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Vaccine-Induced Measles Immunity in Anchorage High School Students

In March 1991, the Section of Epidemiology and Health & Welfare Canada collaborated on a study to evaluate the rubeola serologic status of high school students. This was prompted by concerns in both the U.S. and Canada about the need to administer two doses--rather than one dose--of measles vaccine as part of a routine childhood vaccination schedule. While one dose of live measles vaccine is believed to elicit life-long protection against rubeola infection in 95-98% of vaccinees, large measles epidemics in the U.S. during 1989-90 raised concern about waning vaccine-induced immunity and higher rates of primary vaccine failure than was previously thought. As a result, recommendations for a second, reinforcing dose of measles vaccine were published by the Advisory Council on Immunization Practices and the American Academy of Pediatrics. The purpose of our study was to evaluate rubeola serologic status of high school students with health records indicating full compliance with immunization recommendations.

Methods:

Review of students' health records in Anchorage and in Whitehorse, Yukon identified 11th and 12th grade students who had received 4DTP and 3OPV by 48 months of age, and one dose of measles vaccine between 12 and 48 months of age. Anchorage students who had received more than one dose of measles vaccine were excluded. In Whitehorse, one earlier dose of live measles vaccine was accepted.

We drew an initial blood specimen (S1) and tested the serum for rubeola-specific IgG antibodies. If IgG antibody was not detected in the S1 sample, the participant was revaccinated with MMR vaccine and another blood sample (S2) drawn 14-21 days later. The S2 sample was tested for both IgG and IgM antibodies at the State Public Health Laboratory in Fairbanks using a commercial test kit. If IgG antibody was not detected in the S2 sample, the S1 and S2 sera were re-evaluated at the Centers for Disease Control in Atlanta.

Results:

Ninety-nine students participated at each site. The sex distribution and mean age of the Anchorage and Whitehorse students were similar. Among Whitehorse participants, 38 had had one dose of live measles vaccine (Lirugen□) prior to receiving a second dose of measles vaccine between 12 and 48 months of age.

In Anchorage, 53 (53%) participants had no detectable IgG antibody on initial screening; all were revaccinated. Two of the revaccinees had IgM antibody responses; 44 had rubeola-specific IgG titer rises without an IgM response; and seven had no detectable IgM or IgG antibody (Table 1).

In Whitehorse, 27 participants were seronegative for rubeola IgG antibody; 23 were revaccinated. After revaccination, one person had a primary IgM response, 21 mounted an IgG response but no IgM response, and one had no detectable measles antibody. There was no significant association between having received two doses of live measles vaccine and the presence of detectable IgG antibody either on initial screening (p=.093) or after revaccination (p=.510).

Discussion:

Using as criteria for immunity either a) the presence of rubeola-specific IgG antibody on initial testing or b) the absence of an IgM antibody response after revaccination, 98% of participants were immune to measles infection. This is consistent with studies reporting 95-98% seroconversion following one dose of live measles vaccine. Using the criteria cited, our findings show high levels of protection for high-school-aged children 13-17 years after measles vaccination.

If rubeola immunity is defined by the presence of detectable IgG antibody (either on initial screening or as an anamnestic response to revaccination), 91% of participants in Anchorage and 94% of Whitehorse students can be considered immune as the result of receiving live measles vaccine in childhood. It is unknown whether the eight persons who had no detectable serologic response following revaccination are immune to measles infection. Additional studies are needed to determine how frequently vaccine failure occurs after a second dose of measles vaccine in persons who had no immune response to a first dose.

Recommendation:

Our findings show that at least 91% and as many as 99% of students vaccinated against measles in early childhood are protected through their high school years. These findings, along with observations in two recent Alaskan measles outbreaks (where no measles transmission occurred in schools), support our previous decision not to recommend a routine measles booster dose prior to school entry. Instead, our greatest priority is to concentrate our efforts and resources on ensuring age-appropriate vaccination for all Alaskan children by two years of age.

TABLE 1. Rubeola Serology Results - Anchorage and Whitehorse

		IgM-					IgM+		
Site	**N**	**IgG+**			**IgG- (%)**	**Total (%)**	**IgG+**	**IgG-**	**Total (%)**
		S1	**S2**	**Subtotal (%)**					
Anchorage	99	46	44	90 (91)	7 (7)	97 (98)	1	1	2 (2)
Whitehorse*	95*	72	21	93 (98)	1 (1)	94 (99)	0	1	1 (1)
Total	194	118	65	183 (94)	8 (4)	191 (98)	1	2	3 (2)

*Four seronegatives were not revaccinated

(Contributed by Janine Schoellhorn, MS, MPH and Michael Jones, MD. Acknowledgements to Dr. Richard D'Aeth, Yukon Medical Services Branch, Jaime Felton, RN, Service High School, and to the administrators and staff at Service High School and Whitehorse Health Center who assisted with the project.)