

Social Network Predicts Flu Spread

by Carrie Arnold on 15 September 2010, 5:10 PM

If you want to know when you'll catch the flu, just look at your friends. Researchers who tracked flu symptoms in the friends of a group of college students during the 2009 H1N1 "swine flu" pandemic predicted the flu outbreak in the general college population with at least 2 weeks' advance notice.

In recent years, scientists have improved disease surveillance systems that enable public health officials to follow the emergence and spread of infectious diseases. Most systems collect information from the entire population, such as how many people have visited the doctor for flulike symptoms and how many flu tests have been submitted to the health department. In recent flu seasons, the lag time—the gap between a person showing symptoms of an illness and that data being available to epidemiologists—has decreased to as little as 1 week. Although this improvement gives epidemiologists a better idea of how many people are ill, it doesn't allow them to track an outbreak in real time or anticipate its spread.

With the arrival of H1N1 flu last year, social scientists Nicholas Christakis of Harvard University and James Fowler of the University of California, San Diego, realized they had an unusual opportunity to use their knowledge of social networks to forecast a flu outbreak among undergraduates. Their predictions depend on a characteristic of social networks known as the friendship paradox, which states that your friends have more friends than you do. Although it seems that on average your friends should have the same number of friends as you do, a person named as a friend actually has more friends than you, because people named as friends tend to be more popular. They also tend to be better connected and more central to the social network.

Previous research showed that well-connected people in a network caught infectious diseases before those with fewer connections. Christakis and Fowler hypothesized that these friends could serve as sentinels of a flu outbreak. "We could follow the central people in the network, and those people should, mathematically, be more likely to get anything that's spreading in the network sooner," Christakis says.

The authors randomly chose 319 Harvard undergraduates, who then named 425 of their friends. The researchers checked on the health of these 744 students between 1 September 2009, and 31 December 2009 using two different methods: a twice-weekly e-mail survey that asked the students if they had any flu symptoms and the students' records at the campus health clinic. Christakis and Fowler [report](#) online today in *PLoS ONE* that students in the friend group showed signs of the flu between 14 and 69 days before the epidemic peaked in the control group of randomly selected undergraduates.

"What our method offers is the premise of predicting the future," Christakis says. To apply the strategy to the general population, he notes, all researchers would have to do is ask a randomly selected group of people to identify their friends and then track when these friends become ill. "Today, you can know where the epidemic will be in 2 weeks."

"It's like trendspotting for germs," says Jennifer Gardy of the British Columbia Centre for Disease Control in Canada, who was not a part of the study. Just as fashionistas can predict what next year's popular clothing designs will be by looking at the hipsters of today, Gardy says, epidemiologists can determine when a disease will become widespread by looking at people named as friends.

This lead time can give public health officials more time to develop an effective response to the outbreak. "It's a great practical application of network theory," says network scientist Dirk Helbing of the Swiss Federal Institute of Technology in Zurich. "It can really save lives, particularly as the forecast time reaches 2 weeks. It's enough lead time to take action," such as initiating a vaccination campaign.

But Jonathan Fielding, director of public health in Los Angeles County in California, urges more study first. "This needs to be tried with larger groups than college students living in close proximity," such as people living in a specific city or state, he says.

Social bugs. Influenza symptoms (red circles) in the friends of a randomly selected group of Harvard University undergraduates (yellow circles) showed up 2 weeks before the infection peaked in the general population (white circles).
Credit: Stockbyte/Thinkstock.com, inset: Courtesy James Fowler/UC San Diego

