



## IN DEPTH

A woman gets swabbed at a drive-through testing site in West Palm Beach, Florida, on 16 March.

### INFECTIOUS DISEASES

# Countries test tactics in 'war' against COVID-19

Lockdowns and closings proliferate, but virus testing and contact tracing are lagging

By **Jon Cohen** and **Kai Kupferschmidt**

The United States and Europe have stopped hitting the snooze button. After 2 months of mostly waiting and seeing while the coronavirus disease 2019 (COVID-19) alarm sounded ever more loudly, many countries have suddenly implemented strict measures to slow the spread of the disease, which the World Health Organization (WHO) officially declared a pandemic on 13 March. Thousands of events have been canceled; schools, restaurants, bars, and clubs have been closed; and transit systems are at a standstill.

The countries saw little choice. The case numbers exploded, and, in turn, so did the number of deaths. Hospitals in Italy, the hardest hit European country, are overburdened, forcing doctors to make agonizing decisions about whom to treat and on whom to give up. "This is bad," U.S. President Donald Trump finally acknowledged on 16 March. "This is war," his counterpart Emmanuel Macron told the French people the same day.

But how to fight that war is still under discussion. The hastily introduced measures vary widely between countries and even within countries. The U.S. government advises against gatherings of more than 10 people, but San Francisco has ordered everyone to stay at home. Italy, France, and Spain have

put their populations on an almost complete lockdown, with police or the military in some places patrolling the streets, but as *Science* went to press, pubs in the United Kingdom remained open. Germany, like many countries, has shut its schools, but they remain open for younger children in Sweden.

The patchwork reflects different phases of the epidemic, as well as differences in resources, cultures, governments, and laws. But there's also confusion about what works best, and how to balance what is necessary with what is reasonable, especially for an extended period. South Korea, Hong Kong, and Singapore seem to hold important lessons, having turned their epidemics around without the authoritarian tactics used by China. Yet some of the strategies adopted in those countries are missing elsewhere: widespread testing to find cases, tracing their contacts to test or quarantine them, and encouraging—or forcing—infected people to isolate themselves.

No single step will suffice, WHO Director-General Tedros Adhanom Ghebreyesus stressed at a recent press conference. "Not testing alone. Not contact tracing alone. Not quarantine alone. Not social distancing alone. Do it all."

#### SOCIAL DISTANCING

There's little doubt that social distancing—keeping people from getting physically

close—can greatly reduce virus transmission: It was essential to bringing China's raging epidemic under control in a matter of weeks, according to the report of a joint mission of WHO and the Chinese government released on 28 February (*Science*, 6 March, p. 1061). Other countries are now deciding how far to take that approach.

Many began by banning gatherings of more than 1000 and then successively reduced that number. Some have shut theaters, cinemas, restaurants, and gyms as well as all places of worship. Germany has closed most non-essential stores but extended hours for supermarkets to reduce the number of shoppers at any one time. In some countries, shops are reserving the first hours of the day for older customers at high risk of severe disease.

School closings have sent more than half a billion children home, according to UNESCO. Whether that makes sense is under debate. COVID-19 rarely sickens children, and it's not clear how often they develop asymptomatic infections and transmit the virus. School closures may have the added benefit of forcing more parents to stay home. On the other hand, some children may end up being looked after by elderly grandparents, and closures may force badly needed health care workers to stay home. Moreover, children could end up missing months of education and many depend on free school lunch programs.

That's why some public health experts say measures should be flexible. Austria and the Netherlands have sent most students home, but schools remain open for children of those working in vital sectors. Singapore has halved class sizes, instituted strict hygiene measures, and staggered break periods to reduce playground contact.

Several countries have now resorted to an extreme measure: forcing almost their entire population to stay home. China led the way in late January, when it penned in more than 50 million people in Hubei province. Some experts argued that Western countries could never enforce such draconian measures—which curtail human rights and cripple economies—but Italy, shocked by the strain on the health care system in the north of the country, followed suit on 9 March. In France, 100,000 police officers began to patrol the streets on 17 March to make sure people stay inside except for essential trips.

### TESTING AND ISOLATING

Other countries have beat back the virus without such drastic measures. One example is South Korea, which has seen confirmed infections drop from 909 cases on 29 February to just 74 early this week. “South Korea is a democratic republic; we feel a lockdown is not a reasonable choice,” says Kim Woo-Joo, an infectious disease specialist at Korea University.

Instead, the key to success has been a large, well-organized testing program, combined with extensive efforts to isolate infected people and trace and quarantine their contacts. By 16 March, South Korea had tested more than 270,000 people, many at a network of dozens of drive-through testing stations, a strategy followed elsewhere that eases access to testing and prevents infected people from exposing others in waiting rooms.

But the United States, plagued by an overly bureaucratic system and problems with its test kits, has had a slow start. By 16 March it had done only 74 tests per million inhabitants, compared with 5200 tests per million in South Korea. Only this week did the United States begin to roll out testing on a mass scale. In Europe, Germany is a front-runner, with more than 100,000 tests processed per week, says Christian Drosten, a virologist at the Charité University Hospital in Berlin, who developed the test. But other countries have yet to scale up testing.

The slow rollout has rankled Tedros, who repeats his mantra “testing, testing, test-

ing” almost daily. Countries “cannot fight this pandemic blindfolded,” he said at a 16 March press conference. “They should know where the cases are.” Marcel Salathé, a computational epidemiologist at the Federal Institute of Technology of Lausanne, agrees. “At this point 100% of nations that got it under control did so based on testing and tracing, isolation, quarantining,” he says. What's required is “a determination to find every single infection and follow up on every potential exposure and break every possible chain of transmission.”

Even if they start to test more widely, some countries may lack the capacity to trace the contacts of those infected. In the United States, the job falls to state and local health departments, which often lack the resources to scale up rapidly. “It's going to vary immensely by jurisdiction,” says epidemiologist Caitlin Rivers of the Johns Hopkins University Bloomberg School of Public Health.

in 2003, says Mark Woolhouse, an epidemiologist at the University of Edinburgh: “We will be living with this virus indefinitely.” Keeping it at bay might require locking down society for many months, at staggering costs to the economy, social life, and mental health, at least until a vaccine is available. That is inconceivable to Woolhouse and many others.

A few countries are now thinking about gradually letting the population build up immunity by forgoing a complete lockdown and allowing some infections to take place, preferably in low-risk groups such as children or young adults. That's the strategy Prime Minister Mark Rutte of the Netherlands announced in a televised address in 16 March. “By taking this approach, one in which most people will experience only minor symptoms, we can both build immunity and ensure that our health care system is able to cope,” Rutte said. In a TV interview, epidemiologist Jaap

van Dissel of the Dutch National Institute for Public Health and the Environment explained that the goal was to “titrate” control measures to keep the demand for hospital beds below maximum capacity, a strategy called mitigation. (The U.K. government last week suggested it wanted to build up herd immunity as well, but began to backpedal after receiving pushback.)

A modeling study by researchers at Imperial College London, posted online on 16 March, concluded that even a mitigated epidemic would still overwhelm health care systems and cause at least 250,000 deaths in the United Kingdom and more than 1.1 million in the United States. Suppressing the virus by combining all available measures, including school closings and social distancing of the entire population, is the “only viable strategy

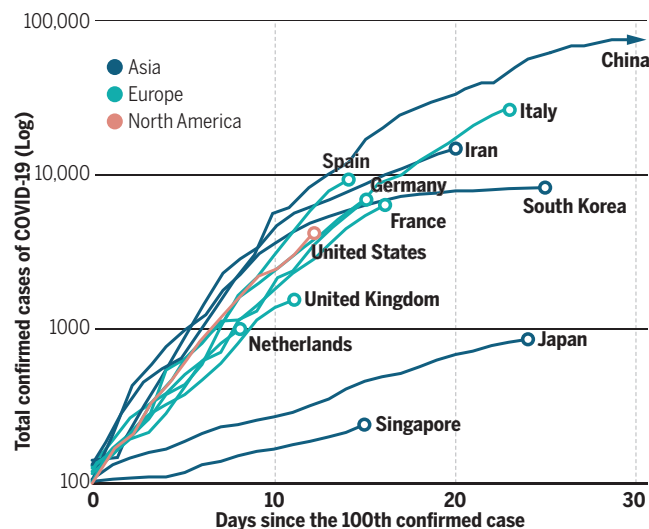
at the current time,” the team wrote.

It did suggest a scheme in which these draconian measures could be relaxed once in a while—a kind of collective “drug holiday”—and then reimposed when case numbers start to climb again. In that scenario, the population would still build up immunity to the virus, but through a series of small outbreaks instead of a massive one. It may not be an attractive scenario, but there may be no other choice. As epidemiologist Seth Berkley, who heads GAVI, the Vaccine Alliance, says, “You cannot say the Earth has to stop for a year or 2 years.” ■

With reporting by Dennis Normile and Martin Enserink.

### Exponential growth

China's outbreak has come to a halt and South Korea has flattened its curve, but COVID-19 case numbers are still rising rapidly in many Western countries.



One way to solve that is to engage the public more actively, says Luciana Borio, the pandemic preparedness point person at the U.S. National Security Council from 2017 to 2019. Borio hopes infected people, if properly educated, will isolate themselves and ask their recent contacts to seek tests, too. “I prefer to empower and educate the population to be able to help them take matters into their own hands,” she says.

### NO ENDGAME

For many, the biggest question is: When, and how, will it end? It's now clear that humanity won't get rid of COVID-19 as it did with SARS (severe acute respiratory syndrome)

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