

Voluntary vaccination programs shown effective for some diseases

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"Conventional wisdom - and conventional theory - tells us that when infection can potentially be spread to almost everyone in a community, such as for measles, a disease outbreak can never be contained using voluntary vaccination," says Chris Bauch and Ana Persic, researchers from the University of Guelph. "However, our work shows conventional wisdom may be wrong for diseases that are spread primarily through close contact, such as smallpox." Their findings appear in the open-access journal *PLoS Computational Biology* on February 6th.

Previous studies have suggested that voluntary programs cannot be 100% effective due to the self-interested behavior of individuals. However, most mathematical models used in these studies assume that populations mix homogenously - in effect, that an individual is just as likely to be infected by a complete stranger as by a close friend or family member. But that is not how infections spread with diseases like smallpox or SARS, which are predominantly to close social contacts.

In this new study, Bauch and Perisic analyze "free-rider" effects under voluntary vaccination for vaccine-preventable diseases where disease transmission occurs in a social network. Individuals choose whether to vaccinate based on the risk of infection from their neighbors and any risks associated with the vaccine itself. Neighbors of an infected person will vaccinate as soon as their neighbor's symptoms appear, so when neighborhood size is small, voluntary vaccination results in rapid containment of an outbreak. As neighborhood size increases, a threshold is reached beyond which the infection can break through due to the

decisions of neighbours who choose not to vaccinate.

"This approach injects greater realism into the transmission modeling of close contact infections and gives us a much more nuanced picture of how people's behavior influences the effectiveness of voluntary versus mandatory vaccination policies," said Bauch. "For those pathogens that are difficult to transmit, the conventional wisdom that free-rider effects will make eradication difficult under voluntary vaccination may be wrong."

More information: Perisic A, Bauch CT (2009) Social Contact Networks and Disease Eradicability under Voluntary Vaccination. PLoS Comput Biol 5(2): e1000280. doi:10.1371/journal.pcbi.1000280
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