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What winter holds for covid-19

Will the spread of the coronavirus accelerate in the northern hemisphere this winter? Adam Vaughan investigates

WITH hindsight, we may come to see late summer in the northern hemisphere as the calm before the storm. While many countries in the north have suppressed the spread of covid-19 for now, there is growing evidence warning us that winter could undo that progress.

Researchers are racing to pinpoint what role temperature and humidity may have in the spread and severity of the illness. They are exploring how SARS-CoV-2, the virus that causes covid-19, will interact with other seasonal respiratory viruses. And people are scouring data from winter in the southern hemisphere to see what the north might face.

These questions are a matter of life and death. In the UK alone, a reasonable worst-case scenario in the event of a resurgence of the coronavirus this winter estimates that there could be as many as 251,000 deaths in hospitals – although the total under the range of possibilities within this scenario is more likely to be less than half that. Whatever the outcome, UK scientific advisers expect cases to increase this winter.

The weather is the obvious change coming. To predict how this will influence the virus’s spread, we need to disentangle the effects of weather from other confounding factors, such as how countries have responded, different demographics and variation in testing rates.

“Some leaders assumed that this would go away in hot weather. That could have led to complacency”

“We have insufficient data on positive coronavirus cases on individual days. The inference you can make is restricted,” says Cohen.

If it is too soon to tease out a link, what are the plausible ways winter weather could affect respiratory viruses like influenza and SARS-CoV-2?

“There have been studies showing warmer temperatures and humid climates prohibit these kinds of viruses. That’s why, in temperate regions, we tend to see them peaking in winter. But the mechanisms are not well understood,” says Lowe.

Colder temperatures could directly affect the survival of the coronavirus itself. We know that flu viruses are more stable on surfaces in the cold, and lower temperatures are associated with increased shedding of flu virus by infected people. With winter sun delivering less virus-destructing ultraviolet light, the coronavirus may be able to survive on surfaces for longer. The winter peak in respiratory viruses might also be because colder weather hampers how our immune system functions – through a lack of vitamin D, for example. Or it could simply be about how we behave, crowding indoors in winter.

Indoor humidity, which is usually at its lowest in winter because of domestic heating, could affect things too. Gordan Lauc at the University of Zagreb in Croatia and his colleagues looked at 7000 people with covid-19...
role in the severity of covid-19. Didn't account for comorbidities, for example, Lauc's research factor, "he says. There are caveats. Weather is a very important factor, but there are other factors. We cannot claim there is such a thing behind covid-19."

On the face of it, though, there seems another way to predict what winter holds: just look at what happened in the southern winter. "Some of the experience in Brazil is not all that encouraging, but on the other hand, New Zealand and Australia are doing pretty well," says Andrew Hayward at University College London. Drawing parallels is hard, however, as both Australia and New Zealand had a much more effective initial response to the pandemic than places like the UK and US. Using the south's winter as an analogue for the north's is unlikely to be further complicated by potentially differing background levels of immunity to the coronavirus in populations and socio-economic factors. "There are scientists in Australia who believe the winter conditions are exacerbating the risk in Melbourne," says Lowe, referring to the recent spike of cases in the state of Victoria. "I personally think it's too early to say. I don't think we have enough data."

Perhaps the biggest issue this winter in the northern hemisphere will be how a virus new to humanity interacts with the existing ones that peak in the season: influenza, respiratory syncytial virus (RSV) and the four coronaviruses that already circulate widely and can cause the common cold (see "Could co-infection cause coronavirus to evolve?", page 10). Respiratory infections tend to transmit more easily in the winter. That applies to seasonal coronaviruses as well, which are the closest analogue we’ve got to SARS-CoV-2," says Hayward. Covid-19 first surged in the northern hemisphere at the end of the peak for respiratory viruses, resulting in countries entering lockdown. This winter promises the opposite. "By the time we hit the winter, maybe we've got back more to normal - with more crowded public transport, people using the shops, going into work more - and my concern is, if you add on the extra degree of transmissibility that winter brings, that could kick [the transmission rate] up to higher levels," says Hayward.

An obvious problem is that other respiratory viruses cause symptoms, such as a dry cough and high temperature, that can also occur with covid-19. At the infection peak of a normal winter in the UK, there are around half a million people with a cough or fever, says Hayward. Overlapping symptoms are likely to increase the workload for the testing- and contact-tracing schemes governments are relying on to keep outbreaks in check.

Another concern is whether catching flu makes you more susceptible to having severe covid-19, and vice versa. That is why governments, including the UK's, are expanding their annual flu vaccination programmes. There is "no strong evidence" from the pandemic's first wave that co-infection with another virus makes covid-19's symptoms more severe, concluded research by Cariad Evans at Sheffield Teaching Hospital, UK, and her colleagues. But the same study notes that those with both influenza and covid-19 in England and Scotland did have higher odds of death than those without flu, after adjusting for age and sex. Evans and her colleagues also say that other viral infections may possibly spur the transmission of the coronavirus by increasing how much it is shed.

There is one other big question about how different viruses interact this winter. Sema Nickbakhsh at the University

**Look south for clues**

Meanwhile, research efforts are intensifying. The UN World Meteorological Organization held a virtual conference in August looking at the potential impact of the weather. At the event, secretary general Petteri Taalas referred to seasonal environmental factors, saying: "So far, I haven’t clear indications whether there is such a thing behind covid-19."

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Drawing parallels is hard, however, as both Australia and New Zealand had a much more effective initial response to the pandemic than places like the UK and US. Using the south's winter as an analogue for the north's is likely to be further complicated by potentially differing background levels of immunity to the coronavirus in populations and socio-economic factors. "There are scientists in Australia who believe the winter conditions are exacerbating the risk in Melbourne," says Lowe, referring to the recent spike of cases in

Australia saw less flu in winter due to face masks and other measures
of Glasgow, UK, and her colleagues last year found that above-average flu years provide a short-lived protective effect at a population level that could explain why respiratory viruses fall in those years. Similarly, infections by rhinoviruses, some of which cause the common cold, were found to lower the chance of being infected by the 2009 strain of H1N1 swine flu. How this happens isn’t fully understood and we don’t know if this has any relevance for the coronavirus.

That fuzziness makes the coming winter hard to predict, says Nickbakhsh. Based on her previous work, she says: “My first hypothesis would be no interactions with flu, but potential for interactions with RSV.” A harmful effect would be a problem as RSV is one of the world’s biggest killers of children under the age of 5.

A dampener on flu

There may be some good news, though. For one, social distancing and face mask-wearing because of covid-19 could lead to fewer flu infections this winter. That appears to have happened in Hong Kong and Australia.

Restricted foreign travel and quarantines may help too. We don’t have a good handle on where flu goes in the northern summer. It could carry on circulating at low levels or be reseeded from the south each season – or both of these may play a part. If reseeding from the south is a big factor, international air travel restrictions may further dampen the north’s flu season.

Scientists are also exploring whether infection by the seasonal coronaviruses that winter brings might trigger some cross-immunity to the new coronavirus through T-cells, the immune cells that help the body fight invading pathogens. For now, we don’t know.

Testing will be key to working out some of these unknowns. Little simultaneous testing for influenza and the coronavirus was done in the UK at the end of last winter, partly because the flu season was ending and because laboratories were overburdened. “Going forwards, we really need to be able to test for all of the pathogens,” says Nickbakhsh.

The UK government’s goal is to have capacity for half a million SARS-CoV-2 tests a day by October, up from about 350,000 now. But without a significant improvement in testing and tracing as UK schools and society reopen, there could be a second peak this December more than twice the size of the first, according to research by Jasmina Panovska-Griffiths at University College London and her team.

Winter is coming. How the northern hemisphere fares will hinge on whether nations prepare enough in advance and act fast enough when it arrives.

Monitoring for outbreaks and imposing local lockdowns is a good idea, but speed will be of the essence this winter, says Hayward. “You don’t have much time to make decisions when infections are increasing. It could be catastrophic”

Could co-infection cause coronavirus to evolve?

Graham Lawton

DOCTORS may be fretting about concurrent outbreaks of flu and covid-19 (see page 8) but some virologists are worrying about another scenario: a Frankenvirus. SARS-CoV-2, the virus that causes covid-19, almost certainly originated from the hybridisation of two different coronaviruses. The details remain hazy, but the virus’s genome sequence suggests that this mash-up occurred in a bat about a decade ago. The bat was simultaneously infected with two closely related coronaviruses, which merged into a new one.

Such recombination isn’t unusual for coronaviruses. “If you look in the family tree of coronavirus, there’s recombination everywhere,” says virologist Samuel Diaz-Muñoz at the University of California, Davis.

It occurs for two reasons. First, coronaviruses are tolerant to co-infection. Unlike many other viruses, they allow co-infection of the same cell by other viruses. Second, the way coronaviruses replicate their genomes makes hybridisation not just possible but likely. They are RNA viruses, which usually have very high rates of mutation – the highest rate of any known biological entity – because the enzymes that copy their RNA don’t have a proofreading function.