Community ecology can advance the fight against infectious diseases

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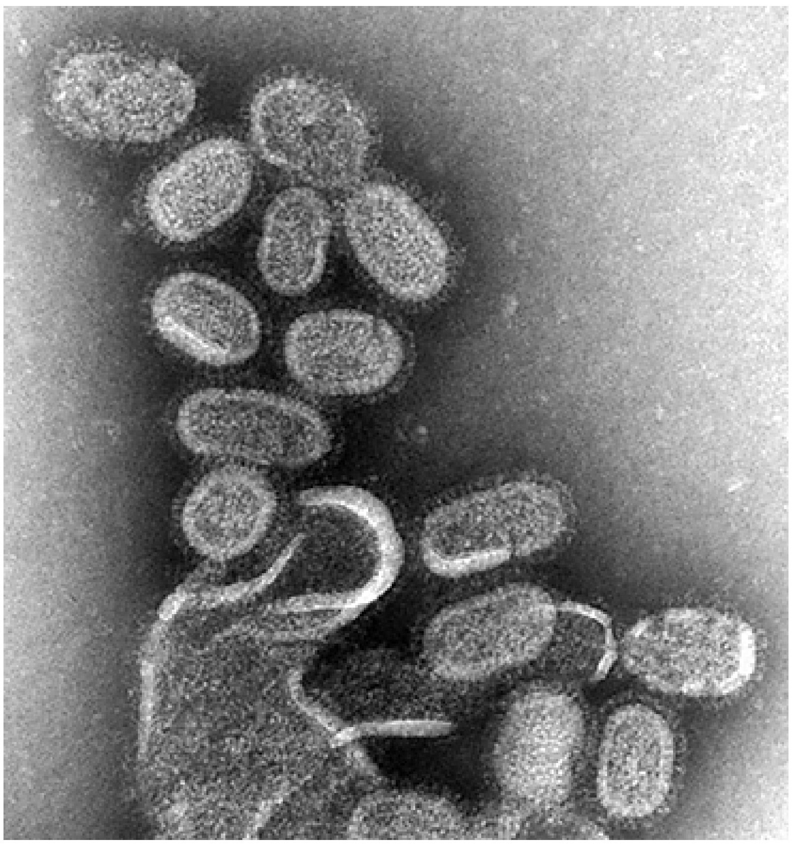

Electron microscopy of influenza virus. Credit: CDC

Despite continued medical advances, infectious diseases kill over 10 million people worldwide each year. The ecological complexity of many emerging disease threats—interactions among multiple hosts, multiple vectors and even multiple parasites—often complicates efforts aimed at controlling disease. Now, a new paper co-authored by a University of Colorado Boulder professor is advancing a multidisciplinary framework that could provide a better mechanistic understanding of emerging outbreaks.

In a study published today in the journal *Science*, researchers demonstrate how community ecology, which focuses on how species interact across different scales of biological organization, can provide new analytical tools for thinking about diseases and their wide-ranging impacts.

"We tend to think of infectious diseases in terms of interactions between a single host and a single parasite," said Pieter Johnson, associate professor in the Department of Ecology and Evolutionary Biology at CU-Boulder and lead author of the study. "But almost without exception, emerging infections are embedded within a complex network of interactions among multiple hosts and multiple vector species, which means that standard one-to-one biomedical approaches can't solve the issue alone."

The study highlights the need for a broad contextual understanding of diseases. Strategies range from managing symbiotic microbial communities within individuals (encouraging beneficial gut bacteria, for example) to preserving biodiversity on a large ecological scale.

"For example, co-infection of mosquito hosts with bacteria can be used to reduce transmission of dengue virus," said Jacobus de Roode, a professor in the Department of Biology at Emory University and a co-author of the paper.

Similarly, the researchers point out, the community ecology-based approach focuses on identifying key ways in which diseases can spread through larger populations. Parasites do not affect all individual hosts equally, and not all infected hosts spread disease as effectively as others. Previous research has shown, for example, that sexually active male field mice transmit around 93 percent of tick-borne encephalitis despite representing only 20 percent of the infected population.

"Super-spreaders" have played an outsized role in human disease outbreaks as far back as Typhoid Mary in the early 1900s and, more recently, epidemics of HIV and SARS. Focusing on these super-spreaders may help quell the spread of an infection through a population.

"This can be either at the individual level, as in Typhoid Mary, or at the community level," said Andy Fenton of the Institute of Integrative Biology at the University of Liverpool and a co-author of the paper. "For example, during the recent Ebola outbreak in West Africa, traditional burials acted as super-spreader events, and the institution of sanitary burials played a large role in curbing the epidemic."

Although it remains unlikely that humans will ever eradicate certain diseases entirely, Johnson said, it may be possible to mitigate them with this approach.

"Using ecological principles to understand how infections emerge and move back and forth between humans and wildlife will provide concrete strategies to manage and reduce disease levels," he said.

More information: Why infectious disease research needs community ecology" www.sciencemag.org/lookup/doi/ … 1126/science.1259504

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