Risk for Measles Related to Immunization Status in Two Tucson High Schools

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Synopsis

An outbreak of measles occurred in Tucson, AZ, in 1985; 112 of the 225 cases were among students at two large high schools. A review of the immunization records of all students at both schools was undertaken in order to assess the risk of a person contracting measles in relation to that person's immunization status.

Two factors, the lack of an immunization record and immunization prior to 12 months of age, showed a positive association with contracting measles. The association was statistically significant at one high school but not the other. At the first high school, students who were immunized at 12 to 14 months of age had a greater risk of infection than those immunized at 15 months or older. However, age at immunization of 12 to 14 months was not associated with a significantly higher risk when persons with multiple doses of vaccine were excluded from the analysis. Students of both schools showed a lower attack rate for those who had received multiple doses of vaccine, but the difference was not statistically significant.

SINCE ATTENUATED MEASLES vaccine was licensed in 1963, the incidence of measles has decreased dramatically in the United States to a record low of 1,497 cases in 1983.

However, measles incidence has risen during the last 3 years, with 6,273 cases reported in 1986 (*1*). An increasing number of measles cases are being classified as nonpreventable (*2*). Nonpreventable cases are defined as those occurring in persons who are younger than 16 months (too young for routine immunization), who were born before 1957 (old enough to be considered immune), who have a documented history of receiving live measles vaccine on or after their first birthday, who have a history of physician-diagnosed measles, or who have a medical, religious, or philosophical exemption from immunization under State law (*3*).

As the incidence of measles has declined, the epidemiology of the disease has changed. Since the introduction of measles vaccine, a greater percentage of cases have occurred in young adults who were not immunized as children and who escaped infection as a result of the decreasing incidence of the disease.

Recently, the percentage of cases seen in school-aged children has increased. In the first 26 weeks of 1985, when 1,802 cases were reported nationally, the highest incidence rate was seen in 15- to 19-year-olds. This age group accounted for 33.5 percent of the cases reported for the period (*4*).

During that time, a 225-case outbreak of measles occurred in Pima County, AZ, which has a population of 531,443 according to 1980 census data. Almost half (49.8 percent) of the cases were in two high schools. We report the circumstances of the outbreak in the two schools, and discuss the findings with respect to measles control strategies.

Methods

Investigation techniques included passive and active surveillance. Passive surveillance involved the investigation of cases of measles or rash illnesses reported by medical personnel in the community, as well as followup on calls received from the public about suspected measles cases. When possible, those with suspected cases were examined, and blood was obtained for serologic

testing. Health care providers were notified of the outbreak by press releases and telephone calls and asked to report suspected cases immediately. Active surveillance was undertaken in both high schools by contacting students who were absent from school during the outbreak.

A clinical case of measles was defined, using Centers for Disease Control criteria, as fever of at least 38.3°C (101°F) (if measured), together with a generalized maculopapular rash lasting 3 or more days, and either cough, coryza, or conjunctivitis (*2*).

At the time of the outbreak, throat swab specimens were obtained from six patients. Measles virus infection was detected in four of these by immunofluorescent demonstration of viral antigen in oropharyngeal cells (*5*). In one patient, infection was confirmed by viral isolation in cell culture. Serologic studies were performed by two laboratories. The complement fixation (CF) method was used on specimens submitted to the Arizona State Laboratory in Phoenix. Indirect immunofluorescence (IF) techniques were used on specimens analyzed by the University Medical Center in Tucson. A case was considered laboratory-confirmed if there was a four-fold or greater rise between acute and convalescent CF or IF antibody titers. During the outbreak at the first high school, all specimens were tested for significant rises in rubella virus hemagglutination inhibiting antibodies.

The review of immunization records consisted of examining the health records on file for all students at the two high schools. Dates of birth and dates of administration of measles vaccine were recorded. The review was designed to address two major questions. One concerned the risk of measles in those who received vaccine between the ages of 12 and 14 months. Some studies have shown lower seroconversion rates or higher risks of vaccine failure in this group (*6,7*). The second question dealt with the effect of multiple doses on the risk of contracting measles.

Some studies have shown that school records are inadequate (*7,8*). We recognize that the findings regarding measles risk might be different if provider-verified records were used to calculate attack rates. However, it was impractical to verify all the records because of the large number of students (4,136 total in the two schools) and because many students had received their immunizations years earlier or in different parts of the country. Similarly, it was unlikely that vaccine failures could be uniformly ascribed to improper storage or administration, or to inadequate potency of a single vaccine lot. Since school records are used by health officials as the basis for exclusion and intervention during an outbreak, we believed that an evaluation of the risk for measles based on these data would be useful. Relative risk and 95 percent confidence limits were calculated using the formulas described by Lilienfeld (*9*).

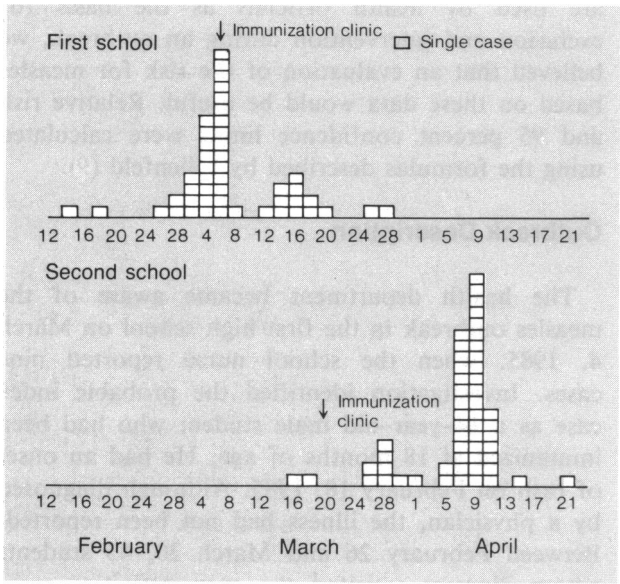
Outbreak Description

The health department became aware of the measles outbreak in the first high school on March 4, 1985, when the school nurse reported nine cases. Investigation identified the probable index case as a 14-year-old male student who had been immunized at 18 months of age. He had an onset of rash on February 18, 1985. Although diagnosed by a physician, the illness had not been reported. Between February 26 and March 20, 45 students whose illnesses satisifed the case definition were identified (see chart). A possible co-index case with rash onset on February 13 was identified. Seven patients (15.2 percent) were serologically studied and laboratory-confirmed. Beginning on March 6, all students without adequate immunization records on file were excluded from school. An onsite clinic was held on March 7, and 78 students who could not provide documentation of measles immunity and had consent forms signed by a parent or guardian were vaccinated. Students who refused vaccination were excluded from school until 2 weeks after rash onset in the last reported case. Two cases with onset dates more than 2 weeks after these interventions were reported.

The overall attack rate at the school, which had an enrollment of 2,372, was 1.9 per 100 students. Five cases (10.9 percent) occurred among students with no records of immunization on file at the school. Five additional cases (10.9 percent) occurred among students whose records indicated that they had been immunized prior to their first birthday. Four cases (8.7 percent) occurred among persons whose records did not permit determination of age at immunization. These 14 cases were classified as preventable. Thirty-two cases (69.6 percent) were among students with records indicating adequate immunization and were classified as nonpreventable.

The first measles case in the second high school was in a 16-year-old female student with onset of rash on March 16. The outbreak at this school lasted until April 21, with 113 rash illnesses investigated. Of these, 66 satisfied the clinical case

Measles cases by date of onset, two high schools, Tucson, AZ, 1985



definition (see chart), for an attack rate of 3.7 per 100 students. Seven patients were serologically studied, and five (7.6 percent of the total cases) were laboratory-confirmed. The outbreak continued despite early identification and exclusion from school of students with inadequate immunization records. Exclusion began on March 20. An onsite clinic was held on March 21, at which 24 students who could not provide evidence of measles immunity and had consent forms signed by a parent or guardian were immunized. However, the majority of cases occurred after April 5. Only 8 (12.1 percent) of the cases could be classified as preventable.

Record Review

The table shows the attack rates by age at the time of immunization and the multiple dose status at both schools. Nine categories of immunization status were recorded, four for single dose recipients and five for multiple dose recipients. Unknown age refers to those students whose records were not specific enough to determine their age at immunization. For example, a person born on January 20, 1971, with a record of immunization in January 1972 would be recorded as unknown age. If the record showed a second dose in 1973, the classification would be listed as multiple dose, first unknown and second after 15 months. Unknown age status was included in the calculation of risk by vaccine status and multiple dose status, but it was excluded from the analyses of age at immunization.

When the statistics for both schools were combined, 23.7 percent of the students had received more than one dose of vaccine. Among those whose age at first immunization was known, 52.3 percent had received both immunizations after the first birthday, and 32.8 percent had received both after 15 months of age. Students at the first high school were more likely to have no record of immunization on file than those at the second high school (relative risk = 7.2, 95 percent confidence interval 3.9, 12.6). Those at the first high school were more likely to have a record indicating a single immunization when younger than 1 year of age, or with an unknown date of immunization (RR = 7.4, 95 percent confidence interval 5.2, 10.4).

At the second high school, a higher percentage of students had received at least one immunization at 15 months of age or older (RR = 1.4, 95 percent confidence interval 1.2, 1.6). These facts suggest that the population of students at the second high school was more adequately immunized and less likely to have a large outbreak of measles. However, the attack rate was significantly higher at the second high school (RR = 2.0, 95 percent confidence interval 1.3, 2.9). Multiple dose status and specificity of record type (such as the percent of records with only the year of immunization) did not differ significantly between schools.

Analysis of risk by vaccine status at the first high school showed that the lack of an immunization record was associated with developing measles (RR = 2.5, 95 percent confidence interval 1.1, 6.8), and those who were immunized before 1 year of age had a significantly higher risk when compared to those who received an immunization at 1 year or older (RR = 6.0, 95 percent confidence interval 2.5, 16.5). In addition, persons immunized between 12 and 14 months of age had a higher risk when compared to those who had received an immunization at 15 months or older (RR = 2.3, 95 percent confidence interval 1.1, 4.8). This increased risk was not observed when the analysis was confined to those who had received a single dose of vaccine (RR = 1.8, 95 percent confidence interval 0.9, 4.2).

Although those who had received multiple doses of vaccine had a lower attack rate (1.2) than those who received a single dose (2.0), the difference was not statistically significant (RR = 1.5, 95 percent confidence interval 0.6, 3.3). Similar results were obtained when those immunized before 15 months

Measles cases, immunization records, and attack rate (AR) percent in outbreak in two high schools, Tucson, AZ, 1985

Type of record	First school			Second school			Total		
	Number of cases	Number of records	AR	Number of cases	Number of records	Number of AR	Number of cases	Number of records	AR
No immunization	5	112	4.5	1	12	8.3	6	124	4.8
Single dose	35	1,737	2.0	51	1,296	3.9	86	3,033	2.8
Less than 12 months	5	58	8.6	2	19	10.5	7	77	9.1
12–14 months	9	345	2.6	11	272	4.0	20	617	3.2
15 months or more	17	1,187	1.4	33	922	3.6	50	2,109	2.4
Unknown age	4	147	2.7	5	83	6.0	9	230	3.9
Multiple doses	6	523	1.2	14	456	3.1	20	979	2.0
Time of first dose/time of second dose:									
Less than 12 months/12–14 months	1	5	20.0	0	6	0	1	11	9.1
Less than 12 months/15 months or more	1	175	0.6	4	152	2.6	5	327	1.5
12–14 months/15 months or more	1	93	1.1	2	45	4.4	3	138	2.2
15 months or more/15 months or more	1	119	0.8	6	113	5.3	7	232	3.0
Unknown/15 months or more	2	131	1.5	2	140	1.4	4	271	1.5
Total	46	2,372	1.9	66	1,764	3.7	112	4,136	2.7

of age were excluded from analysis (RR = 1.5, 95 percent confidence interval 0.5, 3.7). Persons who received a single immunization when younger than 12 months were not included in the analysis of the effect of multiple doses.

At the second high school, the pattern of attack rates was similar to that at the first. Immunization at younger than 1 year was associated with the highest attack rate (10.5). Multiple dose recipients had a lower attack rate (3.1) than single dose recipients (3.9). However, none of the differences in attack rates at the second high school was statistically significant.

Comments

The results of this study should be interpreted cautiously, as immunization histories were not provider-verified. However, because the methodology involved a complete record review and is not subject to the limitation of sampling techniques or case-control studies, the results present a complete analysis of risk based on school records. This risk may differ from that based on provider records or actual immunization status.

Controversies continue concerning the adequacy of the current measles control strategy. These controversies likely will increase in view of recent documentations of outreaks among secondary school adolescents where vaccination levels equaled or exceeded 98 percent (*10,11*). While our data indicate a higher risk for those immunized at 12 to 14 months of age, this group accounted for less than one-quarter of the total cases. Routine reimmunization of these individuals might not appreciably affect the current epidemiology of measles. The risk of measles was lower for multiple dose recipients, but this difference was not statistically significant. Thus, the need for a second dose of vaccine (as suggested by Krugman (*12*), to reduce the rate of primary vaccine failure) is not supported by our data. However, a recent report shows that adolescents who received more than one dose of measles vaccine had lower rates of seronegativity compared to single dose recipients (*10*).

Some of the problems encountered in investigating and controlling this outbreak deserve mention. An obvious problem was the failure to report the index case in the first high school. However, the problems in surveillance and detection of measles infection are more extensive than failure to report diagnosed cases. As measles has become a relatively rare disease, the number of clinicians capable of making the diagnosis has likely decreased. Both over- and under-diagnosis were noted during the investigation. In addition, instances were reported in which persons were told by physicians that they could not have measles because they had been immunized, or that they didn't need to be reimmunized, even those vaccinated before their first birthday.

In order to facilitate measles control and study of the changing epidemiology of the disease, clinicians should know that measles can occur in people presumed immune on the basis of their histories. Continuing research, modification of control strategies when indicated, and cooperation

between the private and public health care sectors are necessary to ensure that measles does not become the health threat that it once was.

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A Health Survey of Klamath Indian Elders 30 Years After the Loss of Tribal Status

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Synopsis

Federal recognition of the tribal status of the Klamath Indians of Oregon was terminated by Congress in 1954, along with all health, education, and welfare services. In the winter and spring of 1985 a health status and health care needs assessment was conducted among 202 Klamath Indians ages 40 years and older with the use of a shortened version of the Older Americans Resources and Services (OARS) instrument. Twenty percent of the Klamaths surveyed reported having diabetes, and more than 30 percent reported having arthritis, rheumatism, or hypertension, or having had their gallbladder removed.

The data were compared with those of national surveys of Indian and non-Indian elders that also used the OARS instrument. Even though the Klamaths surveyed were younger than the comparison groups, their health status was no better than that of other Indians and was worse than that of the non-Indian population. Moreover, among these Klamath adults, health insurance coverage was lower, and perceived unmet needs for medical care were higher than in either of the comparison groups.

SOURCES OF DATA about the economic, social, and physical well-being of older American Indians and Alaska Natives are few. Valuable information on morbidity is available from Indian Health Service (IHS) data on ambulatory and hospital care utilization in its service population. Records of outpatient visits document the increasing prominence of chronic diseases in the health profile of Indian and Alaska Native adults; diabetes and hypertension are the second and fourth leading diagnoses in visits to IHS clinics (*1*). These clinic data, however, do not reflect the health status and health care needs of Indians who do not live on or near a reservation—approximately 40 percent of the Indian population—or who otherwise do not have access to IHS facilities. Mortality data on all