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Computer Model Could Help Prevent Flu Pandemic

Close disease surveillance and targeted use of anti-viral drugs could be enough to keep a small outbreak of avian flu from becoming the first influenza pandemic in 36 years, according to a new computer model designed to prepare at-risk nations for a pandemic that could affect millions worldwide.

The best weapon is containment, said Neil Ferguson, a Howard Hughes Medical Institute international research scholar and professor of mathematical biology at Imperial College London. Ferguson headed a study whose findings are being published online by the journal *Nature* on August 3, 2005.

The last influenza pandemic occurred in 1968, caused by a virus that first appeared in Hong Kong. By September of that year, the so-called Hong Kong flu had arrived in the United States, and by March 1969, an estimated 675,000 Americans had gotten sick and nearly 34,000 had died. Scientists say that an outbreak of avian or bird flu, the most likely candidate for an influenza pandemic, could be much worse now because humans have no immunity to it, and in today's world, infected persons can travel almost anywhere within 48 hours, potentially transmitting the virus to every individual they encounter along the way.

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- Neil Ferguson

The first human cases of avian flu were reported in Hong Kong in 1997, where hundreds were infected and six people died. In that outbreak, humans contracted the virus from infected poultry. But viruses tend to mutate, and scientists fear the virus that causes avian flu—H5N1 influenza A virus—might alter its molecular structure and become transmissible from human to human. There is no vaccine for H5N1, and even if there were, it

would be difficult to develop and distribute enough vaccine for all those at risk around the world.

In the scientists' computer model, a single resident of a rural village in Thailand was infected with a mutated H5N1 virus capable of human-to-human transmission. Scientists say that an avian flu pandemic would likely begin in southeast Asia, and the researchers chose Thailand because the type of national data they needed was easily accessible. Using information on past influenza pandemics, they calculated the number of secondary cases that would occur from the original infected individual, the normal incubation period of the illness, and the speed with which the pandemic would spread.

They then added demographic information such as regional and national population size and age; numbers of households, schools and large companies; and distances that people travel to work and school. This gave them a map of how the virus might spread.

It took the research team a year to collect the data for their model. "You need to collect as much data as possible ahead of time for this sort of modeling," Ferguson said. Few countries in the region publish information about locations of schools and major companies, how far people travel to get to school or work, and use of public transportation, and even where they do, the data needs to be collated and analysed before scientists can use it, he explained.

After crunching the data, the researchers used the model to test a number of strategies to limit the spread of the influenza virus. Since no avian flu vaccine currently exists, they proposed anti-viral prophylaxis as a way to reduce the risk of infection among people surrounding the initial cluster of flu victims. Prophylaxis involves treating healthy people with drugs to protect them against infection. It is like a temporary vaccine.

"To be effective," Ferguson said, "you really must use a combination of strategies. No single one would successfully prevent an epidemic."

"To apply this model in real-time during an outbreak, you'd use it to track the epidemic, to predict trends, to see if what you're doing is working," the scientist added. "Models can be used ahead of time to find out what needs to be done logistically to contain the spread of the virus or mitigate its effects".

The first step in preventing a pandemic, Ferguson said, is for doctors to quickly recognize that the virus is something unusual and notify government health officials. Then, infected patients should be isolated from other populations. Steps such as closing schools and work places and limiting access to gathering spots should be taken to increase "social distance"—reducing opportunities for infected people to transmit the virus to others. Finally, Ferguson and his colleagues recommend that public health

officials treat the 20,000 people closest to the outbreak with anti-viral drugs. It might take a stockpile of as many as 3 million doses of anti-viral treatments to eliminate an outbreak, the scientist said.

The effort and resources required to implement these types of policies are considerable, Ferguson noted. In addition to a drug stockpile, surveillance needs to be improved, and public health teams who would implement a containment strategy need to be trained.

During a new pandemic outbreak, the model would have to be applied within a few days or weeks to be useful in the control effort. "It's an enormous undertaking that will require cooperation among governments on a large scale. But that's what necessary for this to become more than just a computer model, but an actual possibility," Ferguson said.