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Pandemic warning system keys on 'human factors'

WEST LAFAYETTE, Ind. - Researchers are proposing a new system that would warn of an impending pandemic before the first case of disease emerged in a given population by detecting subtle signals in human behavior.

"The goal is a public information and awareness system for pandemic with the same level of credibility, timeliness and visibility as storm-warning icons presented on television screens," said Barrett Caldwell, a Purdue University associate professor of industrial engineering.

The system works by monitoring "event phases" of human behavior leading up to a pandemic, such as an increase in people purchasing flu-related medications or "foraging" on the Internet for certain types of information related to the flu.

Understanding these phases might be a way to overcome a fundamental hurdle in controlling pandemic: Conventional approaches require public-health officials to know when certain events leading to pandemic begin, Caldwell said.

"The problem with this requirement is that by the time you know an event has happened, it's often too late to do much about it," he said.

Caldwell and former Purdue industrial engineering doctoral student Sandra K. Garrett have proposed a new approach to warn the public of an impending pandemic.

"If you can recognize the triggers, the signals suggesting an event is likely to occur, you can start responding to it, gathering resources, preparing and mobilizing people," said Garrett, an assistant professor of industrial engineering at Clemson University. "Our basic research idea could be used for any pandemic, or even other types of disasters."

Garrett and Caldwell detailed the findings in a paper that will be presented June 2 at the Industrial Engineering Research Conference in Miami.

The paper shows how pre-pandemic events are separated into four categories of "human factors," or social behavior: a period during which it is first possible to detect signals of an emerging pandemic; a time when it is possible to begin early efforts to prevent or mitigate spread; a time when it is critical to implement such measures; and a period when it is time to complete mitigation steps.

The method is an elaboration of "signal-detection theory," conceived decades ago.

"Normally, when psychologists study signal detection, they

are looking at very rapid changes, like whether a tone changes, whether a light changes color or turns on and off," Caldwell said.

The new approach proposes to make signal detection sensitive to more gradual events that are slower to develop.

"This is important because a pandemic is not a single point in time but a scenario that may take place in several waves over a period of months," he said. "One of the challenges is that the way influenza spreads, you don't know that someone's sick until several days later, and by then they have had the opportunity to infect other people. At that point you have to project backward to see where people have first been sick and where certain flu-related events have happened. You are reactive, rather than proactive."

The researchers envision a system that uses icons similar to those used to alert the public about an impending blizzard, hurricane or tornado. The new approach would enable public health officials to properly manage "event deadlines," or respond to a problem before it's too late.

"For example, by now we have many cases in the United States, so the event deadline for closing travel boarders with Mexico has already passed," Caldwell said.

The method also would enable officials to recognize a critical "trigger" that marks when people are prompted to act in certain ways based on a mental preview of what they think may happen in the near future.

"This trigger could be that something has already happened or you think that something is going to happen so you are doing something to prepare yourself," Caldwell said. "There are no swine flu cases yet, but you think there might be cases near where you live. You go out and buy cans of food and extra juice, and so on."

A need for such a warning system can be seen in the World Health Organization's unexpectedly rapid response to swine flu, Caldwell said.

"Health officials were very surprised that the World Health Organization went from a phase 3 pandemic alert to phase 5 in 48 hours," he said. "The pandemic preparation materials produced a few years ago stated that these sorts of decisions could be expected to evolve over several days to maybe two weeks, but not two days. So the events have unfolded much faster than people were expecting."

The research was funded by a grant from the Indiana State Department of Health through Purdue's Healthcare Technical Assistance Program, based at Purdue's Discovery Park, which strives to improve health-care performance and delivery.

In related work, the researchers have collaborated with health officials and hospitals in Indiana to determine an "alternative care system" that may need to be activated once a pandemic reaches the local area.

"A pandemic flu alternative care system is designed to respond to concerns that the existing hospital structures may not have the capacity to respond to the number of flu cases," Caldwell said. "One of the problems that we uncovered in research was that a really complex alternative care system requires even more advance planning and even more coordination of signals to know when and how to activate. Something that starts out with just a flu-information telephone number isn't bad, but we had looked at systems all the way up to temporary satellite hospitals

that just handled incoming flu patients."

Previous research emphasized that counties should recognize when and what type of alternative care system would be required based on the signals officials received, determining when to activate the system based on where cases were being reported.

Writer: Emil Venere, (765) 494-4709, venere@purdue.edu

Sources: Barrett Caldwell, 765-494-5412, bscaldwell@purdue.edu

Sandra Garrett, 864-656-3114, garrett@clemson.edu

Purdue News Service: (765) 494-2096; purduenews@purdue.edu

Note to Journalists: Barrett Caldwell is on sabbatical at Tufts University. He can be reached by calling 617-661-2587. A copy of the research paper is available from Emil Venere, Purdue News Service, at 765-494-4709, venere@purdue.edu

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ABSTRACT

Human Factors Aspects of Planning and Response to Pandemic Events

Sandra K. Garrett
(Department of Industrial Engineering, Clemson University)

Barrett S. Caldwell
(School of Industrial Engineering, Purdue University)

The authors describe issues and problems with the definition of "event" as applied to healthcare planning and response to pandemic outbreaks. Unlike traditional signal detection or engineering modeling approaches, events may occur as scenarios that emerge over time, with stages of preparation, proactive and reactive response, and management of deadlines. This paper addresses an expanded characterization of events, using analogies from perceptual and cognitive aspects of signal detection, as well as concepts from resource foraging. The conceptual framework presented in this paper specifically highlights the nature of probabilistic detection of future events, the relationship between event progression and resource foraging types, and the management of event deadlines.

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