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In Southern China, a Mixing Bowl of Swine Flu

By **BRYAN WALSH** Wednesday, May 25, 2011

Pigs may seem cute, but from a virological perspective, they're oinking time bombs. That's because swine can become infected with both avian and human flu viruses, making them influenza mixing bowls. An avian virus can reassort with a human one inside the cells of a pig, mutating and potentially producing a new flu strain that humans have no protection against. That's one way that influenza pandemics can ignite — and when flu pandemics are bad, they're really bad.

Unfortunately, scientists have rarely been able to systematically track the spread and type of flu viruses in pigs — meaning that we're often caught off guard when a new virus emerges to infect human beings, as happened during the H1N1/A flu pandemic of 2009. But there's one place where researchers are keeping close tabs on the swine flu viruses: Hong Kong, a crowded, globalized city where pandemics have begun in the past.

Thanks to new research published in the May 25 *Nature*, scientists have a better idea than ever before about how flu viruses spread among pigs. A team of scientists from Hong Kong, Singapore and the U.S. looked at the epidemiology and genetics of swine flu viruses in Hong Kong from more than 650 samples taken from pigs over 12 years of direct surveillance, and along with more than three decades of supplemental data. They found that the range of swine flu viruses was much larger than scientists had believed, and that the growing genetic diversity of the viruses was likely due to cross-border import of pigs into southern China.

Here's how it works: over the past 20 years, pig producers in southern China have imported swine from North America and Europe, in part to improve the breeding stock. (Southern China is home to the world's biggest population of pigs, and pork is a mainstay in the country's diet — in 2006, the Chinese ate more than 50 million metric tons of pork.) The imported pigs brought whole new families of flu virus with them, and those viruses mixed among the dense population of Chinese pigs. As a result, new strains have emerged, including the Eurasian avian-like H1N1 virus — which is particularly worrisome, because human beings have no immunity to that lineage.

As lead author Vijaykrishna Dhanasekaran, a professor at Duke-NUS Graduate Medical School in Singapore, said in a statement:

> I think the risk of swine-to-human transmission has not increased greatly, but the diversity of swine viruses has increased as shown in our study. This means that the repertoire of viruses that humans are in contact with everyday has increased and this may lead to a higher likelihood of swine-to-human transmission, although the risk remains unquantified.

Just because we don't have antibodies to a flu virus doesn't mean it will be deadly — the ultimate death toll from the 2009 pandemic was relatively small — but the new strain may spread easily among human beings. The best way to protect ourselves is through vigilant surveillance of viruses in pigs, so that researchers can identify new viruses as they emerge and gear up for pandemic prevention. The 2009 flu pandemic may have even been light, but that doesn't mean the next one will.

REUTERS

Flu viruses rode on pig imports into southern China - study

Wed, May 25 2011

By Tan Ee Lyn

HONG KONG, May 26 (Reuters) - China may have unwittingly introduced swine flu viruses when it imported pigs from Europe and North America for breeding over the past few decades, researchers said.

Three virus families are endemic in pigs in southern China and one of them - the Eurasian avian-like H1N1 flu virus from Europe - is viewed as most threatening because humans have no antibodies against it, said the researchers, who published their findings in Nature magazine on Thursday.

The researchers in Hong Kong, Singapore and China reached their findings after monitoring swine flu viruses in pigs in Hong Kong over a 12-year period.

"We found that since 2001, the Eurasian (flu) viruses and North American viruses had entered pig populations in southern China and replaced the earlier viruses," said Vijaykrishna Dhanasekaran, assistant professor at the Duke-NUS Graduate Medical School's Program of Emerging Infectious Diseases in Singapore. "The import of breeding pigs has increased in southern China over the 20 years, this was done to improve the breeds," he said by telephone from Singapore.

From 1998 to 2010, Dhanasekaran and colleagues collected more than than 650 flu virus samples from pigs that ended up in a Hong Kong abattoir and found they all belonged to three lineages.

The most dominant was the Eurasian avian-like H1N1 virus. First detected in pigs in Belgium in 1979, it quickly became the most common flu virus in pigs in Europe.

The other 2 lineages are the North American H1N2 swine flu virus which has been circulating in pigs in North America since the 1990s and the H1N1 swine flu virus which has been circulating worldwide, including in China, for more than 80 years.

VIRUSES RODE ON BREEDING PIGS

"The introduction could have most likely been the breeding pigs ... Now we have a better understanding of how viruses travel globally," said Dhanasekaran.

The Eurasian avian-like virus was potentially most problematic because people do not have immunity, or antibodies, to fight it, he said.

"We have this Eurasian avian-like H1N1 virus which we don't have any antibodies (against) ... and it is likely that this virus can spread among humans easily," he said.

He urged other regions to conduct similar disease surveillance in animals.

"The diversity in other areas can be different and what they should do is conduct surveillance and target viruses that we don't have antibodies towards and these would most likely be candidates for pandemic preparedness," Dhanasekaran said.

What experts fear are animal viruses new to people making a jump to humans and sparking a pandemic. This was how the H5N1 bird flu virus and SARS spread around much of the world in 2003. In 2009, a novel H1N1 swine flu virus caused a pandemic.

Eighty to 95 percent of pigs slaughtered in Hong Kong originate in southern China, which has the largest swine population in the world. (Editing by Robert Birsel) (Created by Ee-lyn Tan)

Featured Articles

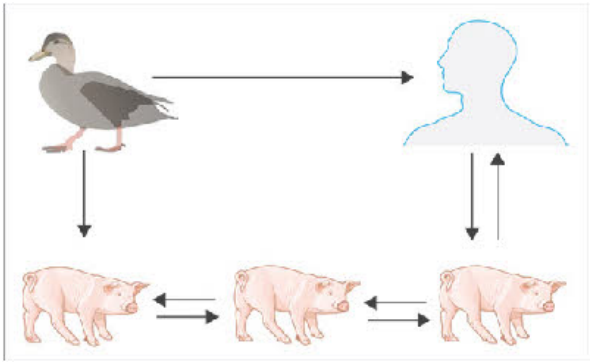
Long-Term Study of Swine Flu Viruses Shows Increasing Viral Diversity

Friday, May 27, 2011

Increased transportation of live pigs appears to have driven an increase in the diversity of swine influenza viruses found in the animals in Hong Kong over the last three decades, according to a new study.

In the longest study of its kind, Duke–NUS Graduate Medical School researchers found that swine viruses crossed geographic borders and mixed with local viruses, increasing their diversity.

"The majority of reported human infections have been people with close contact to farm animals," said Vijaykrishna Dhanasekaran, PhD, an assistant professor at Duke-NUS, who works in the Laboratory of Virus Evolution.



The gene flow of influenza A viruses occurs among birds, pigs and humans

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"This means that the repertoire of viruses that humans are in contact with everyday has increased and this may lead to a higher likelihood of swine-to-human transmission, although the risk remains unquantified."

The study was published online in the journal, *Nature*, on 25 May.

"The geographic transport of swine viruses that we highlight in our study is likely through the transport of live pigs," Dr Dhanasekaran said.

"Most swine viruses that have been described to date have been isolated from farmed pigs in Asia, Europe and North America. Some viruses have been isolated from backyard pigs in southeast Asia. However, no information is available on status of influenza in naturally roaming wild or domestic pigs."

The study looked at the epidemiology, genetics, and antigenic properties of swine influenza virus in Hong Kong from more than 650 samples taken from swine, more than 800 swine blood specimens from 12 years of surveillance, and 34 years worth of other data on swine flu viruses.

Antigens are the features on the surface of the virus that pigs and humans develop antibodies against to fight the infection. Influenza viruses evade the immune response by mutations in the haemagglutinin protein, an attachment protein that

serves as an antigen.

Antibodies formed during previous infections fail to recognise the newly mutated antigen, which is why seasonal influenza vaccines have to be reformulated each year.

Mutations in the swine influenza hemagglutinin have been linked to reassortment, which is the mixing of genetic material from multiple virus species into new combinations, said Dr Dhanasekaran. The greater viral diversity they found in the swine flu viruses may mean more possible combinations from reassortment.

"These results provide important clues into the mechanism of influenza virus evolution in general," he said.

The researchers discovered that two major lineages of H1 subtype viruses and the human H3N2 viruses were frequently detected in swine. Several combinations of the three lineages were detected in pigs, including some avian (bird) viruses.

While the pigs had no symptoms or very mild undetected symptoms to most viruses isolated for the study, the scientists do not know how virulent these viruses can be in humans.

"It is important to monitor viruses in swine, especially those that can emerge in humans that we do not have antibodies for," said Dr Dhanasekaran, who is a faculty member of the Duke-NUS Program on Emerging Infectious Diseases.

Dr Dhanasekaran and Gavin Smith at the Laboratory of Virus Evolution (LoVE) at Duke-NUS conducted the genetic analyses with Dr Oliver Pybus at Oxford University. The swine surveillance used data on swine specimens collected over 34 years, and the laboratory work was done by the University of Hong Kong.

The work was supported in part by the US National Institute of Allergy and Infectious Diseases (NIAID) and the Area of Excellence Scheme of the University Grants Commission of the Hong Kong SAR Government.

The Food and Environmental Hygiene Department of Hong Kong facilitated the study. The authors also note the support of the Royal Society of London, UK COSI, and the Agency for Science, Technology and Research, and the Ministry of Health, Singapore.