Medical Xpress

Localized lockdowns could control pandemics while reducing socioeconomic impact

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Analysis of the COVID-19 pandemic in the Netherlands suggests that locally targeted pandemic control measures could have been just as effective as national lockdowns, according to a study published March 7 in *eLife*.

The findings could be used to develop public health policies that effectively balance control measures to reduce infection spread, while lowering their socio-economic impact.

"Like many countries, control of the first COVID-19 pandemic wave in the Netherlands was largely based on the nationwide implementation of measures such as lockdowns, social distancing and reduced mobility," says lead author Mark Dekker, at the time of this study, a Ph.D. student in the Department of Information and Computing Sciences at Utrecht University, the Netherlands. "The associated societal burden affected all areas of the country, while infections and the health-associated burden affected only some regions, for some of the time. This raises the question of whether the pandemic could have been controlled equally well with interventions specifically tailored to subnational regions."

Addressing this question required a genuinely multidisciplinary team, with the combined expertise of well-known epidemiologists, Coffeng and de Vlas (Erasmus University Medical Center in Rotterdam), as well as the experience of Dekker and Panja in computer science and the simulation of complex systems, further aided by statistics through Pijpers. Dekker and colleagues built an analysis method that includes information on how people travel, mingle and interact in different municipalities in the Netherlands. This allowed them to predict whether subnational interventions would have led to poorer or comparable control of the pandemic in the country as a whole.

Their analysis method was built in several stages. First, they grouped the population into 11 demographic categories and 380 municipalities. Groups of 100 people were defined as "agents." The movements of these "agents" between municipalities were simulated at hourly resolution, based on the analysis of anonymized mobile phone signals and mobility data from Google. The team then determined the likelihood of mixing between agents within a municipality based on the type of activity the agents were engaged in—either "home," "work," "school" or "other."

Next, they added in information about COVID-19 transmission: every agent was labeled as "susceptible," "exposed," "infectious" or "recovered," and "susceptible" agents could move to the "exposed" category depending on the "force of infection"—that is, the prevalence of infectious cases and expected contact rates. Layered on top of this were the pandemic control measures—movement restrictions and school closures—which mirrored those implemented at the national level during the first wave of the pandemic. The model was then used to predict trends in infection, which were converted into predicted hospital admissions.

The decision to introduce a national lockdown during the pandemic was based on when infection rates reached a certain threshold proportion of the population. The same approach was used in the simulation by showing the effect of lockdowns introduced at four different thresholds—3%, 1%, 0.33% and 0.1% of the municipality population. The impact of the lockdowns was then predicted in two ways: number of hospital admissions, and the number of days that people benefitted from not being in a lockdown (additional intervention-free person-days).

At an infection rate of 3%, the model suggests that only a few municipalities required a lockdown, resulting in 185 million intervention-free person-days, but this threshold is too high—it would have resulted in a 157% increase in the number of hospital admissions (around 19,000 additional), compared to levels seen with a national lockdown in the first wave.

The more stringent thresholds of 1% and 0.33% resulted in numbers closer to those seen in a national lockdown: 4,670 and 410 additional hospital admissions, respectively, but only modest benefits in terms of additional intervention-free person-days (103 million and 36 million).

The threshold of 0.1%, closest to a national lockdown, only caused a few additional hospital admissions but still spared 18 municipalities from lockdown for over five weeks. These spared municipalities were more likely to be rural, isolated and less densely populated regions in the North East of the country.

Together, the model suggests that by targeting interventions subnationally; for example, 167 municipalities could have remained without lockdown at the start of the first COVID-19 wave and 12 could still have remained open after five weeks, resulting in only 3.4% more hospital admissions. Such a targeted approach, based on live information about infection levels in subnational areas, could mitigate the need for national lockdowns and has the potential to be expanded to other countries.

"With emerging methods and technologies such as sewage monitoring, fast identification of disease biology, and live tracking through mass testing, a more regionally targeted approach could significantly reduce the societal burden of lockdowns to control infectious diseases," says co-senior author Debabrata Panja, an Assistant Professor in the Department of Information and Computing Sciences and the Center for Complex Systems Studies, Utrecht University.

"Our approach of capturing local context through empirical data on demography, mobility and spatial clustering of the population, and combining this with disease transmission, could be applied in other settings," the authors conclude. "In larger countries, the most appropriate subnational resolution could be at the level of counties, provinces or any other existing administrative regions that make the best use of clear lines of communication and responsibilities."

More information: Mark M Dekker et al, Reducing societal impacts of SARS-CoV-2 interventions through subnational implementation, *eLife* (2023). DOI: 10.7554/eLife.80819

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