Using Locally Derived Seroprevalence Data on Measles, Mumps, Rubella and Varicella by Birth Cohort to Determine Risks for Vaccine Preventable Diseases During International Travel

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Using Locally Derived Seroprevalence Data on Measles, Mumps, Rubella and Varicella by Birth Cohort to Determine Risks for Vaccine Preventable Diseases During International Travel

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Abstract

Background:

Measles, mumps, rubella, and varicella were common diseases in the United States prior to the introduction of their respective vaccines. There are still regions in the world where these diseases are highly prevalent. Even after dramatic reductions in the prevalence of measles, mumps, rubella and varicella in the United States, there continue to be outbreaks of these diseases, stressing the need for ongoing immunization and pre-traveling counseling.

Most prior studies of seroprevalence for these viral diseases are often based on national surveillance data. It is therefore important to get a clearer understanding on the local level of immunity so that more focused recommendations can be made for our patient population.

Methods:

Leftover, non-duplicate outpatient serum samples obtained in Lehigh Valley Pennsylvania were tested for IgG antibodies using commercially available enzyme immunoassays to mumps, measles, rubella, and varicella. Samples were collected sequentially, and de-identified. Five birth cohorts were created and 460 samples were collected as follows: <1957 (52), 1957-1966 (109), 1967-1976 (117), 1977-1988 (121), and 1989-1995 (61).

Results:

Overall seroprevalence (excluding equivocal results) for measles, mumps, rubella, and varicella were (%): 85.8, 82.8, 96.6, and 97.4. There was a significant association between seroprevalence and birth cohort for measles (p=0.010) and mumps (p=0.037) only. Pairwise comparisons of the cohorts found that for measles there was a significant difference between the <1957 versus 1967-1976 (p=0.005) cohort and the <1957 versus 1989-1995 (p=0.001) cohort. Additionally, the overall seroprevalence for our study sample was significantly different than national seroprevalence results for rubella, mumps, and measles.

Conclusion:

Our study on local seroprevalence showed dramatically lower immunity rates to measles and mumps than prior national seroprevalence studies have shown. The rates in many of the later birth year cohorts were significantly lower than rates reported necessary to sustain herd immunity. The results of this study show the tremendous value in determining seroprevalence on a local basis. We will use these results to alter our approach to assessing travelers and others in our clinics based on their birth year.

Table 1: Age by Birth Cohort

Birth Cohort	Mean±SD	Range
Less than 1957	72.6±9.7	58-96
1957 to 1966	52.0±2.8	47-57
1967 to 1976	41.8±2.7	37-47
1977 to 1988	31.2±3.5	25-37
1989 to 1995	21.5±2.0	18-25

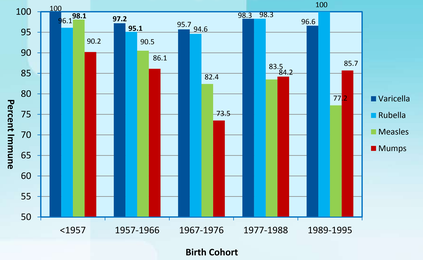
Table 2: Gender by Birth Cohort

Birth Cohort	Male N (%)	Female N (%)	Total N (%)
Less than 1957	27(51.9)	25(48.1)	52(100)
1957 to 1966	51(46.8)	58(53.2)	109(100)
1967 to 1976	59(50.4)	58(49.6)	117(100)
1977 to 1988	58(47.9)	63(52.1)	121(100)
1989 to 1995	28(45.9)	33(54.1)	61(100)

Table 3: LVHN Overall Seroprevalence by Disease Compared to National Seroprevalence (Excluding 1989 - 1955 Cohort)

Disease	LVHN % Immune	US % Immune	P-value
Rubella[1]	96.1	89.4	<0.001
Measles[3]	87.2	93	<0.001
Mumps[4]	82.4	90	<0.001

Figure 1.
Percentage of Birth Cohort Immune to Each Disease (Excluding Equivocal)



- There was a statistically significant association between birth cohort and immune status for both mumps (p=0.037) and measles (p=0.010).
- For measles, the immunity rates of birth cohorts 1967-1976 and 1989-1995 were significantly lower when compared to birth cohort <1957 (82.4% vs 98.1%, p=0.005 and 77.2% vs 98.1%, p=0.001, respectively).
- More males than females showed humoral immunity to measles in the 1989-1995 cohort, 92.6% of males vs 63.3% of females (p=0.009).
- Our local seroprevalence to measles, mumps, and rubella was significantly different than that reported for the national seroprevalence (p<0.001).
- No statistically significant association between gender and immunity was found for mumps, rubella or varicella.
- No statistically significant association between birth cohort and immunity status was found for rubella or varicella.

Discussion

Study Benefits:

- Results of this study will be helpful to guide the approach used when assessing a traveler's vaccination needs.
- Data collected will help identify age groups in our region at risk of acquiring vaccine-preventable diseases.

Study Limitations:

- Our study may be subject to sampling bias due to utilization of a non-probability sampling method.
- Local immunity rates may have been underestimated as we did not evaluate for cellular immunity through vaccination records.

Conclusions

- Our study, performed in the Lehigh Valley, PA on the local seroprevalence for four vaccine preventable diseases (MMRV) showed dramatically lower immunity rates to measles and mumps than previously reported on several national seroprevalence surveys.
- The immunity rates for many of the later birth cohorts were significantly lower than the rates necessary to sustain herd immunity.
- The results of this study show the critical value in determining the local seroprevalence. In the presence of ongoing global outbreaks, the importance of fostering routine childhood vaccinations and promoting pre travel advice is paramount.
- Future studies should be encouraged to document regional and local seroprevalences to vaccine preventable diseases throughout the US; to properly advise pre-traveling immunization.

Future Directions

- Creating a seroprevalence study using a probability sampling method and a larger sample size.
- Expansion of demographic data collection (country of birth, race/ethnicity, family income, education level and religious/ethical beliefs) will help to minimize potential confounders of immunity status.
- To include vaccination records of the sample population to evaluate for cellular immunity.
- Further asses the low immunity rates in youngest birth cohorts.

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