

## News in focus

conclusions about effectiveness are drawn from fewer than 200 people who have developed disease. As a result, it can be difficult to break up the data to look at efficacy in different groups – such as people who are obese or elderly – without losing statistical power. More data are needed across demographics, says Michael Head, an infectious-disease researcher at the University of Southampton, UK.

There are early indications that the three leading vaccines protect people over 65. But researchers will probably need real-world data from large numbers of vaccinated people before they can get the demographic granularity necessary to ensure that parts of the population aren't left unprotected.

There are no data yet on how the vaccines fare in children and pregnant women. On 2 December, Moderna unveiled plans to test its vaccine in adolescents.

### How do the vaccines stack up against each other?

All three leading vaccines have probably beaten the goal of achieving 50% efficacy, and all seem to be safe, on the basis of the clinical-trial data so far. But there might be differences in how well they work.

The vaccines from Pfizer and Moderna rely on RNA encased in a lipid particle that ferries it into cells, where it helps to generate a viral protein that stimulates the immune system. AstraZeneca's vaccine uses DNA that is shuttled into cells inside a harmless virus.

Early data suggest that the RNA approach might be more effective for preventing disease symptoms developing. But there are subtle differences in the immune responses provoked by each approach, notes Griffin. Researchers might eventually find that one approach works better than another in certain groups of people, or that one is the best at limiting transmission.

Differences in costs and logistics will also shape which vaccine is best for which region. Shortly after the UK government announced the authorization of the Pfizer vaccine, officials acknowledged that getting the vaccine to residents in individual care homes would be a challenge, because it needs to be stored at extremely low temperatures ( $-70^{\circ}\text{C}$ ). The other two vaccines do not need to be kept at such low temperatures, and the AstraZeneca immunization is likely to be the easiest and cheapest to store, says Head.

Comparisons between the effectiveness of the different vaccines are important and should be done, but until then, the path forward is clear, says Altmann. "Grab any vaccine that your government can buy," he says.

### Could the virus evolve to evade immunity given by vaccines?

Some viruses, such as the influenza virus, are notorious for mutating. The SARS-CoV-2

genome, however, seems to be fairly stable so far. Most of the vaccines being developed, including the three that lead the pack, target a molecule called the spike protein, which the virus needs to infect cells. And immune responses elicited by those vaccines will probably target multiple sites on that protein.

This gives researchers some reassurance that the virus might not evolve ways to evade immunity. But mass vaccination campaigns will, for the first time, put enormous pressure on SARS-CoV-2 to adapt, and will select for any strain of the virus that might be able to escape immune defences. "We've never seen a virus like this under selective pressure," says Griffin. "So we don't know how it's going to respond."

As a result, researchers will need to monitor samples of SARS-CoV-2 for signs of change, says Charlie Weller, head of vaccines at the biomedical research charity Wellcome in London. "Robust surveillance with ongoing sampling and sequencing will be key," she says.

### How will scientists monitor for long-term safety concerns?

The Pfizer vaccine has completed only a few months of the two-year clinical-trial period needed before it is approved to be sold freely

on the market. As a result, people will be watching closely for as-yet unobserved signs of danger.

Clinical trials vet vaccines rigorously for potential side effects with a combination of self-reporting from participants and data collection by clinicians. Pfizer's trials revealed that some recipients experienced pain at the injection site, along with fever, fatigue, sore muscles and headaches – although these symptoms are generally not serious.

But after a vaccine is approved, whether fully or only for emergency use, clinicians are expected to continue reporting any adverse reactions. Many countries have some kind of programme, such as the US Vaccine Adverse Event Reporting System, that collects reports of serious symptoms after people receive a vaccine. US doctors are legally bound to report such symptoms. For COVID-19 drugs and vaccines, the United Kingdom has set up a specialized Coronavirus Yellow Card reporting site.

Such systems work, says Jerome Kim, director-general of the International Vaccine Institute in Seoul. "You still need strong surveillance. These rare events can be important," he says.

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# CAN JOE BIDEN MAKE GOOD ON HIS AMBITIOUS CLIMATE AGENDA?

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The US president-elect faces an uphill battle, but there are levers he can pull to curb global warming.

By Jeff Tollefson

**W**hen Joe Biden won the US presidency last month, it seemed like a huge opportunity to restore the country's position as a leader in the fight against climate change. But whether he'll be able to deliver on his aggressive climate agenda remains to be seen, especially because he will face a powerful Republican opposition in Congress.

Still, climate-policy experts say that there is a lot the former senator and vice-president to Barack Obama can do, including exerting his authority over federal agencies and leveraging his experience working with both parties in the Senate to push legislation in Congress.

"This is really the first time that a US president is leading with climate," says Vicki Arroyo, executive director of Georgetown University's Climate Center in Washington DC. That's exciting, she says, but suggests cautious optimism:

global warming is still a partisan issue on Capitol Hill, and "that is going to limit what Biden can accomplish".

Biden's election comes at a crucial juncture. President Donald Trump pulled the United States out of the Paris climate agreement last month, but other players on the world stage, from China to the European Union, are preparing to present a new round of commitments at the United Nations climate conference in Glasgow, UK, next year.

Having the United States back on board will give an important boost to these negotiations, says Jean-Pascal van Ypersele, a climatologist at the Catholic University of Louvain in Louvain-la-Neuve, Belgium, and former vice-chair of the Intergovernmental Panel on Climate Change. "The stars are much better aligned for a successful outcome in Glasgow than they would have been if Trump had been re-elected."

Biden's first opportunity to advance his



Biden's climate platform was the most aggressive put forth by a leading presidential candidate.

agenda through Congress could come, as it did for Obama, in the form of an economic stimulus bill. With the US economy reeling from the pandemic, many analysts expect this to be at the top of Biden's agenda when he enters office. His team has made climate a central feature of its economic plan and could use a stimulus package to increase federal investments in low-carbon energy and green infrastructure.

Unlike Obama, Biden will probably next look for ways to advance smaller climate measures through Congress rather than pushing sweeping legislation, because of Republican opposition. One possibility would be bipartisan legislation that creates a carbon tax to reduce US greenhouse-gas emissions – an idea that has backing among many conservatives and business leaders who are concerned about the climate. One proposal developed by the Climate Leadership Council, a non-profit organization based in Washington DC, would levy a tax on carbon dioxide emissions, starting with a modest US\$40 per tonne and increasing over time, with the goal of cutting US emissions in half by 2035. The proceeds would be refunded to taxpayers.

Getting such legislation through the Senate won't be easy, but it's not impossible, says Bob Inglis, who heads the Energy and Enterprise Initiative, a think tank advocating politically conservative environmental solutions at George Mason University in Fairfax, Virginia. "This is a major opportunity," says Inglis.

Regardless of what happens in Congress, many scientists and environmentalists expect that Biden will immediately use his executive authority to advance his climate agenda across the full suite of federal agencies. (It wasn't until Obama's second term, in 2012, that he

got serious about sidestepping Congress with his authority to battle climate change.)

Under Biden, the interior department, for instance, could hasten the processing of federal permits to build offshore wind farms and other renewable-energy projects. And the Department of Energy could raise energy-efficiency standards for appliances.

"There's no need for Biden to wait," says Tim Profeta, who leads Duke University's Nicholas Institute for Environmental Policy Solutions in Durham, North Carolina. "There's a lot the president can do using his own authority, starting from day one."

Profeta co-chairs the Climate 21 Project, an independent group of academics, policy specialists and former government officials

**"There's a lot the president can do using his own authority, starting from day one."**

that has crafted a blueprint for executive action across 11 federal offices and agencies to address global warming. The top-line recommendation from the group is that the new administration should establish a National Climate Council led by an official who reports directly to the president. This person would help to advance Biden's climate agenda by coordinating with various US agencies. "You need somebody in the West Wing who has the president's ear and who is focused on making climate action happen across the federal government," says Profeta.

The president's most powerful tool when it comes to climate change is regulating

greenhouse-gas emissions directly through the Environmental Protection Agency (EPA). Over the past four years, Trump's EPA has reversed or weakened dozens of environmental regulations, including a trio of Obama-era climate policies targeting emissions from vehicles, power plants and oil and gas facilities. Biden is expected to move immediately to restore – and strengthen – those efforts, but this means starting again and crafting new rules.

"That is the killer, in terms of workload," says Betsy Southerland, who spent more than three decades at the EPA before resigning in 2017 in protest against Trump. "The Biden administration is going to have to make a decision: do they laboriously reverse each one of those rules, or is there something more effective and efficient they can do?"

In the case of the policy on fuel-efficiency standards for vehicles, the administration might move forward with an entirely new rule. The Trump administration rolled back standards put in place under Obama so that the car industry has to boost average fuel efficiency by only around 1.5% per year between 2022 and 2025, instead of Obama's 5% per year. Rather than reworking the rule, the Biden administration will probably move to develop an entirely new set of regulations that look forward another 10–15 years for longer-lasting impact, says David Doniger, strategic director of the Climate and Clean Energy Program at the Natural Resources Defense Council, an environmental group based in New York City.

### The road to Glasgow

Getting an early start on implementing his climate agenda will be crucial as Biden reintegrates the country into the Paris climate agreement.

The president-elect will need to develop a climate pledge and present it to the world at next year's conference in Glasgow, where countries are expected to update their commitments for the first time since the agreement was signed in 2015. Under Obama, the United States initially committed to cut greenhouse-gas emissions by at least 26% below 2005 levels by 2025. The challenge is to make sure the new US pledge is both strong and credible, says Joseph Aldy, an economist at Harvard University in Cambridge, Massachusetts, who served as a White House climate adviser under Obama.

"We have lost credibility on many fronts as a result of Donald Trump," says Aldy. If Biden wants to take a leadership role in the Paris process and push other countries to do more, Aldy says, the president-elect will need to convince the global community that any regulations or legislation he puts in place are going to be effective and won't be easily reversed in four or eight years, when a new president is elected. "Our counterparts around the world will be looking very closely at what we are doing."