Answering the right questions for policymakers on COVID-19

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Effectively translating science into both operational and policy action is a nearly universal challenge;[1,2] in an emergency, aligning the interests of scientists and policy makers can be especially difficult. In an effort to minimise uncertainty and harness existing knowledge, scientists often focus on predictive problems that are broad in scale with quantifiable uncertainty; more often than not, this approach can leave policy makers without clear answers for high-consequence decisions that have to be made quickly, regardless of the available evidence base.

In our experience, this mismatch is most acute when crisis responders are seeking support with a rapid turnaround for decisions on local, action-oriented problems. During a hurricane, the US National Oceanic and Atmospheric Administration and the US National Hurricane Center produce forecasts of storm severity and trajectory, using atmospheric models written in deeply technical coding languages and run on supercomputer clusters. The National Hurricane Center and others have worked to develop user-friendly and public-ready methods to communicate those outputs for key decisions around evacuation and other response actions. We have deployed to the US National Response Coordination Center for these events and have been part of the integrated teams that translate these results into operational reality. From our experience, the challenge—and the mismatch between available and missing data—is in the details. A specialist deployed to an airbase in the middle of the country, who needs to know how many pallets of water to load onto the plane on her tarmac, has to choose a number with or without expert input. A Red Cross community manager tasked with taking over an elementary school in Florida, USA, to house those displaced needs to know how many cots to set up, how many meals she will need to prepare, and which roads will still be open to get the deliveries in.

Scientific models are crucial and useful for estimating impacts and prioritising response efforts across an entire state or region, but the tactical questions for each responder are often as well or better informed by data-driven, back-of-the-envelope estimates that are immediately relevant to the action that needs to be taken. These problems are just as acute in the COVID-19 response, if not more. The outpouring of basic descriptive epidemiology and national or global epidemic forecasting models has been key to pandemic response, but it has left many questions unanswered at smaller scales or in applied settings such as hospitals or town halls. We have identified the key questions that officials and experts in the USA need to be able to address and that can be addressed by currently available data or models (panel). These, we believe,

Panel: **Key questions that officials and experts need to be able to address**

1. Clinical presentation and testing
How is the disease transmitted in different settings? How many cases are asymptomatic? How many cases are subclinical? How detectable is COVID-19 in syndromic surveillance data? What is the most effective use of diagnostic and serological testing, given low detection? How long does natural immunity last for those who have recovered? How does disease progression differ for different types of comorbidities? What explains differences in case fatality rate by country?

2. Treatment: supplies, hospital beds, workforce
How many ventilators will each hospital need and when? Are the ventilators the limiting factor or is it the sedatives, beds, or the ability to staff those beds? Where in the hospital and for which tasks are different levels of personal protective equipment sufficient? What specific types of health-care specialties are most needed in regions with different types of comorbidities? What treatments are most successful for different types of patients and how can those be applied in practice?

3. Non-pharmaceutical interventions: adherence and mobility
What is the effectiveness of different types of non-pharmaceutical interventions and what makes them successful (eg, population density, percentage of people who comply, or degree to which they comply)? To what degree does spread appear to be driven by air travel versus other types of travel? What percentage of a community do we need to test to be able to shift back to contact tracing and to lift non-pharmaceutical interventions? What percentage of a hospital needs to be tested to shift back to isolation rooms and reduce personal protective equipment requirements?

4. Public health response: ability to contact trace and identify exposures
How do we use the asymptomatic rate to inform when and how we deploy vaccines? At what level of herd immunity can we safely reopen schools? Can digital data accelerate contact tracing to a similar efficacy level to outbreaks that were contained early (eg, South Korea)? What legal or safety challenges do we need to address to be able to collect and use that data?

5. Compound hazards and concurrent hazard planning
How do we structure emergency housing or evacuation for hurricanes or other natural disasters over the coming year without relying on mass care that might further spread COVID-19? How do we support homeless populations that are displaced? Do we evacuate hospitals with large numbers of contagious patients? How do we prioritise generators and fuel when every hospital is at capacity?

are the questions that should most urgently be driving new analyses.

Some of these questions require dedicated modelling work, but all are basic data questions. Although our questions are focused on the current needs in the USA, informed by what we have been asked by the state and local response in the last 2 weeks, the same core challenges are being faced everywhere that this outbreak hits. As a community of practice, we will have to continue to keep up with frontline decision making needs. Someone will have to load ventilators into a plane. These are the numbers that will save lives.

We declare no competing interests.

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2 Rivers C, Chretien JP, Riley S, et al. Using "outbreak science" to strengthen the use of models during epidemics. *Nat Commun* 2019; **10:** 1–3.