Can social isolation fuel epidemics?

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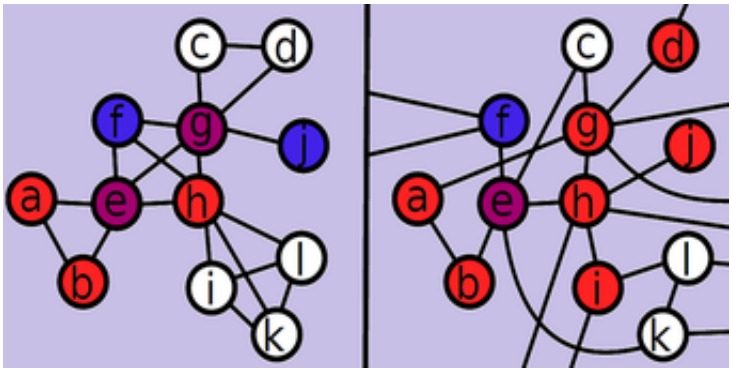

Conventional wisdom has it that the more people stay within their own social groups and avoid others, the less likely it is small disease outbreaks turn into full-blown epidemics. But the conventional wisdom is wrong, according to two SFI researchers, and the consequences could reach far beyond epidemiology.

In a paper published in the July 20 early edition of the *Proceedings of the National Academy of Sciences*, Laurent Hébert-Dufresne and Benjamin Althouse show that when two separate diseases interact with each other, a population clustered into relatively isolated groups can lead to epidemics that spread like wildfire.

"We thought we understood how clustering works," Hébert-Dufresne says,"but it behaves exactly opposite to what we thought once

interactions are added in. Our intuition was totally wrong."

At the heart of the new study are two effects that have had a lot of attention in recent years—social clustering and coinfection, in which one disease can change the infection dynamics of another—but haven't been studied together. That, Hébert-Dufresne and Althouse say, turns out to be a major omission

Ordinarily, the pair say, clustering limits outbreaks. Maybe kids in one preschool get sick, for example, but since those kids don't see kids from other preschools as often, they're not likely to spread the disease very far. Coinfection often works the other way. Once someone is sick with, say, pneumococcal pneumonia, they're more likely than others to come down with the flu, lowering the bar for an epidemic of both diseases.

But put the effects together, Hébert-Dufresne and Althouse discovered, and you get something that is more—and different—than the sum of its parts. While clustering works to prevent single-disease epidemics, interactions between diseases like pneumonia and the flu help keep each other going within a social group long enough that one of them can break out into other clusters, becoming a foothold for the other—or perhaps a spark in a dry forest. Both diseases, Althouse says, "can catch fire." The end result is a larger, more rapidly developing, epidemic than would otherwise be possible.

That conclusion has immediate consequences for public health officials, whose worst-case scenarios might be different or even tame compared with the outbreaks Hébert-Dufresne and Althouse hypothesize. But there are equally important consequences for network scientists and complex systems researchers, who often think in epidemiological terms. Two ideas, for example, might interact with each other so that both spread more rapidly than they would on their own, just as diseases do.

Now that they've realized the importance of such interactions, "we hope to take this work in new and different directions in epidemiology, social science, and the study of dynamic networks," Althouse says. "There's great potential."

More information: "Complex dynamics of synergistic coinfections on realistically clustered networks." *PNAS* 2015 ; published ahead of print July 20, 2015, DOI: 10.1073/pnas.1507820112

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