# Report- Assignment 3

## Implementation

In this assignment, we aimed to assess the impact of the curfew. First, we simulated the base case with the following parameters:

$\alpha = 1/ 5.8$, $\gamma = 1/5$ , N=12400000

Contact rate β(delta) and CIR was taken from the values obtained in Assignment 2

β(delta) = 0.608, CIR= 30

β for this wave was obtained as 2.6*0.608

Using these parameters, the base case SEIR dynamics were implemented using for loops. Implementation has already been described in detail in Assignment 1 and 2

s(0) was taken to be 0.6, meaning r(0) was 0.4, and 100 infections were seeded by putting 100 individuals in the exposed state for the first 6 days.

The number of days to the peak was found to be 53. We were given that the peak occurs on 21 January 2022. Thus, we can conclude that our simulation began on 29 November 2021

Thus, we run the base case simulation for 123 days:

The daily average cases were calculated using N*α*e[t]/CIR

The daily number of hospital beds was calculated as a percentage of daily cases = 0.02*cases

Similarly, the daily ICU beds was taken as a percentage of daily hospitalization= 0.05*hospitalizations

We assumed that a person occupies a hospital bed or ICU bed for 10 days on average, and took a windowed sum of the daily hospitalizations and ICUs to gen the number of beds required on any given day. (Implemented using while loops)

Now, we implemented the curfew case:

For the first 33 days the same SEIR dynamics were implemented.

From 1 January 2022 (Saturday), the time varying β according to the mobility restrictions was used.

β =0.55* β (On Saturdays and Sundays)

β =0.9* β (Monday to Friday)

Thus, in the remaining 90 days there were 12 weeks + 6 days until 31 March 2022 which was a Thursday.

The above time varying β was implemented using for loops and the same SEIR equations were used. The Hospital beds and ICU beds calculation was also similar.

## Results

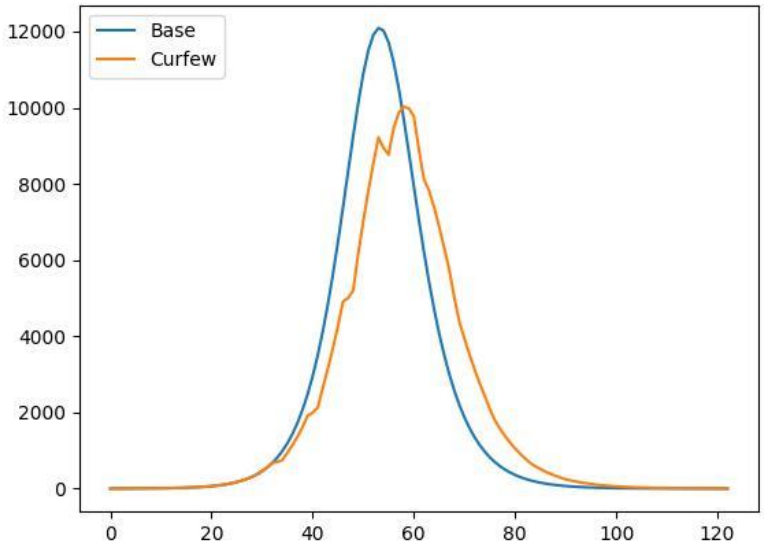
The following Tables contain the results obtained. The same have been saved in 'output.txt'

### Table 1: Daily Average Cases

| Scenario | January 2022 | February 2022 | March 2022 |
|---|---|---|---|
| Base case | 6784 | 1143.107143 | 9.677419 |
| Curfew | 5542.806452 | 2356.464286 | 43.935484 |
| Reduction | 1241.193548 | -1213.357143 | -34.258065 |

Interestingly, we observe a negative reduction, that is a net increase in daily average cases in the month of February and March

If we plot the graph of daily average cases for the base and curfew case, we obtain the following




We observe that the peak gets lowered as well as slightly shifted and delayed. This explains why the daily average cases increase in the month of February and March, as the peak and overall graph has been shifted to the right in case of the curfew.

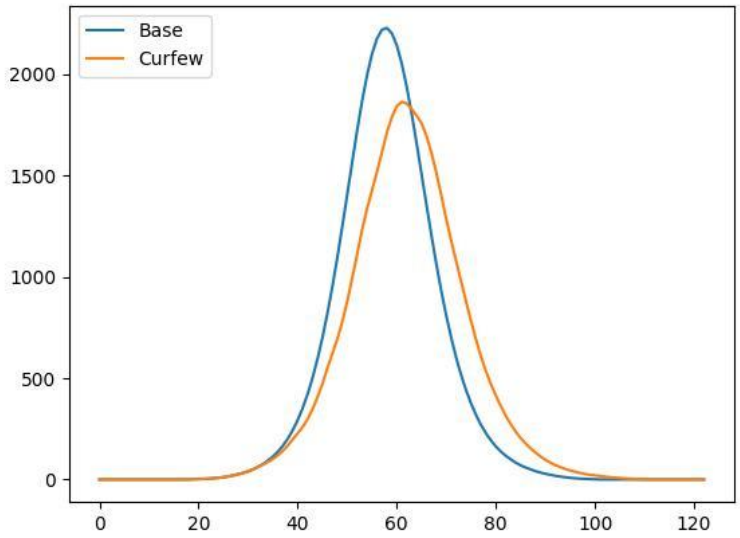
### Table 2

| Scenario | Peak Time | Peak Cases | Peak No. of Hospital Beds | Peak No. of ICU Beds |
|---|---|---|---|---|
| Base case | 21/11/22 | 12091 | 2229 | 107 |
| Curfew | 26/11/22 | 10021 | 1864 | 87 |
| Reduction | 5 | 2070 | 365 | 20 |

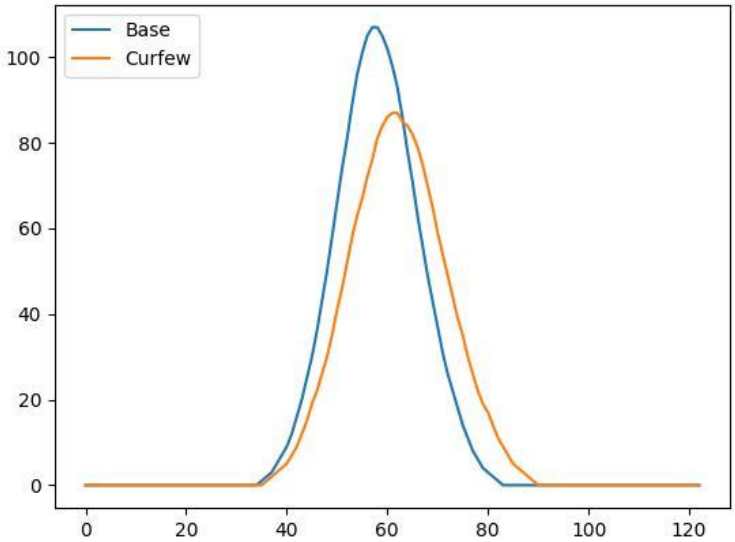
We observe that the peak gets delayed by 5 days. There is also a reduction in the maximum number of cases, hospital bed requirement, and ICU bed requirement on imposing the curfew.

If we plot graphs of the number of hospital beds and the ICU beds, we observe that the follow a similar pattern as the cases graph- a decreased and delayed peak.

Hospital Beds




ICU beds



## Solution to the Wicked Problem

In Table 2, we observe that without the curfew the maximum number of hospital beds is 2229 and Maximum number of ICU beds required is 107 on any given day. Given that Bangalore has 8000 hospital beds available and 400 ICU beds, we find that this is well within the availability.

Also, as we can see from the graphs, imposition of the curfew does not prevent peaking, or even cause a lot of curve flattening. It simply reduces the peak slightly and delays the peak by a few days.

Given that the parameters of the model are correct and give us good estimates, we can conclude that it is better to not have the curfew, as the hospital capabilities as well equipped to handle the projected number of cases without a curfew as of now. Even though we have made assumptions, the values of maximum number of beds required(hospital and ICU) are not at all close to the maximum availability, even without the curfew. Thus, even in reality, if some of our assumptions don't hold and the requirement increases, it is unlikely to increase beyond the availability. The only time we would implement the curfew is if the number of hospital beds and ICU beds were much lower than the given values.