

Researchers reveal hidden patterns that help explain stubborn persistence of measles

August 23 2013, by Steve Carr

Despite the availability of a cheap and effective vaccine, measles remains a leading cause of childhood mortality worldwide, killing more than 150,000 individuals in 2011. In a new study, researchers at the University of New Mexico have revealed hidden patterns that begin to explain the stubborn persistence of measles.

By analyzing historical (1925–1945) weekly case reports from cities in the U.S. and England & Wales, they showed how a city's population size explains long-term patterns of measles epidemics.

"I like to compare measles epidemics with wildfires," said Christian Gunning, UNM Biology Ph.D. student and lead author on the paper published in the August issue of *Ecology Letters*. "If lots of fuel builds up, you tend to get explosive fires, or epidemics. When the fuel runs out, the fire goes out."

With immunity-conferring viruses such as measles and influenza, the fuel is susceptible individuals (people who have never been infected with or vaccinated against that particular virus). In the largest cities, such as New York and London, children are born fast enough to sustain a chain of infection. In these cities, no more than seven people out of 1,000 were infected at the peak of epidemics. But measles frequently goes extinct in smaller cities, only to be reintroduced later from neighboring populations. Inter-epidemic build-up of susceptibles allowed epidemics in these cities to infect as many as 25 out of 1,000 people per week.

Previous work on historical measles patterns has focused on England & Wales. The authors digitized a new dataset of U.S. case reports, allowing them to compare patterns of [persistence](#) and extinction between the U.S. and England & Wales. The U.K. is a densely settled island nation that was more ethnically and socially homogeneous than the U.S. in the early 20th century. Indeed, they found that reporting rates of measles are lower and more variable in the U.S. than in England & Wales.

"By resolving the differences in the reporting of measles cases, we were able to uncover real differences in the underlying process," said Helen Wearing, co-author and UNM Associate Professor of Biology and Mathematics & Statistics. "We found that U.S. cities were more likely to experience measles extinction, even after accounting for city size."

They suggest this is explained by the increased geographic isolation of U.S. cities.

They also describe how collections of cities behave, allowing measles to persist in a country or region (called a metapopulation) despite frequent extinctions in individual cities.

"There are really interesting questions about how long ago measles emerged, and to what extent the largest cities played a role," Gunning said. "Our work argues that a collection of many smaller populations is just as effective at sustaining measles as individual, large cities."

These findings can inform current vaccination efforts in the developing world. Recent measles research has focused on sub-Saharan Africa, where measles incidence remains high and vaccination coverage is low.

"We hope to bring this analysis to bear on modern systems," Gunning said. "One major question is how rural areas affect measles persistence."

Vaccination rates tend to be lower in rural areas compared with cities, which have better educational and health care infrastructure.

Worldwide vaccination has dramatically reduced [measles](#) deaths over the last 20 years, but global eradication remains elusive.

"The polio eradication campaign has shown that we need to think globally when it comes to infectious diseases," Gunning said.

"Particularly in Africa, conflict zones and failed states have fanned the flames of disease, which affects people throughout the world."

The paper is available from *Ecology Letters*: [Probabilistic measures of persistence and extinction in measles \(meta\)populations](#).

Provided by University of New Mexico

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