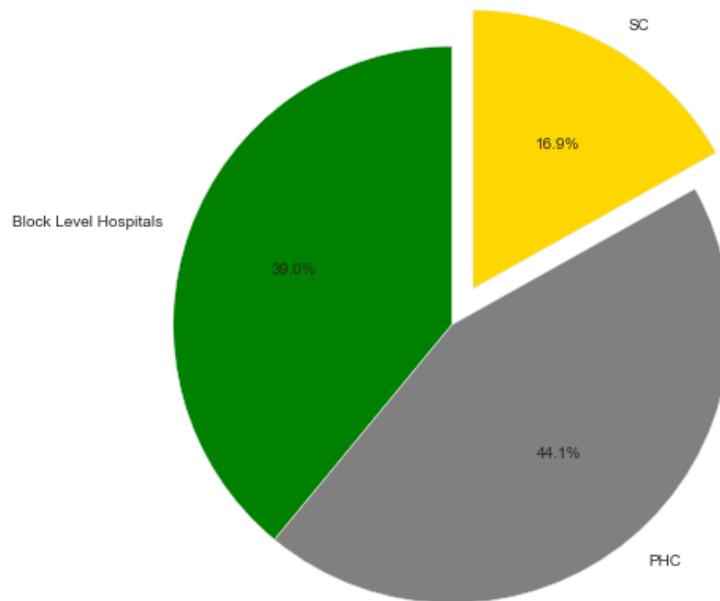
Fig: Total Reports of Health Facility in Nagpur District from Apr2015-Mar2016
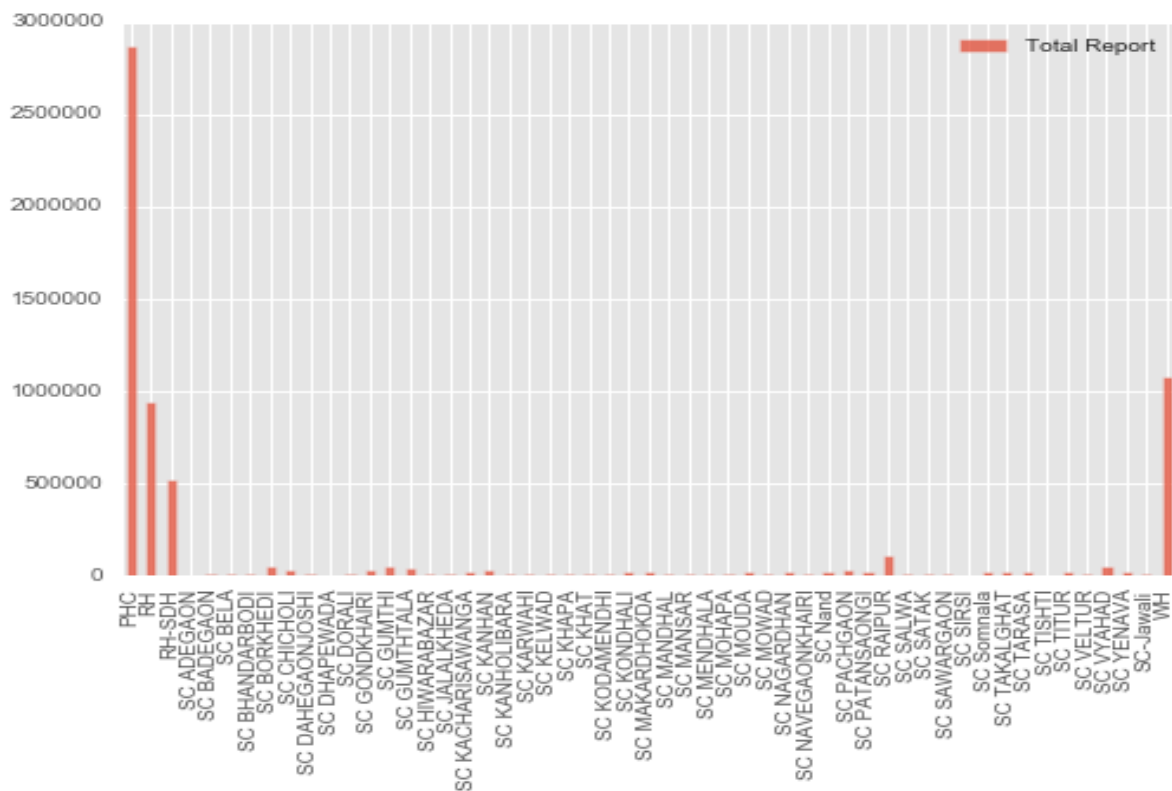

Figure : Total Reports of Type of facility in Nagpur District from Apr2015-Mar2016

Name of the facility has 4 technical components (REPRODUCTIVE AND CHILD HEALTH, Other Programmes, Health Facility Services, Mortality Details). Each technical component further classified into 16 Health Services and their total report is shown below:
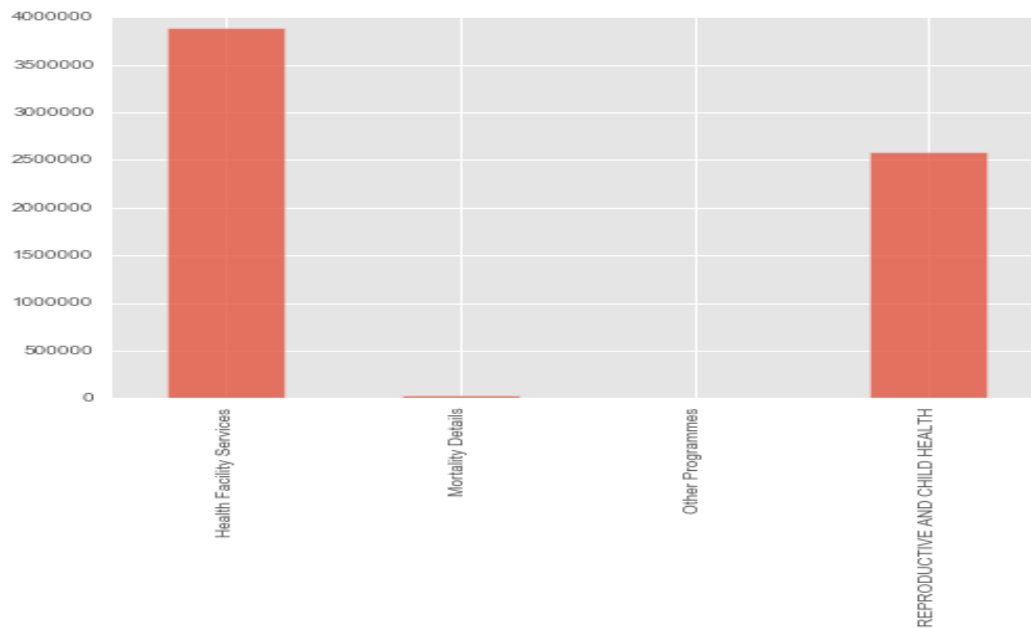

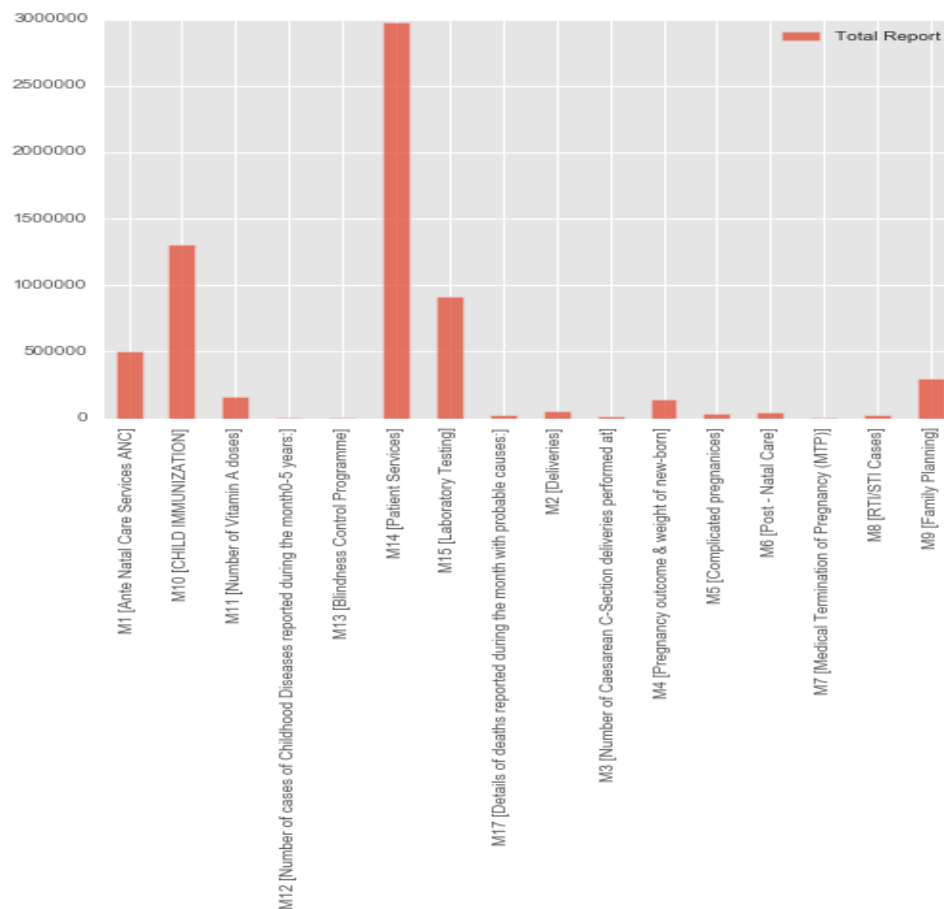Fig: Total Report of Technical components from Apr2015-Mar2016

Fig: Total Report of health services from Apr2015-Mar2016

Next, column name Serial Number is based on Health service column and it has 311 indicators and their total reports are sharing in .csv format because the length of the indicators is too long and if I couldn't insert here in order to the length of the data.

Finally, it has numeric data that's Monthly reports from Apr-2015 to Mar-2016 and Total report. The visualization of monthly reports of the data is shown below:

Data Visualization
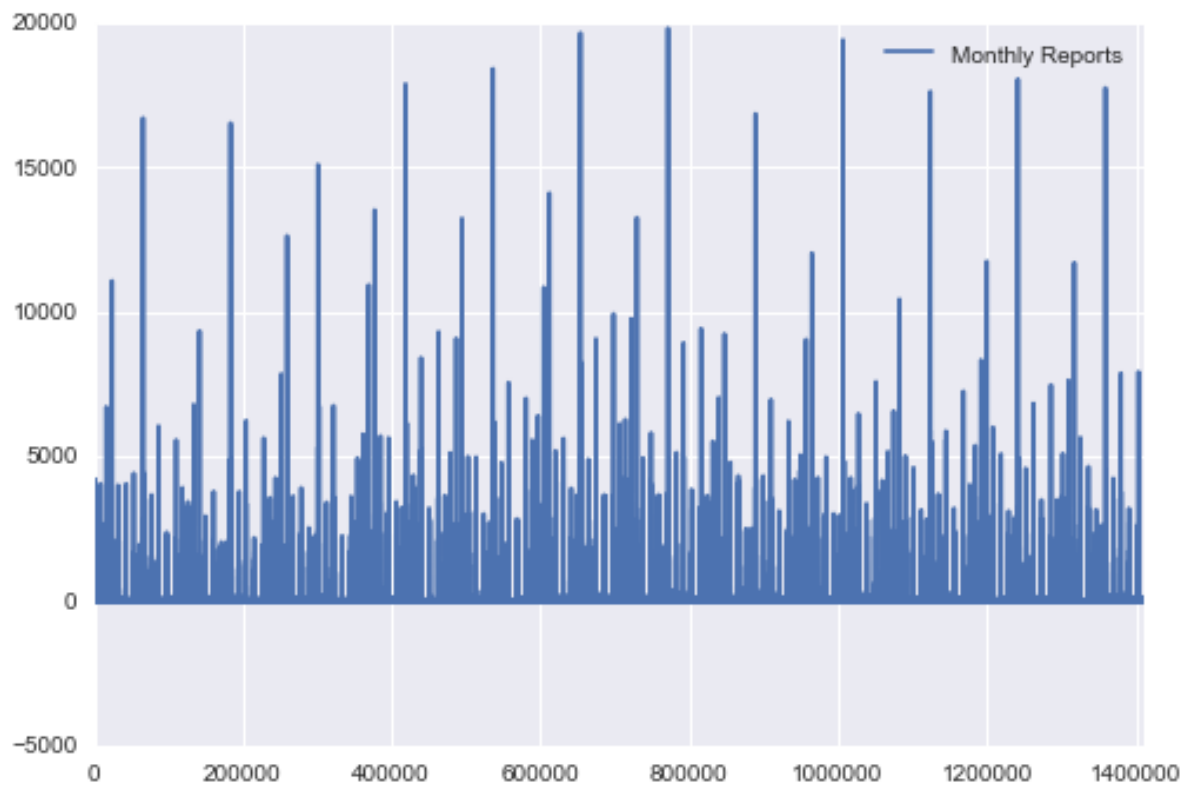
The complete data file after combining all files is shared in data folder and it has 22 variables or columns and 117559 rows. Please find the data in nhrm.csv for analyzation.

Task2:

In the decentralized healthcare scenario, Sub centre makes the lowest division, followed by PHC and then block level hospitals (or RH). Tell us if the numbers follow this vertical hierarchy.

The following vertical hierarchy is shown below

Clustering or Grouping:

In this I completely focused on decentralized scenario. Here I grouped the data by using Total report of the file and Health facility. After grouping or clustering the data I got the below following results. Interestingly after clustering, I got the result of the decentralized scenario in the following order based on numbers.

Block Level Hospitals
↓
PHC
↓
SC
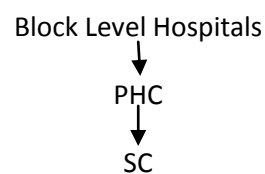
That means it is following the structure of the health care system as shown in below diagram:
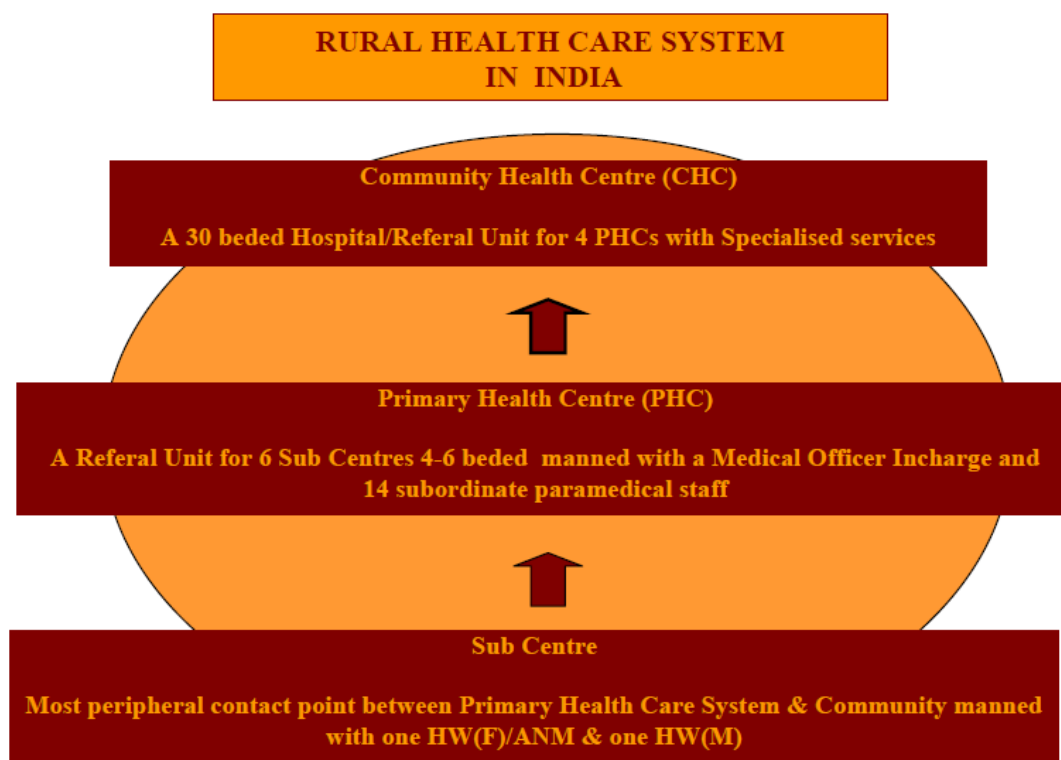
By observing the data it has following number of health centers obtained

```
Block Level Hospital: 12
PHC                  : 49
SC                   :316
```

After hierarchal clustering or grouping of the health facility, following theTotal report of the decentralized health scenario is shown below:

Health FacilityTotal

Block Level Hospitals   2540300.0

PHC   2870956.0

SC   1098957.0

The mean and standard deviation of the above data for finding and plotting the hierarchy of the results is shown below:

Health Facility	mean	std
Block Level Hospitals	712.966601	6609.664866
PHC	197.275888	1582.684126
SC	11.672530	55.281073

If you clearly observe the results the numbers following the vertical hierarchy and is shown graphically below:
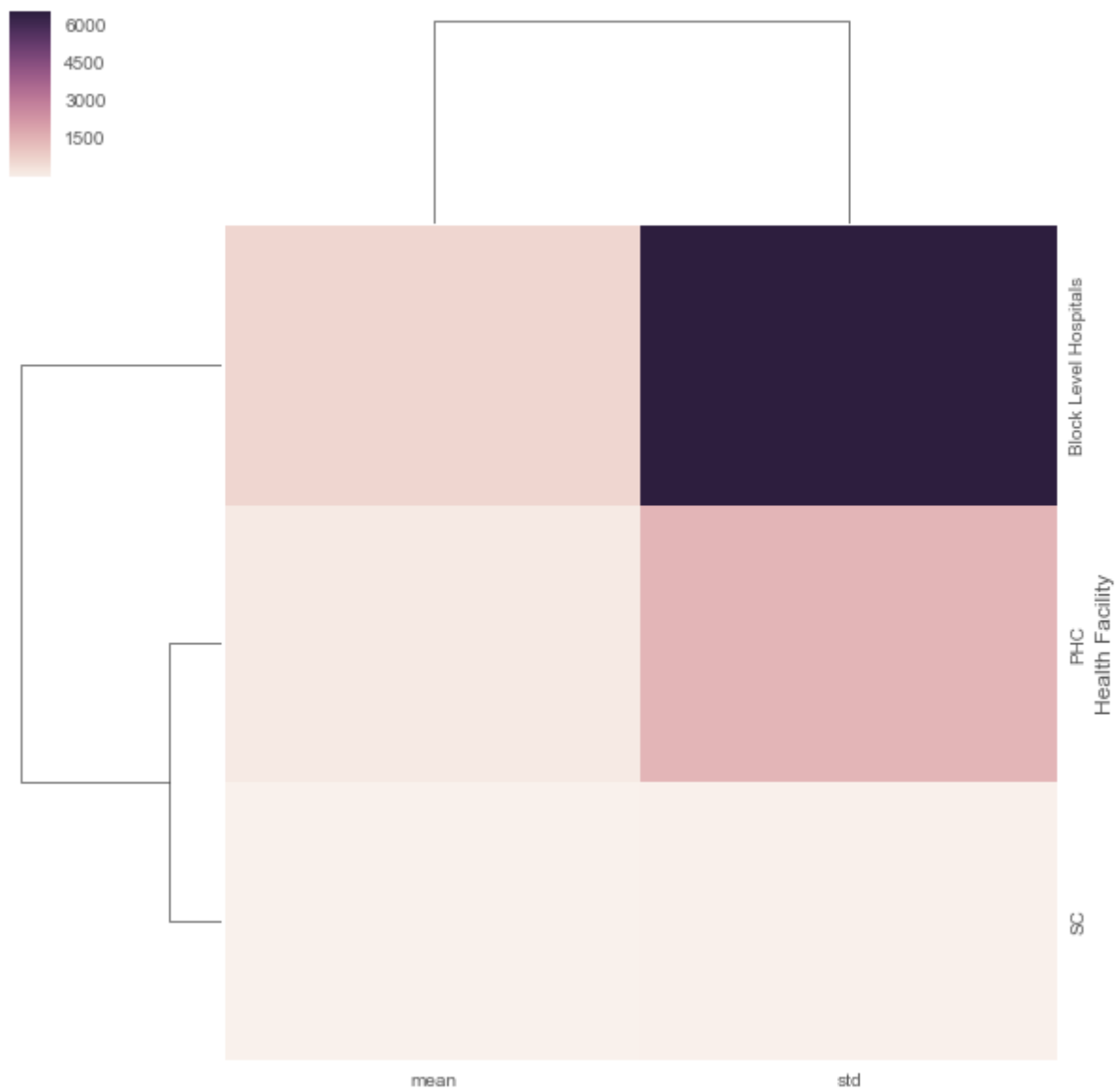
Fig: Hierarchy of the Data

A **trend** exists when there is a long-term increase or decrease in the **data**. It does not have to be linear. Sometimes we will refer to a **trend** "changing direction" when it might go from an increasing **trend** to a decreasing **trend**, Seasonal. Trend visualisation: Visualise whole data based on Indicator Serial No. is shown in below:

It's very difficult to find the trends in whole data because indicator number has the same colour identity in more cases. So, I overcome this disadvantage by dividing the files into 10 files for plotting

After observing each graph, I have found the 10 trends as shown below:

1. Total number of pregnant women Registered for ANC.
2. Total Number of NSV or Conventional Vasectomy conducted at Public facilities i.e. PHC, CHC, SDH, DH and other State owned public institutions (sum of items from 9.1.1.a to 9.1.1.d).
3. Number of Infants (0 to 11 months old) received Pentavalent1 immunisation.
4. Number of Infants (0 to 11 months old) received Pentavalent2 immunisation.
5. Number of Infants (0 to 11 months old) received Pentavalent3 immunisation.
6. Number of Mini-lap sterilizations conducted at PHCs.
7. Total Number of Mini-lap sterilizations conducted at Public facilities i.e. PHC, CHC, SDH, DH and other State owned public institutions (sum of items from 9.3.1.a to 9.3.1.d).
8. Number of Infants (more than 16 months old) received DPT Booster dose.
9. Number of Infants (more than 16 months old) received OPV Booster dose.
10. Number of children (more than 16 years old) given TT16.

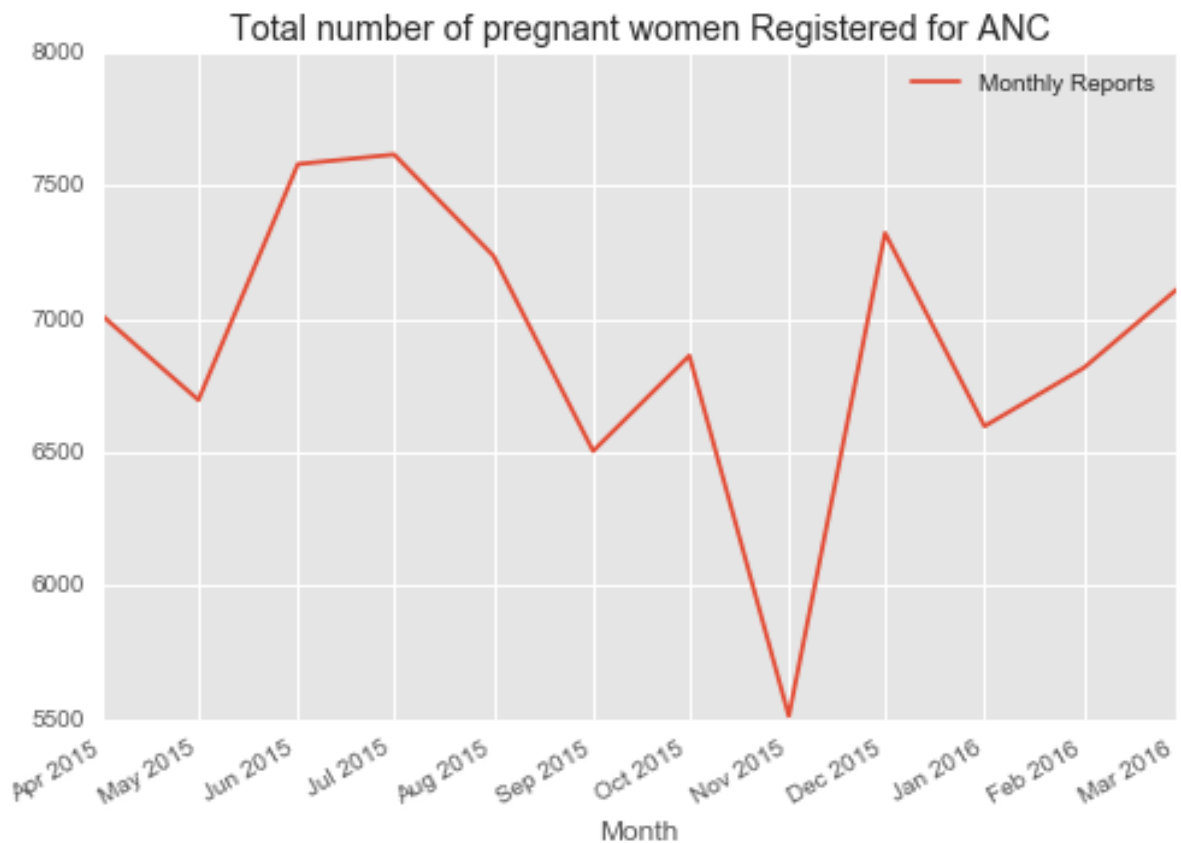1. **Total number of pregnant women Registered for ANC.**

   Proper ANC is one of the important ways in reducing maternal and child morbidity and mortality. Unfortunately, many women in developing countries do not receive such care. Understanding maternal knowledge and practices of the community regarding care during pregnancy and delivery are required for program implementation. Data on this very important issue are scarce in Nagpur District. Therefore, the present report was carried out to tell where pregnant women are not utilising the Ante Natal Care Services.
   In Apr2015-Mar2016, Total No. of pregnant woman registered ANC is 82864.
   ANC registered pregnant women in Nagpur district from Apr-2015 to Mar-2016.

Month	Reports
Apr-2015	7012.0
May-2015	6696.0
Jun-2015	7579.0
Jul-2015	7615.0
Aug-2015	7235.0
Sep-2015	6505.0
Oct-2015	6862.0
Nov-2015	5513.0
Dec-2015	7321.0
Jan-2016	6598.0
Feb-2016	6817.0
Mar-2016	7111.0

If you observe graph the trend is changing the direction in every month. The trend of pregnant women in the month of Nov 2015, the ANC registered pregnant women number is suddenly decreased from Oct-2015 to Nov-2015(6862.0 to 5513.0),change is 1349. Later it increases from Nov-2015 to Dec-2015(5513 to 7321.0)here change is 1808.Later it changes direction line increasing and decreasing.


The data is also plotted as a time series with the names of months on the x-axis and total number of pregnant women registered at ANC figures on the y-axis.

If we observe clearly, we will find where lowest number of pregnant women registering ANC record. In Health block levels the reported number of pregnant women registered ANC at PHC level (35.5%) is very high compared to block level hospitals and SCs. Both Block level hospitals and SCs have approximately equal number of recorded reports. It is clearly shown below
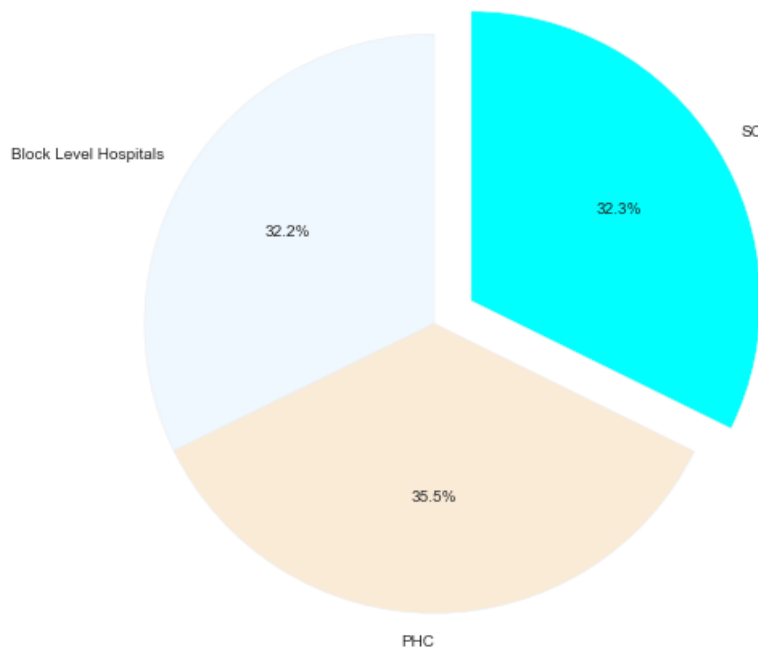
Coming block level or sub-districts the highest number of Ante Natal Care Services ANC utilised in Nagpur sub-district (35.3%). And lowest recorded in Biwapur Sub-District (2.7%). If you observe the below graph we can see where ANC services were not utilising and it causes the maternal and child morbidity and mortality.
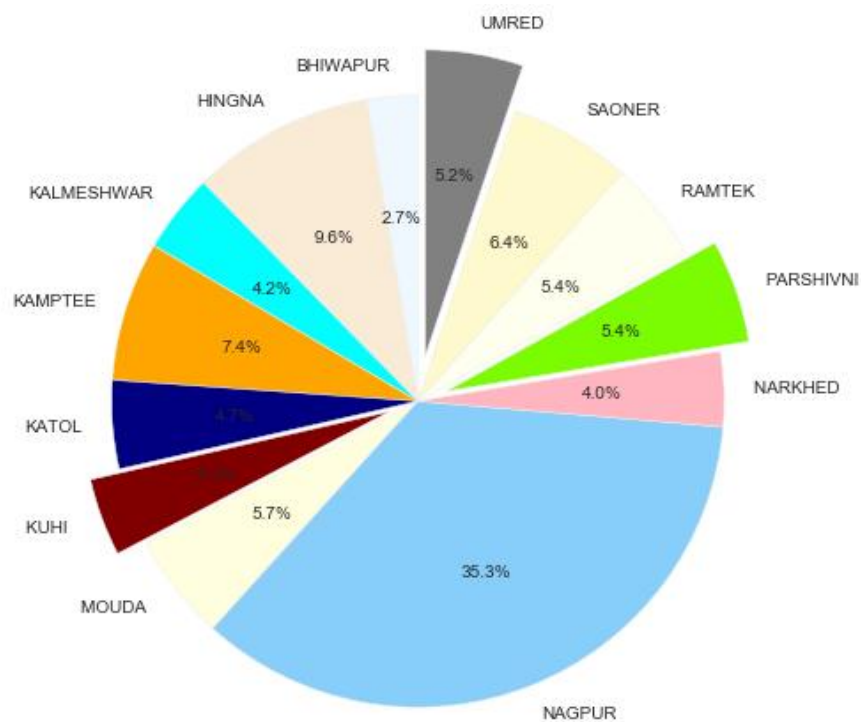
The above reports gives information about only rural areas those are not utilising the ANC services, lack of proper knowledge on ANC and difference in treatment services compared to rural and urban also. So, in this analyzation report, I am suggesting to concentrate on rural areas to implement this scheme effectively compared to previous results and to give benefits to pregnant women.

2. **Total Number of NSV or Conventional Vasectomy conducted at Public facilities i.e. PHC, CHC, SDH, DH and other State owned public institutions (sum of items from 9.1.1.a to 9.1.1.d).**

Vasectomy is the most popular form of permanent surgical birth control for men. In Apr-2015 to Mar-2015, an estimated 454 vasectomies were performed in the Nagpur district.

Month	Report
Apr-2015	16.0
May-2015	2.0
Jun-2015	11.0
Jul-2015	35.0
Aug-2015	27.0
Sep-2015	41.0
Oct-2015	36.0
Nov-2015	49.0
Dec-2015	71.0
Jan-2016	34.0
Feb-2016	50.0
Mar-2016	82.0

The Monthly report of the total Number of NSV or Conventional Vasectomy conducted at Public facilities is shown below:

We can see that the total Number of NSV or Conventional Vasectomy conducted at Public facilities data frame has a clear trend. In Jan-2016, there is a short fall in the increase that is 71 to 34. And later it has steady increase.

In this I am also finding future prediction of this data frame. This suggests that the time series is not stationary and will require differencing to make it stationary, at least a difference in order of 1. And look at an autocorrelation plot of the time series.

ARIMA Model:

The statsmodels library provides the capability to fit an ARIMA model.

An ARIMA model can be created using the statsmodels library as follows:

1. Define the model by calling ARIMA() and passing in the *p*, *d*, and *q* parameters.

2. The model is prepared on the training data by calling the fit() function.

3. Predictions can be made by calling the predict() function and specifying the index of the time or times to be predicted.

Let's start off with something simple. We will fit an ARIMA model to the entire Shampoo Sales dataset and review the residual errors.

First, we fit an ARIMA(5,1,0) model. This sets the lag value to 5 for auto regression, uses a difference order of 1 to make the time series stationary, and uses a moving average model of 0.

When fitting the model, a lot of debug information is provided about the fit of the linear regression model. We can turn this off by setting the *disp* argument to 0. Here I am not attaching autocorrelation and residual graph.
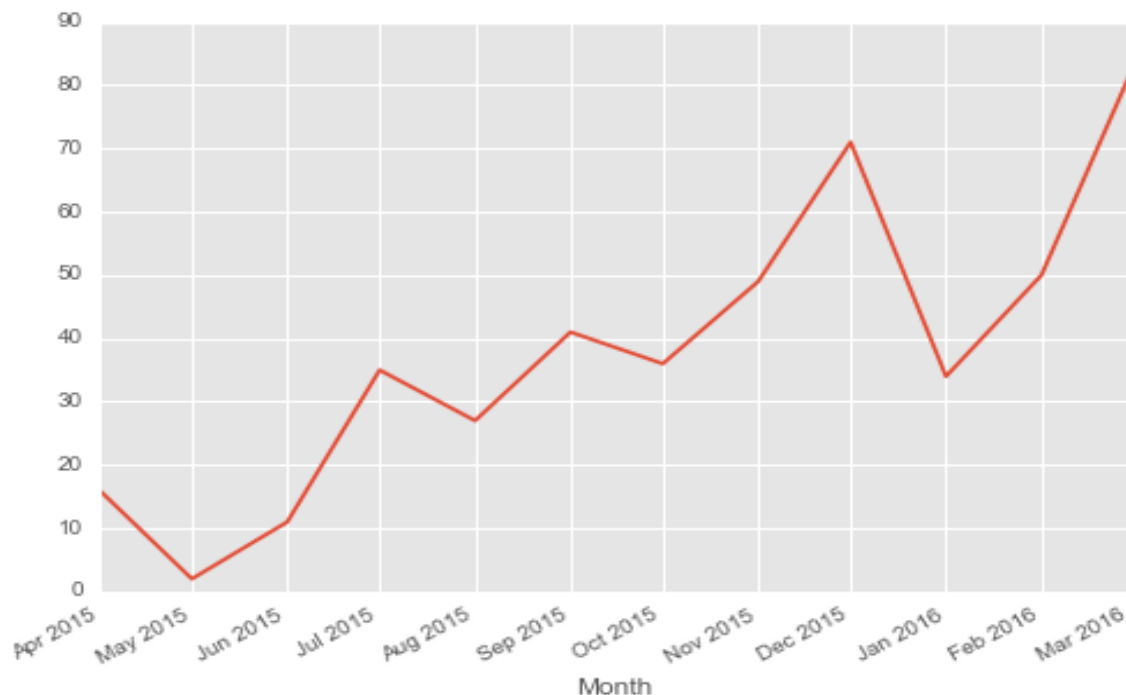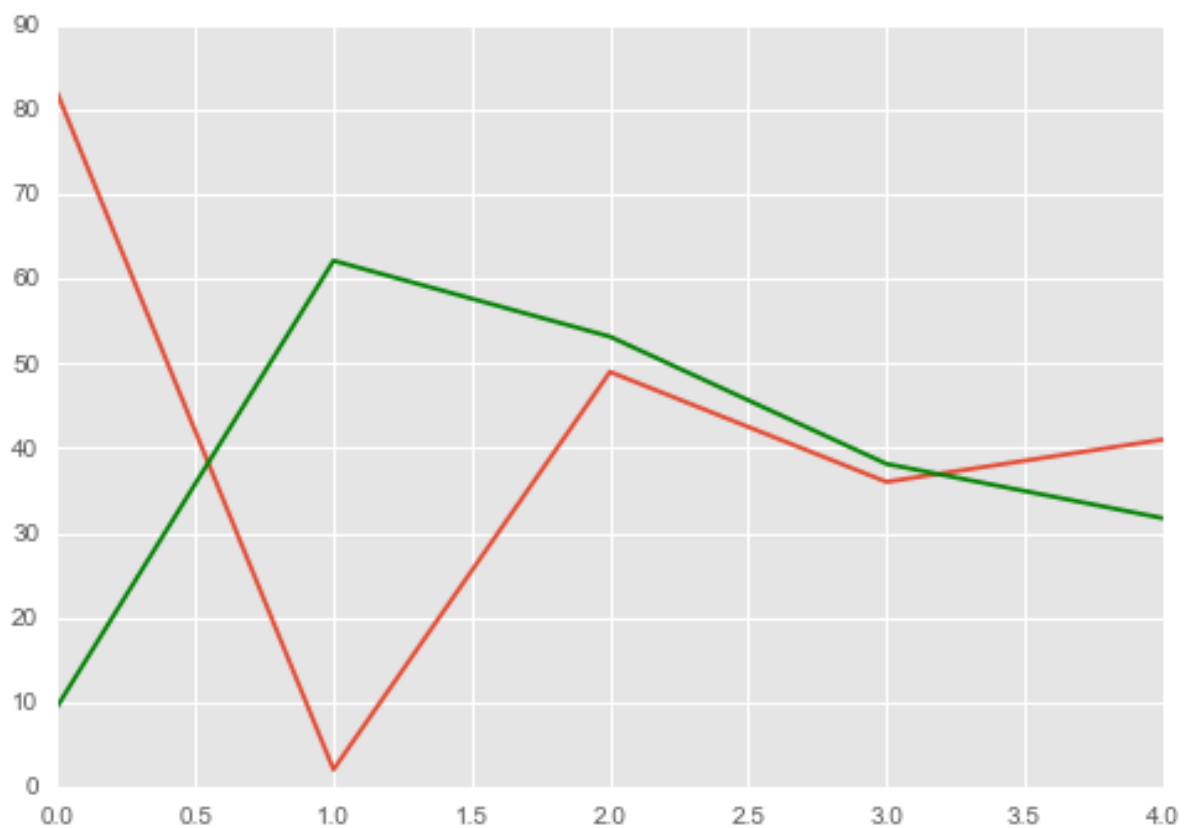

Fig : Total Number of NSV or Conventional Vasectomy conducted at Public facilities i.e. PHC, CHC, SDH, DH and other State owned public institutions (sum of items from 9.1.1.a to 9.1.1.d)

The data is also plotted as a time series with the month on the x-axis and total Number of NSV or Conventional Vasectomy conducted at Public facilities i.e. PHC, CHC, SDH, DH and other State owned public institutions (sum of items from 9.1.1.a to 9.1.1.d) figures on the y-axis.

The Predicted output is

```
predicted=43.601346, expected=16.000000
predicted=37.141019, expected=27.000000
predicted=24.368452, expected=71.000000
predicted=29.817195, expected=50.000000
predicted=58.177612, expected=34.000000
predicted=57.494715, expected=35.000000
predicted=40.253475, expected=11.000000
predicted=28.420125, expected=82.000000
predicted=32.274065, expected=2.000000
predicted=52.395006, expected=49.000000
predicted=35.148768, expected=36.000000
predicted=31.386725, expected=41.000000
```

And predicted graph is

In above graph, red colour line is original prediction graph and green colour is expected predicted one. It is clear that the predicted line is increased from March-2016 to coming next three months but expected line is slightly decreasing. So, I am suggesting that to take necessary action to increase the NSV or Conventional Vasectomy surgeries at Public facilities i.e. CHC, SDH, DH and other State owned public institutions. But it is clear that

only Primary health centres report is only increasing remaining Public facilities has the very low rate in increase. It shown below.
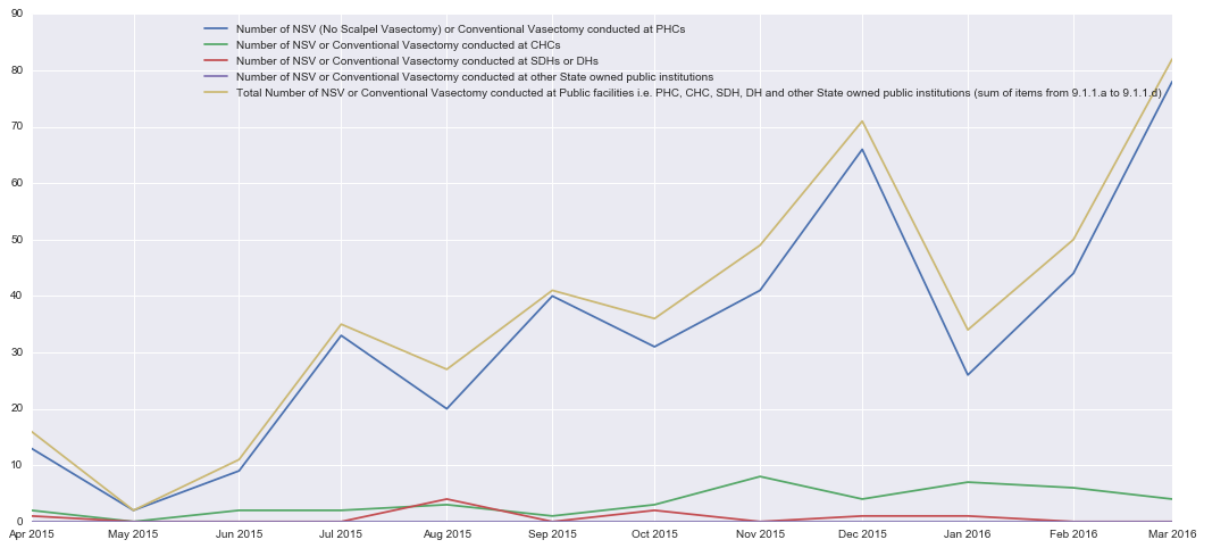
So, NSV or Conventional Vasectomy conducted at Public facilities i.e.PHC, CHC, SDH, DH and other State owned public institutions very low reports recorded.

The total number of NSV or Conventional Vasectomy conducted at Public facilities i.e. PHC, CHC, SDH, DH and other State owned public institutions are visualise at sub-district or block level is shown in below:
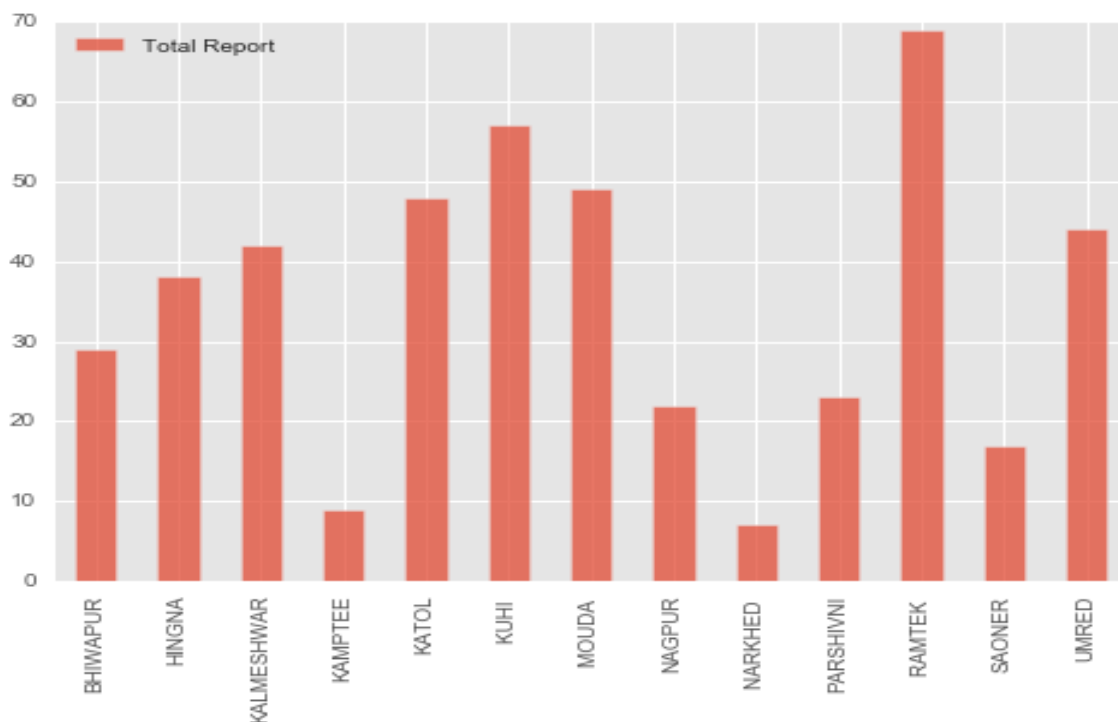
The Report clearly says that Ramtek block has recorded the highest number of reports and Narkhed block has recorded lowest number of reports. Nagpur is a city, capital of Nagpur district even though it recorded lowest number of reports.

The NSV or Conventional Vasectomy conducted at PHC (88.8%) is very high and block level hospital is only 11.2%. The NSV or Conventional Vasectomy are not conducting at Sub-centres(SC). It is conducting at only PHCs and Block level hospitals(CHC/RH/RH-SDH) and the result is shown below. This occurs mostly in rural areas as they have less knowledge regarding this, yet they do it in order to get money from the respective sectors.NSV is better than Minilap Sterilization. So, those who have more than 2 children has to go under the knife in order to control the population. Government should create awareness in men.
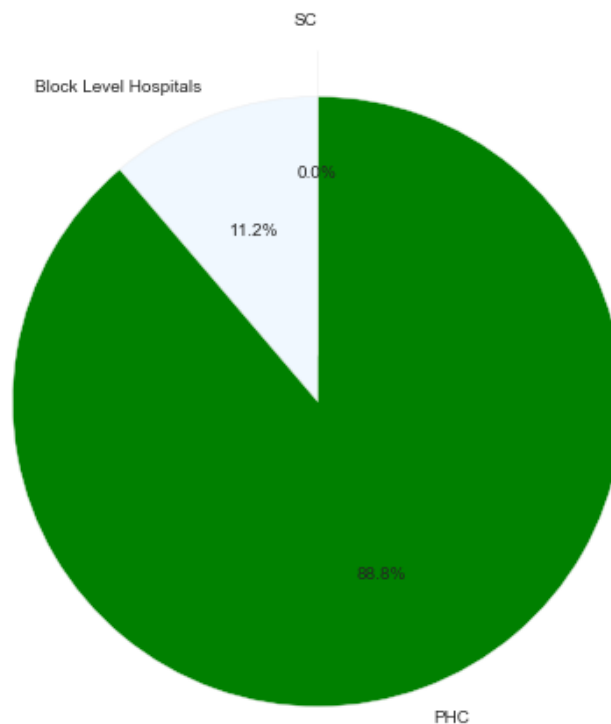
3. **Number of Infants (0 to 11 months old) received Pentavalent1 immunisation.**
4. **Number of Infants (0 to 11 months old) received Pentavalent2 immunisation.**
5. **Number of Infants (0 to 11 months old) received Pentavalent3 immunisation.**

Pentavalent Vaccine

Immunization is one of the most well-known and effective methods of preventing childhood diseases. With the implementation of the Universal Immunization Programme (UIP) by the

Government of India, significant achievements have been made in preventing and controlling vaccine-preventable diseases (VPDs). Introduction of pentavalent vaccine will further reduce the incidence of pneumonia and meningitis caused by Haemophilus influenzae type b (Hib) bacteria. It prevents the 5 diseases by giving one vaccine 3 times(Pentavalent1, Pentavalent2 and Pentavelent3).

In Nagpur district, Number of Infants (0 to 11 months old) received Pentavalent1,2&3 immunisation is 20996, 15189 and 1018.(3 Doses)

The monthly reports of the number of infants(0 to 11 months old) received Pantavalent1, Pantavelent2 and Pentavalent3 immunisation is shown graphically is shown in below:
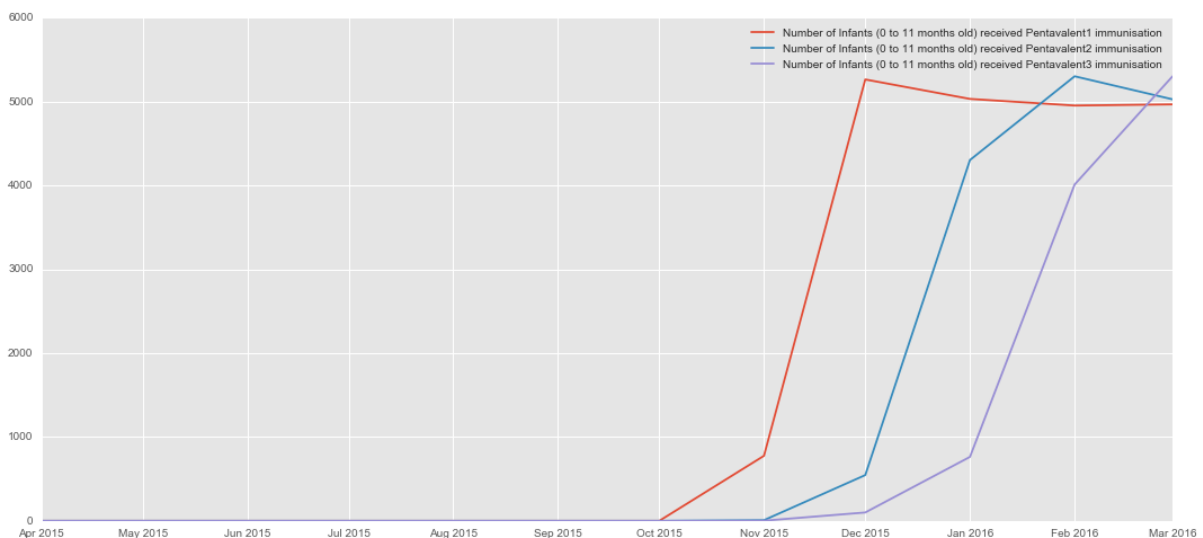

Fig : The number of infants(0 to 11 months old) received Pantavalent1, Pantavelent2 and Pentavalent3 immunisation.

It is clear that pentavalent1 vaccine is trending from Oct-2015, it increases up to Dec-2015 and it changes the direction and flows in constantly. Coming to Pentavalent2, it trends from Nov-2015 to increase the flow and it slightly decrease the flow. The number of infants (0 to 11 months) received Pentavalent3 is trending from Nov-2015 to it increase the number of received children. I float all the lines in single graph is shown above.

The visualisation of health centres of the number of infants (0 to 11 months old) received Pantavalent1, Pantavelent2 and Pentavalent3 immunisation is shown below:
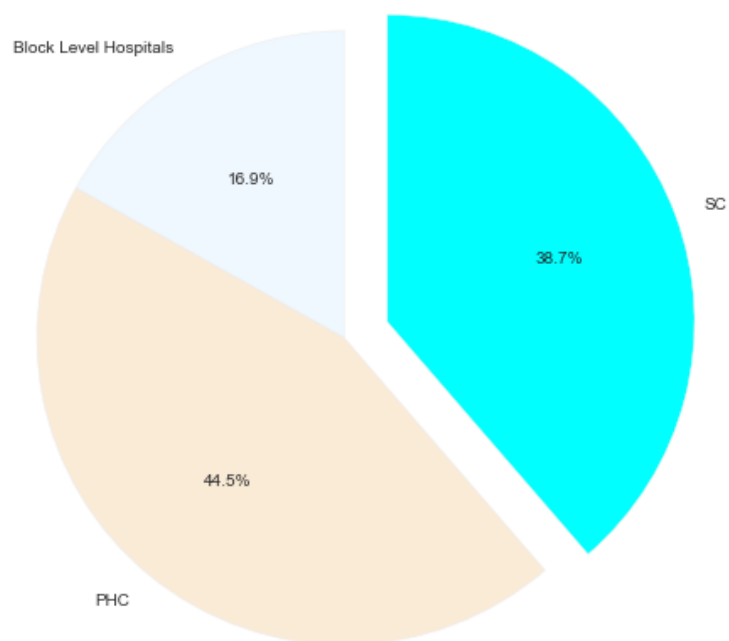
Fig:The number of infants (0 to 11 months old) received Pantavalent1 immunisation at decentralised scenario.
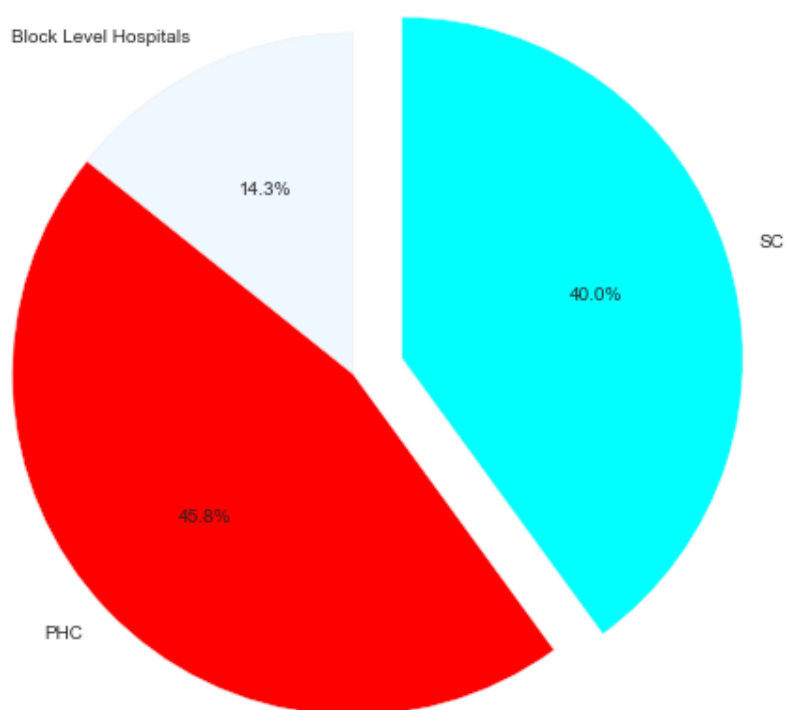

Fig:The number of infants (0 to 11 months old) received Pantavalent1 immunisation at decentralised scenario.
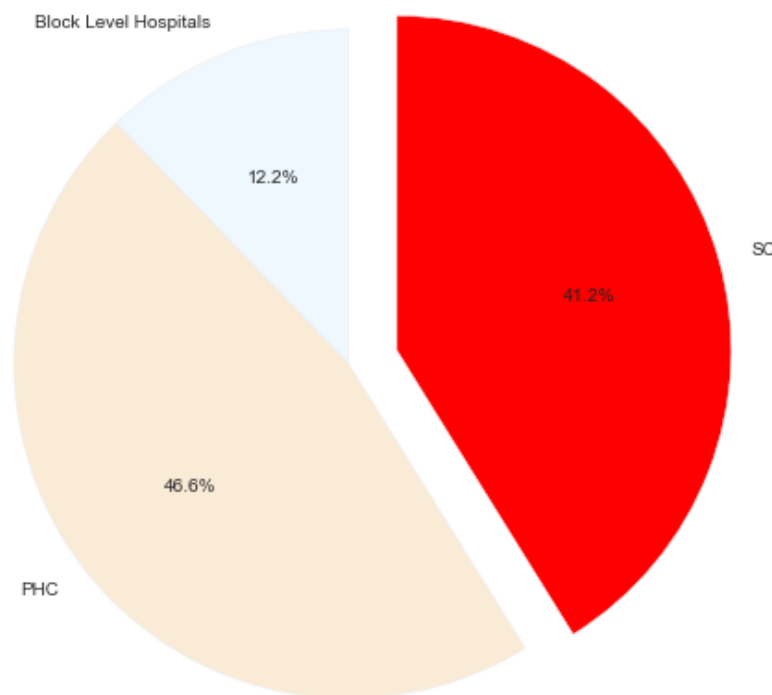
Fig:The number of infants (0 to 11 months old) received Pantavalent1 immunisation at decentralised scenario.

After observing Decentralised health scenario in the number of infants (0 to 11 months old) received Pantavalent1, Pantavalent2, Pantavalent3 immunisation total report is very high in Primary Health centres.

Finally the schedule to give vaccine Pentavalent1, Pentavalent2, and Pentavelent3 is 6 weeks, 10 weeks and 14 weeks. The first dose is given in Oct-2015 and second dose(Pentavelent2) after 6weeks that starts in Nov-2015 and the third dose 3(Pentavelent3) starts increasing in Dec-2015. It clearly observed that next dose is giving after 4 months of first dose and vice versa.

It's clear to say that the reported persons are increasing in only 3rd dose. First and second are after increasing the reports at certain point, it slightly decreasing the number of reports and it is not matching the numbers, who is taking first with second and third. Each child must and should take all the three doses of vaccine Pentavalent. In few cases, who takes first one (Pentavalent1) are not going to take second one (Pentavalent2) but they are ready to take the third dose. This case is also happening in the Second dose also. So, Here I am suggesting that if any one who takes the first dose of vaccine Pentavalent1, Govt should take the care to give second and third dose by using modern communication methods. They should inform them before schedule about the next dose. Because it Prevents 5 diseases by giving 1 vaccine 3 times.

The block wise report of the number of infants (0 to 11 months old) received Pantavalent1, Pantavelent2 and Pentavalent3 immunisation is:
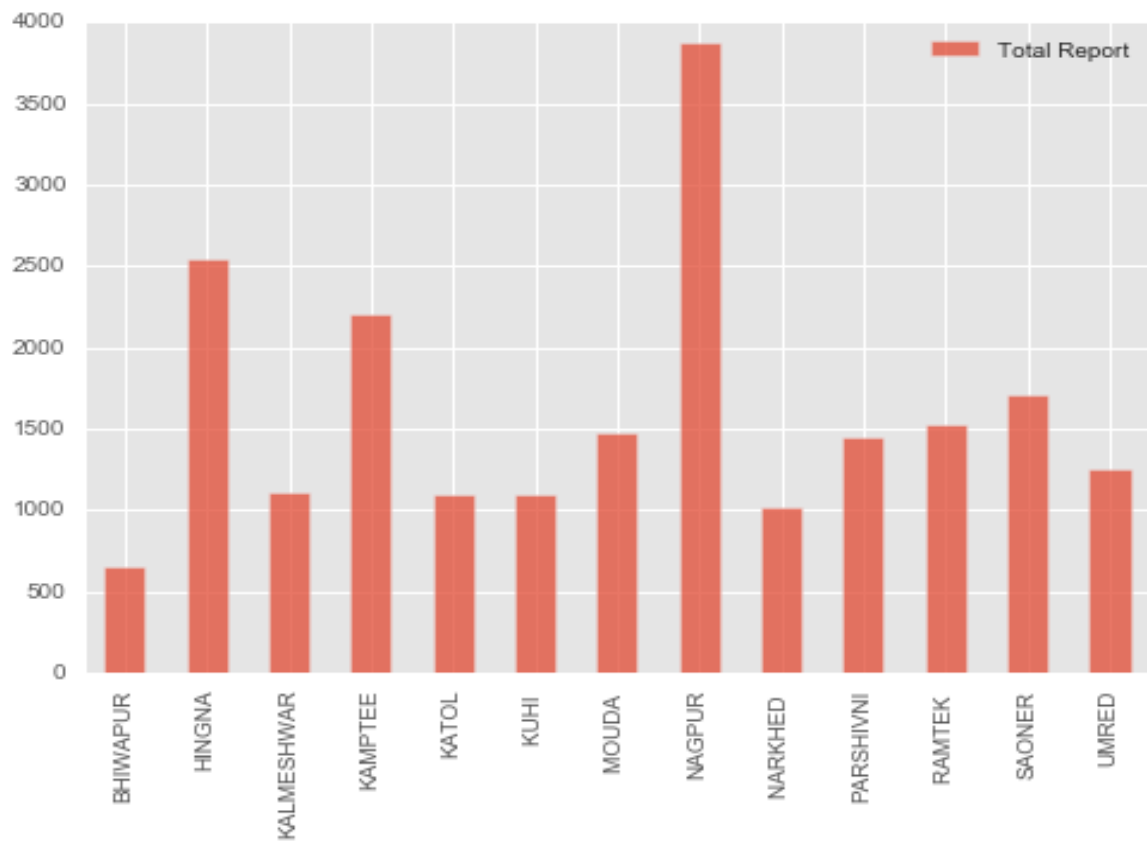
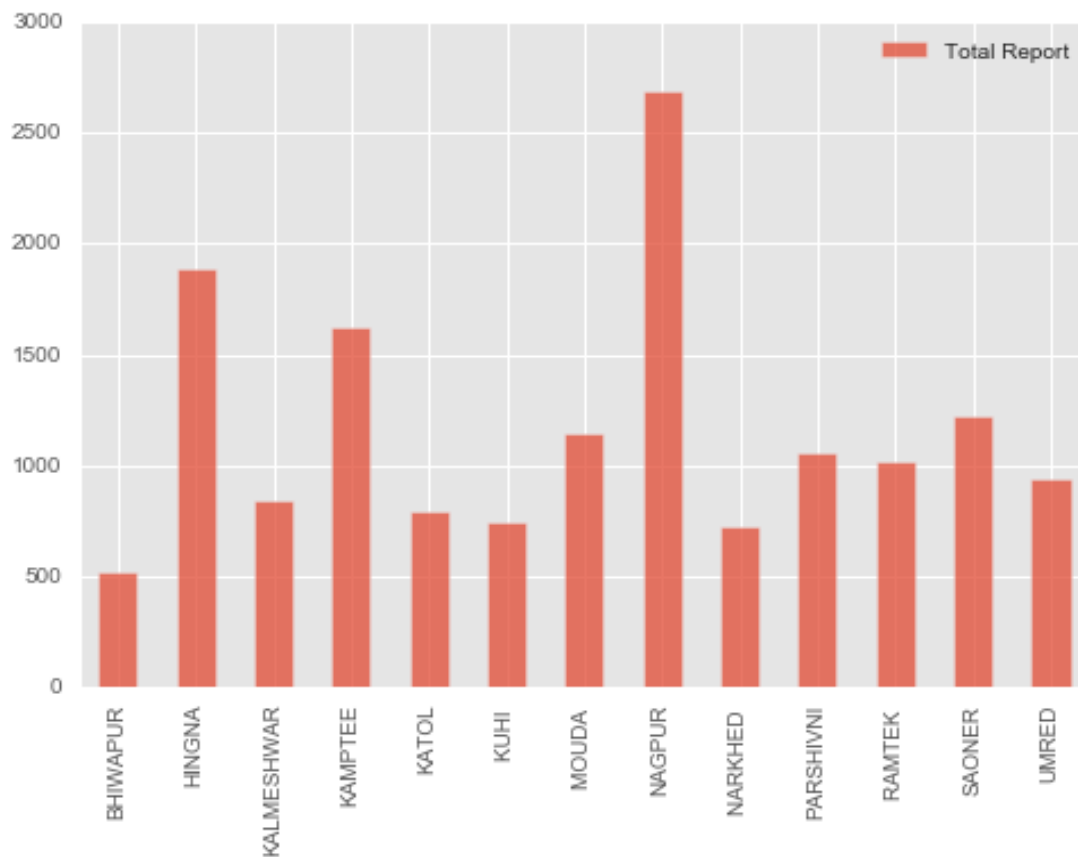Fig: the number of infants (0 to 11 months old) received Pantavalent1 immunisation at blocks.

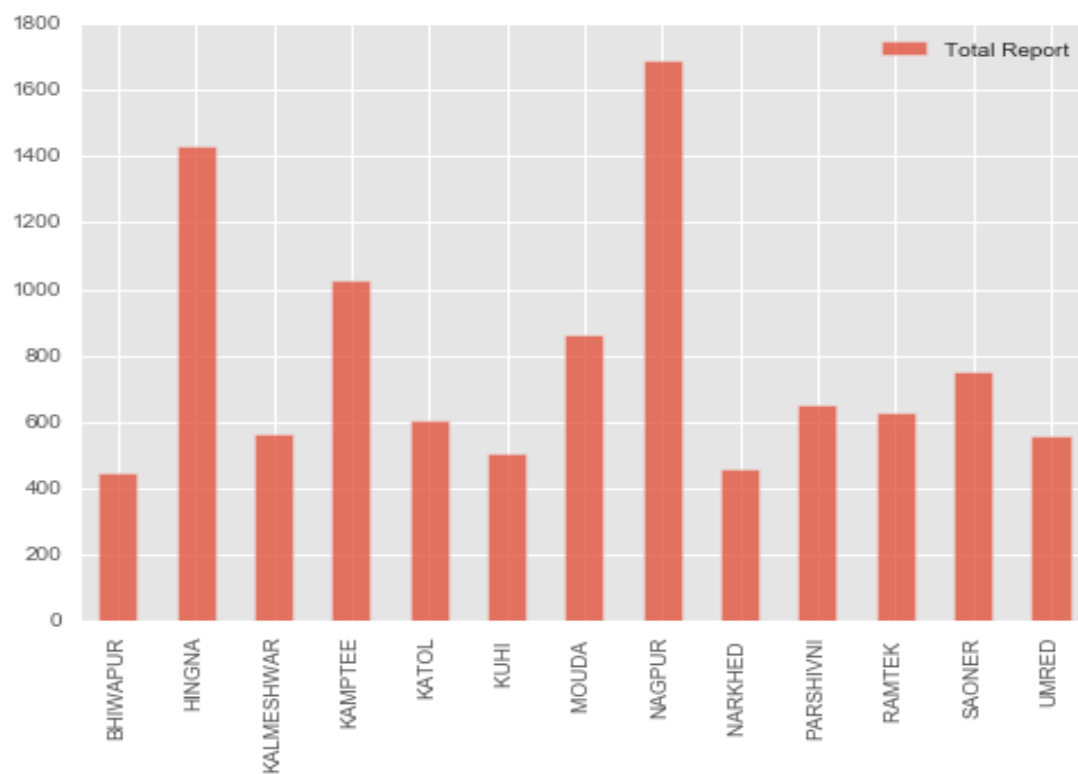Fig: the number of infants (0 to 11 months old) received Pantavalent2 immunisation at blocks.

Fig: the number of infants (0 to 11 months old) received Pantavalent3 immunisation at blocks

6. **Number of Mini-lap sterilizations conducted at PHCs.**
7. **Total Number of Mini-lap sterilizations conducted at Public facilities i.e. PHC, CHC, SDH, DH and other State owned public institutions (sum of items from 9.3.1.a to 9.3.1.d).**

Currently, India is the second most populous country in the world with a population growth rate of 1.74%, contributing to 20% of births worldwide. This rapid increase in population is one of the major factors contributing towards low quality of life inspite of rapid strides being made on the economic front.Mini-lap sterilization is surgery for permanent births control in which women fallopian tubes will be cut, tied, or blocked. Previously we have seen NSV or Conventional Vasectomy in males. The total reports of Number of Mini-lap sterilizations conducted at PHCs is 5691 and Total Number of Mini-lap sterilizations conducted at Public facilities i.e. PHC, CHC, SDH, DH and other State owned public institutions (sum of items from 9.3.1.a to 9.3.1.d) is 6691.

The overall monthly reports of Minilap sterilization at different level of decentralised health scenario is shown below:
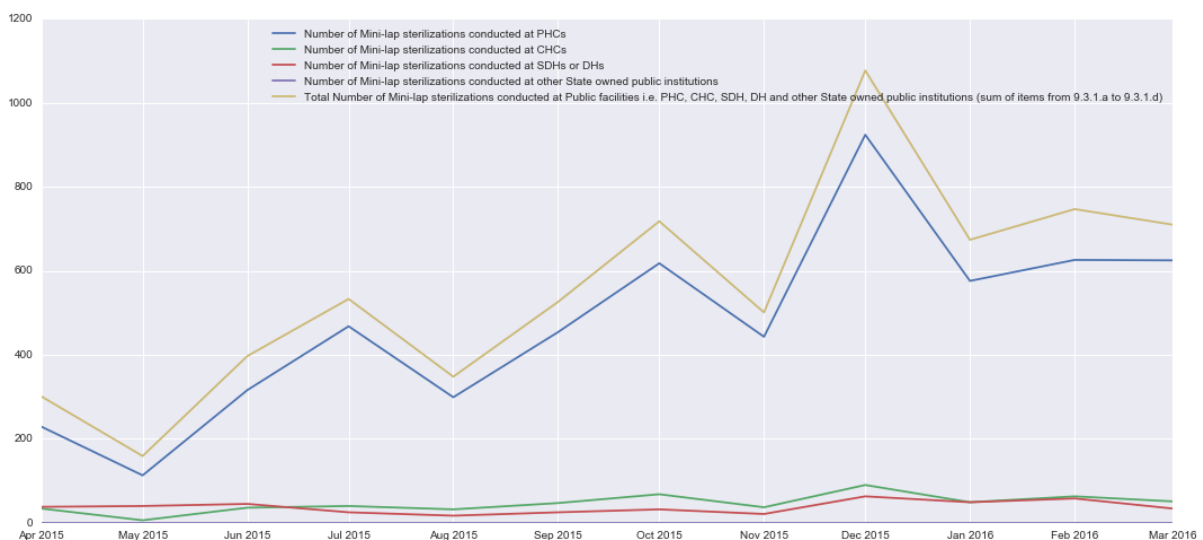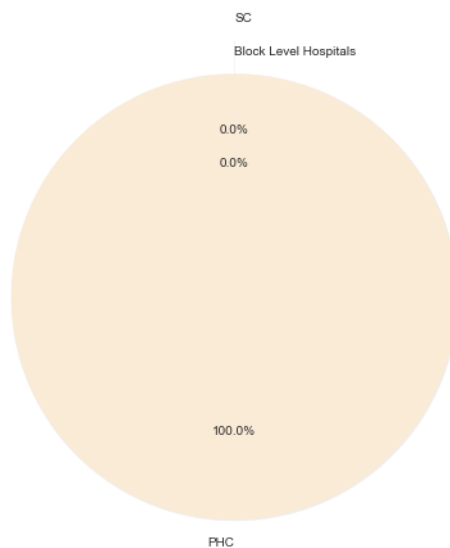

Observing the above graph Mini-lap sterilizations trending conducted at PHC and conducted at Public facilities i.e. PHC, CHC, SDH, DH and other State owned public institutions (sum of items from 9.3.1.a to 9.3.1.d) only. Remaining are flows at constant rate.

Checking the result of Number of Mini-lap sterilizations conducted at PHCs is at health facility or centres is shown below:

Health Facility	Monthly Reports
Block Level Hospitals	0.0
PHC	5691.0
SC	0.0

The result generated is true because it not reported other than PHCs and it is conducting only at PHCs in Nagpur district and it is graphically shown in below

And the result of total Number of Mini-lap sterilizations conducted at Public facilities i.e. PHC, CHC, SDH, DH and other State owned public institutions (sum of items from 9.3.1.a to 9.3.1.d) at health centres is shown in below:
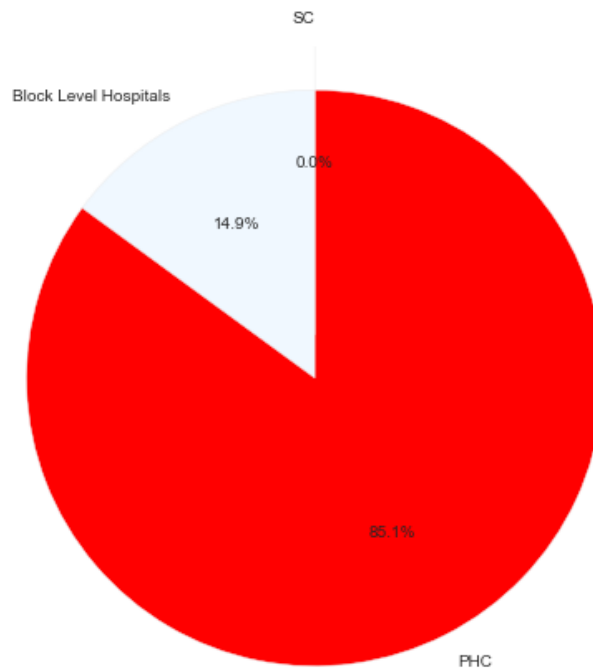
But in this case the total reported at PHC (85.1%) and Block level hospitals(14.9%). The minilap sterilization is not conducting at SCs because it is very dangerous to perform surgery without sufficient equipment. It is conducting at only PHCs and few Block level hospitals like RH, WH etc.
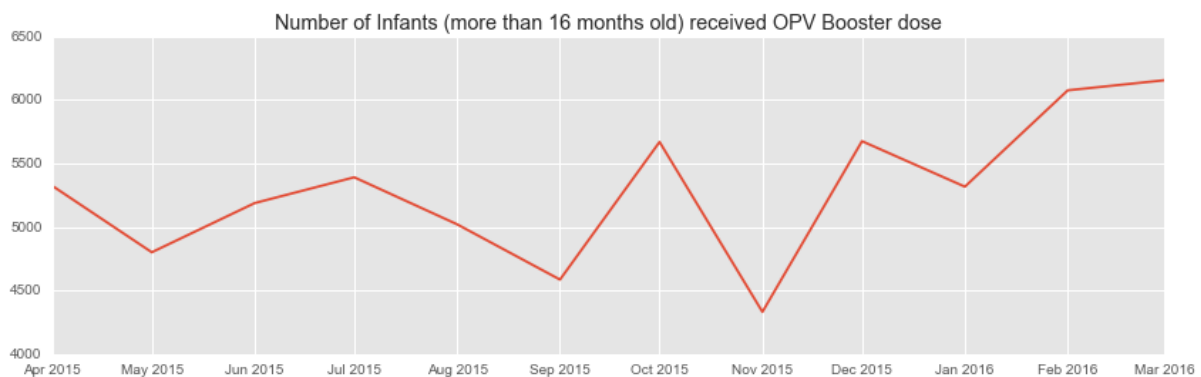
8. **Number of Infants (more than 16 months old) received DPT Booster dose.**
9. **Number of Infants (more than 16 months old) received OPV Booster dose.**
10. **Number of children (more than 16 years old) given TT16.**

Total number of Infants (more than 16 months old) received DPT Booster dose is 63524 and monthly reports is shown in below:
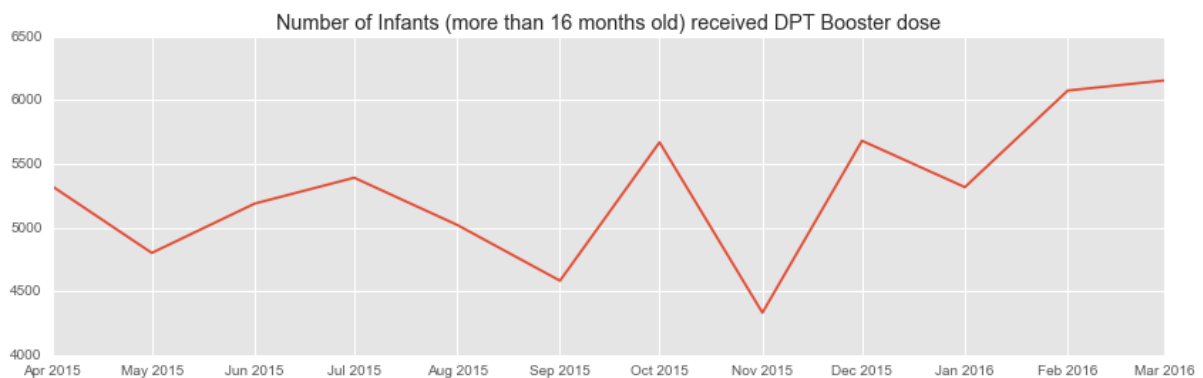
The data is also plotted as a time series with the month on the x-axis and total no. of infants (more than 16 months) received DPT booster dose figures on the y-axis And We can see that this data frame has a clear trend.

Total number of Infants (more than 16 months old) received OPV Booster dose is 63521 and monthly report is shown below:

The data is also plotted as a time series with the month along the x-axis and total no. of infants (more than 16 months) received OPV booster dose figures on the y-axis And We can see that this data frame has a clear trend.

Total number of children (more than 16 years old) given TT16 is 57054 and monthly report is shown below:
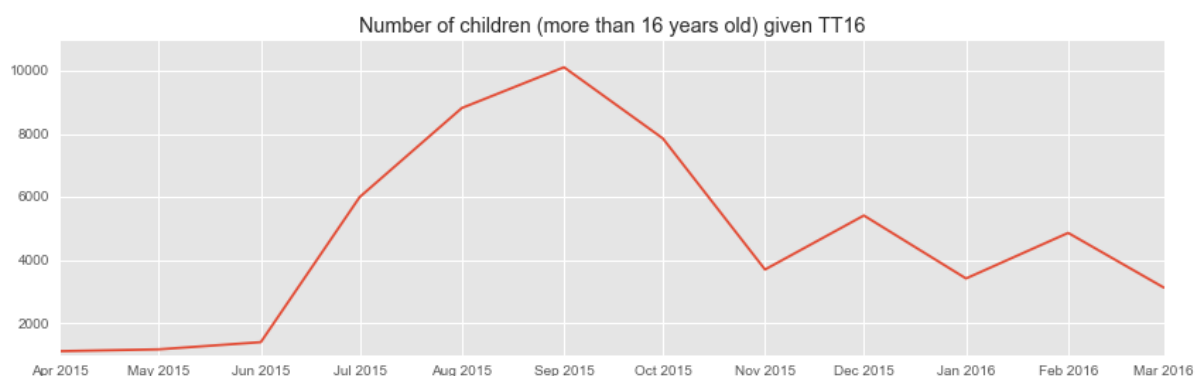
This trend is changing the direction after going to a particular point (Sep-2015). And it's clear that number of children given TT16 are decreasing the season after Sep-2015. First two vaccines are trending and third one report is completely different and it is detrending after Sep-2015.

Finally, observation report on vaccines there is a relationship between Pentavalent vaccine and DPT, OPV, and TT16 vaccines. It is the Pentavalent schedule since birth to the child up

to 11 months and DPT, OPV and TT16 has the schedule after 16 months of the child. Deeply DPT and OPV first booster dose is 15 -18 months and second booster dose is 5 years of child. Finally, TT has the schedule 10 years of the child. Each vaccine prevents different types of diseases. For healthy child needs all the vaccines in respective schedules. From above observations, I am unable to conclude the child who takes all the doses because it need previous data And here I am not forecasting all the indicators, I did for only NSV or Conventional Vasectomy and I am giving only visualisation report of Indicators.

Thanks ☺