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EDITORIALS

Modelling the pandemic

Over-reliance on modelling leads to missteps and blind spots in our response

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The coronavirus pandemic has revealed much about public policy, including the extent to which politicians and their advisers rely on modelling to help predict the future of virus spread and decide what actions are best to take.[1] This is true of many countries such as the US, UK, France, and Germany as well as Hong Kong, Singapore, and China. Although better than relying on intuition or flying completely blind into a crisis, over-reliance on modelling might have led to several missteps.[2] For example, some early covid-19 models did not consider the possible effects of mass "test, trace, and isolate" strategies or potential staff shortages on transmission dynamics. Including these may have led to earlier focus on testing capacity and appropriate protective equipment for frontline workers.

This is not any fault of the modellers themselves; scientists often are cautious about the uncertainty around their predictions, the shaky nature of the data they are inputting, and the assumptions underpinning their analyses. However, when governments want quick answers and a crystal ball, they take modelled projections as certainty and lose sight of other crucial information sources. The models themselves are constructed using advanced statistics and mathematics. They are a technical tool to present different scenarios, but deciding which model to follow and what factors to include is a political choice.

Unfortunately, data to aid this decision making process can be sparse in the event of a truly novel pandemic. Because covid-19 has been around for only a few months, we don't have data from previous outbreaks to inform our response today. Instead, we must make do with data collected in real time—data mired in insufficiencies because of testing, documentation, and reporting practices that vary over time and between countries.[3]

With the true number of infections and deaths as yet unknown and no benchmark from the past, we must rely on models that can accommodate these data insufficiencies while generating important epidemiological insights. These include estimates of the death rate of covid-19 and how fast it may spread, as well as how different these estimates may be across different populations.[4-6]

Limitations, assumptions

Insights from mathematical models are essential for decision making, especially when key characteristics about an outbreak remain unknown. But models have well documented limitations—and the modelling community has a responsibility to make these limitations clear, not only to scientific audiences but more importantly to policy makers and the public.

All models are limited by the assumptions that they make, and sensitivity analyses[7] that explore how much the findings of a given model change if assumptions are relaxed can help lend transparency to the uncertainty inherent in this particular science. We must also go a step further by making the data and code from our modelling studies openly available so others can attempt to reproduce findings, test and discuss limitations, and, most importantly, improve a model's performance.[8]

Where does this leave us? Modelling is a necessary input to public policy decisions but should be taken as just one input among many, one piece of a large puzzle. Other equally valuable sources of information include case study analysis from other countries, talking to frontline health staff and patient groups, and policy documents and historical analyses of previous novel outbreaks.

Triangulation across all these information sources should be the principle used to ascertain the bigger picture and what direction should be taken. Germany's approach is a good illustration of this principle—the authorities considered modelled predictions but also learnt from analyses of South Korea's successful strategy of mass testing, tracing, and isolation.[9]

Humility

Another good principle is one of humility. No discipline has all the answers, and the only way to avoid "groupthink" and blind spots is to ensure representatives with diverse backgrounds and expertise are at the table when major decisions are made. Finally, mathematical models do not include value systems or morals so their outputs must be used cautiously, and with attention to ethics. A model might suggest, for example, that allowing 95% of the population to continue life as normal while 5% become critically ill is a suitable path forward. This is when leaders must

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consider the values, needs, and preferences of their populations when deciding whether to follow it.

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