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Measles Outbreak among Vaccinated High School Students -- Illinois

From December 9, 1983, to January 13, 1984, 21 cases of measles occurred in Sangamon County, Illinois.* Nine of the cases were confirmed serologically. The outbreak involved 16 high school students, all of whom had histories of measles vaccination after 15 months of age documented in their school health records. Of the five remaining cases, four occurred in unvaccinated preschool children, two of whom were under 15 months of age, and one case occurred in a previously vaccinated college student (Figure 5).

The affected high school had 276 students and was in the same building as a junior high school with 135 students. A review of health records in the high school showed that all 411 students had documentation of measles vaccination on or after the first birthday, in accordance with Illinois law.

Measles vaccination histories were obtained from the school health records of all 276 senior high school students. Risk of infection was not significantly associated with type of vaccine, medical provider, age at most recent vaccination, or revaccination. All the students with measles had received their most recent vaccinations after 15 months of age. However, the measles attack rate increased with increasing years since most recent vaccination ($p = 0.024$) (Table 3). The attack rate was four times greater for students vaccinated 10 or more years before the outbreak than for students vaccinated more recently ($p 0.05$). When these data are corrected for the number of vaccinations, the trend was still observed and achieved a borderline level of statistical significance ($p = 0.07$). Age at first or last vaccination was not a confounding variable.

The index patient, Student A, was a 17-year-old male in the 11th grade; he was present in school with a productive cough for 3 consecutive days before his onset of rash. The source of his infection was not identified. Nine students with first-generation cases developed onset of rash 10-14 days after exposure to Student A (Figure 5). The attack rate was 6% (16/276) for senior high school students and 0% (0/135) for junior high school students. The highest attack rate was 12% (9/74) for the 11th grade students ($p 0.02$).

Repeated and close exposure to Student A was associated with a greater risk of illness (Table 4). The eight patients with first-generation cases who attended the high school were used to analyze the degree of exposure to Student A. The measles attack rate was 3% for students who did

have classroom exposure to Student A versus 2% for those who did not. Moreover, the attack rate was 21% for students whom Student A identified as "close friends" from the school enrollment roster, compared with 2% for students not so identified (p 0.001).

No vaccinations were given as part of the outbreak control program. Immune globulin (IG) was administered to three susceptibles: an elementary school child with a medical contraindication to measles revaccination and two preschool siblings who had contact with a measles patient. The outbreak subsided spontaneously, and active surveillance for illnesses with rash in the community did not identify any additional cases of measles during the 4 weeks before or after the outbreak. Reported by J Doglio, PhD, D Goodroe, M Messmore, J Richmond, C Selinger, Auburn School District, O Eastham, MD, GA Weisgerber, MD, Auburn Medical Clinic, Auburn, N Mody, MD, Dept of Laboratory Medicine, Memorial Medical Center, M Schwartz, Springfield City Health Dept, Springfield, R Barger, C Jennings, K Kelly, R March, D Reynolds, Immunization Program, BJ Francis, MD, State Epidemiologist, Illinois Dept of Public Health; Div of Field Svcs, Epidemiology Program Office, Div of Immunization, Center for Prevention Svcs, CDC.

Editorial Note

Editorial Note: This outbreak demonstrates that transmission of measles can occur within a school population with a documented immunization level of 100%. This level was validated during the outbreak investigation. Previous investigations of measles outbreaks among highly immunized populations have revealed risk factors such as improper storage or handling of vaccine, vaccine administered to children under 1 year of age, use of globulin with vaccine, and use of killed virus vaccine (1-5). However, these risk factors did not adequately explain the occurrence of this outbreak.

The attack rates indicated that the greatest transmission occurred within the same grade as the index patient (Student A). This finding suggested a cohort effect, such as a faulty vaccine lot or particular provider, but none was found. Although detailed vaccine information was not available from providers of vaccine, there were several different providers who served these patients, and patients had not been vaccinated during a common time.

In this outbreak, vaccinated persons were at greater risk of clinical illness if they had close exposure to a measles patient and if 10 or more years had elapsed since their most recent measles vaccinations. This finding is different from those of previous studies, some of which covered shorter intervals between vaccination and exposure to measles. Such studies have uniformly revealed the persistence of vaccine-induced immunity over the period studied (5). A serologic study has shown that up to 15% of persons lose detectable measles specific antibody, measured with standard techniques, within the 16 years following vaccination. Upon revaccination, such individuals typically produce secondary immune responses, implying they are still protected from measles disease (6). Further evidence against waning immunity is that measles incidence is at near record low levels 21 years after vaccine licensure. If loss of immunity with time since vaccination were a major problem, higher incidence rates would be expected. Nevertheless, since this outbreak suggests a potential problem, detailed investigations of other measles outbreaks in highly vaccinated populations should address this issue.

If waning immunity is not a problem, this outbreak suggests that measles transmission can occur within the 2%-10% of expected vaccine failures (5,7). However, transmission was not sustained beyond 36 days in this outbreak, and community spread was principally among unvaccinated preschool children. The infrequent occurrence of measles among highly vaccinated persons suggests that this outbreak may have resulted from chance clustering of otherwise randomly distributed vaccine failures in the community. That measles transmission can occur among vaccine failures makes it even more important to ensure persons are adequately vaccinated. Had there been a substantial number

of unvaccinated or inadequately vaccinated students in the high school and the community, transmission in Sangamon County probably would have been sustained.

References

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6. Krugman S. Further-attenuated measles vaccine: characteristics and use. *Rev Infect Dis* 1983;5:477-81.
7. Brunell PA, Weigle K, Murphy MD, Shehab Z, Cobb E. Antibody response following measles-mumps-rubella vaccine under conditions of customary use. *JAMA* 1983;250:1409-12. *All patients met a clinical definition of (1) a generalized maculopapular rash lasting 3 or more days; (2) temperature of 38.3 C (101 F) or greater; and (3) one of the following: cough, coryza, conjunctivitis.

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