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IU scientists use NSF Funding to assess risk of potential flu pandemic spread via global airlines

BLOOMINGTON, Ind. -- An Indiana University School of Informatics-led team of researchers has constructed a model that predicts how an emerging pandemic influenza might spread across the globe by airliners.

The study, "Modeling the Worldwide Spread of Pandemic Influenza: Baseline Case and Containment Intervention," appears in the January issue of the journal PLoS Medicine. The model they devised is said to be the world's largest-scale epidemic simulation of its kind.

Study investigators were Vittoria Colizza, informatics visiting assistant professor; Alessandro Vespignani, professor of informatics; Marc Barthélemey, informatics visiting scholar; Alain Barrat, Université Paris-Sud, France; and Alain-Jacques Valleron, Institut National de la Santé et de la Recherche Médicale, France.

H5N1 avian influenza, commonly referred to as bird flu, has not yet resulted in a pandemic influenza because the virus lacks the ability to spread efficiently and sustainably among humans. However, public health officials are greatly concerned that a human flu strain could be triggered by the H5N1 virus, which is found in bird flocks around the world and has repeatedly crossed the species barrier and infected people.
The recent outbreaks of avian flu started in Southeast Asia in mid-2003. Within two years, the virus had spread beyond that region, very likely carried by wild birds along their migratory routes. The avian influenza virus has been reported in several Asian countries, the Balkans region, Western Europe and some regions in Africa.

"The threat of a pandemic is pushing the international community to discuss scenario analysis and develop adequate preparedness plans," Colizza said. "This calls for the need to understand the possible propagation of a pandemic, in order to devise and test appropriate intervention strategies to contain and mitigate its evolution and impact on the population."

The researchers developed a mathematical model using massive passenger-flow databases from the International Air Transport Association, an organization of airlines comprising 99 percent of worldwide commercial air traffic. Census information from more than 3,000 urban centers in 220 countries and related disease patterns from those areas also was analyzed.

The model already was introduced in a previous study conducted by the same researchers more than a year ago, showing in detail how air-transportation-network properties are responsible for the worldwide pattern of diseases. Using advanced computational tools, the team was able in both studies to simulate how an influenza pandemic would spread, both over time and geographically, and to provide forecasted scenarios and confidence intervals.

Here's one scenario the model predicts: A flu virus, say, originating in Hanoi, Vietnam, with a reproductive number of 1.1 (a measure of how many people are infected on average by an infectious person) poses only a very mild global threat. Increase that number to 1.5 and the flu potentially could infect half the population in more than 100 countries. Intervention measures would therefore be necessary.
The researchers show that strict travel restrictions would do little, if anything, to prevent the flu from spreading throughout the globe.

Encouragingly, the model predicts that the use of antiviral drugs would significantly thwart a global flu outbreak within certain ranges of infectiousness if every country in the world had a drug stockpile sufficient to treat 5-10 percent of their populations.

Next, the study focused on realistic scenarios in which antiviral resources are not equally distributed, with a higher concentration in wealthy countries. Different strategies are compared: a selfish strategy in which each country relies on its own supplies, as opposed to a cooperative approach in which prepared countries would donate part of their resources for global use.

"Surprisingly," said Vespignani, who is internationally known for his research in the statistical analysis and computer modeling of epidemic spread, "the cooperative strategy is shown to be more effective in delaying the pandemic evolution and mitigating its impact on the population of both donor and recipient countries."

Predictions therefore are strongly in favor for a cooperative sharing of resources, which could be organized and managed by the World Health Organization, as an efficient way to deal with an emerging influenza pandemic waiting for vaccine development.
The IU School of Informatics study was funded by the National Science Foundation and the European Community Directorate for Information Technology.

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