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A mural promotes mask use while honouring health workers in Mexico City.

WHAT THE SCIENCE SAYS ABOUT LIFTING MASK MANDATES

With COVID rates dropping and vaccinations on the rise, the United States and other places are removing some requirements for face coverings. Are they moving too fast? **By Lynne Peeples**

A sign is still posted on the front door of the Wolfeboro Food Co-op that reads, "Face masks required." Until recently, another sign had hung directly below it, explaining how the New Hampshire market was following federal policy.

Erin Perkins, manager of the shop, removed that second sign on 14 May — the day after the US Centers for Disease Control and Prevention (CDC) announced that fully vaccinated individuals, in most situations, no longer need to wear a mask. "We weren't expecting that," says Perkins. "It puts us in a precarious position. We were not about to start asking people if they are vaccinated or not."

New Hampshire was the last state in New England to start mandating mask wearing in public to reduce the spread of the coronavirus SARS-CoV-2. And on 16 April, it became the first in the region to lift that mandate, joining several other states around the country that were loosening their pandemic-related restrictions. Cities and businesses in New

Hampshire could still set their own policies, and Perkins wasn't comfortable changing things right away. Even after the CDC announced its latest guidelines — just two weeks after communicating that vaccinated people should continue to mask up indoors — Perkins wasn't personally comfortable with unmasked people in her shop. She also knows that several customers have immune systems that are compromised, and emerging research suggests that people in this group are still at risk even after vaccination[1].

"Until we feel better about the state of things — until the numbers make a little bit more sense to us, we have decided to wait," she says, even if that means dealing with testy customers.

Anne Hoen, an epidemiologist at Dartmouth College in nearby Hanover, can understand Perkins's caution. She says that both the state and federal moves were probably a little too early. Hoen works in New Hampshire but lives just across the border in Vermont, where a state-wide indoor mask mandate remained in force until mid-May, despite Vermont having a lower rate of hospitalizations than practically anywhere else in the country. In the wake of the CDC's announcement, Vermont Governor Phil Scott relaxed the mandate for fully vaccinated individuals.

The weakening policies are out of step with those of many other countries. Germany strengthened its mask requirements at the end of April, for example. It was facing a slowdown in vaccination rates and a surge in cases. Spain tightened its requirements at the end of March.

The evidence is clear that masks cut down on COVID-19 deaths, but nearly a year and a half into the pandemic and with vaccination coverage climbing in many places, public-health scientists and officials are still struggling to get people — particularly unvaccinated people — to wear masks at appropriate times. Average mask use across the United States has been declining since mid-February. Meanwhile, infection rates in some places have increased. A patchwork of policies and mixed messages from both politicians and public-health officials has resulted in confusion, consternation and a mess of data to interpret. "We're all over the map," says Monica Gandhi, an infectious-disease physician at the University of California, San Francisco. "That's been the problem this entire pandemic. We've been making it up as we go along."

It wasn't until late April, for example, that the US government finally distinguished between indoor and outdoor mask use in its recommendations, even though the science had been clear for months that the risk of transmission was much lower outdoors[2]. And now, after the CDC released its latest revision, agency director Rochelle Walensky noted that it could change its mask guidance yet again. Hoen and other epidemiologists warn that it is very difficult to reinstate a rule after it has been revoked.

Mask use will continue for this pandemic, and it's likely to become a common response to future outbreaks. So researchers are trying to get a handle on what the science says about how to encourage people to wear them. As the COVID-19 pandemic enters a new phase, scientists around the world are accessing the accumulated data and asking what makes some policies more effective than others, and probing when and how they need to change.

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Gandhi is among those who emphasize that mask messaging should evolve in light of rising vaccination rates. Officials should begin relaxing restrictions to give people hope and to motivate vaccination, she says. But changes need to be made carefully.

Around the same time that New Hampshire rescinded its rule, for example, COVID-19 cases in India began to surge. Strict mask mandates there had reined in the country's first wave of infections last September. But as COVID-19 numbers came under control, fewer people wore masks, and many attended large gatherings. The disease quickly gained the upper hand. The country is now scrambling to get people to vaccinate and to use masks again.

"Wearing masks should probably be one of the last things we stop doing," says Hoen, adding that she hopes no other countries are looking to the United States for guidance.

Masks and mandates

The case for mask mandates was made relatively early in the pandemic. On 6 April 2020, the city of Jena, Germany, became one of the first communities in the world to require people to wear masks in public. Thomas Nitzsche, the town's mayor, says he was sleepless for two nights before the policy went into effect. "I didn't know if the public would comply," he says. "Luckily, they did."

Researchers estimate that new cases in the city, home to around 110,000 people, dropped by about 75% during the 20 days after the rule was brought in[3].

But it wasn't as simple as flipping a switch one day and then reaping the rewards. Evidence is building that, although a mandate can be a powerful measure, effective messaging and role models are crucial for public uptake.

In the days leading up to the order in Jena, city officials launched a campaign to give the local population an idea of what was to come. Posters around the city declared "*Jena zeigt Maske*" ("Jena shows mask"), and Nitzsche posed for photos on a city tram wearing a mask.

Making the case for masks, and making them obligatory early on, was a common-sense move for Nitzsche. Meanwhile, mask policies in most of the surrounding state of Thuringia and elsewhere in Germany lagged behind. There, officials generally adopted mandates only after case counts surged. Although there were no new COVID-19 cases in Jena five days after implementation of the mask mandate, for example, the virus continued to spread in nearby Erfurt, the state capital, and slowed only after a mask requirement was imposed, according to a preprint study[4] by public-health leaders in Jena.

It was a similar story around the globe, with a few exceptions. China and other Asian nations quickly adopted mask policies that probably prevented large-scale spread of the disease. Nitzsche says he was personally inspired by the Czech Republic, which began requiring masks in certain public places in mid-March 2020.

Klaus Wälde, an economist at Johannes-Gutenberg University Mainz in Germany, says that the rest of the country should have followed Jena's lead. But the asynchronous mask mandates across Germany — and elsewhere — provided Wälde and others with a unique opportunity.

He and his colleagues used data from 401 regions in Germany to estimate the effect of mask mandates on SARS-CoV-2 transmission[3]. They took advantage of the regional variation to create artificial controls, and then estimated what would have happened had the intervention not been implemented. His team's conclusion: requiring people to wear face masks decreases the daily growth rate of reported COVID-19 cases by more than 40%. The economists' approach was "clever", says Hoen. "This adds to the body of evidence that masks work."

In a similar study in the United States, published this January[5], researchers found that a national mandate for employees to wear face masks early in the pandemic could have reduced the weekly growth rate of cases and deaths by more than 10 percentage points in late April 2020. The study suggests that this could have reduced deaths by as much as 47% (or by nearly 50,000) across the country by the end of May last year. Another preprint, published in October, linked mask mandates

MATTHEW HORWOOD/GETTY

A sign about mask requirements goes up at a shop in Wales, UK, after regulations changed there in September.

with a 20–22% weekly reduction in COVID-19 cases in Canada[6].

Still, US data suggest that regulation alone might not have been enough to produce a benefit from masks. In a survey of more than 350,000 people, published this March, self-reported mask wearing increased separately from government mask mandates[7]. The mandates do have an effect, "but when we looked at it, it was really the behaviour of the population that was a better metric", says John Brownstein, an epidemiologist at Harvard Medical School in Boston, Massachusetts, and a co-author of the study. "There's a difference between government policy and community buy-in."

The research builds on evidence from hundreds of observational and laboratory studies, which find that masks protect both the wearer and the people around them. Masks can block viral particles that hitch rides on droplets and aerosols. And a study from the US National Institutes of Health, published this February, further suggests that the humidity that builds up inside a mask could help to bolster the lungs' defences against pathogens[8].

Still, the debate over the effectiveness of masks, and whether or not they continue to be necessary, trundles on. What will it take to get people to wear masks in countries that still mandate them, and, in the United States, if infections surge again? What will motivate the unvaccinated everywhere to mask up, especially as pandemic fatigue continues to rise? Some researchers have looked to lessons from previous crises.

Protective barriers

Early in the HIV–AIDS epidemic in the 1980s, public-health officials faced a major challenge in trying to slow the spread of the virus. The problem wasn't necessarily convincing people that a physical barrier — in this case, a condom — could prevent infection. "I don't think the issue was so much about the level of protection as it was the perception of risk," says Ronald Valdiserri, an epidemiologist at Emory University in Atlanta, Georgia. Whereas homosexual men on the east and west coasts of the United States couldn't ignore the widespread deaths in the gay community early in the epidemic, many heterosexuals saw HIV–AIDS as a "gay disease", and did not consider themselves at risk of infection, he says.

The early days of COVID-19 drew a tragic parallel in many places. "You had people thinking, 'Well, you know, this is not something that's going to affect my community, or my town, or my neighbourhood. So, why should I be wearing a mask?'" says Valdiserri, who co-authored a paper on how the lessons from research on promoting condom use during the early HIV epidemic could inform face-mask policy[9]. "Like any human behaviour, it's more complex than saying, 'Thou shalt do this.'"

Public-health efforts to combat HIV–AIDS have revolved around tailoring the condom-use message and its delivery to different populations. Among sex workers in sub-Saharan Africa, peers have proved to be the best spokespeople. Popular footballers have successfully marketed condom use to men. When HIV swept through San Francisco and New York in the early 1980s, an effective campaign included an attractive gay man communicating to other gay men, and making condoms "fun and sexy", says Susan Hassig, an infectious-disease epidemiologist at Tulane University in New Orleans.

But could face masks ever be made fun or sexy? Although there's been no formal study on the effectiveness of mask marketing, the idea might not be far-fetched. Instructions for creating fun masks for children are easy to find, as are shops selling bedazzled masks for adults. At the Grammy Awards in Los Angeles, California, in March, stars drew attention with masks that matched their outfits.

Helene-Mari van der Westhuizen, a public-health scientist at the University of Oxford, UK, laments how early COVID-19 guidelines framed masks as "sterile and scary" — medical objects that required specific handling and use, including specific temperatures for washing. "Cloth masks and associated fashion brought playfulness and an everyday feeling to mask wearing. That contributed to

HENRY NICHOLLS/REUTERS

A protester displays their displeasure with mask mandates in London.

its acceptability," says van der Westhuizen, who co-authored a paper arguing that policies should consider masking as a social behaviour, not a medical one[10].

Balance and nuance are still important: masks need to work. "Masks with valves became really fashionable," she adds, even though they allow virus particles from infected people to spread. "That's an example of fashion gone awry," says van der Westhuizen.

Further complicating mask use is the fact that masks are not all created equal. Simple cloth masks will "do a good job of protecting others from you, but don't necessarily do a great job of protecting you from others", says Jeremy Howard, a research scientist at the University of San Francisco, who co-authored a January review on face masks[11]. At the other extreme, medical-grade N95 masks might be overkill, he says. They are tested with much higher air pressures than what comes from normal breathing. Although they do protect the wearer, he instead recommends the widely available and more-comfortable KN95 masks.

"It's time for nuanced messaging," adds Gandhi, who co-authored a separate review on the effectiveness of various face masks in January[12]. She says that Germany did the right thing in specifying acceptable masks in its messaging. Cloth masks are no longer enough to comply with the mandate in Jena, or anywhere in the country. In January, Germany began requiring medical-grade or surgical masks in public spaces. The country, which has lagged behind the United States in vaccination rates, further upgraded its rule in April, mandating N95 or KN95 masks on public transport. The country is distributing masks to people who are at high risk of disease and those who can't afford them. And leaders

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are enforcing their use. "If you're not wearing a mask, you'll get fined," says Nitzsche. "Or people will start to stare at you."

Cultural change

South Korea is among the east Asian countries that had a head start on the West. A pre-existing culture of mask use bolstered quick and widespread adoption after the emergence of COVID-19 — a stark contrast to Western nations, where even public-health officials at the World Health Organization and the US CDC were initially dissuading their use, describing them as unhelpful or even harmful.

The culture makes a difference, says Hong Bin Kim, who studies internal medicine and infectious disease at Seoul National University College of Medicine, and is author of a paper detailing mask use in South Korea[13]. Bin's work also highlights the importance of leaders serving as models for the public. Politicians and doctors filled that role in his country, much like Nitzsche and public-health officials did in Jena.

Although it's unlikely that the United States and other Western nations will adopt the same level of mask use beyond this pandemic, van der Westhuizen anticipates it will become much more common and acceptable than before. "It's truly remarkable how widespread this new habit has become," she says. "We have gained a valuable preventative tool."

She is referring to more than COVID-19 and its variants, or even influenza. Tuberculosis, for example, has been a leading cause of death in South Africa and a long-time focus of her research. Although data show that masks could help to control the spread of that disease, social norms and stigma have impeded their adoption[14]. When initial COVID-19 guidelines suggested only people with symptoms needed to wear masks, she says, her thoughts immediately went to tuberculosis, for which public-health officials have made similar concessions. Thankfully, mask recommendations evolved. "The pandemic has broken that previous stigma," says van der Westhuizen.

Hassig is reminded of other public-health interventions. The use of vehicle seat belts first arrived in the United States and United Kingdom as a recommendation, then became a law, for instance. Eventually, police began fining those who were non-compliant, and buckling up became the norm. "Very rarely does a public-health intervention wind up being widely accepted without some kind of enforcement mechanism," says Hassig, who still wears a mask despite being fully vaccinated, in part to encourage mask wearing.

Perkins, meanwhile, has to police her customers in rural New Hampshire — a challenging task without the backing of a state or federal mandate. At least once a day, she says, she gets a customer who asks why the shop still requires masks. One man even chose to leave rather than put on the free mask she offered him. "People just keep asking 'why, why, why, why?' Some people have very strong feelings about it," says Perkins. "I just keep telling people this is our policy at this time. It will change when we feel it is okay to do so."

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