

From herd immunity and complacency to group panic: How vaccine scares unfold

April 5 2012

Worries over vaccine risks can allow preventable contagious diseases, such as measles and whooping cough, to make a comeback. A new study, published in *PLoS Computational Biology*, shows how to predict ways in which population vaccinating behavior might unfold during a vaccine scare.

"These findings might help in evaluating and developing global [immunization programs](#) and [public health policy](#)", said Professor Chris Bauch of the University of Guelph's Department of Mathematics and Statistics.

Prof. Bauch and Samit Bhattacharyya of the University of Utah developed a mathematical, "Behavior-incidence" [model](#) based on [game theory](#) and social learning. They tested the model with real data from two infamous vaccine scares in England and Wales: the 1970s [pertussis](#) outbreak and the measles-mumps-rubella vaccine scare in the 1990s. In both cases, the publication of alleged vaccine risks was followed by a media firestorm in national newspapers, television, and radio. In light of this, the fact that it took 4-5 years for vaccine uptake to bottom out was puzzling. They found that the model could explain the patterns of the vaccine scares very well, and could also be applied predictively to the data sets.

The model captured the interplay between disease dynamics and vaccination behaviour during those episodes. One of the theoretical dynamics for the model was the phenomenon known as "herd

immunity"; an entire population—including unvaccinated individuals—can be protected from infection by vaccinating only a certain percentage of the population. This suggests that immunization programs can be victims of their own success as past vaccinations drive disease incidence to such low levels that unvaccinated individuals feel no incentive to get vaccinated, creating ideal conditions for vaccine scares and thus future outbreaks.

Due to these conditions, as Prof. Bauch says, "Vaccine scares could become more common as eradication goals are approached for more vaccine-preventable diseases. Such models could help us predict how vaccine scares might unfold and assist in mitigation efforts."

More information: Bauch CT, Bhattacharyya S (2012) Evolutionary Game Theory and Social Learning Can Determine How Vaccine Scares Unfold. *PLoS Comput Biol* 8(4): e1002452.
[doi:10.1371/journal.pcbi.1002452](https://doi.org/10.1371/journal.pcbi.1002452)

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Citation: From herd immunity and complacency to group panic: How vaccine scares unfold (2012, April 5) retrieved 25 April 2024 from <https://phys.org/news/2012-04-herd-immunity-complacency-group-panic.html>

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