Contact among age groups key to understanding whooping cough spread and control

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Strategies for preventing the spread of whooping cough -- on the rise in the United States and several other countries in recent years -- should take into account how often people in different age groups interact, research at the University of Michigan suggests.

The findings appear in the Nov. 12 issue of the journal *Science*.

Thanks to widespread childhood vaccination, whooping cough (pertussis) once seemed to be under control. But the illness, which in infants causes violent, gasping coughing spells, has made a comeback in some developed countries since the 1980s, becoming a major public health concern. In addition, there's been a shift in who's getting sick, with fewer cases seen in preschool children and more in teenagers, but the reasons for the changing patterns have been unclear.

A variety of explanations have been proposed---genetic changes in the bacterium that causes the disease or the "wearing off" of immunity in people who were vaccinated years ago, for example.

But by combining two independent sets of data from previous studies, epidemiologists Pejman Rohani, Xue Zhong and Aaron King found that age-specific contact patterns alone can explain the observed shifts in prevalence and age-specific incidence.

One set of data came from an unplanned "natural experiment." In Sweden, where infants had been routinely vaccinated for nearly 30 years, concerns about vaccine safety and efficacy led to a halt in pertussis vaccination in 1979. Immunization resumed in 1996 using a different vaccine. During the hiatus and after vaccination resumed, the Swedish Institute for Infectious Disease Control collected data on whooping cough incidence by age group.

The second data set was from a 2008 study in which more than 7,000 people from eight European countries kept track of all the contacts they had with other people during one day, recording the age and sex of the person they interacted with, where the interaction took place and the duration and type of contact (such as conversation or physical contact). A key finding of that study was that children interacted far more frequently with other children than with adults.

The U-M researchers developed a simple mathematical model of whooping cough transmission that incorporated the contact data and then compared the model's predictions with the actual incidence data. The model accurately predicted the declines in whooping cough cases seen in Swedish infants, toddlers and adults and the upturn in cases among teenagers with the resumption of vaccination.

The results cast doubt on the prevalent notion that infected adults, in whom the illness often goes undiagnosed, act as a reservoir for the disease and are a major source of transmission to younger folk. In many countries, concerns about this possibility have prompted adult booster vaccination programs.

But the U-M study shows that, overall, "the role of adults in transmission is minimal," and that blanket booster-vaccination of adults is unlikely to be an efficient strategy for controlling the disease, said King, an assistant professor of ecology and evolutionary biology with a joint appointment

in mathematics.

The researchers stressed that because the study used incidence data from Sweden, one can only speculate on how its results apply to the United States, where infant vaccination compliance rates are lower and the population is much more diverse. "We need similar analyses for the United States," said Rohani, a professor of ecology and evolutionary biology with a joint appointment in the Center for the Study of Complex Systems.

The study makes two robust conclusions, said King. "The first point is that we see strong evidence for the efficacy of vaccination directed at children when compliance is high. The second is that better knowledge of actual contact patterns among age groups is crucial for the design of more effective and economical vaccination strategies."

More information: www.sciencemag.org/

Provided by University of Michigan

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