News in focus

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Lockdown in Italy: scientists are working out what effects specific measures, such as social distancing, have in slowing the spread of COVID-19.

WHOSE CORONAVIRUS STRATEGY WORKED BEST? SCIENTISTS HUNT MOST EFFECTIVE POLICIES

Researchers sift through data to compare nations' vastly different containment measures.

By Elizabeth Gibney

Hong Kong seems to have given the world a lesson in how to curb COVID-19 effectively. With a population of 7.5 million, it has reported just 4 deaths. Researchers studying its approach have found that swift surveillance, quarantine and social-distancing measures, such as school closures, helped to cut coronavirus transmission — measured by the average number of people each infected person infects, or *R* — to close to the critical level of 1 by early February. But the paper, published in April, couldn't tease apart the effects of the various measures and behavioural changes happening at the same time (B. Cowling *et al. Lancet Public Health* **5**, e279–e288; 2020).

Working out the effectiveness of the measures implemented worldwide to limit the coronavirus's spread is now one of scientists' most pressing questions. Researchers hope that, ultimately, they will be able to accurately predict how adding and removing control measures affects transmission rates and infection numbers. This information will be vital to governments as they design strategies to return life to normal, while keeping transmission low to prevent second waves of infection. "This is not about the next epidemic. It's about 'what do we do now?'" says Rosalind Eggo, a mathematical modeller at the London School of Hygiene and Tropical Medicine (LSHTM).

Researchers are already working on models that use data from individual countries to understand the effect of various control measures. Models based on real data should be more nuanced than those that, at the start of the outbreak, predicted the effects of interventions mainly using assumptions. Combining data from around the world will allow scientists to compare countries' responses. And this should allow them to design models that can make more accurate predictions about new phases of the pandemic and across nations.

But untangling cause and effect is extremely challenging, in part because circumstances differ in each country and because there is uncertainty over how well people adhere to control measures, cautions Eggo. "It's really hard but it doesn't mean we shouldn't try."

Pulling together

Efforts to tackle these questions will soon get a boost from a database that brings together information on the hundreds of different interventions introduced worldwide. The platform, being prepared for the World Health Organization (WHO) by a team at the LSHTM, gathers data collected by ten groups already tracking interventions. These include researchers at the University of Oxford, UK, and at the Complexity Science Hub Vienna (CSH Vienna).

The database will standardize the information collected by the different teams and should be more comprehensive than anything an individual group could generate, says Chris Grundy, a data scientist behind the LSHTM project. Agencies such as the WHO routinely track control measures used in an outbreak, but for COVID-19 the picture is complicated by the pandemic's speed and scale, says Grundy. The data set will be open, and improved in future releases, he says. Speed is of the essence: "Days make a difference right now."

The trackers lay bare the vast range of policies deployed in different nations. The Vienna team has captured details of around 170 interventions in 52 countries, ranging from small measures such as floor stickers that mark a 2-metre separation to major policies such as school closures. The team is also following some countries' recent efforts to restart normal daily life. Oxford's project, the COVID-19 Government Response Tracker, is monitoring 13 interventions in more than 100 countries. It compiles 7 of the 13 into a single 'stringency' index that captures the overall severity of each country's response and allows for comparison between countries' approaches (see 'Pandemic protections').

Already, scientists are analysing their data to explore differences in responses. The Vienna team is looking for patterns, using methods that include clustering countries by how early in their epidemics they began introducing interventions and by the total number of restrictions introduced. In Europe, for example, algorithms group Sweden, the United Kingdom and the Netherlands together as countries that acted relatively slowly.

"If we don't know what works, it's going to be really difficult to decide what to do next."

Meanwhile, Germany and Austria stand out as nations that adopted aggressive and early control strategies, compared with Italy, France and Spain, which implemented similar measures, including lockdowns, but later in their epidemics. So far, Germany and Austria have, per capita, seen a fraction of the deaths from COVID-19 reported in these other countries.

Early findings from the Oxford team also suggest that poorer nations tended to bring in stricter measures than did richer countries, relative to the severity of their outbreaks. For example, the Caribbean nation of Haiti enforced lockdown on confirming its first case, whereas the United States waited until more than two weeks after its first death to issue stay-at-home orders. That might be because lower-income countries with less-developed health-care systems act more cautiously, says Anna Petherick, a public-policy researcher at Oxford. It could also reflect the fact that the outbreak reached these nations later, giving them longer to learn from others, she says.

Patterns and predictions

Ultimately, researchers hope to use data from the LSHTM database to understand how effective these strategies were in limiting the outbreak. "We really need to evaluate those interventions in real time, so everybody can make real policies," says Eggo, who was not involved in creating the database but plans to use it. "If we don't know what works and we don't know how much, it's going to be really difficult to decide what to do next." Eggo and her colleagues will use the data to test the accuracy of mathematical models – which use equations to describe the rate of transmission and mechanisms behind it – under varying intervention types and timing.

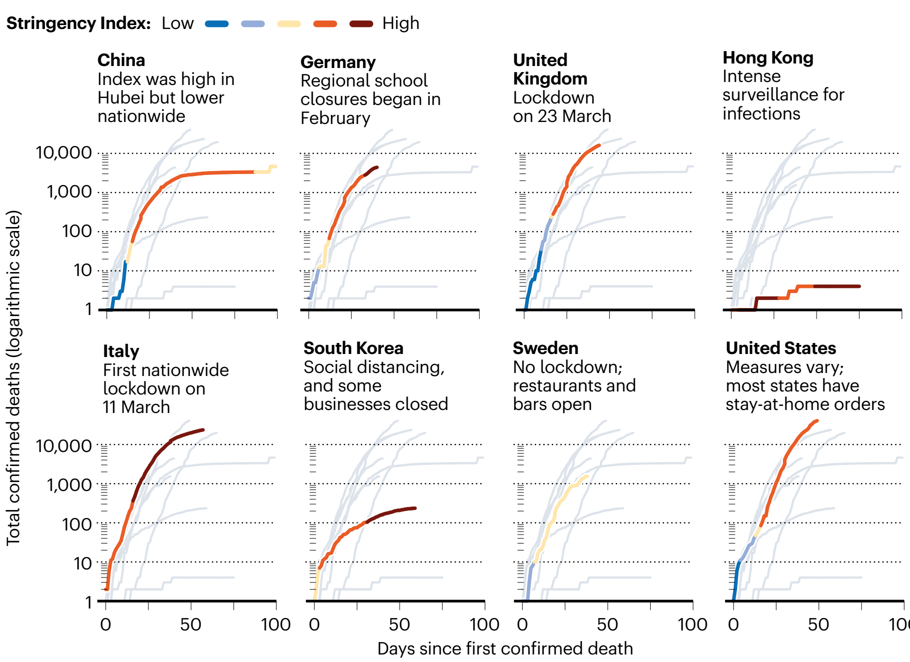
Ideally, researchers will be able to forecast how adding and removing interventions would change the number of infections over time. Policymakers could use such predictions, together with data on intensive-care capacity, to make decisions – on whether to reopen schools, for example – says Nils Haug, a mathematical physicist at CSH Vienna and the Medical University of Vienna.

Haug and his team of modellers are exploring which statistical approaches to use. Rather than directly determining the precise effect of each intervention, these methods can find ways to identify the measures that best predict infection rates. One approach involves using a machine-learning technique called a recurrent neural network to learn from patterns in the data and make predictions. Scientists can learn how important a given intervention is by looking at how predictions shift when they remove information about it from the network.

Without a vaccine or effective treatment, stopping transmission remains the only defence against COVID-19. Knowing the effects of each control measure is crucial to figuring out which ones can be safely altered or removed, says Petherick. "I think that would be a huge contribution."

PANDEMIC PROTECTIONS

Researchers have created a 'stringency index' that describes the overall severity of a country's response to the coronavirus outbreak and allows responses to be compared. The index takes into account seven control measures, such as school closures and restrictions on people's movements.



Confirmed deaths undercount true COVID-19 mortality. Stringency index developed by the Oxford COVID-19 Government Response Tracker. Data downloaded on 21 April; countries vary in day of most recent data update.

SOURCE: OXFORD CORONAVIRUS GOVERNMENT RESPONSE TRACKER (DATA); *NATURE* (CHARTS).