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Australian COVID-19 Response Inquiry
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Background

This response is submitted on behalf of Professor [redacted], Dean of Medicine at the Department of Western Sydney, and Associate Professor Jason Thompson (PhD, MPsych (Clinical), BSc(Hons)), Co-Director of the Transport, Health, and Urban Systems Research Lab at the University of Melbourne.

[redacted] and A/Prof. Thompson were among others [redacted] who led the development of models used by the Victorian Department of Health in 2020 to overcome the deadly 2nd wave outbreak. These models were instrumental in formulating the State Government's Roadmap to Recovery and effectively eliminating Covid-19 in Victoria until mid-2021. Our response is intended to guide the Inquiry towards relevant published research that details our modeling efforts and their influence on public health policy. We particularly focus on the experiences and lessons from the modeling exercises that supported government decision-making and how these principles should be taken forward.

The model and its utility

Our model, its outcomes, and its use in supporting Government decision-making in Victoria are detailed in the Australian and New Zealand Journal of Public Health (Thompson, McClure, Blakely, et al., 2022). This article, along with follow-up publications in 'Health Research Policy and Systems' (Thompson, McClure, Scott, et al., 2022), delves into the nuances of modeling efforts and their intersection with policymaking. Additionally, the successes and failures of Australia's national Covid-19 policy response, which provide a context for the application of our work, are discussed in a 2021 publication of Australia's Covid response in Health Economics, Policy and Law (Stobart & Duckett, 2022). Below, we summarize important aspects of this work and offer recommendations beyond the published material.

Computational Social Science: The Advantage of using Artificial Societies for Policy Testing

The Victorian Government used our models as decision-support to help guide effective policy. These models incorporated social processes driving disease transmission in Australia and Victoria at the time and were built with policy levers relevant to government deliberations. This approach allowed for the testing of policy impacts (e.g., school and business re-openings, relaxation of movement restrictions and stay-at-home orders) on infection rates, associated health outcomes, and hospital demand among other considerations.

The models were conceived by computational social scientists who operate at the nexus of social processes, health system design, and public policy modeling. Rather than starting with a disease as the basis of the model, the focus was on modeling dominant social interactions within Australian society – like transportation, work, and family life – and how these processes facilitated or mitigated disease

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transmission. Collaborations with epidemiologists and experts from the Department of Health who held domain and operational expertise then enhanced the models to ensure accurate representation of pathogens within these modelled societies. These models, underpinned by dynamic social interactions, offered a longer, policy-relevant forecasts for decision-makers based on projections of movement and interaction patterns within society.

Epidemiology – but specifically designed for use by policy-makers

Conventional epidemiological models use a baseline reproduction number (R0) as an input, with policy interventions estimated to modify it, resulting in an effective reproduction number (the Reff) whose impact on the population is then estimated. This conventional approach cannot easily model social dynamics nor the behavioural interactions that drive community transmission. These conventional models are not designed to support detailed public health or social policy responses to crises.

By contrast, agent-based models can be designed to mathematically represent social processes and dynamics from the outset. Public health policies, when introduced as levers in the model, influence modelled interactions, thereby affecting the modelled Reff and the demographics of who is likely to be infected and under what circumstances. This more nuanced approach enables a direct reflection of policy options available to Government and facilitates rapid 'what if?' scenario testing for decision support. It is this type of model architecture that successfully formed the basis of risk assessments performed for the Victorian Department of Health in 2020 and which we believe should be a focus for crisis responses into the future.

Recommendations

Our experience highlights the importance of generating policy relevant models as described in (Thompson, McClure, Scott, et al., 2022). To be better prepared for future pandemics, we recommend investing in the development of large-scale models that mirror contemporary behaviour and dynamics of Australian society – a real time, social science 'digital twin'. This model (or set of models) could be used by policy-makers to test policy ideas and scenarios related to infectious disease outbreaks and crises that could strike Australia into the future. Given that infectious disease outbreaks are also a sub-set of a broader range of crises facing Australia (e.g., natural hazards including floods & fires, economic crises, etc.), the model architecture would also have utility above and beyond applications to infectious disease.

To be useful for policy-makers we recommend that models should be built from the perspective of contemporary understanding of demographics, dominant social dynamics, and patterns of behaviour that are uniquely Australian or unique to other areas and cultures within Australia where required. This would allow social policy interventions and their impacts on transmission and social functioning to be observed in these synthetic societies prior to implementation in the real world. **In short, a comprehensive, nationally representative social system faithful to the structure and dynamics of contemporary Australian society should be built that enables pathogens with given properties to be introduced into that model.**

This approach would differ from that which is instead 'pathogen-first' and holds the advantage that work on this national social digital twin could begin immediately without complete understanding of the properties of the next pathogen – i.e., before the next crisis strikes. A broad public health, systems-thinking and interdisciplinary approach will be necessary. It should be inclusive of social scientists, computational social scientists, public health experts, and epidemiologists who can study, understand, and model both existing and future social, psychological, economic, physical, and physiological dynamics related to combating and remaining resilient to future pandemics.

References

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