Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Epidemics 41 (2022) 100651

Contents lists available at ScienceDirect

Epidemics

journal homepage: www.elsevier.com/locate/epidemics

Epidemic SI COVID-19 modeling in LMICs: Accompanying commentary

In this special issue of Epidemics, we present ten papers on COVID-19 modeling. Many of these excellent papers have key authors coming from a range of low and middle income countries (LMIC).

COVID-19 has brought into the limelight the use of mathematical modeling to inform policies of infectious disease control. Though modeling was widely used in this area in some countries around the world, COVID-19 also brought into sharp focus the differences in the resources available to mobilize teams to undertake modeling across countries. When such work was being undertaken it was sometimes not straightforward to get that work published. In this issue, we publish papers highlighting some of the work that has been undertaken in LMICs as well as papers that discuss the use of modeling in COVID-19 policy in LMICs.

The papers in the issue can be grouped into 3 themes; methods development, country relevant policy modeling, and those more generally considering the use of modeling in policy making in LMIC settings.

The first theme of these papers, that of methods developments, highlights one of the key ways in which the field of epidemiological modeling benefits from more work and a wider appreciation of work being undertaken globally; more people working on methods that can be of use to us all. In this special issue we include one of the early applications using Ct values as extra information to understand epidemics dynamics (Andriamandimby et al., 2022), and a novel Bayesian approach to combining disease forecasts (Daza-Torres et al., 2022). There were two approaches to understanding spatial patterns using new approaches and/or new combinations of data (Ramiadantsoa et al., 2022; Saba et al., 2022) as well as a novel approach to modeling household transmission and interventions (Franco et al., 2022). All of these are valuable additions to the field, proposing methods that can be applied to other countries.

The second group of papers is those using perhaps more standard methodology, but applying those methods to both data and policy for specific LMICs. In these papers, though in general the policies were those being considered globally, the timing of these questions and the specifics of the policy were relevant to the specific country at the time the work was conducted. The policies covered include use of facemasks in Bangladesh in 2020 (Ferguson et al., 2022), and particular vaccination policies in Malaysia (Jayasundara et al., 2021). Close collaboration between academia and policy makers can be seen in these papers. This highlights another important factor in increasing the amount of modeling undertaken in different places, the ability to answer the pertinent questions at the pertinent time for each country, so that governments can make timely decisions with the best evidence. This applies not just to the COVID-19 pandemic but also to other diseases, for example questions around the introduction of new vaccines. Another strength of these papers is the collaboration with local data generators, leading to nuanced understanding of the context in which data were collected.

The final group of papers focuses on understanding the use of epidemiological modeling in LMICs. The systematic review provides vital information on what was done for modeling COVID-19 in Africa (Kimani et al., 2022). The authors highlight that within Africa, a small proportion of countries are producing the majority of papers, with many countries not having any modeling publications. The review also highlights the authorship of the papers, with 78% having a first author with an African affiliation, and 65% a last author. They highlight however that only 13% used local data for calibration. Similar reviews for work in Asia and other regions would also provide valuable information.

The last paper (Teerawattananon et al., 2022) comments more generally on some of the issues raised throughout on the use of modelling in policy in LMICs, and provides thoughts on ways forward for the use of modeling for policy in LMICs. The authors raise issues regarding both who is doing the modeling as well as the data used for contextualizing these models. Though these are in some ways linked, they are not entirely so, with different factors influencing each.

All papers in this issue had authors based in LMICs, and seven of the nine papers had both first and last authors based in LMICs. Many of the authors had two affiliations, one in a High income country (HIC) and one in an LMIC. The seven research papers all used local data.

Using the work presented here as an example of work done during COVID, what can be done to support more policy-relevant modeling done and acknowledged in a wider range of places? Of course, some of the support is purely financial- ensuring that there is sufficient funding for manpower to undertake this work and so additional funding from agencies would be very welcome in this area. There is also an onus on funders to foster locally-led modeling for diseases in LMICs and prioritize investment in local capacity to do this work. Research funding should be supplemented with funding for in-depth training in both technical and soft skills and with systemic investments - e.g. to create sustainable career paths for modelers within local institutions and to support networks for dialog between researchers to share ideas and methods. In South Africa, the South African COVID-19 Modeling Consortium brought together modeling expertise from across the country to facilitate access to local data, collaborative work among local modelers, and engagement with decision-makers and implementations partners (Silal et al., 2021). Similarly, the newly formed MIDSEA in South East Asia will aim to build such networks. Support from journals for publishing work coming from these areas will also be vital; we hope this special issue has highlighted some of this work and will lead to more

https://doi.org/10.1016/j.epidem.2022.100651

Available online 31 October 2022

opportunities to publish work led by LMIC authors.

As anywhere, building relationships between policy makers and modelers and having agreements in place for data sharing will also be vital. Both of these will be best undertaken outside of the outbreak time, so they can be built upon at the time of crisis. These relationships can be built via working on endemic diseases as well as through "preparedness" exercises.

There is a lot of great work in infectious disease modeling being undertaken in LMICs. To those doing this work, please reach out and let us know about your work, and we encourage you to submit your work to *Epidemics* in future. For those in HICs, particularly those working on diseases in LMICs, it is the responsibility of all of us to build a modeling community that is more inclusive and representative.

References

Andriamandimby, S.F., Brook, C.E., Razanajatovo, N., Randriambolamanantsoa, T.H., Rakotondramanga, J.M., Rasambainarivo, F., Raharimanga, V., Razanajatovo, I.M., Mangahasimbola, R., Razafindratsimandresy, R., Randrianarisoa, S., Bernardson, B., Rabarison, J.H., Randrianarisoa, M., Nasolo, F.S., Rabetombosoa, R.M., Ratsimbazafy, A.M., Raharinosy, V., Rabemananjara, A.H., Dussart, P., 2022. Cross-sectional cycle threshold values reflect epidemic dynamics of COVID-19 in Madagascar. Epidemics 38, 100533. https://doi.org/10.1016/J.EPIDEM.2021.100533.

Daza-Torres, M.L., Capistrán, M.A., Capella, A., Christen, J.A., 2022. Bayesian sequential data assimilation for COVID-19 forecasting. Epidemics 39, 100564. https://doi.org/10.1016/J.EPIDEM.2022.100564.

Ferguson, E.A., Brum, E., Chowdhury, A., Chowdhury, S., Kundegorski, M., Mahmud, A. S., Purno, N., Sania, A., Steenson, R., Tasneem, M., Hampson, K., 2022. Modelling how face masks and symptoms-based quarantine synergistically and cost-effectively reduce SARS-CoV-2 transmission in Bangladesh. Epidemics 40, 100592. https://doi.org/10.1016/J.EPIDEM.2022.100592.

Franco, C., Ferreira, L.S., Sudbrack, V., Borges, M.E., Poloni, S., Prado, P.I., White, L.J., Águas, R., Kraenkel, R.A., Coutinho, R.M., 2022. Percolation across households in mechanistic models of non-pharmaceutical interventions in SARS-CoV-2 disease dynamics. Epidemics 39, 100551. https://doi.org/10.1016/J.EPIDEM.2022.100551.

Jayasundara, P., Pearlasamy, K.M., Law, K.B., Abd Rahim, K.N.K., Lee, S.W., Ghazali, I. M.M., Abayawardana, M., Le, L.V., Khalaf, R.K.S., Razali, K., Le, X., Chong, Z.L., McBryde, E.S., Meehan, M.T., Caldwell, J.M., Ragonnet, R., Trauer, J.M., 2021. Sustaining effective COVID-19 control in Malaysia through large-scale vaccination. Epidemics 37, 100517. https://doi.org/10.1016/J.EPIDEM.2021.100517.

Kimani, T.N., Nyamai, M., Owino, L., Makori, A., Ombajo, L.A., Maritim, M.B., Anzala, O., Thumbi, S.M., 2022. Infectious disease modelling for SARS-CoV-2 in Africa to guide policy: a systematic review. Epidemics 40, 100610. https://doi.org/10.1016/J.EPIDEM.2022.100610.

Ramiadantsoa, T., Metcalf, C.J.E., Raherinandrasana, A.H., Randrianarisoa, S., Rice, B.L., Wesolowski, A., Randriatsarafara, F.M., Rasambainarivo, F., 2022. Existing human mobility data sources poorly predicted the spatial spread of SARS-CoV-2 in Madagascar. Epidemics 38, 100534. https://doi.org/10.1016/J.EPIDEM.2021.100534.

Saba, H., Nascimento Filho, A.S., Miranda, J.G.V., Rosário, R.S., Murari, T.B., Jorge, E.M. F., Cambui, E.C.B., Souza, M.S.P.L., Silva, A.C.F.N., Araújo, M.L.V., 2022. Synchronized spread of COVID-19 in the cities of Bahia, Brazil. Epidemics 39, 100587. https://doi.org/10.1016/J.EPIDEM.2022.100587.

Silal, S.P., Pulliam, J., Jamieson, L., Nichols, B., Moultrie, H., Meyer-Rath, G., 2021. The role of modelling in planning and budgeting for South Africa's COVID-19 response. S. Afr. Health Rev. https://www.hst.org.za/publications/South%20African%20Health%20Reviews/Chapter2_SAHR21_04022022_OD.pdf.

Teerawattananon, Y., KC, S., Chi, Y.L., Dabak, S., Kazibwe, J., Clapham, H., Lopez Hernandez, C., Leung, G.M., Sharifi, H., Habtemariam, M., Blecher, M., Nishtar, S., Sarkar, S., Wilson, D., Chalkidou, K., Gorgens, M., Hutubessy, R., Wibulpolprasert, S., 2022. Recalibrating the notion of modelling for policymaking during pandemics. Epidemics 38, 100552. https://doi.org/10.1016/J.EPIDEM.2022.100552.

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