

Who gets to have the vaccine?

If a covid-19 vaccine is finally developed, tough decisions await about who should be first in line for the limited initial supply, says **Graham Lawton**

IT IS August 2021, and the moment the world has been waiting for has finally arrived. After many false dawns, a vaccine against covid-19 has passed all the tests and is ready to be rolled out.

It has been an arduous journey, but at last vaccine manufacturers around the world are cranking out thousands of doses a day. The end of the pandemic is on the horizon.

But this isn't the end. It isn't even the beginning of the end. There are more than 7.5 billion people in need of vaccination but perhaps only a billion doses available in the first six months of production.

Who gets one? Everyone agrees that front-line healthcare workers must be first in the queue. But who should be next? What is the best way to attain herd immunity? Will people accept the vaccine? And is it possible to stop rich countries from hoarding the supplies?

The answers to these questions depend largely on decisions being made now, in 2020, long before a successful vaccine has been developed. Of course, that day may never arrive. But let us assume that it does. What happens next?

No single approach

Even if a vaccine works, there is no one-size-fits-all vaccination regime. The two newest vaccines to be developed give a flavour of the problem facing epidemiologists. These are the Ebola vaccine Ervebo, approved in November 2019, and a dengue fever vaccine Dengvaxia, approved in 2015.

Consider Ervebo. Before covid-19 stalled its roll-out there was enough time to devise and test containment strategies. These show that the most effective approach is ring vaccination. That means tracking down confirmed



KIRSTY WIGGLESWORTH/SHUTTERSTOCK

cases and vaccinating all of their contacts and all of their contacts' contacts, thus throwing a ring of immunity around the virus.

For Dengvaxia, however, the most effective strategy depends on local circumstances. When the virus is rampant, mass vaccination offers the most protection to the largest number of people. But where transmission rates are lower, it is better to selectively vaccinate adults who have already had the virus. This is because a second bout is more dangerous than the first one due to the way the immune system ratchets up. That also means that vaccinating infants, who are unlikely to have had the virus, can backfire because the vaccine acts like a first bout.

So what works for one disease might be less than optimal for another, because diseases and vaccines are all different. For covid-19, the absence of both a vaccine and full understanding of the disease means that designing

Who will get a vaccine, and when, according to the World Health Organization's strategy

50 million

Healthcare workers – doctors, community health workers, nurses and midwives – are the first priority for vaccinations

600 million

Adults over the age of 65, making up 8 per cent of the global population, are the second priority

1.1 billion

High-risk adults, with conditions such as diabetes, cardiovascular disease, cancer or obesity, are third in the queue

SOURCE: WORLD HEALTH ORGANIZATION

a strategy is a very inexact science.

A team led by Emma McBryde at James Cook University in Australia has started modelling possible scenarios, but the results are still under wraps. One thing we can say, however, is that ring vaccination isn't going to work. Ebola is transmitted by contact with bodily fluids, so spreads relatively slowly, whereas covid-19 is a respiratory disease that spreads very rapidly.

Regardless of the specifics, the overwhelming rationale for introducing any new vaccine is to reduce severe illness and mortality. That holds true for covid-19. But there are other considerations, says Nicholas Grassly, a vaccine epidemiologist at Imperial College London who sits on the Strategic Advisory Group of Experts covid-19 vaccine group for the World Health Organization (WHO) but spoke to *New Scientist* in a personal capacity. "Vaccination for covid-19 is not just about health, it is about

A volunteer in London is injected with a trial vaccine against covid-19

the economy and protecting essential services, too," he says. "That is a little bit different from how vaccines are traditionally looked at. So the question is, who should we vaccinate to maximise the health benefits, facilitate a return to productivity and protect health and education services?"

That decision would be more straightforward if vaccine stocks were unlimited. But they won't be, at least not at first; the most ambitious scale-up plan so far is by a vaccine team in Oxford, UK, which says it could produce 2 billion doses within 12 months of approval. It is possible that two doses will be needed per person, so that would only be enough shots for fewer than 1 billion people, allowing for a 15 per cent wastage rate.

"It is quite unlikely that there is going to be enough vaccine for the entire world," says Beate Kampmann, director of the Vaccine Centre at the London School of Hygiene & Tropical Medicine (LSHTM). That means tough choices await.

The hard work has already started. The WHO published a preliminary vaccine allocation plan in June. It prioritises healthcare workers, of which there are about 50 million worldwide. Next are the 600 million adults over the age of 65, and then the 1.1 billion adults over 30 with cardiovascular disease, cancer, diabetes, obesity or respiratory disease.

Individual countries are also formulating plans. In the UK, the Joint Committee on Vaccination and Immunisation held an extraordinary meeting on vaccine prioritisation on 18 June. It started

from the premise that the priority is to "save lives and protect the NHS", a familiar slogan to anyone who has been watching the UK response to the pandemic.

To that end, the committee decided that healthcare workers must be the highest priority, followed by care workers. Next in line should be people at increased risk of disease and death from covid-19, which means older people and those with pre-existing conditions. Everybody else will have to wait, although perhaps not as long as people in lower-income countries (see "Vaccine nationalism", page 10).

Herd immunity

The US Centers for Disease Control and Prevention is also exploring the options. Its plan similarly puts 12 million "critical health care and other workers" at the head of the queue, followed by 110 million other health workers and high-risk individuals. The general population – 206 million people – go to the back.

It is notable that none of these plans mention herd immunity, which arises when there are enough immune people in the

population to stop a virus from circulating. Despite its somewhat tarnished reputation after "natural" herd immunity was briefly and unscientifically touted as an exit strategy in some countries including the UK, vaccine-induced herd immunity is still our best bet for ending the pandemic and even eradicating the virus. "We are going to need global herd immunity," says Gavin Yamey at the Duke University Global Health Institute in Durham, North Carolina.

There is a reason that vaccine-induced herd immunity hasn't yet been incorporated into planning, says Grassly. It is often taken for granted that mass vaccination covering between 60 and 70 per cent of the population will lead to herd immunity to the coronavirus, but it may not.

Vaccines are designed to protect individuals from severe illness or death, not to induce herd immunity. They sometimes produce it by preventing infection and transmission, but that is a happy accident. The nasal flu vaccine, for example, halts transmission of the virus and can therefore create herd immunity. For this reason, it is principally

given to children to prevent them from infecting vulnerable older relatives who are unlikely to respond strongly to a vaccine.

But as yet we don't know whether a covid-19 vaccine will work this way. "If vaccines become available, it will be because they are protective against disease,"

"Vaccination for covid-19 is not just about health, it is about the economy and protecting vital services"

says Grassly. "They may, or may not, also be protective against infection or transmission, but we don't know yet."

If a vaccine does promise herd immunity, it would probably be worth revising the vaccination priorities to take advantage, says Grassly. We know, for example, that some people who don't develop symptoms can still be highly contagious. There are also "superspreaders" who infect many more people than average. The difficulty will lie in identifying who those people are, but it may pay to prioritise vaccination for teachers and those working on public transport or in supermarkets, he says.

There would also be an argument for vaccinating children rather than vulnerable adults. "Healthcare workers should be first, then the intuitive thing is to prioritise the elderly," says Alberto Giubilini of the Uehiro Centre for Practical Ethics at the University of Oxford. "But, paradoxically, the best strategy might be to vaccinate children. Their immune system responds better to vaccines. To reach herd immunity you want to give the vaccine to the people for whom it works best."

It is even possible that the vaccine might not work

In short supply

Even if an effective vaccine is developed, it will take years to produce the estimated 14 billion doses needed to protect the global population. Why so slow? Making vaccines at scale is a laborious process, with quality control taking up a big share of the resources. The world's largest vaccine manufacturer, the Serum Institute of India, produces about 1.5 billion doses of various vaccines a year, which shows the scale of the challenge.

"Trying to come up with an approach for 7 billion people is an enormous undertaking," says Robin Shattock, who leads the vaccine team at Imperial College London. "Currently the biggest number of vaccines that are made a year is about half a billion doses of polio vaccine. Nobody has made a billion doses of any vaccine globally in any single year."

in older people, in which case the strategy would be to vaccinate the people around them.

Another factor that could scupper herd immunity is what researchers call vaccine hesitancy. According to Heidi Larson, director of the Vaccine Confidence Project at the LSHTM, covid-19 anti-vaccine posts on social media outnumber positive voices by about four to one.

In denial

There are signs that the anti-vaccination misinformation is cutting through. In the UK, for example, Larson's team has been asking samples of more than 2000 people whether they would be willing to be vaccinated. In late March, 80 per cent of people said yes. By the end of May, that had fallen to 67 per cent.

In the US, a poll conducted in May found that 42 per cent of people would definitely get vaccinated against coronavirus, 27 per cent definitely wouldn't and the rest were unsure.

A similar obstacle is the growing number of people who refuse to accept that covid-19 even exists, says Leesa Lin at the LSHTM. "Covid-19 denialism is likely to pose a threat to convincing people to take a vaccine. There is a significant association between perception of the disease risk and vaccine uptake," says Lin.

All told, then, the outlook remains highly uncertain. A vaccine may not even be possible. If it is, there won't be enough to go round, at least at first. Even when there is, it may not induce herd immunity. And even if it does, too few people may choose to take it. The beginning of the end? Not likely. "If this was a 100-metre race, we have only run the first few metres," says Yamey. ■

Vaccine nationalism

During the flu pandemic of 2009, high-income nations were criticised for hoarding vaccine doses. Will "vaccine nationalism" raise its ugly head again?

Some world leaders seem to have learned the lessons of 2009, says Gavin Yamey at Duke University in Durham, North Carolina. "There is clearly enormous political will that when vaccines are developed, rich countries don't monopolise them," he says. "We've heard world leaders like Emmanuel Macron saying that vaccines should be a 'global public good'. That is significant because underlying it is a realisation, at the very highest levels, that without global herd immunity it's going to be very difficult to bring this pandemic to an end."

The World Health Organization (WHO) covid-19 vaccine prioritisation plan (see main article) emphasises the need for "equitable and fair global allocation", and a global coalition called COVAX is working to ensure that this happens. Countries that sign up then pool resources so that if one vaccine succeeds, all can have it. It is effectively an insurance policy, says Yamey.

At the time of writing, 170 countries with a combined population of 4.5 billion have expressed an intention to sign up, including the UK, Canada, New Zealand and Ireland. The poorest 92 of these countries will get a vaccine for free.

Meanwhile, the teams behind the UK's leading vaccine

Full protections: a lab technician at work to develop a vaccine against covid-19

candidates at the University of Oxford and Imperial College London have pledged to make their vaccines available on a not-for-profit basis.

But the nationalist drumbeat is growing. Neither the US nor China has yet publicly declared an interest in COVAX. And several countries have signed deals with firms to buy disproportionate

"Without global herd immunity, it's going to be difficult to bring this pandemic to an end"

amounts of vaccine. "It is already obvious that countries that have contributed significantly to the funding of the research will want to have the first pick at the crop," says Beate Kampmann, director of the Vaccine Centre at the London School of Hygiene & Tropical Medicine. For example, the UK government has secured a deal for 100 million doses of the Oxford vaccine, which is 5 per

cent of the projected world supply for a country with less than 1 per cent of the global population.

The US has signed a deal to buy 350 million doses of the Oxford vaccine, 17.5 per cent of global supply for a country with 4 per cent of its population. US president Donald Trump has also set up an explicitly nationalist vaccine development programme called Operation Warp Speed.

"There is no such thing as a British or Chinese or American vaccine, any vaccine must be a global public good," says Yamey. "The billion-dollar question is, are these deals a threat to the global fair distribution of vaccine? My answer is, they are."

Meanwhile, Russia announced this week that it has become the first country to approve a vaccine. However, according to the WHO, the vaccine, being developed by the Gamaleya Institute in Moscow, is only in early stage trials raising concerns that it is being used before it is known to be safe. ■ GL



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Pollution

The plastic pandemic

The coronavirus has led to a resurgence in single-use plastics, but there is still time to reverse course, says Adam Vaughan

IT LOOKED as if the tide had turned against single-use plastic last year, with the European Union approving a ban on cutlery, straws and more, New York backing a plastic bag ban and consumer pressure continuing to grow.

Then the coronavirus hit. Hygiene fears and the demand for masks have unleashed a plastic pollution pandemic, while industry lobbyists are pushing to roll back restrictions.

It hasn't been long enough for there to be official data on plastic waste and recycling rates, but there is no shortage of estimates and anecdotes. If every person in the UK used one single-use mask a day for a year, it would create 66,000 tonnes of plastic waste, according to one estimate by a University College London team. *New Scientist* readers have reported masks dumped on beaches, streets and in harbours.

Meanwhile, large parts of the retail and hospitality industry have suspended efforts to cut plastic use. Many coffee chains have stopped accepting reusable cups, pubs in the UK are only serving drinks in plastic, not glass, and more petrol station pumps have been equipped with single-use plastic gloves. Online supermarkets have stopped collecting and recycling plastic bags. The list goes on.

"Members of the public can help by using reusable face masks, and disposing of any single-use masks and gloves carefully, to avoid adding to the plastic pollution that already clogs up our rivers and seas," says Louise Edge at Greenpeace UK.

Governments and local authorities are also going backwards. California dropped its ban on single-use plastic bags for several months, although it has since reinstated it. Other



ANDREY NEKRASOV/ZUMA WIRE/ALAMY LIVE NEWS

places in the US, from Denver to Minneapolis, have delayed bag bans or fees or lifted existing ones. Italy postponed a plastics tax on bottles, bags and more until 2021. A Norway-backed effort to establish an international treaty on marine plastic pollution has indefinitely postponed its meetings because of covid-19.

"The plastic industry is cynically using covid-19 as justification for removal of restrictions"

As this goes on, the plastic industry has grabbed the opportunity to push back against growing restrictions in recent years, arguing that single-use plastic is safer and more hygienic amid a pandemic. "The plastic

A discarded face mask on the shores of Budva, Montenegro

industry is cynically using covid-19 as justification for removal of restrictions," says Julian Kirby at Friends of the Earth. The drive might not succeed. Trade bodies in the US, Europe and the UK have written to government and state officials asking for them to promote the supposed benefits of single-use plastics during the pandemic, but haven't yet won policy shifts.

Meanwhile, plastic recycling rates may have fallen. Mushtaq Memon at the United Nations Environment Programme (UNEP) says he has heard reports of a decline due to broken supply chains, lower collections and fear

of contaminated plastics. In the UK, 26 per cent of local authorities reported disruption to recycling at the start of April, at the height of lockdown. That figure fell to 18 per cent by late July.

Plastic's resurgence has been sparked by fears over transmission of the coronavirus, but it isn't clear whether these are well-founded. Several papers have found that the virus seems to last longer on plastic than on other materials, including glass and cardboard. Scores of academics signed a statement saying reusable products "can be used safely by employing basic hygiene".

One cause for hope is that people still seem to care about stemming plastic use despite the pandemic. In the UK, 74 per cent of people said covid-19 had made no difference to their plans to cut their use of plastic packaging, market-research firm YouGov found in early April. Similarly, UNEP polling of people in Indonesia, Malaysia, the Philippines, Thailand and Vietnam suggests that concern about plastic pollution remains high.

While some businesses may have taken short-term steps backwards, there is little sign of big players reneging on long-term targets, such as UK supermarket Sainsbury's last year pledging to halve plastic packaging by 2025.

Some campaigners see covid-19 economic recovery plans and changes in consumer behaviour as a chance to clamp down on single-use plastic. "We have to move towards a more circular economy – slowing down the conveyor belt from production to waste, through more recycling, less single use throw-away material, better design and targeted use of materials," says Richard Bailey at the University of Oxford. ■