The spread of COVID-19 modeling with focus on Nizamuddin

Case study: Nizamuddin

In the wake of the global crisis due to COVID-19, almost all affected countries, have seen an exponential growth in the number of confirmed case count. In most of such countries, health workers discovered a group of people who got infected at one place and mostly at the same time. Such groups are termed *clusters*. For example, in South Korea, close to 56% of the infections started from a church frequented by an infected woman. In Singapore, a dinner party was found responsible for 10% of the cases. In India one such case has been identified at the Nizamuddin basti in Delhi. Nizamuddin is a crowded, busy neighborhood of narrow lanes lined with market stalls and tiny shops, known for two important historic sites. The map, 1, shows just how densely populated the locality is. It is this locality that has been identified as a massive *cluster*, after a religious congregation held in mid-March in this locality led to COVID-19 spread among the attendees; at least 130 cases have been identified as having originated from this cluster. .

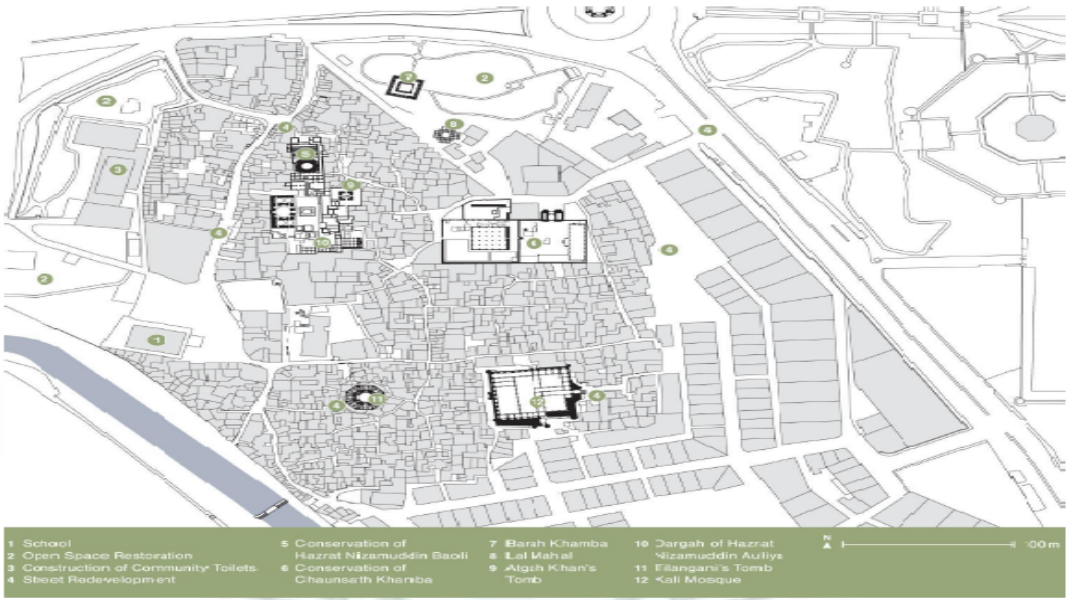


Figure 1: Map of Nizamuddin basti.

As a special case study in connection to our previous post, we have used the SEIQHRF model to simulated the spread of the virus through infected individuals from the Nizamuddin *cluster*. A stochastic individual contact model (ICM) is used to simulate the baseline projections of the timeline of incubation period, illness duration and survival time of the case fatalities. In the five panels of figure 2 all the distributions of the time spent in the various compartments look reasonable, with the exception of *Hospital care required duration*. For quite a few individuals, that duration happens to be zero. These can be considered day-only admissions or it can also be attributed to the unavailability of hospital beds. The last panel is very insightful; it shows the survival time of case fatalities. The highest frequency is seen for day 5 and 7 the frequency is highest, the individuals for the whom the disease turned fatal mostly survived for five to seven days.

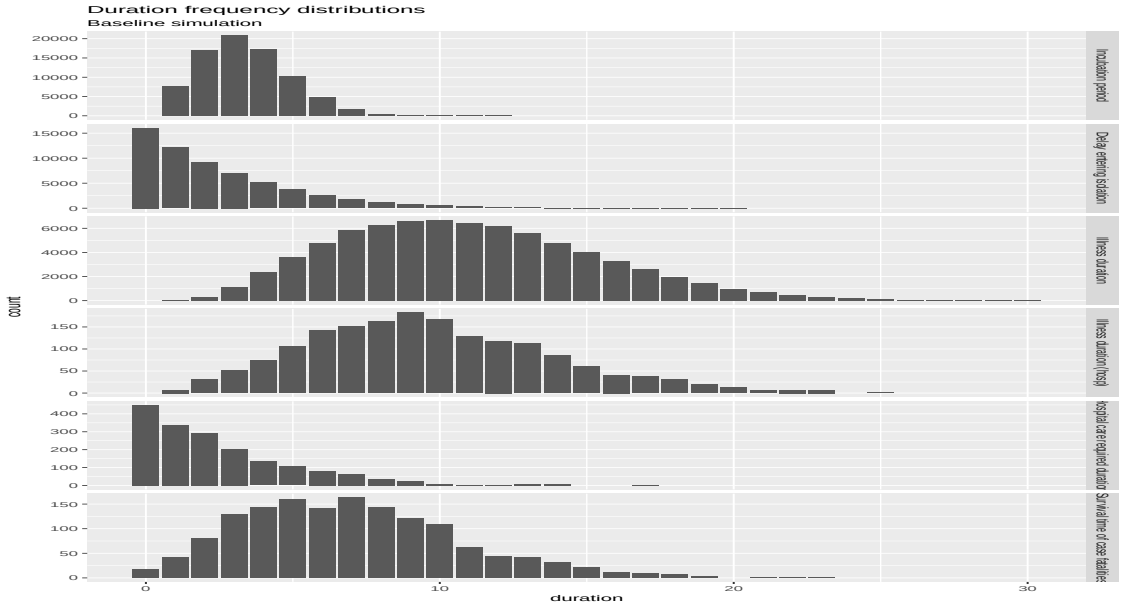
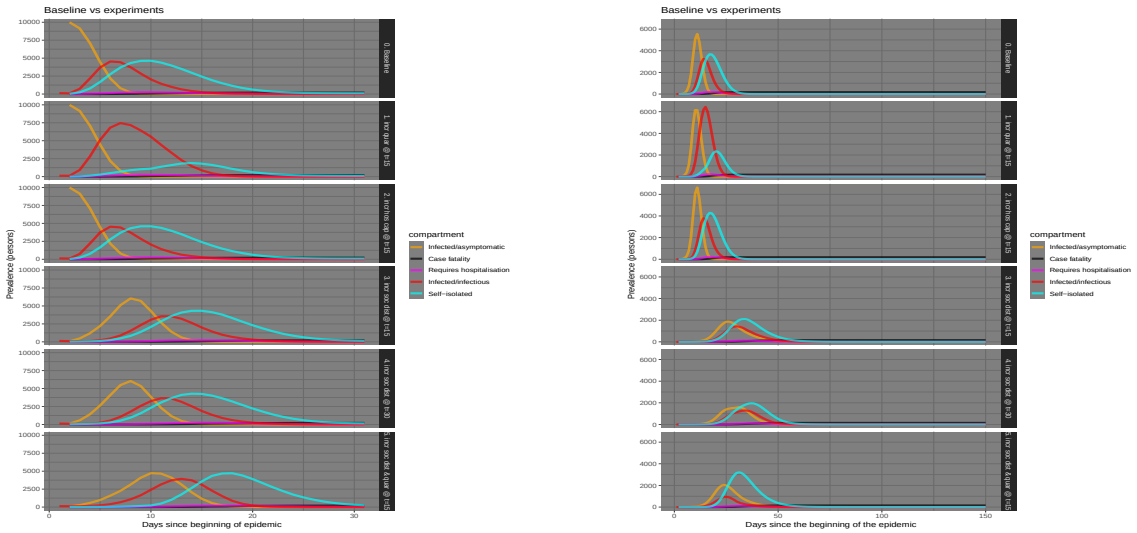


Figure 2: Prevalence of COVID-19.

Prevalence is the number of individuals in each compartment at each point in time (each day). The next plot shows the prevalence of COVID-19 among the Nizamuddin population. Given the dense nature of the population in the Nizamuddin basti, the prevalence of COVID-19 will also be very high. The *act* parameter (average number of exposure events between infectious individuals and susceptible individuals) for this area is quite high making it a hotbed for the virus spread in the community. From figure **??** we can see how peaked the distribution of infected/asymptomatic individuals is in the neighbourhood. Also due to the delayed signs of this viral infection among individuals, the ones living in these densely populated areas unknowingly pass on the virus to others. The distribution of the self-isolated individuals shows a comparatively low peak, thus not many people in the neighbourhood are isolating themselves to stop potential contact with others. In India, to fight COVID-19 the most important strategy so far has been to implement social distancing. However, important steps should be taken like increasing hospital capacity. The admin-

istration and the medical community have recommended lockdown and social distancing at various stages and phases with a combination of home confinement of population, suspension of all natural human activities and movements barring a few emergencies. Some of these administrative interventions are implemented in the simulation of the Nizamuddin cluster and represented in figure 3a. A side-by-side comparison of similar implementation in Delhi is in figure 3b. The baseline plot shows that the number of infected/infectious individuals in the Nizamuddin cluster is close to 10,000, almost double of that in Delhi. This can mostly be due to the fact that in a densely populated area there is a higher propensity for people to mingle with more number of individuals. Thus, increasing the prevalnce of the spread of COVID-19 manifold.



(a) Nizamuddin cluster (b) Delhi

Figure 3: Comparison of baseline prevalence with those with interventions comparison1

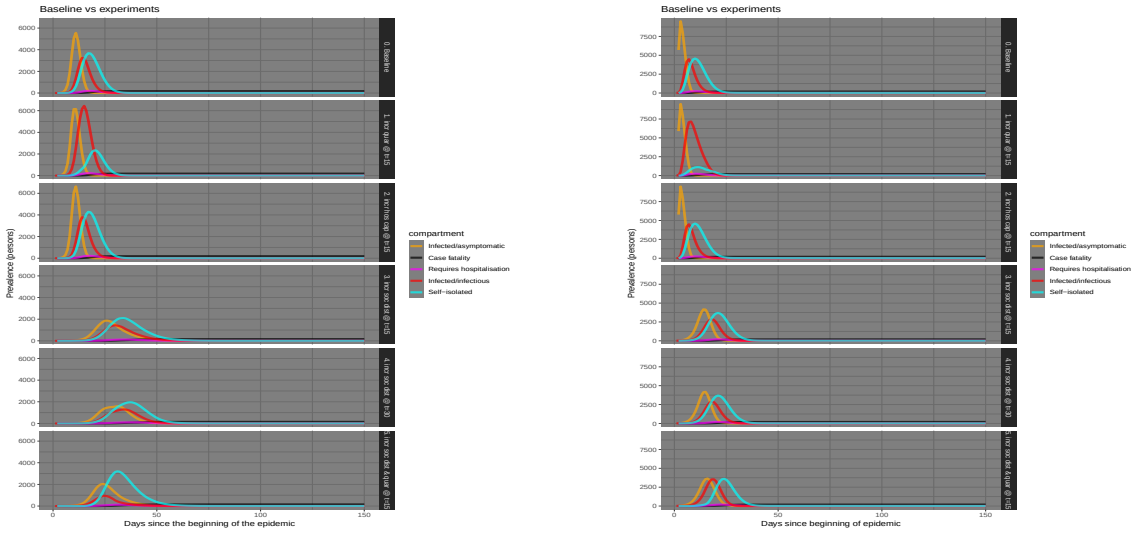
The administrative interventions implemented are;

- Ramp up hospital capacity to triple the baseline level, starting at day 15.
- Step up social distancing (decrease exposure opportunities), starting at day 15, for everyone except the self-isolated, who are already practising it.
- More social distancing but starting at day 30.
- Increase both social distancing and self-isolation rate starting at day 15.

In both Nizamuddin cluster and Delhi, the curve of infected/infectious individuals have falttened with implementation of the above interventions. Among the administrative mediation, increasing both social disyancing and self-isolation starting at day 15 after the start of the disease produces the best results in flattening the disease spread curve. However, a comparison shows that the Nizamuddin cluster increased the number of confirmed cases

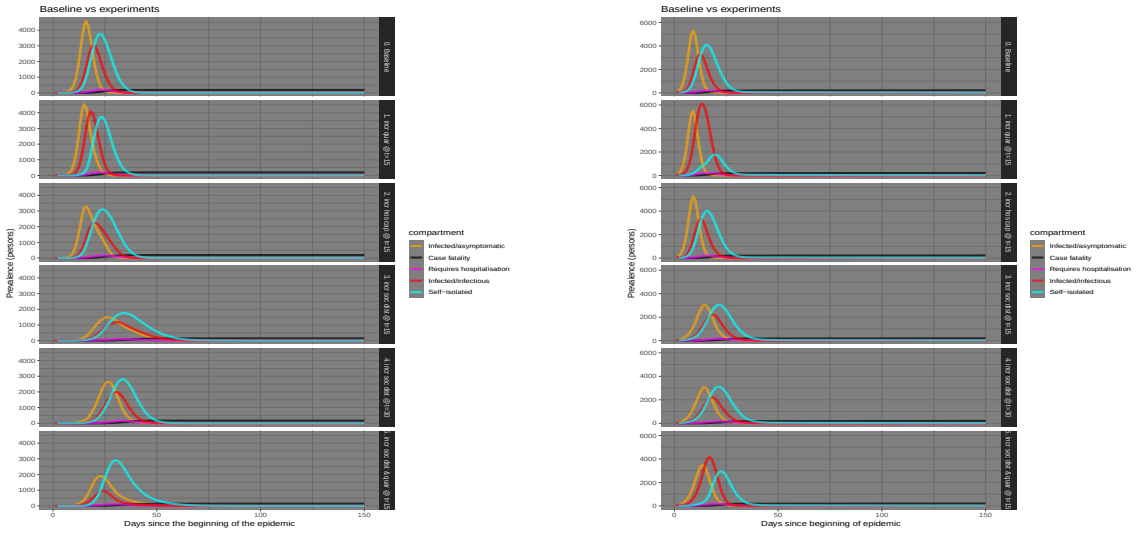
and also the number requiring hospitalisation. The numbers have almost doubled from that of Delhi.

The Nizamuddin cluster was discovered in mid-March and at least 130 cases in India have been identified as having originated from this cluster. There was then a second wave of infectious individuals identified in several other states that were linked to the Nizamuddin cluster. Tamil Nadu, Delhi, Telengana, Gujarat, Maharashtra are a few such states. The attendees of the gathering in Nizamuddin then exposed the states to a second wave of COVID-19 infection.



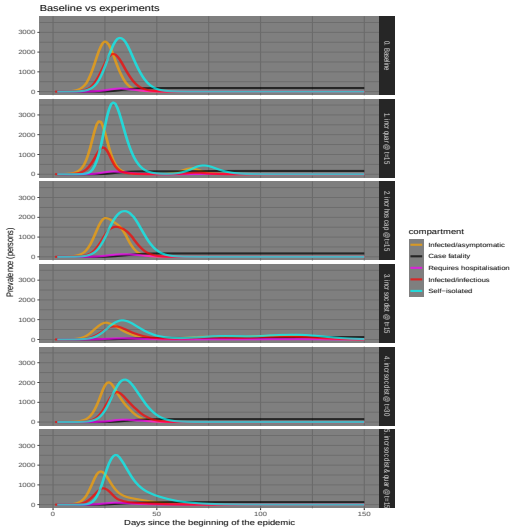
(a) Delhi 1st wave (b) Delhi 2nd wave

Figure 4: Comparison of baseline prevalence with those with interventions

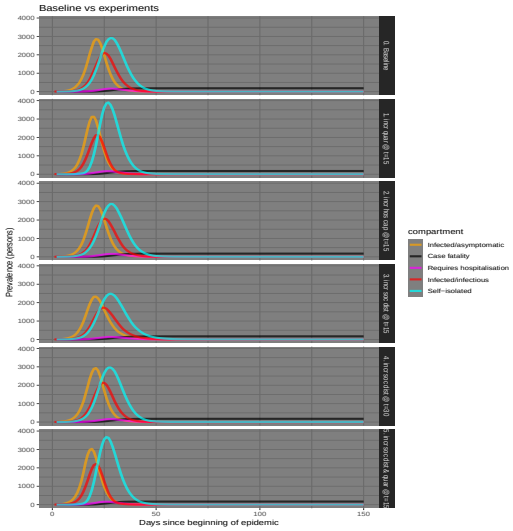


(a) Tamil Nadu 1st wave (b) Tamil Nadu 2nd wave

Figure 5: Comparison of baseline prevalence with those with interventions



(a) Telengana 1st wave



(b) Telengana 2nd wave

Figure 6: Comparison of baseline prevalence with those with interventions

In each of the states above (Tamil Nadu, Delhi, Telengana) the number infected individuals linked to Nizamuddin cluster are 72, 24 and 6 respectively. The comparison in figures 4, 5 and 6 show that in the second phase the number of infected individuals had seen a multitudinous increase. Thereby, increasing the risk of the disease spread in the respective states. However, the simulations reveal that the administrative interventions, if implemented strictly, flatten the curve of disease spread. Specifically, the best results are seen if social distancing is atrictly practised by day 15 since the disease outbreak.