Researchers study dynamics of workers at poultry farms and markets to track bird flu

August 19 2013, by Rina Shaikh-Lesko

Live poultry markets bring many animals and people together in one place, increasing the risk of flu strains spreading between them. The highly pathogenic H5N1 avian influenza A has has been detected in birds in about 60 countries. Credit: Mario Ruckh

When a new strain of bird flu surfaced in China in February, it was an ominous echo of the 1997 outbreak in Hong Kong. People connected to poultry markets were again falling ill as scientists raced to decipher a novel strain: Who gets sick from it? Who dies of it? How do they catch it?

"What's happening in China is influenza doing what it does," said Stephen Luby, MD, professor of medicine and director of research at Stanford's Center for Innovation in Global Health. "Flu is a highly

changeable virus. It behooves us to understand the evolution of these viruses and how they move into people."

Today, he and several other Stanford researchers are part of team studying how the virus is transmitted between people. To do so, they are focusing on human social networks—specifically, the dynamics among people who spend time on farms and in poultry markets—using methods pioneered by James Holland Jones, PhD, associate professor of anthropology. Most models of contagion assume people in a group, like a town or a live-bird market, mix equally, but that's not usually the case. Most people only interact with a small group that they know. Some people, however, serve as bridges connecting otherwise separate subgroups. These bridges may be the best targets for medical interventions like vaccinations or antiviral treatment.

Understanding how flu spreads in hot zones, among people who have frequent contact with birds, which are a regular source of new flu strains, could provide critical information about whom to target for treatment when the next pandemic strain emerges.

The team has a one-year seed grant from the Fogarty International Center at the National Institutes of Health to begin studying these interactions among people who work on poultry farms and in poultry markets in Bangladesh. The team hopes to use its findings over the next year to expand the study to other countries where the the highly pathogenic strain of H5N1 avian influenza A virus circulates. This strain of bird flu was first known to have infected humans in Hong Kong. (A less virulent subtype of the virus, H7N9, was the cause of the more recent bird-flu outbreak in China.) Researchers from UCLA, the University of Oklahoma, the International Centre for Diarrhoeal Disease Research in Bangladesh and the nonprofit organization EcoHealth Alliance also are collaborating on this project.

In July, Ashley Hazel, PhD, a postdoctoral scholar in Jones' lab, departed for Bangladesh to begin collecting preliminary data. She'll be working with local health officials to track interactions among people who work at poultry farms and poultry markets, as well gather information on people who report to hospitals with flu-like symptoms and flu outbreaks among poultry in the country. She and other members of the team will analyze social network interactions between people who are in contact with poultry to see the routes the flu virus could take once it jumps from birds to people. Jones has already used this method to study how flu might be spread in settings like high schools in the United States. "We want to understand the types of social connections—what people who work in live-bird markets are like," he said.

Bangladesh, which has had an ongoing avian flu epidemic in its domestic birds, is a good starting point. Luby came to Stanford in 2012 after eight years leading the Centre for Communicable Diseases at the International Centre for Diarrhoeal Disease Research in Bangladesh. The research builds on his previous collaborations with local public health officials on avian influenza in that country, but the addition of human-network analysis means the researchers will have much better information about interactions on many levels.

"The new piece that the project with Jamie Jones brings is looking at human networks," Luby said. "Who are the people who connect one community with another—who's going to the markets, and who's having contact." Human influenza can spread between people standing just a few feet apart, so understanding how people move physically in large groups can provide details critical to stopping it.

The findings from the study could help health authorities see where the influenza virus is likely to spread rapidly between people once it spills over from animals to humans. For example, Luby said, it could be due to large live-bird markets that stay open 24 hours a day, but not weekly

markets. The researchers may be able to identify certain people—poultry wholesalers, for example—who are more likely to spread the virus. Authorities can then focus prevention strategies on those people who are hubs of infection. Antiretroviral therapies and vaccines are usually prohibitively expensive for poor countries to provide to everyone. But if health authorities know with some confidence that vaccinating people in a particular job category will help, it becomes more feasible to use those tools.

Flu can infect many kinds of animals. It's common in pigs, poultry and people. Farms and live poultry markets bring many animals and people together in one place, making it easy for flu strains to spread between them. In poor countries, farmers usually can't afford to separate their flocks from wild ducks and other birds, which are known to carry H5N1.

They also can't afford to separate their animals from the people in their households.

"When I say raising them in the backyard, I mean they're not confined," Luby said. "So they're running around the living area, the eating area, going in and out of the houses. The children are picking them up."

Influenza viruses are constantly remolding their identities, mixing their genetic material with other strains. This process is called reassortment. The dominant circulating strains also change constantly. The annual influenza vaccine changes every year based on which strains are circulating and most likely to cause flu each season. Multiple strains that infect an animal can mingle, swapping genetic material and potentially creating a unique strain of flu. Flu viruses can also swap genetic codes for other qualities, like the ability to spread from person to person or the ability to cause serious illness, leading to a high death rates. The chances that the virus will jump to members of the farmer's household are higher if animals have frequent contact with people.

Usually, these genetic changes are gradual, but periodically, a radically different virus will appear, like the H1N1 flu virus, popularly known as swine flu, in 2009. Farms and poultry markets are pivotal environments for these genetic shake-ups.

"We remain concerned with the risk that the strains of influenza could develop the capacity to efficiently infect humans," Luby said. "This could be very dangerous."

When the highly pathogenic version of H5N1 first emerged in 1997 (there is also a milder form), Hong Kong's bustling poultry markets were shut down and millions of birds were slaughtered to control the infection. By the end of the year, hundreds of people became ill, about 20 were hospitalized and six died as a result of the virus. In 2003, it re-emerged. Since then, it has been spreading across the globe, infecting more than 600 people in 15 different countries, and killing 60 percent of them. It's been found in domestic birds in about 60 countries, ranging from West Africa to Northeast Asia, and is still spreading. Despite the slaughter of hundreds of millions of domestic birds and export bans from affected countries, the virus continues to circulate widely. Experts worry it could turn into a deadly pandemic flu virus.

Throughout the 20th century, influenza pandemics infected thousands of people, though none matched the devastation and the terror of the 1918 Spanish flu, which infected a third of the world's population and killed 50 million. Whenever a new strain makes the leap from animals to humans, health authorities worry that it will have all the ingredients for another deadly pandemic.

For now, H5N1 rarely infects people and doesn't spread easily from person to person. But because it's so widespread in birds and mutates at such a gallop, its potential to spark a global pandemic makes health authorities anxious to control it. But they can't do that until they better

understand how flu spreads among networks of people.

Even after several years of studying the virus, scientists don't entirely understand why the same strain seems to behave so differently, depending on what part of the world it's in. For example, in Bangladesh, H5N1 swooped in as a large outbreak among the country's poultry in 2007 and has made a permanent home there. But it's led to just a handful of human cases in the intervening years. In contrast, in Thailand and Vietnam, outbreaks occasionally roll through the country like surf crashing against a shoreline, infecting hundreds of animals and dozens of people in a short period, but then receding quickly.

"We're trying better to understand the ecology of the places where the virus lives," Luby said.

While the study's immediate goals are to develop a flu prevention tool for poor nations, Luby points out that it has wider implications. "We're addressing the risk of disease emergence in low-income countries, but the risk is to all humanity," Luby said. What they learn could crack some of influenza's toughest mysteries and help us prepare for the pandemic that scientists fear is right around the corner.

Provided by Stanford University Medical Center