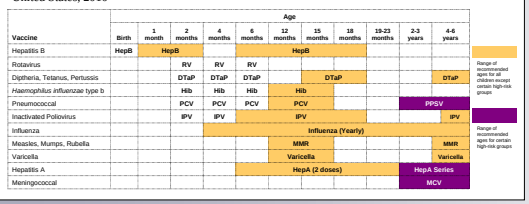
Characteristics Associated with Failure to Complete the Pneumococcal Vaccine Series among Children with Sickle Cell Disease or Sickle Cell Trait

Mary Kleyn, MSc, Violanda Grigorescu, MD, MSPH, Rachel Potter, DVM, MSc, Patricia Vranesich, RN, BSN, Robin O'Neill, MPH, William Young, PhD, Robert Swanson, MPH
Michigan Department of Community Health

BACKGROUND

- The Centers for Disease Control and Prevention (CDC) releases immunization schedules for various age groups that are approved by the Advisory Committee on Immunization Practices, the American Academy of Pediatrics, and the American Academy of Family Physicians (Table 1).[1]
- Children with sickle cell disease (SCD) are at increased risk of acquiring invasive infections.
- Timely completion of the pneumococcal vaccine series, defined as receiving 4 pneumococcal vaccines by 15 months of age, could reduce the number and burden of invasive infections among children with SCD.

Table 1. Recommended Immunization Schedule for Persons Aged 0 Through 6 Years, United States, 2010



STUDY QUESTIONS

- What proportion of children with SCD or sickle cell trait (SCT) in Michigan completes the pneumococcal vaccine series following the recommended schedule?
- What maternal and infant characteristics are associated with failure to complete the pneumococcal vaccine series?

METHODS

- Newborn screening (NBS) records for all children born from 2004-2008 with SCD or SCT were linked with live birth certificates.[2]
- Through live birth certificates, NBS data were linked with the Michigan Care Improvement Registry (MCIR), a web-based system where all immunizations of Michigan residents are reported.
- Immunization data were retrieved for children with SCD or SCT.
- Data Sources for Maternal and Infant Characteristics
  - Birth certificate records: Birth date, race, maternal age at time of birth, gestational age, maternal education, maternal county of residence at time of birth, sex, and neonatal intensive care unit (NICU) admission after birth
  - Immunization records: Vaccine type and date

METHODS

- Age at time of vaccination was calculated using the birth date and vaccine date.
- Characteristics of those with SCD were compared to those of children with SCT using chi-square tests.
- Bivariate and multivariable logistic regression analyses were conducted to assess characteristics associated with failure to complete the pneumococcal vaccine series.

RESULTS

- From 2004-2008, 291 newborns were diagnosed with SCD and 14,536 were reported as SCT.
- Through linkages, approximately 97% of these newborns were matched with birth certificate records, and immunization data were available for 90% of the linked NBS/birth certificate records (n=12,743).
- Overall, 45% of children with SCD (n=117) and 36% of children with SCT (n=4,392) completed the pneumococcal vaccine series by 15 months of age (Table 2).
- Children with SCD were similar to those with SCT, though they did differ on a few characteristics. Children with SCD were significantly more likely to be admitted to the NICU at birth, to be black, and to reside in the region of Detroit at birth compared to children with SCT.
- Among those with SCD, no characteristics were significantly associated with pneumococcal vaccination series completion in either crude or adjusted analyses.
- Among those with SCT, NICU admission at birth, black race, residing in the Detroit region, maternal education of high school or less, and maternal age <25 years were all significantly associated with increased odds of failing to complete the pneumococcal series in both crude and adjusted analyses.

Table 2. Characteristics and Associations between those Characteristics and Failure to Complete the Pneumococcal Vaccination Series among those with Sickle Cell Disease or Sickle Cell Trait born 2004-2008, Michigan

	Children with Sickle Cell Disease				Children with Sickle Cell Trait			
	Overall		Crude	Adjusted*	Overall		Crude	Adjusted*
Characteristic	N	%	OR (95% CI)	OR (95% CI)	N	%	OR (95% CI)	OR (95% CI)
Gestational Age								
<34 weeks	15	5.8	1.8 (0.6, 5.3)	1.3 (0.3, 5.3)	443	3.6	1.0 (0.8, 1.2)	0.8 (0.6, 1.0)
34-36 weeks	25	9.7	1.3 (0.6, 3.1)	1.3 (0.5, 3.3)	1083	8.7	**1.2 (1.0, 1.4)**	1.1 (1.0, 1.3)
≥37 weeks	218	84.5	1.0	1.0	10898	87.7	1.0	1.0
NICU Admission at Birth								
Yes	29	11.2	1.6 (0.7, 3.7)	1.5 (0.5, 4.1)	940	7.6	**1.2 (1.0, 1.3)**	**1.2 (1.0, 1.4)**
No	229	88.8	1.0	1.0	11455	92.4	1.0	1.0
Sex								
Male	118	45.4	1.2 (0.7, 2.0)	1.3 (0.8, 2.1)	6351	50.9	1.0 (0.9, 1.0)	1.0 (0.9, 1.1)
Female	142	54.6	1.0	1.0	6123	49.1	1.0	1.0
Race								
Black	249	95.8			9675	77.9	**1.4 (1.3, 1.5)**	**1.3 (1.1, 1.4)**
White	11	4.2			2186	17.6	1.0	1.0
Other	0	0.0			559	4.5	**0.8 (0.6, 0.9)**	**0.8 (0.6, 0.9)**
Region of Residence at Birth								
Detroit	154	59.2	0.9 (0.5, 1.5)	0.9 (0.6, 1.6)	6635	53.2	**1.6 (1.5, 1.7)**	**1.5 (1.4, 1.7)**
Elsewhere	106	40.8	1.0	1.0	5835	46.8	1.0	1.0
Maternal Education								
Less than high school	62	24.1	0.8 (0.4, 1.4)	0.7 (0.3, 1.5)	3245	26.7	**1.4 (1.3, 1.5)**	**1.4 (1.2, 1.5)**
High school	95	37.0	0.7 (0.4, 1.3)	0.6 (0.3, 1.2)	4565	37.5	**1.2 (1.1, 1.3)**	**1.2 (1.1, 1.3)**
More than high school	100	38.9	1.0	1.0	4353	35.8	1.0	1.0
Maternal Age								
<20 years	51	19.8	0.7 (0.3, 1.6)	0.9 (0.4, 2.2)	2171	17.7	**1.2 (1.0, 1.3)**	1.0 (0.9, 1.1)
20-24 years	69	26.7	1.1 (0.5, 2.4)	1.2 (0.5, 2.9)	3783	30.9	**1.2 (1.0, 1.4)**	**1.1 (1.0, 1.3)**
25-29 years	75	29.1	1.0 (0.4, 2.0)	1.0 (0.4, 2.1)	3090	25.3	1.1 (1.0, 1.2)	1.1 (0.9, 1.2)
30-34 years	42	16.3	1.0	1.0	2072	16.9	1.0	1.0
≥35 years	21	8.1	0.6 (0.2, 1.6)	0.5 (0.2, 1.5)	1119	9.1	1.1 (1.0, 1.3)	1.1 (1.0, 1.3)
Timely Vaccine Completion								
Yes	117	45.0			4392	36.1		
No	143	55.0			7782	63.9		

*Adjusted for all characteristics in the table except for timely vaccine completion.

CONCLUSIONS

- Children with SCD had slightly higher pneumococcal vaccination series completion rates compared to children with SCT, though both groups had completion rates below 50%.
- The immunization completion rates for the pneumococcal vaccination series should be improved for children with SCD given their increased risk for infections.
- Select characteristics are associated with decreased likelihood of vaccine receipt among children with SCT, while no associations were found among children with SCD. This study finding could be due to a lack of heterogeneity among the SCD population.

PUBLIC HEALTH IMPLICATIONS

- Linkages between NBS, live births, and immunization data provide up-to-date, continued information on immunization status. This information was used to develop educational materials to meet the needs of specific high-risk populations.

- Using the lifespan surveillance process as a long-term follow-up strategy for SCD and SCT proved to be an efficient way of identifying unmet needs and developing targeted prevention strategies.[3]

FUTURE DIRECTIONS

- Knowing the predictors of receiving immunizations in a timely manner is helpful in further targeting educational materials.
- Plans are in place to assess what specific factors are associated with decreased immunization receipt for other vaccinations of particular importance for the SCD population.
- Michigan recently launched a Sickle Cell Follow-up Module on MCIR. The information collected through this module will be used for continued assessment of health outcomes of those with SCD.

REFERENCES

1. Recommended Immunization Schedule for Persons Aged 0 Through 6 Years, United States, 2010. (http://www.cdc.gov/vaccines/recs/schedules/downloads/child/2010/10_0-6yrs-schedule-pr.pdf)
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