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Model finds 'middle ground' for India's lockdown exit

Alternate weeks of strict restrictions and milder physical distancing may be a good way for parts of India to exit the lockdown after 3 May 2020, predicts a new model that also bears at heart the socio-economic fallout of the coronavirus pandemic.

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A man practices physical distancing while buying fruits from a vendor in Ghaziabad, Uttar Pradesh.

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As Indian public health policy makers draft region-specific lockdown exit policies, a new computer-based model suggests that a combination of strict and mild restrictions imposed alternate weeks may best slow the spread of the novel coronavirus while minimising any further social and economic harm.

A team of researchers at Harvard University and Massachusetts Institute of Technology (MIT) in the US has developed an agent-based model[1] (a computer simulation which considers each person as an 'agent' capable of free interaction in a population) that projects a realistic 'middle ground' of non-pharmaceutical interventions to contain the virus, while keeping in mind the interests of those living in the fringes of society.

To come up with some probable scenarios post-lockdown, the team fed into these models population-specific data such as age distribution, family and household structure, daily contact rates, and prevalence rates of co-morbidities (diabetes and hypertension) alongside publicly available data of reported COVID-19-related deaths.

"These elements allow us to simulate different policies in ways that are closer to reality than approaches that don't incorporate these population-specific factors," says one of the modellers Maimuna Majumder, a junior faculty at the Computational Health Informatics Program (CHIP) based out of Boston Children's Hospital and Harvard Medical School.

The modellers caution, however, that the predictions of disease spread from their model are as good as the data inputs from these publicly available sources.

Majumder says choosing the right policy at the national or regional level may be a challenging tightrope that India may have to walk in the coming weeks necessitating a model that keeps in mind the social and economic fallouts of long-term lockdowns.

The team tailored their computer simulations[2] to two states in India – Maharashtra and Uttar Pradesh. They chose Maharashtra because it was leading the charts in terms of epidemic severity and contrasted it with Uttar Pradesh, India's most populous state, which had reported considerably fewer cases at time of modelling. (The number of deaths and infections has since gone up considerably in Uttar Pradesh).
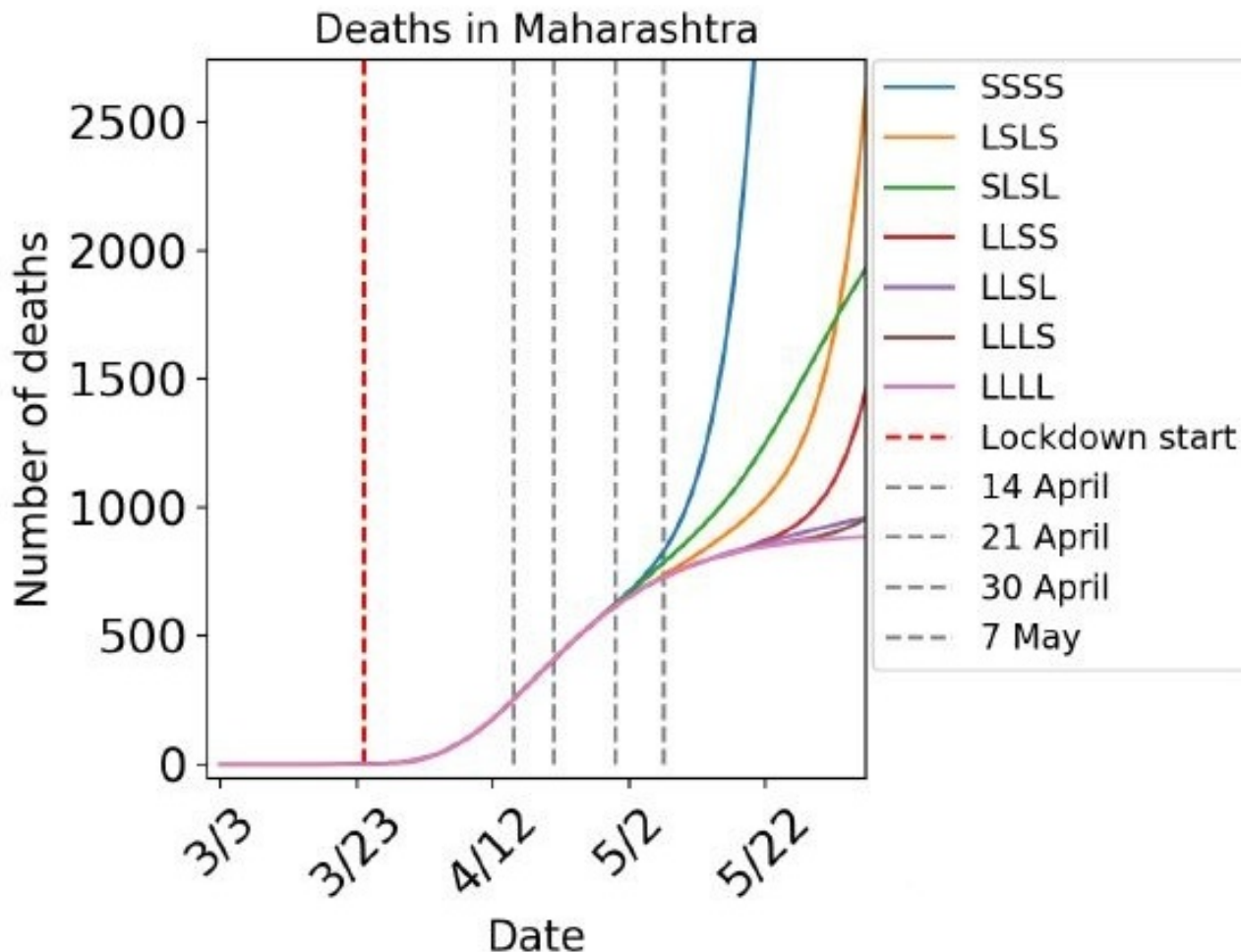
They mapped how the disease transmission may pan out in these states if they imposed complete lockdown as opposed to adopting the alternate week stringency method. Their analysis suggests that due to a higher number of affected people, Maharashtra may need to continue being in lockdown for longer than Uttar Pradesh before the western stated employs the 'middle ground' policy.

Graph illustrating the effect of policies that alternate milder physical distancing strategies ("S" time periods) with stringent lockdown ("L" time periods) on the total number of simulated deaths in Maharashtra. The "L" regime represents an average of 1-2 daily contacts with other individuals, while the"S" regime represents 10 - 90 average daily contacts. The red vertical dashed line indicates the start of the nationwide lockdown in India on March 25. Each of the four gray dashed lines represents a time point at which a simulated "strategy switch" may occur. Each solid colored curve represents a specific "middle ground policy".
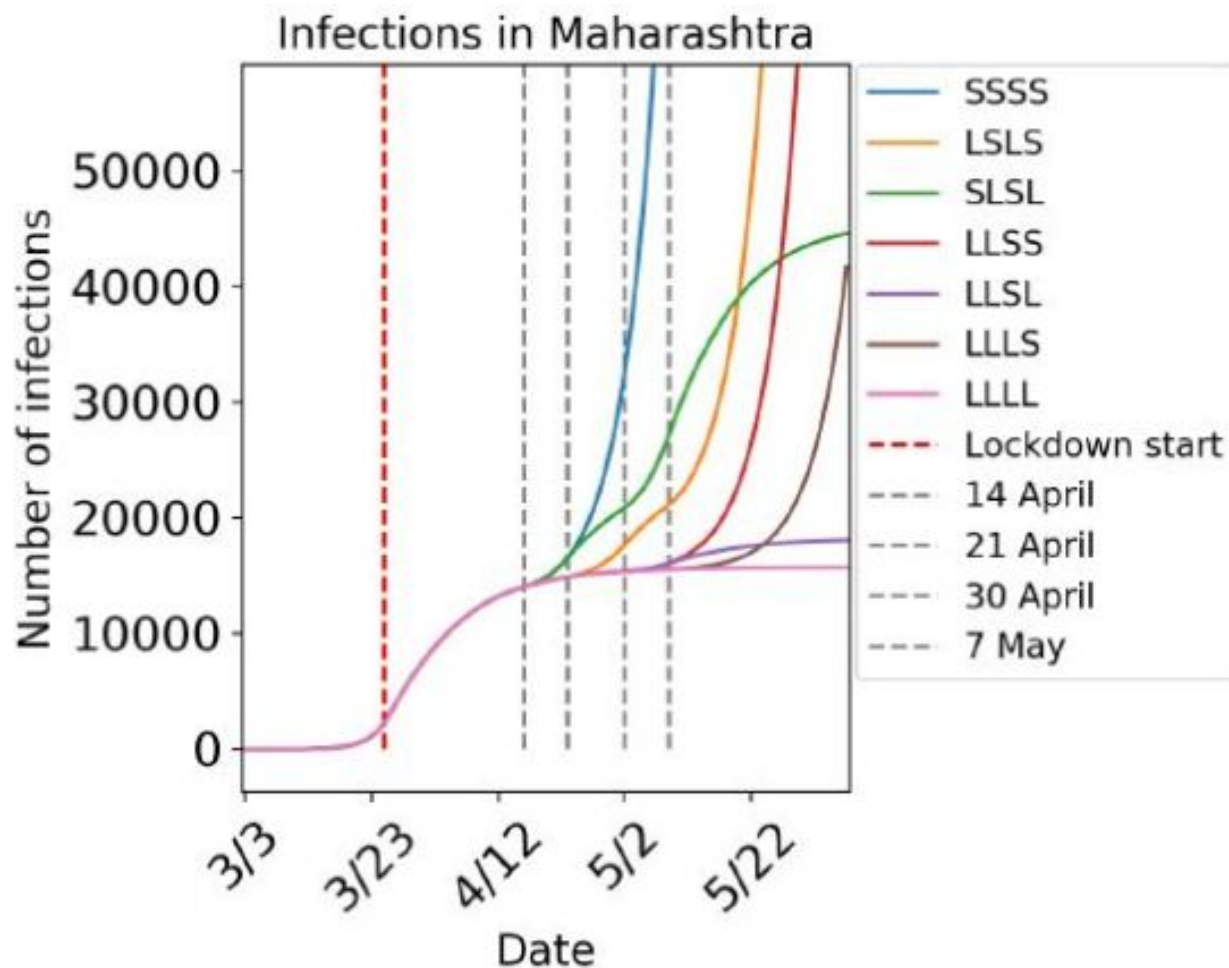
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Infections in Maharashtra

Similar graph as above illustrating the effect of alternating policies on the total number of simulated infections in Maharashtra.

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"We investigated an entire gamut of middle ground policies – policies that alternate, perhaps weekly, between stringent lockdown and milder physical distancing," says Aditya Mate from Harvard University's Center for Research on Computation and Society.

The researchers looked at scenarios for seven weeks (from 15 April to 7 June 2020) and compared them to pure lockdown or pure physical distancing scenarios. They estimated the number of deaths and infections through 7 June 2020. For this they considered both documented and undocumented rates of deaths. "The documentation rate is given by the number of reported cases on the ground divided by the number of estimated infections in our simulated system. The assumption is that deaths from COVID-19 are less likely to be undercounted, so we fit our model assuming the reported number of deaths on the ground to be ground truth," Majumder explains.

The model is capable of quantitatively estimating the likely outcomes of proposed policies way before they are put to action, helping correct any error in judgement, the researchers say.

Through their simulations, they figured that if India lifted the 3-week lockdown on 25 March 2020, as originally planned, it would have led to widespread community transmission. Also, since Maharashtra is high up on the disease burden chart, it may need to enforce a longer lockdown than Uttar Pradesh before a middle ground policy can be employed, says Milind Tambe, a professor of Computer Science at Harvard University.

"Even a temporary switch to a milder physical distancing strategy should only be implemented when the number of active infections no longer puts the population at risk of explosive transmission," Tambe says.

The model assumes that every individual in the population is either susceptible, exposed, infected or removed (recovered or dead). It tracks disease transmission as a random process than can spread through individual contact.

"Given the population-specific dynamics of COVID-19 in India, periodic implementation of stringent lockdowns may be necessary until alternative interventions become available," Tambe says.

Majumder hopes that the eye to the socio-economic aspect makes their model more 'human' and useful. "The George Box aphorism still stands: All models are wrong but some are useful."

[Nature India's latest coverage on the novel coronavirus and COVID-19 pandemic here. More updates on the global crisis here.]

References

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