Meeting on modelling the 3rd wave of COVID-19

10-6-2021, 5 to 7 pm

Introduction & Background

COVID-19 has affected the normal life of humans across the world. Thousands of people worldwide have lost their lives due to COVID-19 and many survive with no hope as their near and dear ones have lost their lives and livelihood. In the maths of Life and Death, mathematical epidemiology is playing a crucial role in the fight against large-scale infectious diseases such as COVID-19. While there are many complicating factors, simple mathematical models can provide much insight into the dynamics of disease epidemics and help officials and decision-makers make critical decisions about health policy. With basic mathematical and epidemiological models like SIR, SEIR, ARIMA, researchers can begin to forecast the progression of diseases and understand the effect of interventions on disease spread and thereby mitigate the risk. With more complex models, answer to questions about how to efficiently allocate limited resources or tease out the consequences of public health interventions, like the closing of non-essential office spaces, bringing in the containment zone restrictions, wearing of masks, and physical distancing.

The meeting was designed to discuss the existing mathematical models used for COVID-19 prediction and what to look forward in the next wave and its predictions. The discussion was vital so as to ensure that authorities can prevent as many new infections and deaths as possible. As the COVID-19 pandemic escalates, the meeting brought together various modelling experts from around the globe to brainstorm on what could be done during the next wave. The meeting started at 5pm on 10th June 2021 via Webex meeting portal. Participants were by invite only.

Objectives

1. What would be the epidemiological characteristics of COVID-19 in its 3rd wave.
    a. What would be its nature and spread; timings, peak burden, etc
    b. What section of population needs more attention
    c. Related aspects to be focussed on.
2. What would be the manifestations of COVID-19 in the 3rd wave
3. Availability of reliable datasets
4. How do you model the curve of 3rd wave and what can be predicted on effective allocation of limited resources around it
    a. What data, numbers are to be looked into
    b. How to move forward in modelling 3rd wave.

Schedule

Time	Topic	Panel/Speaker
17:00 – 19:10 IST*	Welcome and introduction to the discussion	Dr. Sekhar L Kuriakose, Member Secretary, KSDMA and Head, KSEOC, KSDMA, Kerala
	Inauguration and Experience sharing on COVID-19 modelling – National perspective	Shri. Kamal Kishore, Member, NDMA, Kerala
	Experience sharing on COVID-19 – International perspective	Dr. Muralee Thumarakkudy, Chief – Disaster Risk Reduction, UNEP, Geneva
	Experience sharing on COVID-19 – Kerala State perspective	Dr. Sriram Venkitaraman IAS, Joint secretary, Department of Health and Social justice, Kerala
	Modelling 3rd wave of COVID-19 Epidemiology and Public health	Dr. Jacob John, Professor, Department of Community Health Christian Medical College, Vellore, Tamil Nadu
	3rd wave of COVID-19 – Virological perspective	Dr. Vinod Scaria, Principal Scientist, CSIR Institute of Genomics and Integrative Biology (CSIR-IGIB)
	3rd wave of COVID-19- Epidemiological perspective	Dr. Anish T S, Associate Professor, Department of Community Medicine, Government Medical College, Thiruvananthapuram, Kerala
	COVID-19 - Health informatics and behavioral science	Dr. Jina Joan Dcruz, Health Scientist, Center for Disease Control and Prevention, Atlanta, US
	COVID-19 prediction model for Kerala – SEIR	Dr. Birenjith Sasidharan, Assistant Professor, Government Engineering College, Barton Hill, Thiruvananthapuram, Kerala
	Modelling 3rd wave – COVID-19 data consolidation (covid19kerala.info), analysis and modelling (ARIMA model)	Dr. Jijo P Ulahanan, Assistant Professor, Department of Physics, Government College Kasaragod, Kerala
		Dr. Sunil Thomas, Principal, College of Engineering, Attingal, Thiruvananthapuram, Kerala
	Modelling 3rd wave – COVID-19 Prediction models, statistical methods and machine learning	Dr. Siya S, MR Physics Research Fellow, GIGA-Cyclotron Research Center, University of Liege, Belgium
	Modelling 3rd wave – COVID-19 Designing, developing and implementation of prediction models, COVID-19 forecasting tool - SUTRA	Dr. Deepu Philip, Associate Professor, IME Department and the Design program, IIT Kanpur
19:10 – 19:40 IST	Open Discussion	

*Each speaker was allotted 7 minutes not exceeding 10 minutes to present their views.

Proceedings of the meeting

Welcome and introduction to the discussion

The meeting commenced at 5 PM. Dr. Sekhar L. Kuriakose, Member Secretary, KSDMA welcomed the speakers and the participants. Dr. Sekhar delivered the welcome note and an overview of the topic of discussion along with an update of what Kerala has been doing on modelling the COVID-19 since its initial days.

Inauguration and Experience sharing on COVID-19 modelling – National perspective

The discussion was formally inaugurated by Shri. Kamal Kishore, Member, NDMA. He firstly lauded the initiative taken by Kerala State Disaster Management Authority in bringing experts from different parts of the world to discuss this topic. Shri. Kamal was majorly stressing on 5 major points linked to modelling and managing the COVID-19 but also in managing the risk in general in Indian context along with following recommendations.

1. One cannot over emphasize the predictability, not just for epidemics but for all hazards. For some events like earthquake, there are no prediction capabilities at all. Only few probabilistic models could be found based on certain parameters like exposure and the existing vulnerabilities in an area. Modelling is to be seen as an iterative process and more one does it, more predictive capability it would have.

2. The discussion should not just focus on a single discipline, but to be seen as a multi-disciplinary approach, linking the epidemics or any health-related hazards. Hence, it requires more people from different sectors linked to pandemic to analyze the situation and give different management perspectives.

3. Looking into various COVID-19 prediction models from across the globe, some prediction models have worked in some geographies, for some section of population, for few months, phases etc. There is a need to analyse which model works in Indian context and how could that be improved.

4. There is a need to have a user interaction. There is no point if the models cannot reflect back to the users of the data and managing the pandemic. There requires a regular dialogue with the people working with these data.

5. The entire process of modelling is a learning process and this also needs to be institutionalized to increase our capacities in constructing multi-disciplinary experts.

Experience sharing on COVID-19 – International perspective

Dr. Muralee Thumarakkudy was invited to give his views based on the COVID-19 experience from across the globe. Based on the events across the globe, Dr. Muralee emphasized on following points with few recommendations as follows.

1. 3rd wave is a reality, it has already started and are going through in few places like UK, Switzerland etc. In Korea they are going through
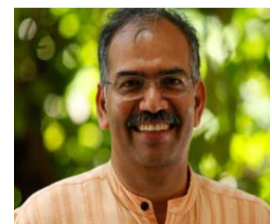
their 4th wave. Its seen that in countries which managed to keep the new confirmed cases low, the pool of people who are susceptible are more and is same as the case in Kerala. Leaving out the people who are already infected or vaccinated, the pool of people who are still susceptible are more than 50%. Once the lockdown is released, we could see a rise in cases again and there needs to be a system to manage the economy then.

2. With the various models, some models match the actual number and few others don't. One needs to keep a check on the healthcare facilities available based on a range of scenarios based on these models.

3. Assurance given to the community that there will be a check on different scenarios by implementing and releasing certain restrictions based on the numbers available. As WHO says, COVID is not just a health crisis, it is also an economy crisis and a mental health crisis. There is an uncertainty that looms around the entire scenario. Across the globe there are few thresholds which puts in place some controls. This, in a way helps the economy to stabilize itself looking into the numbers. It also changes the behaviors of people in dealing with the threshold. There needs to be some predefined outputs set in the models that may help in managing the uncertainties.

4. We are in historic times; hence it is necessary that we learn, even from our mistakes and document them.

5. One may look into the global models and keep an official predictive model for official numbers. At the same time, one need to experiment with things like artificial intelligence, the predictions not only at the national or state level but also in the ward level or in the local cluster level. In places like Israel these AI models which had a proactive nature proved successful. We have more data and we have many studies; we need to look at it from all possible scenarios.

Experience sharing on COVID-19 – Kerala State perspective

Dr. Sriram Venkitaraman was invited to speak on the Kerala experience, its numbers and how various management protocols were changed accordingly like allocation of number of beds, ICUs, oxygen availability, human resource availability etc based on the predicted numbers. He gave a brief presentation on the numbers (categories of people in various Covid care facilities and hospitals, test positivity rate, tests per million, occupancy status, human resource) starting from first wave to current scenario.

Modelling 3rd wave of COVID-19 Epidemiology and Public health

Dr. Jacob discussed about the models that are available – mathematical trend projections and epidemiological models – compartmental and agent-based models. He gave insights on the data that goes into each of these models and the efficiency of the model output. He also emphasized on "what will happen" vs "what should we do". More inputs on public health aspects were also discussed like key drivers of what happens next like the population proportion that is immune – reinfections, immune escape if vaccinated, leaky immunity, children – immunity, reliable averages at different geographical levels, what would be the variants – nature of transmissibility, severity and how do the contact patterns change. Dr. Jacob also discussed the different levels of population immunity – Serosurveys, vaccine coverage data; Disease surveillance – Frequency trends, genomic analysis of clusters, case severity, vaccine breakthroughs, reinfections. He concluded by saying, models are only as good as the data / theory that it is built on and some models are useful – when they inspire action.

3rd wave of COVID-19 – Virological perspective

Dr. Vinod Scaria discussed the Genetic Epidemiology of SARS-CoV-2 in Kerala. He highlighted the details of genomic surveys happening in Kerala. Dr. Scaria described the various genetic variability and lineages of isolates, mutation rates, Predominance of various mutant variants prevalent in Kerala across different districts. He also discussed what is driving the lineages of these various mutant variants and what is common in various mutations – its transmissibility and immune escape possibilities. The properties and characteristics of each of these variants were also discussed. Dr. Scaria suggested that fine mapping of outbreaks in Kerala needs to be done at local self-government institutions, reporting of abnormalities, need for whole genome sequencing to identify suspicious and emerging variants, and need for evaluation of spread and evidence-based policies and interventions.

3rd wave of COVID-19- Epidemiological perspective

Dr. Anish discussed about the prediction of 3rd wave of COVID-19 from an epidemiological aspect and explained about the modelling activities that happened during the first wave in Kerala based on biological SIR models. Dr. Anish also explained about the Evolutionary Pressure (Selection Pressure) on the virus. Possibilities of Herd Immunity, Immune escape, use of Mask, characteristics of High infectivity of virus in 3rd wave, how Social distancing

could prove efficient during high infectivity. Dr. Anish also laid out some Basic questions on modelling the third wave like Infectivity – increases/decreases; immune escape – Role of herd immunity and its possibilities, Immunity rate; case fatality rate; alteration of Risk among younger age, risk of airborne transmission, etc. Dr. Anish suggested the alteration of Risk Perception should be on a Cognitive bias. Dr. Anish also explored the values of R naught and effective R, dispersion parameters across different demographic groups and among different social/geographical groups; instances of reporting fidelity which could be low because asymptomatic may be high because of involvement of children and youngsters. Its effect on the system was also discussed. Dr. Anish laid out few action points – Containment vs mitigation; general community approach vs high risk approach for prevention; Long-term community engagement and capacity building; Upliftment of infrastructure based on epidemiological features; possibilities of continuous virological analysis; Intervention in social/economical/geographical factors and groups; evidence-based vaccination strategies.

COVID-19 - Health informatics and behavioral science

Dr. Jina D Cruz shared her experience sharing based on few case studies from US on the topic - data drive decision making for COVID-19. Dr. Jina stressed on the point of getting the right data at the right time to the right people. She explained the need to have good data on public health decision making. As part of the disease control, she suggested the Multiple layers improve success could happen by implementing Swiss cheese model Pandemic Defense which suggests no single intervention is perfect at preventing the spread of the coronavirus, each intervention layer has various drawbacks which could be corrected based on Personal responsibilities (Physical distance, stay at home if sick, Hand hygiene, cough

etiquette, If crowded, limit your time); shared responsibilities (Ventilation, outdoors, air filtration; Quarantine and isolation). Dr. Jina also gave few case studies from US – Case 1 - on identifying most vulnerable communities using Pandemic Vulnerability Index (PVI) and spatial representation of different variables like infection rate, population concentration, intervention, health and environment – relevant county-level data. Case 2 - study of modeling for specific demographic groups. Case 3 – Retrospective counterfactual modeling – This has comparison rates of transmission rate and transit stations of google and apple.

COVID-19 prediction model for Kerala – SEIR

Dr. Birenjith Sasidharan discussed various models -Deterministic compartmental model and Probabilistic Agent-based models; SEIR Models – adopted by KSDMA, parameters used, its values, proposals for action and the measurable impacts, projections on first wave using the models; challenges in modelling 3rd wave, lack of homogeneity (earlier and at present) – adoption of a meta-population compartment model requires identification and tuning of a large number of interaction constants, difficulty with setting initial conditions, fetching and analyzing the impact of vaccination and possibilities of Re-infections.

Modelling 3rd wave – COVID-19 data consolidation (covid19kerala.info), analysis and modelling (ARIMA model)

Dr. Jijo P Ulahannan and Dr. Sunil Thomas Thonikkuzhiyil showcased the portal developed by them along with a team of researchers and data management team – www.covid19kerala.info. They both shared the different models used by them – SEIR, ARIMA, SARIMA, Prophet, LSTM, RNN. One important point stressed by both was the unavailability of authentic data open to public in a platform (Eg: sero-survey data), so that they could use it to create meaningful projections that academicians and management professionals could utilize in analyzing and using them in projection-based studies.

Modelling 3rd wave – COVID-19
Prediction models, statistical methods and machine learning

Dr. Siya Sherif gave insights on how does dynamic causal modelling -A Neuroimaging model for COVID-19 is put into use at GIGA institute. He explained how generic Neuroimaging – fMRI is converted to timeseries based on measurement and how different variables are used as stimulus contextual and perturbation inputs to a set model. This was connected with a causal modelling of COVID – DCM LIST Model which takes the variables as Location, Testing, Symptoms and Infection rates. It was proposed variables like lockdown, travel restrictions could be added to the model that gives a generative model, ensemble dynamics and one could put to use a Bayesian model comparison for predictions about long term future in Kerala. Dr. Siya also stressed on the point of authenticity of the available datasets and more data like New infection, Re-infection details etc. He also suggested the possibilities of the model could be used to predictions in Kerala, testing large sample – saliva-based test. He also suggested the prime focus during way forward should be maximum vaccination, identifying new mutations, mass testing and laying down the lockdown and relaxation policies based on the findings.

Modelling 3rd wave – COVID-19 Designing, developing and implementation of prediction models, COVID-19 forecasting tool – SUTRA

Dr. Deepu Philip gave an insight to SUTRA portal developed by them that gives rough projection of resources availability and capacities across various cities in India taking in variables like detected infections, mortalities and other parameters across different time periods and lockdown phases.

Open Discussions

The floor was open for discussion after this session and Mr. Anil Pokhrel from Nepal Disaster Management Authority shared his views on the subject and his experience in Nepal dealing with the pandemic. Mr. Anil lauded the efforts made by KSDMA in conducting such a session and he also mentioned about the collaborations with India and Kerala in predicting the number of cases if there is a third wave and other related resources, knowledge sharing based on the predictions given by various models. A general discussion on how each could collaborate together and predict 3rd wave of COVID-19 along with knowledge sharing happened towards the end of the session. Dr. Sekhar Kuriakose in his closing remarks mentioned about conducting a more in - depth discussion on way forward and conducting a second session on management strategies.

The meeting ended at 7:40 pm.

Annexure -

Participants list

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