Impact of an Accelerated MMR Immunization Schedule on Completion of Childhood Vaccinations During a Measles Outbreak

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OBJECTIVES

To determine if receipt of an accelerated measles-mumps-rubella (MMRa) vaccine impacted the delivery of subsequent MMR doses and completion of other childhood vaccination schedules.

BACKGROUND

Measles

- Measles is a highly contagious, acute, respiratory illness caused by the rubeola virus[1]
- Symptoms may include fever, cough, coryza, conjunctivitis and Koplik spots[1]
- Infection can result in serious complications including ear infection, pneumonia, encephalitis, seizures and even death[1]
- Currently, indigenous transmission of measles in the United States has been eliminated, however importation of the measles virus can still pose a risk to the population[2]

Measles Outbreak

- In February 2008, an outbreak of measles occurred in Pima County originating from a foreign tourist
- Resulted in 13 additional measles cases
- The Arizona Department of Health Services (ADHS) & the Pima County Health Department (PCHD) recommended the implementation of MMRa vaccination schedule for Pima County children until the close of the outbreak in July 2008
- Vaccination recommendations were as follows:
  - Accelerate MMR vaccination for children 6-12 months of age who had not previously received an MMR dose (Figure 1)
  - Accelerate 2nd MMR dose for children >12 months of age who had already received their first MMR dose on the standard schedule

Arizona State Immunization Information System (ASIIS)

- Childhood immunizations are required to be reported to the state immunization registry
- Captures these immunizations through health care provider reports
- Birth certificate data are downloaded daily from the ADHS Office of Vital Records

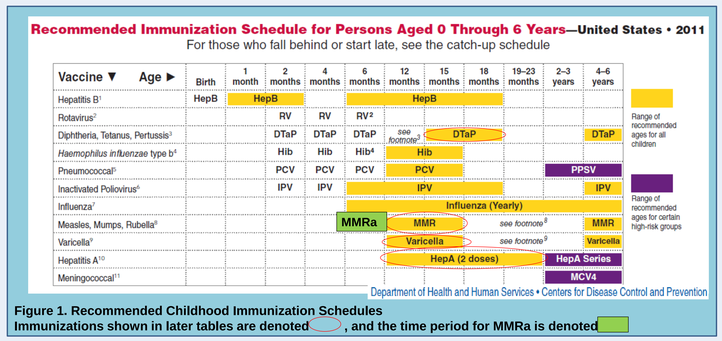

Figure 1. Recommended Childhood Immunization Schedules
Immunizations shown in later tables are denoted ( ), and the time period for MMRa is denoted ( )

METHODS

- We reviewed immunization records reported to ASIIS for a selected birth cohort of children
- The eligibility criteria for the selected cohort were as follows:
  - Born between March 18th, 2007 and January 19th, 2008 (6-12 months old during outbreak)
  - Pima County resident (determined by zip code)
  - Alive, and currently living in Arizona
  - Proof of at least one vaccination in ASIIS
- Children were divided into two groups based on vaccination status:
  - Accelerated Vaccination Group: Children who received a dose of MMR at <361 days of age
  - Standard Vaccination Group: Children who received their first MMR dose at 12-15 months of age

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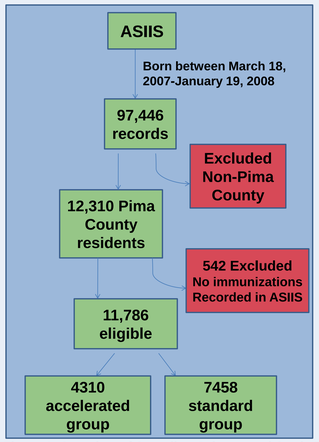

Figure 2. Overview of Sampling Scheme and Study Eligibility

- A subset of medical records were reviewed to verify data reported into ASIIS. Specific criteria evaluated included: immunization history, administration of MMR doses, reason for visit and number of health care visits where an immunization was given
- Statistical Analysis
  - Data were extracted on 08/31/2010 and analyzed using SAS 9.1
  - For each group, timing and receipt of the vaccine doses were compared
  - χ^2 tests used for categorical variable analysis & t tests were used for continuous variables
  - Risk ratios with 95% confidence intervals (CIs) were calculated to evaluate differences in completion of each vaccine series between the two groups
  - A two-tailed *P* value <0.05 was considered statistically significant

RESULTS

Cohort Characteristics (Table 1)

- 4310 children received MMRa (36.6%)
- There was no difference in sex between the groups
- The accelerated group was 2.6 wks younger on average

Comparison of Vaccine Completion Rates

- Compared to the standard group, the accelerated group was:
  - -significantly more likely to have received a dose of MMR after one year of age (82.8% vs. 68.1%; *P* <.001) (Table 1)
  - -57% more likely to have received 4 doses of DTaP (Table 2)
  - -32% more likely to have received 1 dose of varicella vaccine (Table 2)
  - -28% more likely to have received one dose of hepatitis A vaccine (Table 2)
  - -66% more likely to have completed the 4:3:1:3:3:1 vaccination series (Table 2)
- The accelerated group received MMR (1), DTaP, varicella vaccine, and hepatitis A vaccine, and completed the 4:3:1:3:3:1 vaccination series at a significantly younger age (Table 3)

Medical Record Reviews

- 88 medical records were included in the analysis
  - -81% of children received their MMRa during a routine health care visit

Table 1. Descriptive Statistics by Group

Characteristic	Accelerated Group, No. (%)	Standard Group, No. (%)	P Value
Total no.	4310 (36.6)	7458 (63.4)	
Sex (male)	2248 (52.3)	3775 (51.0)	0.18
Mean age (SD), wks[a]	156.4 (8.56)	159.0 (14.2)	<.001
No. completed 4:3:1:3:3:1 series	2713 (63.0)	2821 (37.8)	<.001
Mean no. of visits to complete 4:3:1:3:3:1 series (SD)	6.39 (1.00)	5.89 (0.89)	<.001
1st valid MMR dose[b]	3568 (82.8)	5079 (68.1)	<.001

[a]As of data extraction on 8/31/2010
[b]MMR dose after 1 year of age

Table 2. Completion of Selected Childhood Vaccines by Group

Vaccine, (No. of Doses Received)	Accelerated Group, No. (%)	Standard Group, No. (%)	Relative Risk (95% CI)
DTaP (4)	3123 (72.5)	3433 (46.0)	1.57 (1.52-1.62)
Varicella (1)	3842 (89.1)	5048 (67.7)	1.32 (1.29-1.34)
HepA (1)	3885 (90.1)	5232 (70.2)	1.28 (1.26-1.31)
All completed[a]	2057 (47.7)	2032 (27.3)	1.75 (1.67-1.84)
4:3:1:3:3:1 series completed[b]	2713 (63.0)	2821 (37.8)	1.66 (1.60-1.73)

[a]Includes 1 MMR, 4 DTaP, 3 IPV, 3 HIB, 3 HBV, 1 Varicella, 3 PCV, 2 HepA
[b]Includes 4 DTaP, 3 IPV, 1 MMR, 3 HIB, 3 HepB, 1 Varicella

Table 3. Average Age of Completion of Selected Childhood Vaccines (Weeks)

Vaccine, (No. of Doses Received)	Mean Age at Completion (95% CI), wks		
	Accelerated Group	Standard Group	*P* Value
MMRa	34.6 (34.4-34.9)	N/A	
MMR (1)[a]	60.0 (59.6-60.5)	62.7 (62.3-63.2)	<.001
MMR (2)	80.7 (75.5-86.0)	76.1 (73.4-78.8)	0.10
DTaP (4)	69.1 (68.4-69.7)	73.4 (72.7-74.1)	<.001
Varicella (1)	59.7 (59.3-60.2)	63.6 (63.1-64.1)	<.001
HepA (1)	69.1 (68.5-69.7)	74.5 (73.8-75.1)	<.001
All Completed[b]	104.0 (103.3-104.7)	107.9 (107.1-108.9)	<.001
4:3:1:3:3:1 series completed[c]	78.1 (77.3-78.8)	82.3 (81.3-83.2)	<.001

[a]MMR dose after 1 year of age
[b]Includes 1 MMR, 4 DtaP, 3 IPV, 3 HIB, 3 HBV, 1 Varicella, 3 PCV, 2 HepA
[c]Includes 4 DtaP, 3 IPV, 1 MMR, 3 HIB, 3 HepB, 1 Varicella

CONCLUSIONS

- These data suggest a positive association between having an MMRa and receipt of subsequent MMR doses as well as completion of other childhood vaccines
- The accelerated vaccination schedule seemed well accepted by health care providers, with over a third of children receiving MMRa
- Data suggest that providers were able to incorporate MMRa doses into routine childhood health care visits, thus no special visits for these doses were required in the majority of cases
- Public health recommendations to provide accelerated vaccination do not appear to adversely impact the receipt of subsequent vaccines

Limitations:

- Immunization data are underreported to ASIIS therefore true vaccination coverage may be higher
- Were not able to assess whether there were reporting differences between the accelerated and the standard groups
- Children in this study, at the time of data extraction were 2.5-3.5 years old, therefore unable able to evaluate the impact of public health recommendations on receipt of MMR (2)

FUTURE WORK

- It is important to understand the role under reporting has in evaluating public health recommendations and estimating vaccine coverage in selected communities
- Plan to continue to follow this cohort to asses the following:
  - Receipt of MMR2
  - Reporting differences between the two groups
  - Underlying differences between the groups in relation to vaccine hesitancy among families
  - Provider behavior and attitudes towards vaccines

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REFERENCES

1. Centers for Disease Control and Prevention. *Epidemiology and Prevention of Vaccine-Preventable Diseases*. 11th ed. Washington, DC: Public Health Foundation; 2009:157-176. http://www.cdc.gov/vaccines/pubs/pinkbook/default.htm. Accessed December 21, 2010.
2. Oster NV, Harpaz H, Redd SB, Papania MJ. International Importation of Measles Virus-Unites States, 1993-2001. *J Infect Dis*. 2004;189(Suppl 1):S49-S53.