



Open-air learning forms part of the Felix Rodriguez de la Fuente school's programme in Cartagena, Spain, during the COVID-19 pandemic.

ALFONSO DURAN/GETTY

THE SCIENCE BEHIND SCHOOL REOPENINGS

After a school term filled with anxiety and vitriol, researchers assess the spread of coronavirus and the prospects for a return to normal. **By Cassandra Willyard**

On a bright, crisp morning in March, Salah Guyot said goodbye to his stuffed tiger, Stripes, and his cat, Meowington, and started walking the two short blocks to Herbert Schenk Elementary School in Madison, Wisconsin. He had started kindergarten there months ago, but he had only seen his teacher on a computer screen.

This would be his first day inside the school. He looked tiny in his NASA mask and raccoon hat, which he had pulled down over the hood of

his coat. He felt shy and a little nervous about the transition from 'zoomie' to 'roomie'.

Outside the school, carefully chalked messages lined the pavement: "We can't wait to see you!" and "Welcome Ks". Signs directed parents to "Drop your shark off here" and "Hug and kiss goodbye here". Salah hesitated briefly, then made his way to the open double doors.

Back in March, the decision to reopen Schenk and other shuttered schools across the United States sparked heated debate. The US Centers for Disease Control and Prevention (CDC) had announced that schools could

reopen safely without driving up community spread or putting teachers and students at risk, as long as steps were taken to mitigate transmission of the virus. But that did little to calm the anxiety among parents, school staff and even scientists. It sometimes spilled into public arguments.

Monica Gandhi, an infectious-disease researcher at the University of California, San Francisco, often tweets about COVID-19 and schools, but she took a break in March. The discourse became too emotional, especially when people lobbed horrible accusations at

her. “There is one thing that always ends an argument,” she says. That’s “the statement that you would want children dead”.

Now, as the academic year wraps up in many countries, school administrators are taking stock of their experiences and looking to public-health officials to help them plan for the coming school year. In the United Kingdom, children returned to school in March and April. In France, a third COVID-19 wave shuttered schools briefly around that time, but pupils were back in class by May. In the United States, more than half of all school districts had resumed full-time instruction by early June, and nearly all offered at least some in-person learning.

But across the world, 770 million children still weren’t going to school full time by the end of June 2021. And more than 150 million kids in 19 countries had no access to in-person schooling. They were either learning virtually or had no schooling at all. Even when schools open back up, many kids won’t return. The United Nations cultural organization UNESCO estimated last year that around 24 million schoolchildren will drop out as a result of the pandemic. Because they provide so many essential services in addition to learning, schools should be the last to close and the first to open, says Robert Jenkins, chief of education for the UN children’s charity UNICEF in New York City. “There are many countries in which parents can go out and have a nice steak dinner, but their seven-year-old is not going to school,” he says. “That’s a problem.”

A growing body of evidence suggests that schools can be opened safely. But that hasn’t quelled debate over whether they should be open and, if so, what steps should be taken to limit the spread of the virus. By September, when schools in many parts of the world will open again, fresh concerns and debates will be in play. Many teenagers and preteens will have been vaccinated in the United States and other wealthy countries. But in some low- and middle-income countries, vaccine access will still be limited. Younger children will probably still be in the queue in most parts of the world. And the virus continues to mutate and evolve. “The big unknown is a new variant,” says Christina Pagel, a mathematician at University College London.

Debate club

In March 2020, when many schools shut their doors, little was known about SARS-CoV-2. “We closed schools early, not only to help flatten the curve, but also because for most respiratory illnesses, children are the most at risk,” says John Bailey, a visiting fellow at the right-leaning American Enterprise Institute think tank in Washington DC who recently reviewed the literature on schools and COVID-19.

Scientists soon discovered that kids are the least likely to develop serious illness, but

it wasn’t yet clear whether children were as susceptible to infection as adults, and whether kids who did get infected could pass the virus on to others. Some researchers worried that sending children back to school might fuel the pandemic. But the debate soon shifted from a scientific one to a political one.

“SCHOOLS MUST OPEN IN THE FALL!!!” tweeted then-President Donald Trump in July 2020. “That became a partisan moment,” Bailey says. “So many of us we were wired to not believe anything the president was saying.” Tracy Høeg, an epidemiologist and private-practice physician in Grass Valley, California, agrees. “It suddenly became sacrilegious for anyone in science to say it was OK for schools to be open,” she says.

Some of the political divisiveness was inevitable, says Ellen Peters, a decision researcher and director of the Center for Science Communication Research at the University of Oregon



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in Eugene. People who are conservative have different world views from people who are more liberal. But “Trump so vastly exacerbated that”, she says.

Other countries weren’t immune to the squabbling. When Danish primary schools reopened in April 2020, some parents worried that their kids were being used as guinea pigs. In France, where schools have mostly remained open, teens protested last November, saying that COVID-19 protections inside classrooms were inadequate. In some districts, teachers failed to show up as the coronavirus swept through communities. And parents were reluctant to report cases because they would have to isolate at home with their children and might lose their jobs. In Berlin, authorities scrapped plans to partially reopen schools in January, in the middle of a national lockdown, after backlash from parents, teachers and government officials.

One sticking point was the issue of prioritizing vaccines. When schools began to open up in March and April, the vast majority of teachers hadn’t yet been vaccinated. That made weighing up the risks and benefits particularly tricky. “The biggest risks are for the adults in the school system,” says Jennifer Nuzzo, an epidemiologist at the Johns Hopkins Center for Health Security in Baltimore, Maryland. “And the benefits of being in the classroom are for the kids.”

Equity also became a flashpoint in the debate. Researchers argued that remote learning would widen disparities between white students and students of colour in many countries. “The fear is that achievement gaps will become achievement chasms for those kids,” says Robin Lake, director of the Center on Reinventing Public Education, a non-partisan research and policy analysis organization in Seattle, Washington. And kids of colour aren’t the only groups that have been forgotten, Lake says. “We also know that students with disabilities have been left behind, and kids with other complex needs.”

In the United States, however, surveys showed that families of colour didn’t necessarily want in-person schooling. When schools did open, these families were among those least willing to send their kids back. That’s not surprising, says Durryle Brooks, a social scientist at Johns Hopkins University and policy chair for the Baltimore City Board of School Commissioners. “Systems have continually failed Black and brown people in this country,” he adds. Why would that trust suddenly appear now? And sending pupils back to in-person school wouldn’t fix the achievement gap. “In Baltimore City, Black students have been underperforming” for a long time, even before the pandemic, Brooks says.

Study hall

Now, more than a year after the pandemic began, researchers know a lot more about COVID-19. And they know more about how the disease does (and doesn’t) spread. Although some kids and teachers have caught SARS-CoV-2, schools don’t seem to be environments where transmission is rampant. “The rates in the schools have not been higher than in the community,” Høeg says.

Tracking cases in schools is relatively straightforward. But what public-health officials really want to know is whether students and staff are spreading the virus on school grounds, or just bringing in cases they acquired elsewhere. That’s trickier to tease out.

One of the largest studies¹ on COVID-19 in schools in the United States looked at more than 90,000 pupils and teachers in North Carolina over 9 weeks last autumn. Given the rate of transmission in the community, “we would have expected to see about 900 cases” in the schools, says Daniel Benjamin, a paediatrician at Duke Clinical Research Institute in Durham, North Carolina, and co-lead author on the study. But when the researchers conducted contact tracing to identify school-related transmissions, they identified only 32 cases (see ‘Meagre spread’).

That study, published in January, “should have been a watershed event for people who were really going to just be data driven with their policy”, says Jeanne Noble, an emergency physician who directs the COVID-19 response

at the University of California, San Francisco's medical centre. Yet many schools remained closed. Since then, "it's just been a slew of other similar studies", Noble says.

Another study² looked at 17 schools in rural Wisconsin. The research team observed 191 COVID-19 cases in staff and students during 13 weeks in the autumn of 2020, a time of high transmission for that area. Only seven of those cases seemed to originate in the schools. A second study, not yet published, looked at Nebraska. "They were open the whole year with over 20,000 students and staff, and there were only 2 transmission events during that entire study period," Høeg says.

Critics argue that without surveillance testing, kids who don't have symptoms won't be identified or counted, so the true number could be much higher. But even if the real case numbers were double or even triple the numbers in these studies, the transmission rate would have been much lower than in the community, Benjamin says. "It's safer for them to be in school than to be outside of school."

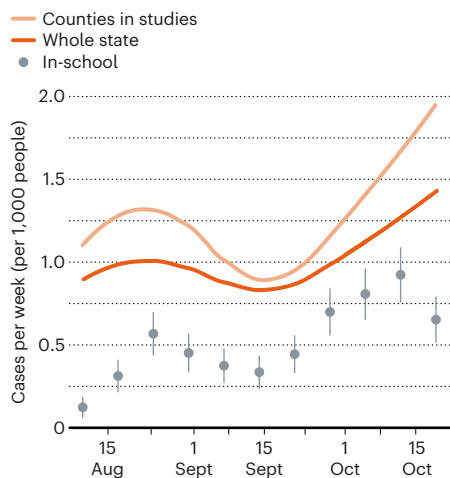
Studies that have included testing tend to show similarly low transmission rates. Researchers in Norway³ identified 13 confirmed cases in children aged 5–13 in schools, and tested nearly 300 of their close contacts to assess the secondary attack rate – the percentage of contacts who become infected from a single case. Just 0.9% of the child contacts and 1.7% of the adult contacts contracted the virus.

In Salt Lake City⁴, researchers went one step further. They offered COVID-19 tests to more than 1,000 students and staff who had come into contact with any of 51 pupils who had tested positive. Of the roughly 700 people who took the tests, just 12 tested positive. The scientists then used contact tracing and genetic sequencing to identify transmissions that occurred at school. Only 5 of the 12 were school-related – an attack rate of just 0.7%. This suggests that students who contract the virus don't tend to spread it at school. A similar study⁵ in New York City found that the attack rate was even lower, just 0.5%.

When mitigation measures aren't in place, however, attack rates can be much higher. In Israel⁶, schools reopened in mid-May 2020. Within two weeks, a large outbreak occurred in one secondary school. Administrators tested more than 1,200 close contacts of the two people who initially tested positive. They identified 153 infected students and 25 infected staff members – attack rates of 13.2% and 16.6%, respectively. By mid-June, the Ministry of Health had identified nearly 90 more cases among the close contacts of those who were initially infected, including family members, friends and team mates. The outbreak was probably exacerbated by a heatwave. To make conditions less stifling, the government had rolled back its mask-wearing rules, and schools had closed windows and started using

MEAGRE SPREAD

Data from 11 school districts in North Carolina show that rates of COVID-19 transmission in 2020 were lower for students attending schools in person than they were for all residents in those districts and for the entire state.



air conditioning, which recycled air inside the classroom. There were too many students to ensure social distancing.

The bulk of the literature on transmission in schools, however, suggests that kids aren't driving viral spread. Investigations in Germany, France, Ireland, Australia, Singapore and the United States show no, or very low, secondary attack rates within school settings.

"It has been perpetuated in the American media that COVID is dangerous and kids are superspreaders and schools are superspreader places," Høeg says. "And none of that has been validated in the scientific literature."

That's not to say there are no risks. Some children have died of the disease. A study⁷ looking at COVID-19-related deaths in children in 7 countries found that 231 kids died of the disease between March 2020 and February 2021. In the United States, the number as of June was 471. Some who died succumbed to a rare, but terrifying inflammatory syndrome. And emerging evidence hints that at least some kids who become infected have symptoms that persist. Deepti Gurdasani, an epidemiologist at the Queen Mary University of London, says some of her colleagues seem too blasé about the impact of COVID-19 on children. "It has really puzzled me why we're so comfortable exposing children to a virus that we haven't studied that much," she says.

But keeping kids out of school comes with its own set of risks. Many parents have seen the social isolation take its toll and witnessed their children struggling to stay engaged with lessons delivered by screen. Emerging studies suggest that kids in remote-learning situations are falling behind academically, especially children who were already struggling. Schools provide more than education. They serve as a safety net for many kids, offering free meals and a safe place to spend the day. Educators

and school counsellors are often the first to spot signs of domestic or sexual abuse and intervene. What's more, the closure of schools has been a disaster for many working parents. Those with young children were left trying to juggle virtual school, normal parenting duties and their own jobs.

Emergency physician Leana Wen, currently at George Washington University's Milken Institute School of Public Health in Washington DC, argues that many have been focused on the wrong question. "Stop asking whether schools are safe. Instead, acknowledge that in-person instruction is essential; then apply the principles we learned from other essential services to keep schools open," she wrote in a *Washington Post* opinion piece.

Justin Lessler, an epidemiologist at Johns Hopkins University, agrees. "We've already decided school is important," he says. And "we should do important things, even when they're hard".

Advanced calculus

In countries where vaccination programmes have moved forwards rapidly, it looks like schools will open in the next academic year with fewer restrictions and mitigation measures than they have had over the past few months.

The greatest source of uncertainty, however, is the emergence of new variants. The variant of concern B.1.617.2, or Delta, which was first identified in India, seems to be about 40–60% more transmissible than the Alpha variant, B.1.1.7, which was first noticed in the United Kingdom, and has supplanted Alpha to become the dominant variant.

In the United Kingdom, cases have begun to skyrocket. In a study⁸ posted on a preprint server, researchers randomly swabbed individuals across the nation for COVID-19. Between 20 May and 7 June, the rate of positive cases grew exponentially, with a doubling time of 11 days. By 7 June, about 90% of the cases were attributed to the Delta variant. The prevalence was highest in children aged 5–12 and in young adults. That worries Gurdasani.

Measures such as mask wearing and improved ventilation should help to curb the spread of the virus in schools, even for the more transmissible variants. But the science around which mitigation measures matter most is not yet settled. Initially, the CDC advised schools to keep students 6 feet (1.83 metres) apart; in March, it halved that, on the basis of new studies. In the United Kingdom, the guidance is to distance when and where it's feasible. "Doing this where you can, even some of the time will help," the documents note. In the Wisconsin schools, says Høeg, "we actually had students at less than three feet in the classroom this spring", she says. Yet they identified only two cases of in-school spread even with surveillance testing of people with

SOURCE: REF. 1



Preschoolers at Stark Elementary School in Stamford, Connecticut, practise social distancing.

no symptoms. “The distance of two, versus three, versus six feet doesn’t seem to be what’s making the difference,” she says.

And although the evidence supporting mask use indoors has been accumulating, it is still a controversial topic. When schools reopened in England in March, only secondary-school students were required to wear masks. But the UK Department of Education stopped recommending face coverings for pupils and staff on 17 May “based on the current state of the pandemic and the positive progress being made”. Some schools in which cases have surged have reintroduced mask policies. In US schools, mask use varies from state to state and district to district. The CDC changed its guidance on masks in May, and now says that vaccinated people do not need to wear them. In the wake of that announcement, mask mandates have been dropped across the country. A handful of states even passed laws that prohibit local school districts from requiring them indoors.

Gandhi, Høeg and two other specialists wrote an op-ed in the *Washington Post* arguing that kids should “return to their normal lives in the upcoming school year, without masks and regardless of their vaccination status”.

But others take a more cautious view. Kate-lyn Jetelina, an epidemiologist at the University of Texas Health Science Center at Houston, found the op-ed unconvincing. “It doesn’t give the full story,” she says. Jetelina points out that transmission is still really high among unvaccinated people in the United States, and most

“**The system just collapsed because everybody was looking at everybody else waiting for direction.”**

kids aren’t yet vaccinated. “We need to keep that at the forefront of our minds,” she says.

Still, case numbers in the United States are at the lowest they’ve been since late March 2020. The number of deaths has plummeted, and more than 80% of teachers have been vaccinated. In May, New York City, the country’s largest school district, announced that schools will be opening full time in the autumn. “We have every reason for optimism,” Gandhi says.

Høeg agrees: “At some point we have to say that COVID has reached a level of risk where we would be better served by going back to a more normal life.”

Whether that time is now is up for debate. The United Kingdom might prove to be a cautionary tale about the risks of lifting restrictions and mitigation measures too soon in the face of fresh variants such as Delta.

Lake hopes the pandemic will provide a much-needed reset for public schools. “Public education has really been designed to do

things the same way and to minimize risk, not to innovate and solve unsolved problems,” Lake says. The pandemic highlighted the huge disadvantages of that model. “The system just collapsed because everybody was looking at everybody else waiting for direction,” she says.

UNICEF’s Jenkins also wants to avoid a return to the status quo. Even before the pandemic, there were plenty of schools that were failing kids. Jenkins wants teachers and administrators to think creatively about how to bring the technology that students relied on for virtual learning into the classrooms, how to teach important skills such as problem solving, and how to address not just learning, but mental health, nutrition, social-emotional development and more. “We have a once-in-a-generation opportunity to welcome kids back to vibrant new interactive ways of learning,” Jenkins says. “It would be a great shame if we didn’t seize that opportunity.”

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Clarification

This Feature gave the impression that Tracy Høeg's work on school openings was done at the University of California, Davis. In fact, she did this in her capacity as an independent researcher.