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Introduction

- Hepatitis A virus (HAV) causes acute illness, typically by ingestion of food or water contaminated with fecal matter
- 2013 incidence rate was 0.6 cases per 100,000 in U.S.
 - 1,781 cases reported to CDC (likely an underestimate)
- 1996 HAV vaccination introduced, provides immunity for 20+ years
 - 2006 ACIP recommended routine vaccination for all children in U.S. beginning at one year of age
- 3 vaccines available in the U.S.
 - Two given as 2-dose sequence, 6 - 18 months apart; approved for use in pediatric and adult populations
 - One combination HAV/HBV vaccine administered as 3-dose sequence; only approved for use in adult population
- HAV vaccination is lagging behind that of other recommended vaccines; 2nd dose of sequence has lowest coverage level of all recommended childhood vaccines
- Childcare and school entry mandates for HAV vaccination vary widely
- Previous studies have indicated missed opportunities for vaccination (MOV) as a primary reason for underimmunization

Methods

Data Sources and Study Population

- Cross-sectional analysis of data from 2013 National Immunization Survey Child (NIS-Child), available through CDC
- U.S. children 19 - 35 months of age, with provider verified vaccination history
- After restrictions, 13,460 (60%) of subjects retained for analysis

Study Variable Measurements

- Selected *a priori* based on previous research findings and availability of data
- Included maternal and child sociodemographic and geographic data

Data Analysis

- Analysis done using SAS v9.4 (The SAS Institute, Cary NC)
- Survey procedures in SAS used to account for sampling methods in data collection and to assign sample weights
- Vaccination eligibility determined using 2013 ACIP dosing guidelines
 - 1st dose at 12 months of age, 2nd dose 6 - 18 months after first
- MOV quantified by counting number of visits a child made to a health care facility to receive another vaccine and were eligible for HAV vaccination, but did not receive one
 - MOV tallied and categorized into three groups (0, 1, 2+)
- Weighted frequency of each covariate of interest presented for restricted study population using PROC SURVEYFREQ
- Cross-sectional associations of MOV with covariates, bivariate and multivariate polytomous logistic regression using PROC SURVEY LOGISTIC

Results

- Of the selected covariates of interest, only the distribution of gender & first born status did not differ significantly across MOV categories
- Mean MOV were 0.77 per child (95% CI 0.74, 0.80)
 - 56.2% of children had 0 MOV
 - 22.6% of children had 1 MOV
 - 21.2% of children had 2+ MOV
- Median age of vaccine initiation was higher among those with more MOV (Table 2)
- Bivariate findings
 - Reduced odds for MOV associated with: younger age, younger mothers, receipt of WIC benefits, living below poverty line, living in Southern census region, living in a state with childcare or school entry mandates
 - Increased odds for MOV associated with: more educated mothers, married mothers
- Multivariate findings (Table 3)

Table 1. Mean number of MOV and frequency of children with one or more MOV, by number of doses received, NIS-Child, 2013.

Doses Received	Mean # MOV	% with MOV (by dose)	
		1 st	2 nd
0	1.77	75.1%	-
1	0.97	48.4%	15.0%
2	0.43	23.2%	7.1%

Figure 1. Frequency of MOV stratified by number of Hepatitis A doses received, NIS-Child, 2013.

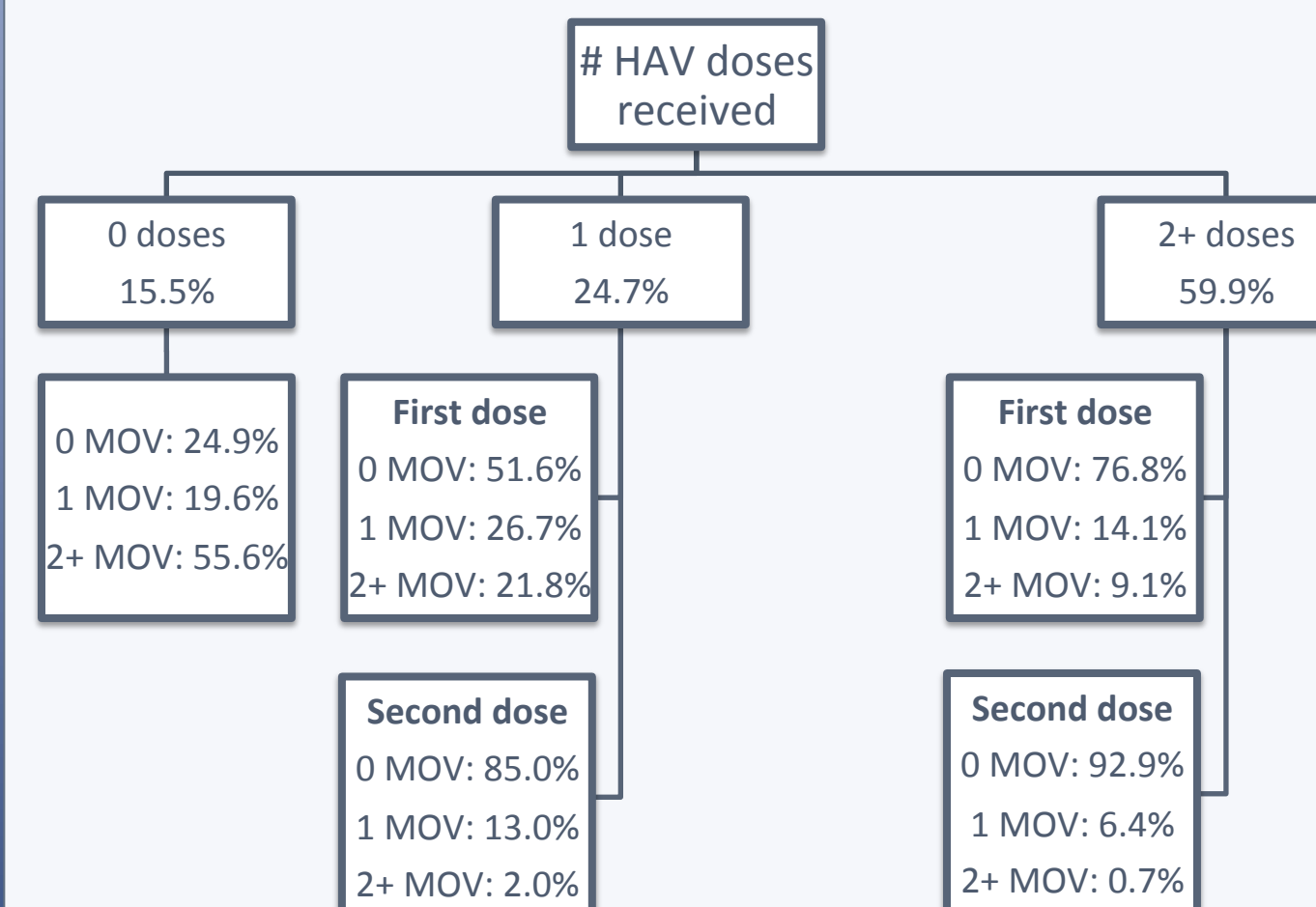


Table 2. Age in days at administration of first and second dose of HAV vaccine, stratified by number of MOV, NIS-Child, 2013.

Dose	# of MOV	% of Population (95% CI)	Median age in days (IQR)	Mean age in days (95% CI)	Pr>F ¹
1st					
	0	40.4 (37.2, 43.6)	375.1 (368.4, 393.7)	395.4 (392.9, 397.9)	<.001
	1	33.9 (30.9, 37.0)	462.6 (396.2, 543.9)	487.8 (477.4, 498.2)	
	2+	25.7 (23.1, 28.4)	565.4 (546.5, 661.9)	588.3 (575.3, 601.3)	
	Overall		387.4 (370.2, 477.4)	445.6 (441.5, 449.8)	
2nd					
	0	70.8 (68.9, 72.8)	582.3 (558.2, 660.3)	621.4 (617.1, 625.7)	<.001
	1	18.7 (17.0, 20.3)	738.2 (729.3, 764.7)	745.1 (734.2, 756.0)	
	2+	10.6 (9.2, 11.9)	756.1 (735.7, 817.5)	799.2 (783.6, 814.7)	
	Overall		617.3 (564.6, 738.5)	663.2 (658.5, 667.9)	

Table 3. Multivariate polytomous logistic regression, odds ratios for 1 and 2+ vs. 0 MOV, among 19-35 month olds with provider verified vaccination history, NIS-Child, 2013.

		OR for 1 vs 0	OR for 2+ vs 0
Child demographics			
Gender	Female	0.89 (0.76, 1.04)	1.03 (0.87, 1.21)
	Male	ref	ref
Age category	19-23 months	0.82 (0.68, 1.00)	0.75 (0.61, 0.93)
	24-39 months	0.98 (0.81, 1.19)	0.93 (0.77, 1.13)
	30-35 months	ref	ref
Race/ Ethnicity	Hispanic	ref	ref
	Non-Hispanic white only	1.02 (0.81, 1.30)	1.20 (0.91, 1.57)
	Non-Hispanic black only	1.35 (1.01, 1.82)	1.05 (0.73, 1.52)
	Non-Hispanic other + multiple race	1.16 (0.86, 1.57)	0.92 (0.66, 1.28)
First born status	Yes	ref	ref
	No	1.03 (0.87, 1.21)	1.06 (0.89, 1.28)
Maternal Demographics			
Age of mother	≤ 19 years	1.04 (0.54, 2.01)	1.02 (0.41, 2.56)
	20-29 years	1.12 (0.93, 1.35)	0.87 (0.72, 1.07)
	≥ 30 years	ref	ref
Education of mother	<12 years	ref	ref
	12 years	1.35 (1.02, 1.78)	1.32 (0.95, 1.84)
	>12 years, non-college grad	1.32 (0.99, 1.75)	1.27 (0.90, 1.78)
	College grad	1.17 (0.86, 1.59)	1.26 (0.88, 1.81)
Marital status of mother	Married	ref	ref
	Not currently married	0.78 (0.64, 0.97)	0.97 (0.77, 1.23)
Socio-economic Variables			
Child ever received WIC benefits	Yes	0.95 (0.75, 1.20)	0.59 (0.45, 0.77)
	No	ref	ref
	Never heard of WIC/Don't Know	1.25 (0.52, 2.99)	0.67 (0.17, 2.58)
Poverty status	Above poverty, >75k	ref	ref
	Above poverty, ≤ 75k	1.02 (0.82, 1.27)	0.97 (0.78, 1.22)
	Below poverty	0.85 (0.62, 1.15)	0.69 (0.50, 0.96)
	Unknown	0.80 (0.50, 1.29)	1.08 (0.63, 1.85)
Geographic Variables			
Census region	Northeast	ref	ref
	Midwest	0.80 (0.65, 0.98)	0.52 (0.42, 0.63)
	South	0.96 (0.78, 1.19)	0.62 (0.51, 0.76)
	West	0.87 (0.67, 1.12)	0.51 (0.38, 0.68)
Childcare entry mandates	Yes	0.69 (0.56, 0.86)	0.43 (0.33, 0.55)
	No	ref	ref
School entry mandates	Yes	0.94 (0.72, 1.23)	1.02 (0.74, 1.42)
	No	ref	ref

Discussion

- Children with 2+ MOV start the HAV vaccination series ≈ 6 months later than children with 0 MOV
 - Gap in ability to protect these children and reduce further transmission of the virus
- Coverage for both doses still behind Healthy People 2020 targets for 85% coverage (Dose 1: 84.6%, Dose 2: 59.9%)
- Important to determine what is contributing to MOV
 - Parental refusal, alternate vaccine schedules, failure of providers to recognize vaccinating opportunities
- Implementing childcare and school entry mandates could help improve vaccination coverage

Strengths & Limitations

Strengths

- Large sample size
- Can be considered representative of U.S. children 19 - 35 months of age due to sampling methods
- NIS-Child is only source that provides data at state/local level; able to assess association of childcare & school entry mandates with MOV

Limitations

- MOV likely an underestimate since only other vaccinating visits were considered in the quantification
- Limited to variables in data set; unable to answer why children are having high numbers of MOV
- Restricted to children with provider verified vaccination history, omission of others may create bias

Conclusions

- Opportunities exist to improve vaccination coverage for HAV
- Children are frequently seen in health care facilities when they are eligible for HAV vaccine, but it is not being administered
- Health care providers need to take advantage of all encounters to ensure children receive all recommended vaccines