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Researchers use a game to change how scientists study outbreaks

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An international team of scientists has created an innovative tool for teaching the fundamentals of epidemiology—the science of how infectious diseases move through a population.

The team teaches a workshop annually in South Africa that helps epidemiologists improve the mathematical models they use to study outbreaks of diseases like cholera, AIDS and malaria. Led by Steve Bellan from the University of California at Berkeley, the team created a new game as a teaching aid for the workshop. The exercise, which has proven extremely effective in demonstrating concepts in epidemiology, is presented in the April 3 edition of the online, open-access journal *PLoS Biology*.

In the game, players simulate a real-life epidemic by passing around pieces of paper that say, "You have been infected," followed by instructions for propagating the disease.

"Infectious disease modeling is an established field of study in bio-mathematics," said Juliet Pulliam, a biologist at the University of Florida and co-author on the paper. But there has been a tendency for mathematicians doing this sort of work to operate separately from practitioners on the ground who track diseases as they are spreading, she said. The game is meant to illustrate why collaboration yields better results.

"Not knowing how data about an outbreak was collected can lead to

misinterpretations," Pulliam said. For example, if procedures change for how infected individuals are counted, it could create a spike in the data that falsely portrays how the disease is actually being spread. The misinformation, once introduced into a model, could throw off projections and interfere with efforts on the ground to prevent further outbreaks.

Collaborations between bio-mathematicians and classical epidemiologists have resulted in valuable lessons for tracking the spread of diseases, Bellan noted. For example, HIV interventions and efforts to eliminate trachoma, a bacterial infection that causes blindness, have successfully used the tag-team approach. In both cases, studies have shown that when practitioners employ the power of mathematical modeling to improve their intervention strategies, they are more likely to interrupt the progress of an epidemic.

"This is about the importance of collaboration," said Bellan, an ecologist who specializes in epidemiology of wildlife diseases. "No one can be an expert in everything. We want to see more scientists working together from the start."

To that end, Bellan, Pulliam and six other scientists from South Africa, Canada and the US, offer two-week clinics every year at the African Institute for Mathematical Sciences. The clinics immerse epidemiological number-crunchers more fully into the human aspects of how disease spreads. The addition of the new game has significantly changed how this is achieved.

In the game, an "infectious" piece of paper notifies people that they have been exposed and instructs them to email Bellan of their fate. They then use a random number generator to determine how many others should be infected, and then pass that number of "infections" to other participants. The rules serve to propagate the disease, but also to build a data set of

who infected whom and when. "The drill produced an outbreak with data that looks like a real epidemic," Pulliam said.

Clinic attendees typically spend the first week talking about where data sets come from, who collects them, and what the numbers refer to. "Using the game as a way to demonstrate those issues instead of talking about them is instructive on its own," Pulliam said.

But the real benefit came during the second week, when groups experiment with various epidemiological models using actual data sets – typically from HIV studies or other ongoing projects.

"Many opted to work with data sets from the game," said Pulliam. They found that familiarity with the process for collecting data greatly improved their ability to customize mathematical models so that they accurately represented how a disease was moving through a population.

"And that's exactly what we wanted them to get out of the workshop," she said.

More information: Bellan SE, Pulliam JR, Scott JC, Dushoff J, the MMED Organizing Committee (2012) How to Make Epidemiological Training Infectious. PLoS Biol 10(4): e1001295. doi:10.1371/journal.pbio.1001295

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