

Managing medium term dialysis requirements of patients in Mumbai, India during Covid-19

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Need

The large metropolitan area of Mumbai is estimated to have about 10000 patients of Chronic Kidney Disease (CKD) who require regular dialysis to support kidney functioning. These patients typically require to be dialyzed three times a week in slots of 4-5 hours and this facility is provided in about 150 dialysis centres in the city. Many of these facilities are attached to hospitals but there are also stand alone dialysis facilities in the city, in the last few years.

During the Covid-19 pandemic, it became difficult to isolate parts of such facilities for those patients who were either tested positive for the virus or had symptoms suggestive of infection, which makes them Covid suspect. The risk to health care professionals and other patients made it necessary to create separate facilities for such patients for dialysis during the two or three weeks that they were under observation and mitigation of Covid-19 symptoms. After this period, ranging for 7-21 days for patients in most cases, a majority of them could return to their regular dialysis facility after certified testing. The logistical problem was for patients to identify where capacity was available in 20 central Covid positive dialysis treatment facilities made available in the city and to get a slot there.

Response

The municipal corporation in the city of Mumbai decided to pool together the resources of these central facilities through a centralized portal designed for the purpose and patients who needed to, could register through their local facility. On a daily basis, patients were allotted to available slots in facilities that were as close as possible to their place of residence or treatment. The entire system was set up in about three weeks with most of the dialysis centres in the city participating and assigning patients to the central facilities that were created. The system is currently functioning with close to 1000 patients registering in the system so far, and being allotted dialysis facilities, some directly and some through a central coordinator.

Capacity for this was created by re-deploying dialysis machines and technicians from existing use for the new requirement, but now at dedicated facilities with the right protocols for Covid-19 patients. The requirement is dynamic for the following reasons: (1) the progression of Covid-19 in the city (this seems to have stabilized by mid June in terms of number of new

patients that require the service), (2) the length of stay in the medium term facility (this is a function of the progression of the infection and the treatment protocol that is advised) and (3) the testing procedure for certifying the status of the patient (this was uncertain and evolving in the early stages, but is now steady). The allocation is through a dashboard provided to a central coordinator, who has the available position of slots and the requirements on a daily basis.

Because of the shortage of testing facilities, an additional complication was the need to provide facilities for those symptomatic patients whose tests were to be conducted or whose test results were awaited, i.e. Covid suspect patients. These were short term requirements for 2-3 days, for which two facilities were created separately. The treatment protocol is the same as Covid-positive facilities, and with better testing, the requirement for this category would no longer be needed.

The centralized Covid positive dialysis facilities are also used for treatment of short term patients on a one off basis, for those who need kidney function support as part of general treatment during their Covid positive phase. These are not CKD patients and they may require one to four dialysis sessions during their treatment.

Reducing the number of deaths of patients because of insufficient access to dialysis facilities was the first goal of the system, which was achieved after the first few days of the Covid-19 pandemic in the city and subsequently reducing the serious impact and improving the local access has now become the goal of the system.

Operations Research challenges

From a decision perspective, the core of the system is to create sufficient capacity for the requirement and to dynamically allocate as per the requirement. The capacity creation is important at an aggregate level so that the overall requirement is met without a shortfall. The requirement is dynamic, but can now be forecasted for the next few days. Together with the (evolving) estimate for time spent in the system, a simple, but interesting application of Little's Law yields corresponding forecasts of the overall requirement for capacity. It has been seen that an appropriate fraction of the available dialysis capacity in the city has been set aside for this ongoing need, which will be adjusted from time to time in the weeks to come.

The actual allocation of patients to facilities is currently manual, by a central co-ordinator, but with analytics support through the dashboard. Depending on the continuing need, the allocation also needs to be supported with an associated transport arrangement which the municipal corporation has made for this purpose. This is an ongoing effort.

System design challenges

The portal had to be designed from scratch to link 150 dialysis centres capturing the information of those patients at their centres who were tested positive and needed specialized dialysis facilities. Once this was done, the next challenge was to capture the available slots at the 15 central Covid-positive facilities and the 3 Covid-suspect facilities in a real-time sense, so that allocations could be made. This required considerable follow up and the creation of convenient interfaces for updating slot information and status of patients who were discharged from the system.

Opportunities for Analytics

As the system has stabilized, a number of analysis possibilities have emerged. These are being investigated. The questions of interest are (a) the overall pattern of Covid-19 spread related to the patient population which requires kidney care, (b) the duration of time that Covid positive patients require for dialysis in the medium term, and (c) the geographical spread of the requirement within the city. There are many other questions related to the efficient use of facilities at each centre, allocation efficiency and the local need for short term dialysis which are being analyzed.

Conclusion

A dashboard for an allocation system for assigning dialysis centres for Covid positive patients was created by the Municipal Corporation in Mumbai in a short time, to address an evolving requirement. This was managed by a team of nephrologists and analysts from an academic institution in Mumbai, and over 1000 patients have been allotted, both locally and through the central co-ordinator, over the last many weeks of the Covid-19 pandemic. The key was in data management and providing for updated data to flow in regularly, with self driven and system incentives to participate and collaborate to address an urgent requirement for public good.

