What is avian influenza H5N1 and how can we protect ourselves?

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What is avian influenza H5N1 and how can we protect ourselves? Infectious disease expert Matthew Miller answers questions about vaccines, viruses and ways to stay safe. Credit: McMaster University

A recent outbreak of H5N1 at a mink farm in Spain caused international concern that the avian influenza virus might be creeping closer to achieving pandemic potential.

We asked Matthew Miller, scientific director of the Michael G. DeGroote Institute for Infectious Disease Research about the merits of those concerns.

Miller's lab, which also supports Canada's Global Nexus for Pandemics and Biological Threats, has a long history of studying flu viruses. In fact, his team, in collaboration with scientists from across Canada and the U.S., is currently working on a universal flu vaccine that would offer broad protection against all influenza viruses.

While the H5N1 virus is highly pathogenic, it is not yet able to cause widespread infection in humans, Miller says. Still, it is a very serious threat, and he advises staying informed as the situation progresses.

Here's what you need to know:

What is H5N1?

H5N1 is what we call a highly pathogenic avian influenza virus. What differentiates it from other types of influenza is that it is very deadly. Waterfowl (i.e., ducks, geese, etc.) are the natural hosts of most influenza A viruses, and highly pathogenic H5N1 can kill birds in really high numbers.

In birds, influenza virus causes infection in the gastrointestinal tract and can be spread through birds' feces. Spillover events can happen when animals or humans come into contact with infected birds or the feces of infected birds.

Influenza viruses are often very limited in the tissues that they can infect, but highly pathogenic avian influenzas like H5N1 can cause infection throughout the body, including in places like the brain. This is what makes it particularly deadly for not only birds, but other animals

and humans too.

How has it evolved recently, and why are such changes concerning?

Highly pathogenic H5N1 has been around for a long time, but it used to be significantly more geographically limited. Spillover events were more common in Asia, the Middle East, and northeast Africa, but over the past year, waterfowl that migrate along seasonal migratory paths from Europe had a large outbreak of H5N1. As they migrated, they brought that virus with them throughout Europe and into North and South America.

Birds like to congregate in farm fields and in coastal areas, so this poses a particular risk to these areas, where other species of animals often live.

In Canada, there was a large outbreak of highly pathogenic H5N2 influenza virus in turkey and chicken farms in 2015. The good news is that there are really good surveillance programs in place on the agricultural side to detect highly pathogenic avian flus in poultry.

Another change we've seen recently is increased spread into other animal species, like mink and sea lions. Mink are very susceptible to flu, but what has been observed in the past is that the spread of this virus into mink usually causes a dead-end infection. This means mink aren't spreading it to other mink—they're only getting it from infected birds or their droppings.

But what seems to have happened recently in Spain is that the virus has recently been transmitted from mink to mink. This has raised some concerns because mink are mammals, so they're biologically one step closer to humans than birds are.

Although there's been an extraordinarily high death rate in people who get infected with highly pathogenic avian influenza—around 50 percent—humans, like mink, have historically been a dead-end host. We don't transmit the virus efficiently to other humans. This is a prerequisite for pandemics, and is a reason why H5N1 has not caused a pandemic to date.

Does the virus have pandemic potential for humans?

Efficient transmission between humans is a prerequisite for a pandemic, and there is currently no evidence that the virus is capable of doing this, so the pandemic risk is low, at least for now. That said, the risk posed by H5N1 warrants hyper-vigilance when it comes to surveillance and prevention.

Almost 10 years ago, there was a series of very famous studies that experimentally tried to determine how the virus would need to change in ferrets to move beyond dead-end infections and become transmissible. The authors discovered a series of mutations that were associated with transmissibility.

Though it's not clear whether these same mutations would enable the virus to transmit in humans, they at least give us something to monitor and help assess risk.

In addition, the authors found that initially—when the virus could not transmit—it caused very severe disease in the ferrets. But as the virus became transmissible in ferrets, it no longer caused severe disease. So the evolution toward transmissibility reduced the virus' pathogenicity. There's no guarantee that this will always happen, but for respiratory viruses, what often occurs is that when they cause severe disease, they do so in the lower lung.

But more efficient transmission tends to occur when the virus moves toward the upper respiratory tract, which in turn often reduces infection severity.

Viruses only "care" about transmitting efficiently. Virulence, or the severity of illness a virus causes, is a secondary by-product of infection.

Are there any vaccines or therapeutics available to help protect against or treat H5N1?

Unlike the situation we were in with COVID-19, where there were no approved vaccines at all on the market for any type of coronavirus, we have a huge global infrastructure for developing and distributing flu vaccines. In fact, new flu shots are literally produced every year. So to make a vaccine for a new flu virus, we can rely on the existing vaccine manufacturing processes that we use for seasonal flus.

However, there are some limitations. The process of producing a new vaccine to respond to a pandemic is slow—probably too slow to stop a pandemic from happening. In addition, the efficacy of flu vaccines could always be better.

But the good news is that we know how to make them, there are existing manufacturing facilities located all around the world, and many manufacturers already stockpile avian flu vaccines in the event that a new epidemic or pandemic were to emerge.

We also have a small number of approved antivirals for influenza. Most H5N1 viruses are susceptible to these drugs.

Your lab has been working on developing a universal flu vaccine. Is that something that could help against highly pathogenic flus, like

H5N1?

A universal vaccine would be a game-changer to mitigate risk of pandemics caused by highly pathogenic flus. In the event of a new flu pandemic, a universal vaccine would reduce the number and severity of infections, buying researchers time to develop an even more specific vaccine to address the specific virus that is circulating.

We're also working on "universal" monoclonal antibodies. During the COVID-19 pandemic, we saw the approval of monoclonal antibodies to prevent infection in high-risk people and to treat people who were severely ill. The problem was that as the virus evolved and mutated, those antibodies didn't work anymore. But we've identified antibodies that bind to parts of the flu virus that are shared among all types of flu, and are intolerant to mutations, and so we could deploy those antibodies to provide immediate immunity to people.

This is beneficial because, when you get a vaccine, it takes about two weeks for your body to mount an immune response that protects you. But when you get antibodies, you're protected right away. So having these different layered approaches is really important to pandemic preparedness strategies.

What can people do to protect themselves from catching H5N1?

The most important thing right now is to be incredibly cautious around birds, because they are the main vehicles for spreading these highly pathogenic avian flus. Hunters, farmers, poultry workers, and even homeowners who has birds on their property should be particularly cautious right now. People should also avoid direct handling of dead animals.

Is there any risk to consuming poultry right now?

No. Surveillance is excellent in poultry farms, so consumption of poultry really shouldn't be a risk. Plus, H5N1, much like the virus that causes COVID-19, is a virus that is very environmentally sensitive. So, when you cook poultry, you would definitely kill any possible traces of the virus in the process.

What are some common symptoms to watch for, and when should you see a doctor?

Flus in humans typically present as a respiratory infection. But the difference with highly pathogenic avian flus is that they can spread beyond the respiratory tract and that's what makes them so dangerous. It's highly unlikely that you would contract H5N1 at this point, but, as a general rule, if you experience any signs of illness that you think are unusual (e.g., fever, chills, muscle aches, severe lethargy), that's always the best time to see a doctor. The average person has an extremely low risk of contracting H5N1 at this point.

Provided by McMaster University

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