



Perinatal Hepatitis B Prevention Program 2018 Annual Report

SAINT LOUIS COUNTY DEPARTMENT OF PUBLIC HEALTH
6121 NORTH HANLEY ROAD, BERKELEY, MO 63134

Contents

Saint Louis County Department of Public Health	2
Report Preparation	3
Executive Summary	4
Introduction.....	5
Perinatal Hepatitis B Prevention Program: Women.....	7
Perinatal Hepatitis B Prevention Program: Children	12
Appendix A: Hepatitis B Vaccine Schedules for Newborn Infants.....	20
Appendix B: Population Flow of the 2013 to 2017 Cohort.....	21
Appendix C: Notes on the Data	22
Appendix D: CDC Global Regions.....	28
References	29

Saint Louis County Department of Public Health

Mission

The Saint Louis County Department of Public Health strives to keep Saint Louis County one of the best places in the region to live, work, or visit. This is accomplished by regularly assessing the health and environment of the county and responding with sound policies that help assure the availability of high quality public health services for everyone.

Vision

The Saint Louis County Department of Public Health's vision is a collaborative public health system entrusted to coordinate and allocate resources for prevention and outreach to promote and create a healthy and safe environment.

Values

The Saint Louis County Department of Public Health is committed to:

- Being a public health leader in the community;
- Operating in a manner that recognizes the value of all people;
- Continuously improving its operations;
- Using evidence-based practices;
- Attaining the highest level of service through efficiency, consistency, and relationship development;
- Promoting innovation to ensure all people in the community are served; and
- Operating in a transparent manner and accepting responsibility for outcomes.

Report Preparation

This report was prepared by the Saint Louis County Department of Public Health, Division of Communicable Disease Control Services.

- Perinatal Hepatitis B Prevention Program
- Epidemiology Program

Saint Louis County Department of Public Health

6121 North Hanley Road

Berkeley, MO 63134

For additional information, please contact 314-615-1630 or cdcs.doh@stlouisco.com.

Executive Summary

Hepatitis B is a liver disease caused by infection with the hepatitis B virus (HBV). While approximately 90% of infants infected with HBV through perinatal transmission (transmission occurring during birth) will develop chronic HBV infections, the risk of perinatal hepatitis B transmission can be reduced by more than 90% if newborns are given appropriate post-exposure prophylaxis (PEP).

Through the Perinatal Hepatitis B Prevention Program (PHBPP), Saint Louis County Department of Public Health (DPH) provides case management to pregnant Saint Louis County residents who are infected with HBV and their infants. Services provided by the DPH PHBPP include: educating pregnant women with HBV about the infection; working with mothers and health care providers to ensure newborns receive appropriate PEP; and ensuring infants complete the hepatitis B vaccine series and receive timely post-vaccination serology testing (PVST).

The 2018 Perinatal Hepatitis B Prevention Program Annual Report includes data on pregnant hepatitis B surface antigen positive (HBsAg+) Saint Louis County residents with estimated dates of delivery (EDDs) between 01/01/2013 and 12/31/2017, as well as infants residing in Saint Louis County and born to HBsAg+ women with these EDDs. Key findings are below.

Pregnant HBsAg+ Women

- The report contains information on 135 pregnancies in 110 unique HBsAg+ Saint Louis County residents with EDDs between 01/01/2013 and 12/31/2017.
- The number of pregnancies per year among HBsAg+ women in Saint Louis County ranged from a low of 21 in 2013 to a high of 35 in 2014.
- Overall, 19.3% of pregnancies in HBsAg+ Saint Louis County residents were in U.S.-born women.
 - Among non-U.S.-born women, the percentage of pregnancies by region was: Africa, 30.7%; East Asia, 25.0%; Southeast Asia, 18.2%; and other regions, 26.2%.
- The average annual rate of pregnancies in HBsAg+ women in Saint Louis County was 10.6 per 100,000 women aged 10 to 49 years.

Infants Born to HBsAg+ Mothers

- From 2013 to 2017, 159 infants received case management by the DPH PHBPP.
- Over 99% of infants (131 out of 132) received the hepatitis B vaccine birth dose within 12 hours of birth. The remaining child received the hepatitis B vaccine birth dose after the first day of life.
- All of the 123 children on whom DPH has vaccine completion information successfully completed their hepatitis B vaccine series.
 - Completion rates by age for infants enrolled in the PHBPP were 87.8% and 99.2% by ages 9 (as recommended) and 12 months.
- PVST results indicated that 96.6% of children on whom DPH has information developed HBV immunity following the first vaccination series.

Introduction

Hepatitis B

Hepatitis B is a liver disease which is caused by infection with the hepatitis B virus (HBV). Acute hepatitis B infections may be asymptomatic, but can also cause such symptoms as fever, headache, or jaundice. Although many people are able to fight the infection and clear the virus, for others the virus remains in their body and can cause chronic illness. Chronic infections can be life-threatening, leading to advanced liver disease, cirrhosis, or liver cancer. Transmission of HBV occurs from contact with infected blood or other bodily fluids, and transmission routes include: sharing needles, syringes, or drug equipment; sexual contact; accidental medical exposures; sharing household items (e.g., razors or toothbrushes) with an infected person; and exposure to infected blood during childbirth.

According to the World Health Organization, globally, an estimated 257 million people are living with HBV and 887,000 deaths were attributed to the virus in 2015 alone.¹ Data from the Centers for Disease Control and Prevention (CDC) show that the incidence of acute HBV infections in the United States was 1.0 cases per 100,000 (in 2016) and the CDC estimates there are currently 862,000 people chronically infected with HBV in the United States.²

Since the introduction of the HBV vaccine in 1982, vaccination has become the most effective strategy to prevent HBV infection. A core component of the recommendations by the Advisory Committee on Immunization Practices (ACIP) has been universal hepatitis B vaccination for all infants born in the United States. Routine hepatitis B vaccination is a 3-dose vaccine schedule received at birth, age 1 to 2 months, and age 6 months.³ ACIP recommends infants born to hepatitis B surface antigen negative (HBsAg-) women receive the first dose of hepatitis B vaccine within 24 hours of birth.³ For more information on ACIP hepatitis B vaccination recommendations for newborns, see [Appendix A](#).

Perinatal Hepatitis B

Transmission of HBV which occurs during childbirth is called *perinatal transmission*. Without appropriate preventive measures, approximately 90% of infants who become infected will develop chronic HBV infections. In comparison, 25% to 50% of children aged one to five years and only 5% of adults who contract HBV will remain chronically infected. The risk of perinatal hepatitis B transmission can be reduced by more than 90% if newborns are given appropriate post-exposure prophylaxis (PEP).

To prevent perinatal HBV transmission, the following strategies are recommended in the United States:

- Universal HBsAg screening of all pregnant women irrespective of previous HBsAg results;
- Case management of HBsAg positive (HBsAg+) pregnant women;
- Suggestion of antiviral therapy when maternal HBV DNA is >200,000 IU/mL (as recommended by the American Association for the Study of Liver Diseases in their 2016 guidelines⁴); and

- Case management of infants born to HBsAg+ mothers, including:
 - PEP, including administration of hepatitis B immune globulin;
 - Routine vaccination with hepatitis B vaccine; and
 - Post-vaccination serology testing (PVST).

In 1990, the CDC created the U.S. Perinatal Hepatitis B Prevention Program (PHBPP) to eliminate perinatal HBV transmission by testing all pregnant women for HBsAg to screen for HBV.⁵ Infants born to HBsAg+ women are case managed by local public health departments to ensure timely administration of PEP, completion of the hepatitis B vaccine series, and PVST. For additional information on the hepatitis B vaccine schedule for infants born to HBsAg+ women, see [Appendix A](#).

The Saint Louis County Department of Public Health (DPH) PHBPP

In accordance with U.S. and Missouri guidelines, Saint Louis County DPH provides case management to pregnant Saint Louis County residents who are infected with HBV to prevent perinatal transmission. DPH verifies the pregnancy status of all women aged 11 to 47 years with positive HBsAg tests and provides case management services to HBsAg+ pregnant women for the duration of their pregnancy and to their infants through PVST completion at age nine to 12 months (or one to two months after vaccine completion if vaccination was delayed). DPH PHBPP services include using evidence-based methods and educational materials to inform HBV-infected women about hepatitis B and ensuring their infants receive appropriate PEP and subsequent vaccination and serology testing to prevent infection. Successful achievement of program goals requires labor-intensive surveillance and collaboration with families, health care providers, and other jurisdictions' public health departments.

This report presents data on the 2013 to 2017 cohort of DPH PHBPP participants. This cohort includes pregnant HBsAg+ Saint Louis County residents with estimated dates of delivery (EDDs) between 01/01/2013 and 12/31/2017, as well as infants residing in Saint Louis County and born to HBsAg+ women with the above mentioned EDDs. Additional information on inclusion and exclusion criteria for the 2013 to 2017 cohort, as well as for individual tables and figures presented in the report, can be found in [Appendix C](#). This report is divided into two sections. The first section presents information on the *pregnant HBsAg+ women* who received case management by the DPH PHBPP and the second section presents information on *infants born to HBsAg+ women* who received case management by the DPH PHBPP.

Perinatal Hepatitis B Prevention Program: Women

This report contains information on 135 pregnancies in 110 unique women who make up the Saint Louis County Department of Public Health (DPH) Perinatal Hepatitis B Prevention Program (PHBPP) 2013 to 2017 cohort.

Women were included if they:

- Resided in Saint Louis County at some time during pregnancy;
- Had contact with the Saint Louis County DPH PHBPP during pregnancy (regardless of the initial jurisdiction where the case was reported); and
- Had an estimated date of delivery (EDD) between 01/01/2013 and 12/31/2017.

Women’s inclusion in the cohort was irrespective of pregnancy outcome. For a more detailed explanation on the inclusion/exclusion criteria, see [Appendix C](#).

Pregnancies in Hepatitis B Surface Antigen Positive (HBsAg+) Saint Louis County

Residents

There were 135 total pregnancies among 110 unique HBsAg+ women who received case management from the Saint Louis County DPH PHBPP with EDDs from 01/01/2013 to 12/31/2017 (Table 1). During that same time period, there were 67,461 total pregnancies among Saint Louis County residents. The number of pregnancies per year among HBsAg+ women ranged from a low of 21 in 2013 to a high of 35 in 2014.

Table 1: Number of Pregnancies in Saint Louis County Residents: HBsAg+ Women Only vs. County Total*†
Saint Louis County, MO 2013 to 2017

Year	# Pregnancies in HBsAg+ Saint Louis County Residents	# Pregnancies in Saint Louis County Residents (Total)
2013	21	13,831
2014	35	13,731
2015	32	13,564
2016	23	13,448
2017	24	12,887

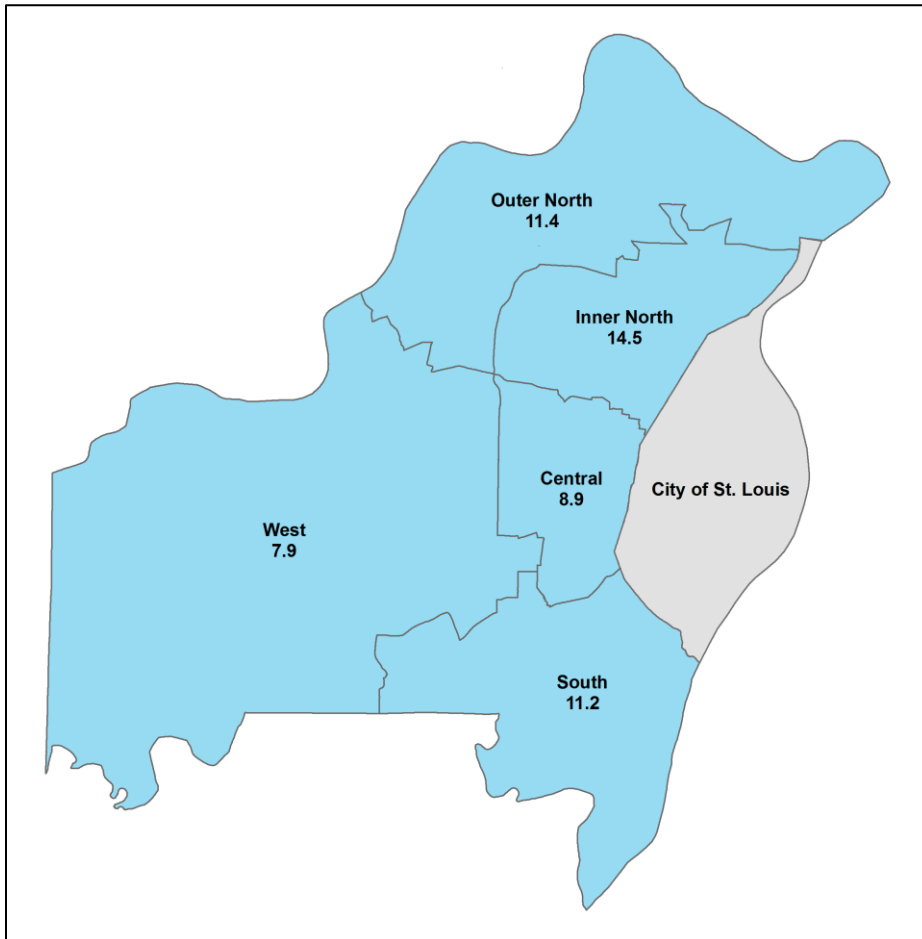
* HBsAg+: Hepatitis B surface antigen positive

† Data for HBsAg+ women include women with EDDs from 01/01/2013 to 12/31/2017. See [Appendix C](#) for inclusion/exclusion details. Data for all Saint Louis County residents are taken from the Missouri Information for Community Assessment (MICA) and include all pregnancies for that calendar year.

Overall, the average annual rate of pregnancies in HBsAg+ Saint Louis County residents was 10.6 per 100,000 women aged 10 to 49 years. DPH, along with the Saint Louis County Department of Planning, established five Saint Louis County regions based on the social and demographic characteristics of the regions’ residents. Using five County regions also allows for sub-County-level comparisons, without the volatility or risk of individual identifiers which may be present in ZIP Code- or census tract-level comparisons. When stratifying by Saint Louis County region, the West region had the lowest rate of pregnancies among HBsAg+ women, with 7.9 pregnancies per 100,000 women aged 10 to 49 years (Figure 1). The Central region also had a rate lower than the County

average, with 8.9 cases per 100,000 women aged 10 to 49 years. The highest rate of pregnancies in HBsAg+ Saint Louis County residents was in the Inner North region, with 14.5 per 100,000 women aged 10 to 49 years, followed by the Outer North and South regions, with 11.4 cases and 11.2 cases per 100,000 women aged 10 to 49 years, respectively.

**Figure 1: Distribution of Pregnancies in HBsAg+ Pregnant Women by Saint Louis County Region*
Average Annual Rates per 100,000 Females Aged 10 to 49 Years
Saint Louis County, MO 2013 to 2017 (n=135[†])**



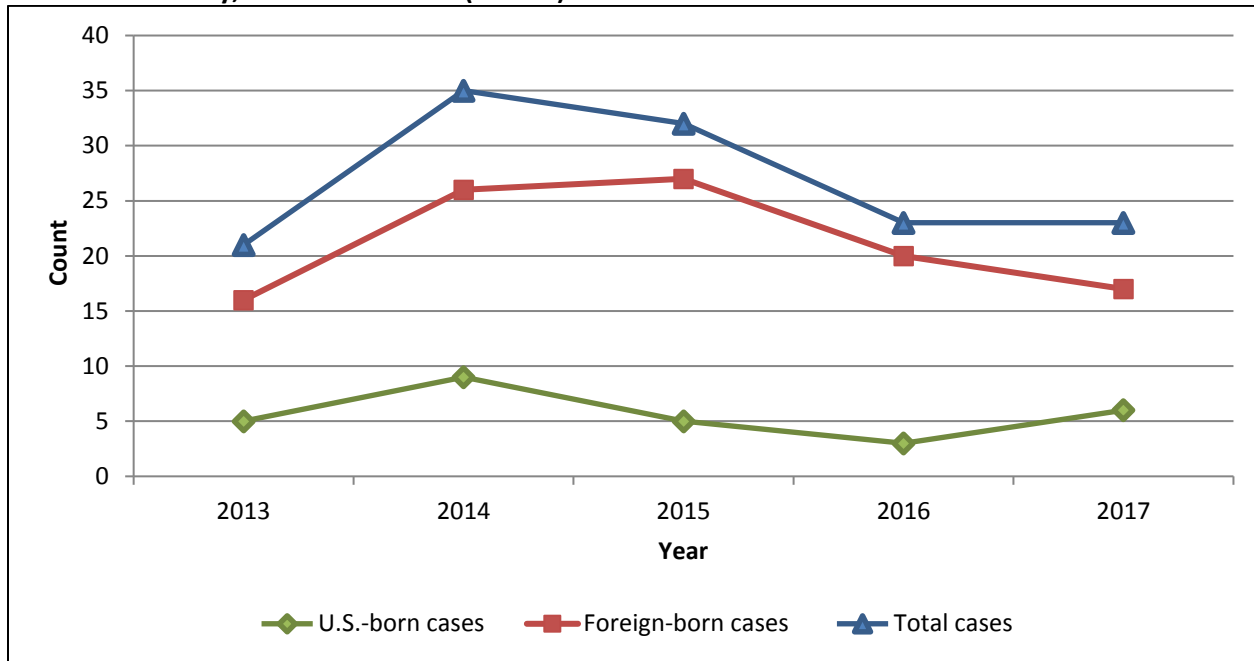
* HBsAg+: Hepatitis B surface antigen positive

† This graph contains information on 135 pregnancies in 110 unique women. See [Appendix C](#) for inclusion/exclusion details.

Country of Origin of HBsAg+ Saint Louis County Residents

The majority of the HBsAg+ women receiving case management were non-U.S.-born (Figure 2). Overall, 20.9% of women were U.S.-born, though the yearly percentage ranged from 13.0% in 2016 to 26.1% in 2017.

Figure 2: Country of Origin of HBsAg+ Pregnant Women*
Saint Louis County, MO 2013 to 2017 (n=134†)

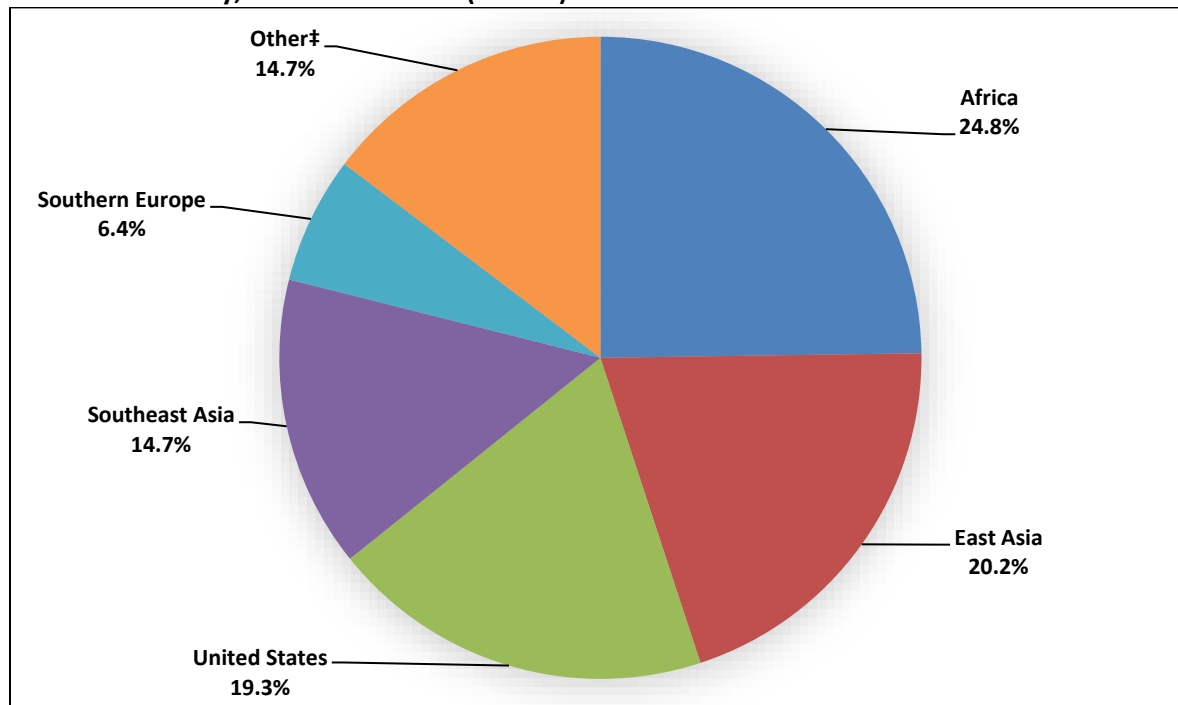


* HBsAg+: Hepatitis B surface antigen positive

† This graph contains information on 109 unique women who had 134 pregnancies with estimated dates of delivery between 01/01/2013 and 12/31/2017. Country of origin was not available for one woman who gave birth in 2017. See [Appendix C](#) for inclusion/exclusion details.

The Saint Louis County DPH PHBPP utilizes global regions proposed by the Centers for Disease Control and Prevention to further de-identify report data. For a full list of countries/territories included in each region, see [Appendix D](#). Among non-U.S.-born women, the distribution of global regions of maternal birth was: Africa – 30.7%; East Asia – 25.0%; Southeast Asia – 18.2%; Southern Europe – 8.0%; and other – 18.2% (Figure 3).

**Figure 3: Global Region of Origin of HBsAg+ Pregnant Women*
Saint Louis County, MO 2013 to 2017 (n=109†)**



* HBsAg+: Hepatitis B surface antigen positive

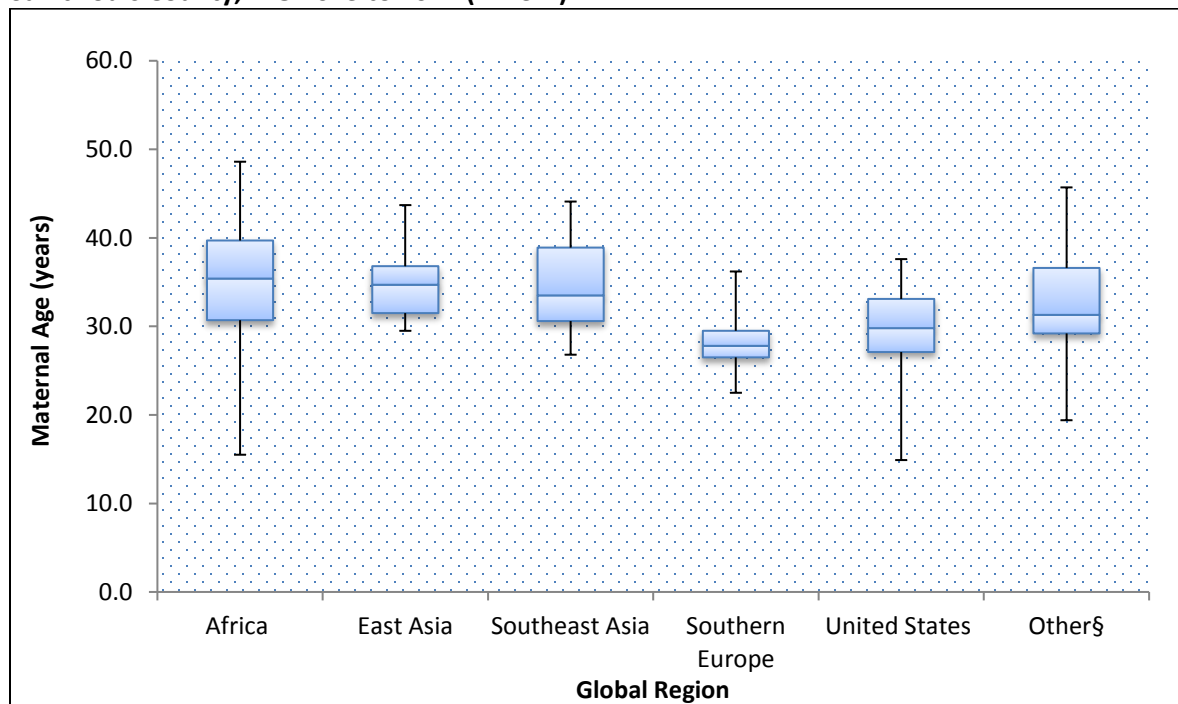
† This graph contains information on 109 unique women who had 134 pregnancies with estimated dates of delivery between 01/01/2013 and 12/31/2017. Country of origin was not available for one woman who gave birth in 2017. See [Appendix C](#) for inclusion/exclusion details.

‡ Other includes: South Asia; Eastern Europe; West/Central Asia; and the Middle East.

Median Age of HBsAg+ Saint Louis County Residents, by Global Region of Origin

Median age of all HBsAg+ women was 32.8 years (range 14.9 to 48.6 years), and U.S.-born women were statistically significantly younger than non-U.S.-born women (29.8 years vs. 33.9 years, Wilcoxon rank sum p-value<0.01) (Figure 4).

Figure 4: Age Distribution* of HBsAg+ Pregnant Women†, by Global Region of Origin Saint Louis County, MO 2013 to 2017 (n=134‡)



* Median, interquartile range, range

† HBsAg+: Hepatitis B surface antigen positive

‡ This graph contains information on 109 unique women who had 134 pregnancies with estimated dates of delivery between 01/01/2013 and 12/31/2017. Country of origin was not available for one woman who gave birth in 2017. See [Appendix C](#) for inclusion/exclusion details.

§ Other includes: South Asia; Eastern Europe; West/Central Asia; and the Middle East.

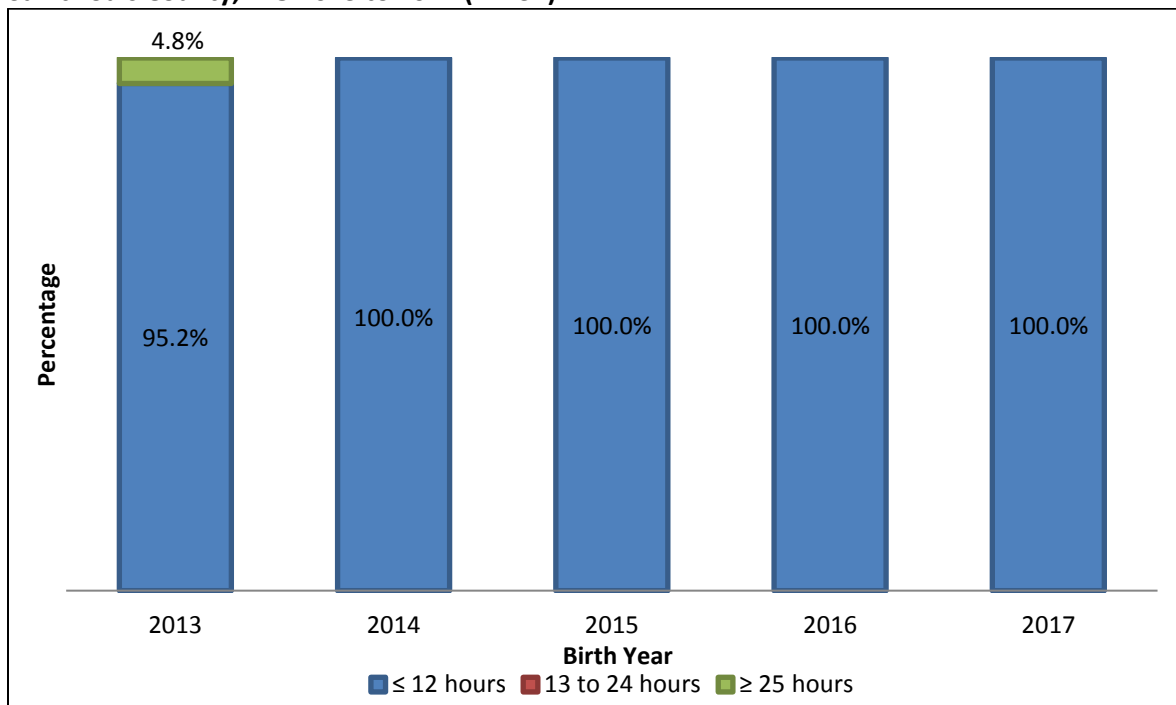
Perinatal Hepatitis B Prevention Program: Children

This report contains information on 159 total children who received case management from the Saint Louis County Department of Public Health (DPH) Perinatal Hepatitis B Prevention Program (PHBPP) and were part of the 2013 to 2017 cohort, though this population was fluid throughout the time period of interest. For example, from delivery through the receipt of post-vaccination serology testing (PVST) results, 18 children transferred into the jurisdiction of the Saint Louis County DPH PHBPP, 19 children transferred out of jurisdiction, and five children were lost to follow-up. Two children transferred into the jurisdiction during the vaccination series, but transferred out before vaccination was complete. Each figure below presents the most complete data available (i.e., the largest sample size on whom we had complete data). For a more detailed explanation on the inclusion/exclusion criteria, see [Appendix C](#). Full details on the flow into and out of the cohort can be found in the 2013 to 2017 Cohort Population Flowchart ([Appendix B](#)).

Hepatitis B Vaccine Birth Dose

From 2013 to 2017, 132 infants were born to hepatitis B surface antigen positive (HBsAg+) women in Saint Louis County. Of these, 99.2% received the hepatitis B vaccine birth dose within 12 hours of birth, as recommended by the Advisory Committee on Immunization Practices (ACIP) (Figure 5). No children received the hepatitis B vaccine birth dose between 13 and 24 hours, and one child received the hepatitis B birth dose vaccine after the first day of life.

Figure 5: Timing of Hepatitis B Vaccine Birth Dose Administration, by Birth Year as a Percentage of Annual Total Saint Louis County, MO 2013 to 2017 (n=132)



Hepatitis B Vaccine Series Completion

All of the 123 children on whom we have vaccine completion information successfully completed their hepatitis B vaccine series (Figure 6). Of these, 87.8% (n=108) completed the series by age nine months (as recommended by ACIP). An additional 11.4% (n=14) completed by age 12 months and one child completed the series at age 13 months. Per year, the proportion of children who completed the hepatitis B vaccine series by age nine months ranged from 82.1% in 2014 to 96.3% in 2015 (Figure 7). Vaccine completion information was unavailable on two children lost to follow-up and 14 children who moved out of jurisdiction prior to completion. Seven children transferred into jurisdiction after delivery, but prior to completion of the vaccine series, and completed the vaccine series while under the jurisdiction of the Saint Louis County DPH PHBPP. These children are included in the aforementioned statistics. Two children transferred into the jurisdiction after delivery and transferred out prior to completion of the vaccine series. These children are not included in the above statistics.

**Figure 6: Age at Completion of the Hepatitis B Vaccine Series
Saint Louis County, MO 2013 to 2017 (n=123)**

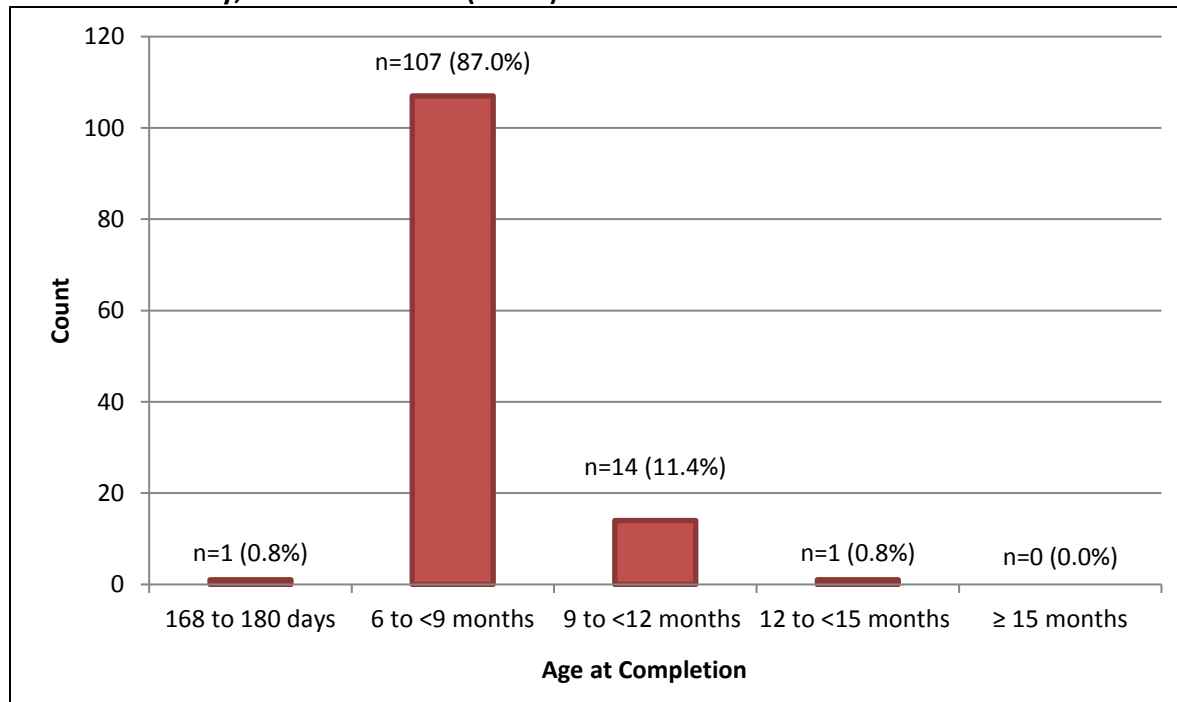
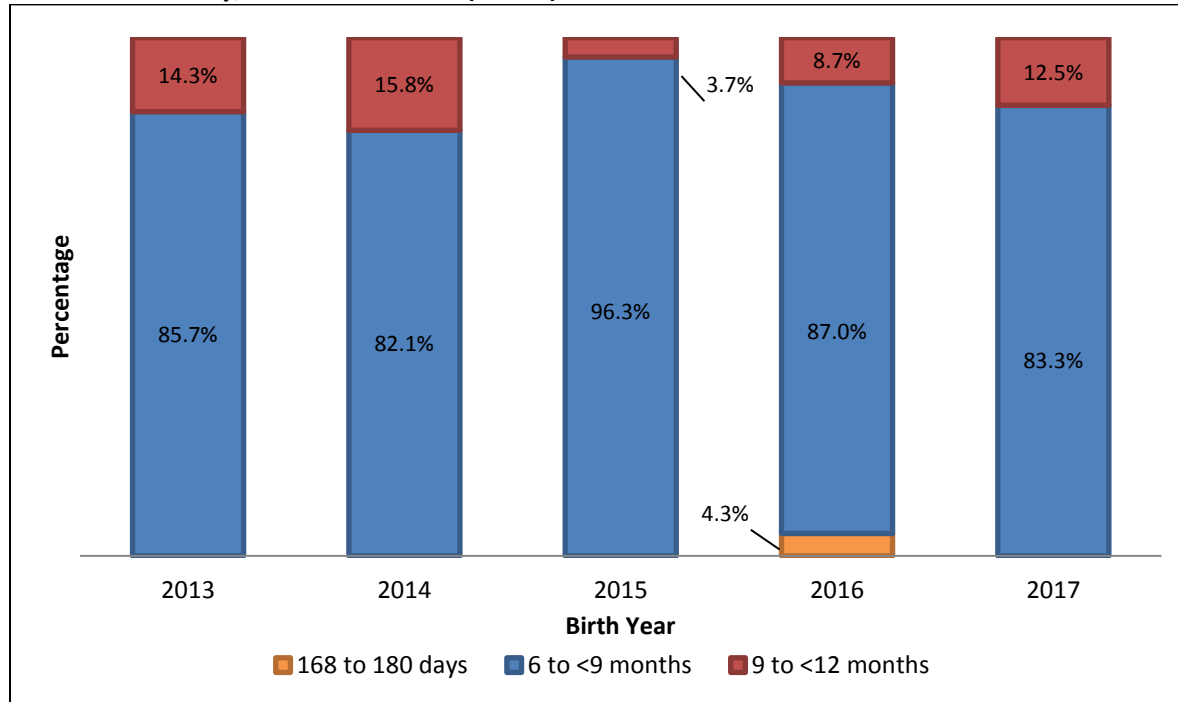


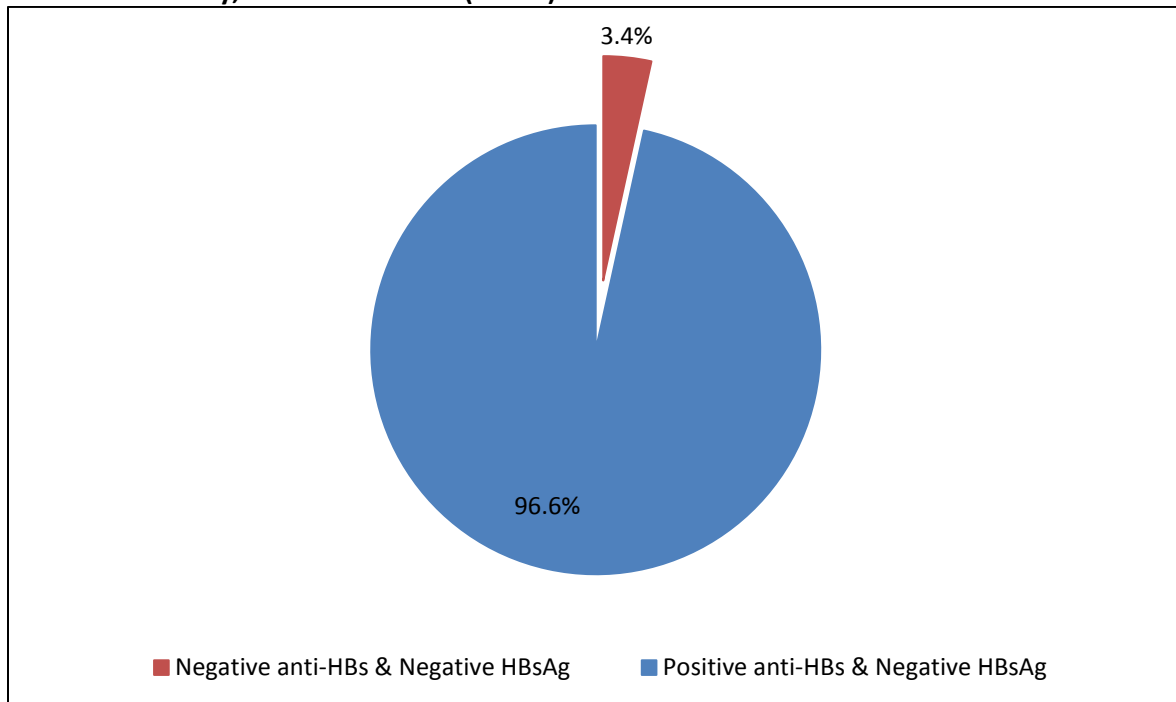
Figure 7: Age at Completion of the Hepatitis B Vaccine Series, by Birth Year as a Percentage of Annual Total Saint Louis County, MO 2013 to 2017 (n=123)



Post-Vaccination Serology Testing (PVST)

PVST results were available on 116 children (three children transferred into jurisdiction after vaccine series completion (but prior to PVST), 5 children transferred out prior to PVST, 2 children were lost to follow-up prior to PVST, and the parents of 3 children refused PVST) (Figure 8). PVST indicated that 96.6% (n=112) of children developed HBV immunity following the first vaccination series. Three children received a repeat vaccination series (one child was lost to follow-up after initial PVST results), of which two successfully seroconverted. The immunity status of the third child could not be determined. Additionally, one child transferred into the jurisdiction prior to beginning a revaccination series. The Saint Louis County DPH PHBPP provided case management to this infant throughout the revaccination series and through receipt of the second PVST results. This infant is not included in Figure 8, which includes information only on children receiving initial PVST in Saint Louis County.

**Figure 8: Post-Vaccination Serology Testing Results – HBsAg and anti-HBs*†
Saint Louis County, MO 2013 to 2017 (n=116)**



* HBsAg: Hepatitis B surface antigen; anti-HBs: antibody to the hepatitis B surface antigen

† Instead of an HBsAg test, a polymerase chain reaction test was run on one child to identify hepatitis B viral DNA. No viral DNA was detected and this child was considered immune.

Comparison with State and National Data

When comparing data on children from the Saint Louis County DPH PHBPP with data from the Missouri and U.S. PHBPPs, a few differences must be noted from the methods utilized above. In order for local, state, and federal data to be more directly comparable, children are included in the U.S. jurisdiction from which they last received case management. If Saint Louis County (or Missouri) transfers a child to another state (or from Saint Louis County to another jurisdiction within Missouri), that child *is not included* in the Saint Louis County (or Missouri) sample. If a child moves out of the United States, that child *is included* in the Saint Louis County (and Missouri, and the U.S.) sample. For additional details on inclusion criteria, see [Appendix C](#). Also for comparability, Figures 9 to 11 below present data for the following metrics:

- Post-exposure prophylaxis (PEP; hepatitis B immune globulin and dose one of the hepatitis b vaccine) within one calendar day of birth;
- Completion of the hepatitis B vaccine series within eight and 12 months of birth; and
- Completion of PEP, the hepatitis B vaccine series, and PVST by December 31st of the calendar year following the year of birth.

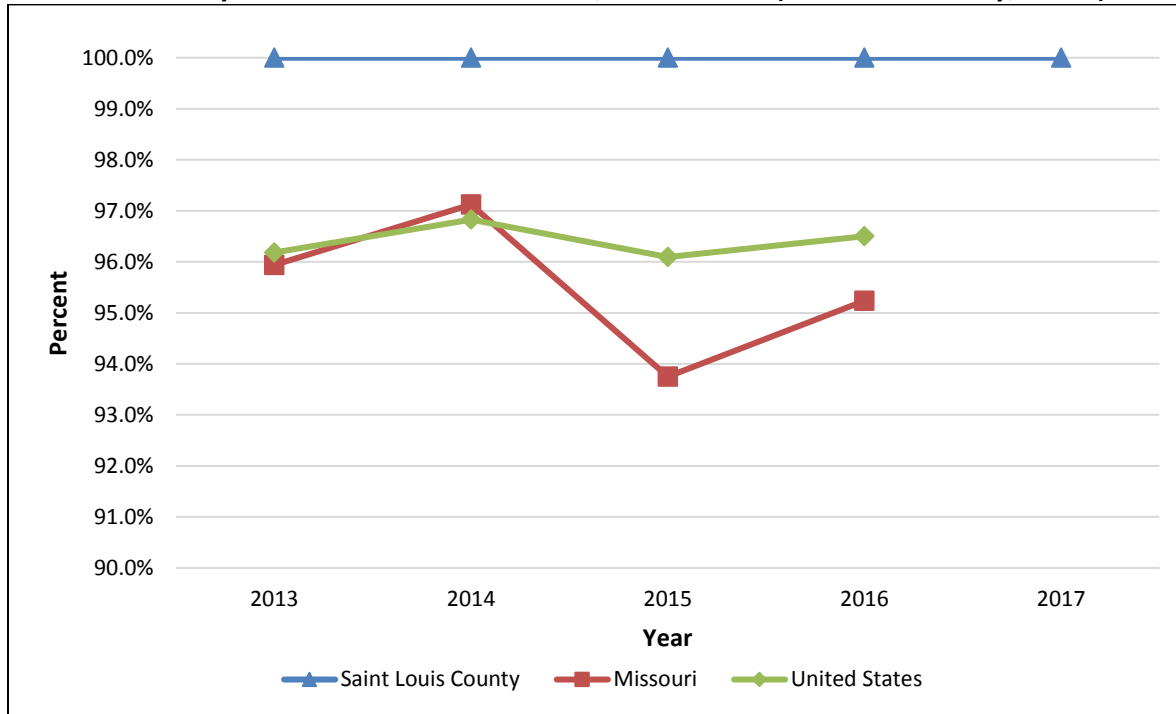
The number of infants enrolled each year in the Saint Louis County, Missouri, and U.S. PHBPPs who meet the above criteria can be found in Table 2. Data from the 2017 birth cohort are not yet available for the Missouri and U.S. PHBPPs.

Table 2: Number of Infants Enrolled in the Perinatal Hepatitis B Prevention Program Saint Louis County vs. Missouri vs. United States, 2013 to 2017

	2013	2014	2015	2016	2017
Saint Louis County	23	31	28	24	24
Missouri	123	139	128	105	/
United States	10,902	11,157	11,186	11,487	/

All children in the Saint Louis County DPH PHBPP included in this analysis completed PEP within one calendar day of birth (Figure 9). Overall, 95.6% of infants in the Missouri PHBPP completed PEP within one calendar day of birth, with the annual percentages ranging from 93.8% (in 2015) to 97.1% (in 2014). The overall percentage of children in the U.S. PHBPP completing PEP within one calendar day of birth was 96.4%. The annual percentages remained fairly stable over time, ranging from 96.1% (in 2015) to 96.8% (in 2014).

Figure 9: Infants Completing Hepatitis B Post-Exposure Prophylaxis Within One Calendar Day of Birth Saint Louis County vs. Missouri vs. United States, 2013 to 2017 (Saint Louis County, n=130)



Overall, 82.3% of infants enrolled in the Saint Louis County DPH PHBPP completed the hepatitis B vaccine series by age eight months (Figure 10a). The eight-month completion rate for the Saint Louis County PHBPP varied notably over time, with annual percentages ranging from a low of 74.2% (in 2014) to a high of 89.3% (in 2015). The 8-month vaccine series completion rate was higher in Saint Louis County than both Missouri and the United States overall (Missouri – 75.6%, U.S. – 74.5%) and for three of the four comparison years. Only in 2014, was the 8-month completion rate lower in Saint Louis County (74.2%) than in Missouri (75.5%) and the U.S. (74.3%).

Overall, 93.1% of infants enrolled in the Saint Louis County DPH PHBPP completed the hepatitis B vaccine series by age 12 months, compared with 83.4% and 82.0% for the Missouri and U.S. PHBPPs, respectively (Figure 10b). The annual percentages for completion of the hepatitis B vaccines series for the Saint Louis County DPH PHBPP ranged from 87.1% (in 2014) to 96.4% (in 2015). For the Missouri PHBPP, the annual percentages ranged from 77.1% (in 2016) to 87.8% (in 2013). For the U.S. PHBPP, the annual percentages ranged from 80.3% (in 2015) to 84.1% (in 2013).

Figure 10a: Percent of Infants with Hepatitis B Vaccine Series Completion by Age Eight Months Saint Louis County vs. Missouri vs. United States, 2013 to 2017 (Saint Louis County, n=130)

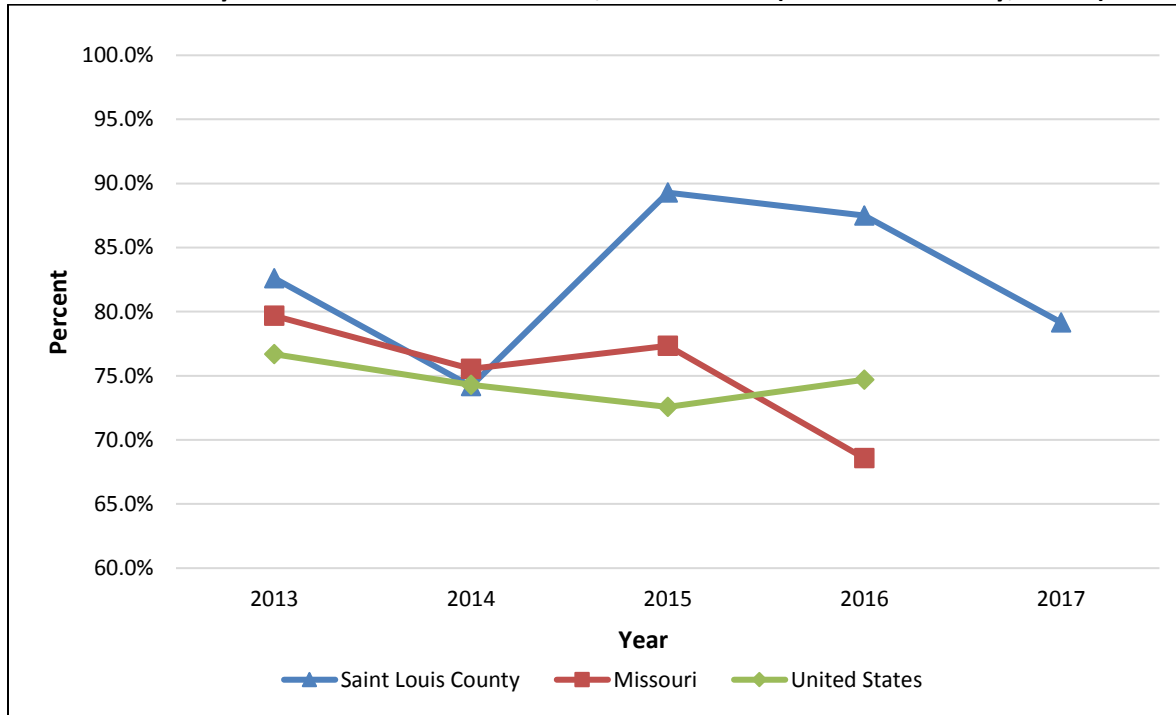
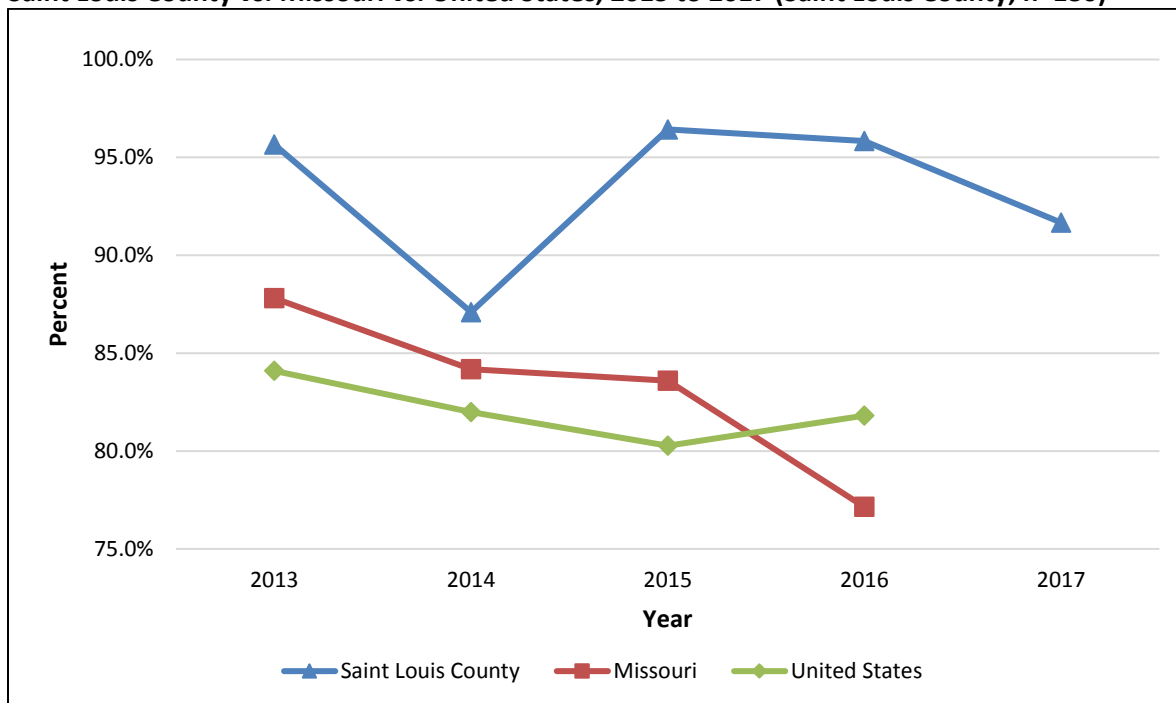
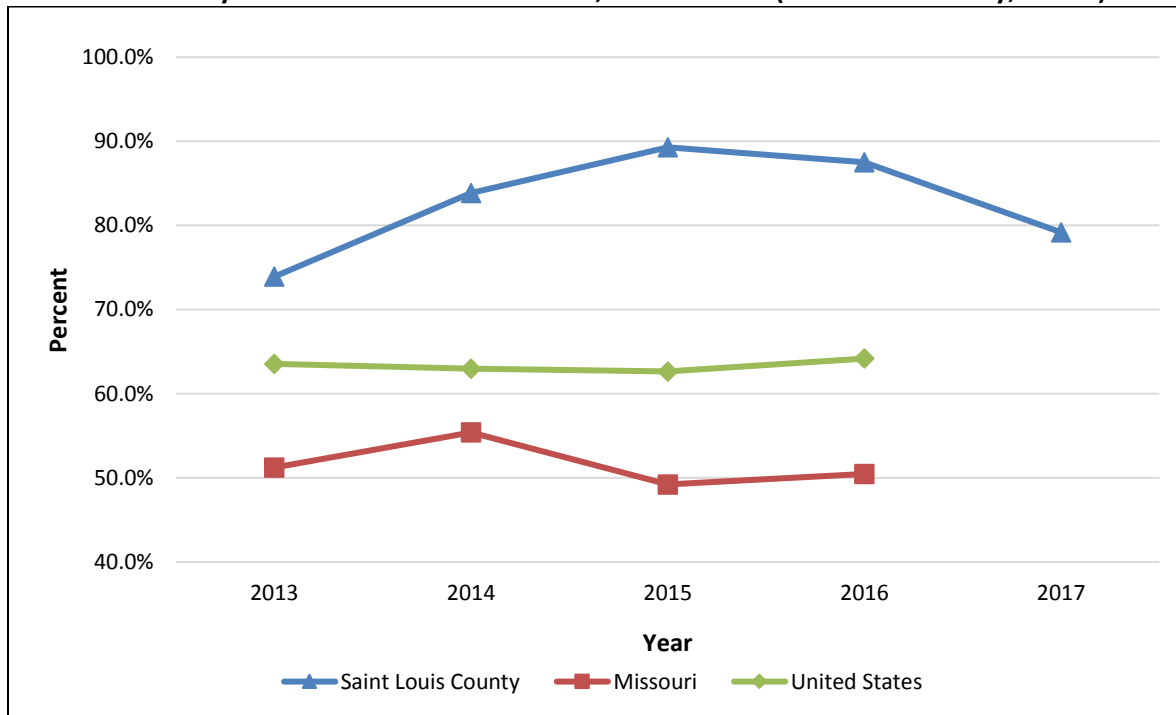


Figure 10b: Percent of Infants with Hepatitis B Vaccine Series Completion by Age 12 Months Saint Louis County vs. Missouri vs. United States, 2013 to 2017 (Saint Louis County, n=130)



Approximately 83% of children enrolled in the Saint Louis County DPH PHBPP completed PEP, the hepatitis B vaccine series and PVST by December 31st of the calendar year following the year of their birth, compared with 51.7% and 63.3% of children enrolled in the Missouri and U.S. PHBPPs, respectively. The annual percentages for completion for the Saint Louis County DPH PHBPP ranged from 73.9% (in 2013) to 89.3% (in 2015). For the Missouri PHBPP, the annual percentages ranged from 49.2% (in 2015) to 55.4% (in 2014). For the U.S. PHBPP, the annual percentages ranged from 63.0% (in 2014) to 64.2% (in 2016).

Figure 11: Percent of Infants Completing Post-Exposure Prophylaxis, the Hepatitis B Vaccine Series, and Post-Vaccination Serology Testing by December 31st of the Year Following Their Birth Year Saint Louis County vs. Missouri vs. United States, 2013 to 2017 (Saint Louis County, n=130)



Appendix A: Hepatitis B Vaccine Schedules for Newborn Infants

The information in Appendix A was obtained on September 16, 2019 from:

Schillie S, Vellozzi C, Reingold A, *et al.* Prevention of Hepatitis B Virus Infection in the United States: Recommendations of the Advisory Committee on Immunization Practices. MMWR Recomm Rep 2018; 67(No. RR-1):1–31.

This report can be accessed at: <https://www.cdc.gov/mmwr/volumes/67/rr/pdfs/rr6701-H.PDF>

Table 3: Hepatitis B Vaccine Schedules Infants, by Infant Birthweight and Maternal Hepatitis B Surface Antigen (HBsAg) Status

Birthweight	Maternal HBsAg status	Single-antigen vaccine		Single-antigen + combination vaccine [†]	
		Dose	Age	Dose	Age
≥2,000 g	Positive	1	Birth (≤12 hrs)	1	Birth (≤12 hrs)
		HBIG [§]	Birth (≤12 hrs)	HBIG	Birth (≤12 hrs)
		2	1–2 mos	2	2 mos
		3	6 mos [¶]	3	4 mos
	Unknown*	4		4	6 mos [¶]
		1	Birth (≤12 hrs)	1	Birth (≤12 hrs)
		2	1–2 mos	2	2 mos
		3	6 mos [¶]	3	4 mos
	Negative	4		4	6 mos [¶]
		1	Birth (≤24 hrs)	1	Birth (≤24 hrs)
		2	1–2 mos	2	2 mos
		3	6–18 mos [¶]	3	4 mos
<2,000 g	Positive	4		4	6 mos [¶]
		1	Birth (≤12 hrs)	1	Birth (≤12 hrs)
		HBIG	Birth (≤12 hrs)	HBIG	Birth (≤12 hrs)
		2	1 mos	2	2 mos
	Unknown	3	2–3 mos	3	4 mos
		4	6 mos [¶]	4	6 mos [¶]
		1	Birth (≤12 hrs)	1	Birth (≤12 hrs)
		HBIG	Birth (≤12 hrs)	HBIG	Birth (≤12 hrs)
	Negative	2	1 mos	2	2 mos
		3	2–3 mos	3	4 mos
		4	6 mos [¶]	4	6 mos [¶]
		1	Hospital discharge or age 1 mo	1	Hospital discharge or age 1 mo
	2	2 mos	2	2 mos	
	3	6–18 mos [¶]	3	4 mos	
	4		4	6 mos [¶]	

Abbreviations: HBIG = hepatitis B immune globulin; HBsAg = hepatitis B surface antigen.

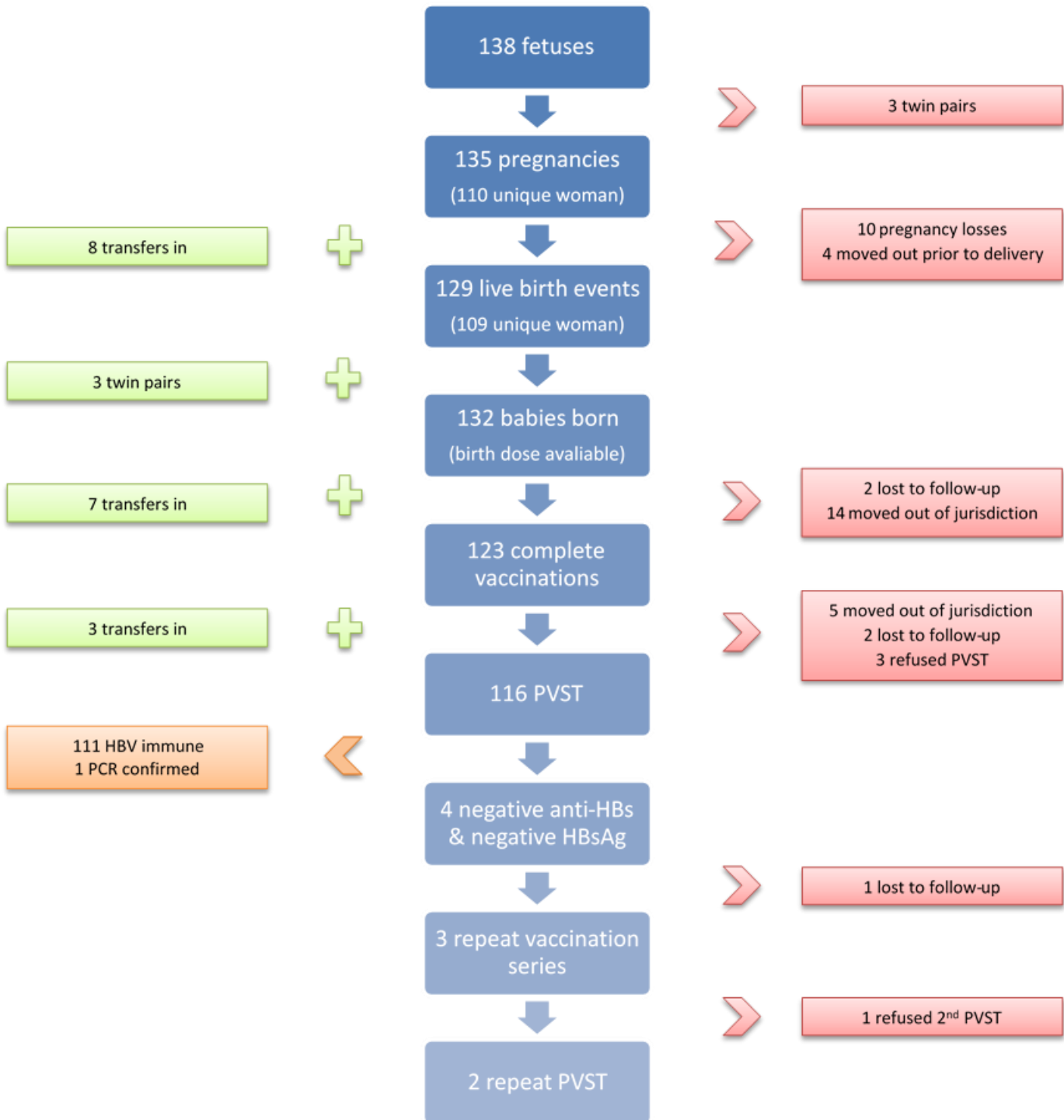
* Mothers should have blood drawn and tested for HBsAg as soon as possible after admission for delivery; if the mother is found to be HBsAg positive, the infant should receive HBIG as soon as possible but no later than age 7 days.

[†] Pediarix should not be administered before age 6 weeks.

[§] HBIG should be administered at a separate anatomical site from vaccine.

[¶] The final dose in the vaccine series should not be administered before age 24 weeks (164 days).

Appendix B: Population Flow of the 2013 to 2017 Cohort



Appendix C: Notes on the Data

Exact inclusion/exclusion criteria for each table or figure, including examples, are provided below. All tables and figures in the graph represent the most complete data available (i.e., the largest sample size on whom we had complete data).

Information for:

- Table 1: Number of Pregnancies in Saint Louis County Residents: HBsAg+ Women Only vs. County Total
- Figure 1: Distribution of Pregnancies in HBsAg+ Pregnant Women by Saint Louis County Region, Average Annual Rates per 100,000 Females Aged 10 to 49 Years

Sample Size (n)=135

Figures 2 and 4 present data on the same base sample, although country of origin was not known for one woman.

- Figure 2: Country of Origin of HBsAg+ Pregnant Women
- Figure 4: Age Distribution of HBsAg+ Pregnant Women, by Global Region of Origin
- Sample Size (n)=134

Inclusion criteria

- Residence in Saint Louis County at some time during pregnancy
- Contact with the Saint Louis County Department of Public Health (DPH) Perinatal Hepatitis B Prevention Program (PHBPP) during pregnancy (regardless of the initial jurisdiction where the case was reported)
- Pregnancy with an EDD between 01/01/2013 and 12/31/2017

Notes

- Each pregnancy with an EDD between 01/01/2013 and 12/31/2017 is included in Table 1 and Figures 1, 2, and 4, regardless of pregnancy outcome or whether the woman had experienced previous pregnancies in this timeframe.
 - If a woman had more than one pregnancy with EDDs in different years between 01/01/2013 and 12/31/2017, each pregnancy is counted in the year of its corresponding EDD.
 - Example: A woman had a live singleton birth with an EDD of 10/25/2013 and a second live singleton birth with an EDD of 04/08/2015. This woman is counted as n=1 in 2013 and n=1 in 2015.
 - If a woman experienced a pregnancy loss after case management for that pregnancy had begun, that pregnancy is included in the year of its corresponding EDD (regardless of the year of the pregnancy loss).

- Example: A woman had a live singleton birth with an EDD of 03/01/2013 and a pregnancy loss during a pregnancy with an EDD of 09/18/2014. This woman is counted as n=1 in 2013 and n=1 in 2014.
 - Example: A woman had a pregnancy loss during a pregnancy with an EDD of 02/20/2014 and a live singleton birth with an EDD of 12/14/2014. This woman is counted as n=2 in 2014.
 - If a woman had a pregnancy which resulted in multiple births (e.g., twins), the woman’s pregnancy was counted once in the year of its corresponding EDD.
 - Example: A woman gave birth to twins with an EDD of 07/09/2013. This woman is counted as n=1 in 2013.
- If infants transferred into our jurisdiction at or after delivery, but the mother did not receive case management by DPH during pregnancy, the mother is not included in Table 1 or Figures 1, 2, or 4.
- Because address of Saint Louis County residence could vary for different pregnancies, all pregnancies (rather than unique women) are included for Figure 1. Similarly, because age changes for different pregnancies, all pregnancies (rather than unique women) are included for Figure 4.
- For Figure 1, the Saint Louis County population was taken from the 2017 American Community Survey (ACS) 5-year population estimates (<https://factfinder.census.gov/faces/nav/jsf/pages/index.xhtml>). Because the Saint Louis County DPH PHBPP is responsible for case management of HBsAg+ pregnant women between the ages of 11 and 47 years, the ACS age range 10 to 49 years was selected. DPH, along with the Saint Louis County Department of Planning, established five Saint Louis County regions based on the social and demographic characteristics of the regions’ residents. Using five County regions also allows for sub-County-level comparisons, without the volatility or risk of individual identifiers which may be present in ZIP Code- or census tract-level comparisons.

Information for:

- Figure 3: Global Region of Origin of HBsAg+ Pregnant Women

Sample Size (n)=109

Note: There were 110 unique women in the base sample, but country of origin was not known for one woman.

Inclusion criteria

- Residence in Saint Louis County at some time during pregnancy
- Contact with the Saint Louis County DPH PHBPP during pregnancy (regardless of the initial jurisdiction where the case was reported)
- Pregnancy with an EDD between 01/01/2013 and 12/31/2017

Notes

- Pregnancies with an EDD between 01/01/2013 and 12/31/2017 are included in Figure 3, regardless of pregnancy outcome. *If a woman had more than one pregnancy in this timeframe, she is only counted once in Figure 3.*
 - In all of the following examples, the woman is counted only once in Figure 3:
 - A woman had a live singleton birth with an EDD of 10/25/2013 and a second live singleton birth with an EDD of 04/08/2015.
 - A woman had a live singleton birth with an EDD of 03/01/2013 and a pregnancy loss during a pregnancy with an EDD of 09/18/2014.
 - A woman had a pregnancy loss during a pregnancy with an EDD of 02/20/2014 and a live singleton birth with an EDD of 12/14/2014.
 - A woman gave birth to twins with an EDD of 07/09/2013.
- If infants transferred into our jurisdiction at or after delivery, but the mother did not receive case management by DPH during pregnancy, the mother is not included in Figure 3.

Information for:

- Figure 5: Timing of Hepatitis B Vaccine Birth Dose Administration, by Birth Year as a Percentage of Annual Total

Sample Size (n)=132

Inclusion criteria

- Infant was a Saint Louis County resident at the time of delivery
- Infant was a result of a live birth from a pregnancy with an EDD between 01/01/2013 and 12/31/2017
 - Note: EDD between 01/01/2013 and 12/31/2017 is a component of inclusion into the analysis dataset. Once included, the infant’s birth year (rather than the year of EDD) is utilized for each infant in Figure 5.

Notes

- If an infant’s mother did not receive case management by the Saint Louis County DPH PHBPP prior to delivery, but the infant was a resident of Saint Louis County at birth and was subsequently case managed by the PHBPP at any point during the primary vaccination series, the infant is included in Figure 5.
- If an infant received case management by the Saint Louis County DPH PHBPP at the time of delivery but transferred out of jurisdiction prior to completion of the HBV vaccine series, the infant is included in Figure 5.
- If an infant transfers into our jurisdiction after birth, the infant is *not* included in Figure 5.
- Each infant in a multiple birth is counted individually in Figure 5 (e.g., twins are counted as two infants).

Information for:

- [Figure 6](#): Age at Completion of the Hepatitis B Vaccine Series
- [Figure 7](#): Age at Completion of the Hepatitis B Vaccine Series, by Birth Year as a Percentage of Annual Total

Sample Size (n)=123

Inclusion criteria

- Infant received case management by the Saint Louis County DPH PHBPP at the time of completion of the hepatitis B vaccine series
- Age at vaccine administration for all doses of hepatitis B vaccine was available (regardless of the jurisdiction where hepatitis B vaccine was administered)
- Infant was a result of a live birth from a pregnancy with an EDD between 01/01/2013 and 12/31/2017
 - Note: EDD between 01/01/2013 and 12/31/2017 is a component of inclusion into the analysis dataset. Once included, the infant’s birth year (rather than the year of EDD) is utilized for each infant in Figures 6 and 7.

Notes

- If an infant transfers into our jurisdiction before the completion of vaccination series (and prior vaccination history is available), the infant is included in Figures 6 and 7.
 - Example: An infant receives case management in Saint Charles County, Missouri when receiving doses 1 and 2 of the hepatitis B vaccine, then transfers into Saint Louis County before receiving dose 3. Dose 3 is completed while receiving case management by the Saint Louis County DPH PHBPP.
- If an infant receiving case management by the Saint Louis County DPH PHBPP is lost to follow-up or transfers out of jurisdiction prior to the completion of the vaccine series, the infant is excluded from Figures 6 and 7.

Information for:

- [Figure 8](#): Post-Vaccination Serology Testing Results – HBsAg and anti-HBs

Sample Size (n)=116

Inclusion criteria

- Infant received case management by the Saint Louis County DPH PHBPP at the time of primary (i.e., first round) post-vaccination serology testing (PVST)
- An infant’s PVST results were available (regardless of the jurisdiction where any or all HBV vaccine doses were administered)

- Infant was a result of a live birth from a pregnancy with an EDD between 01/01/2013 and 12/31/2017
 - Note: EDD between 01/01/2013 and 12/31/2017 is a component of inclusion into the analysis dataset. Once included, the infant’s birth year (rather than the year of EDD) is utilized for each infant in Figure 8.

Notes

- If an infant moves out of jurisdiction after the completion of the hepatitis B vaccine series, but prior to PVST, the infant is excluded from Figure 8.
- If an infant completed the hepatitis B vaccine series, but the parent refuses PVST, the infant is excluded from Figure 8.
- An infant’s immunity status is typically confirmed with a positive anti-HBs and negative HBsAg result. One infant in this cohort reported a positive anti-HBs test, but the HBsAg test was not run. Instead, a polymerase chain reaction test to identify hepatitis B viral DNA was run. No viral DNA was detected, and the infant was considered immune.

Information for:

- Table 2: Number of Infants Enrolled in the Perinatal Hepatitis B Prevention Program
- Figure 9: Infants Completing Hepatitis B Post-Exposure Prophylaxis Within One Calendar Day of Birth
- Figure 10a: Percent of Infants with Hepatitis B Vaccine Series Completion by Age Eight Months
- Figure 10b: Percent of Infants with Hepatitis B Vaccine Series Completion by Age 12 Months
- Figure 11: Percent of Infants Completing Post-Exposure Prophylaxis, the Hepatitis B Vaccine Series, and Post-Vaccination Serology Testing by December 31st of the Year Following Their Birth Year

Sample Size for Saint Louis County (n)=130

Inclusion criteria

For Saint Louis County

- The Saint Louis County DPH PHBPP was the final U.S. jurisdiction from which the child received case management
- Infant was a result of a live birth from a pregnancy with an EDD between 01/01/2013 and 12/31/2017
 - Note: EDD between 01/01/2013 and 12/31/2017 is a component of inclusion into the analysis dataset. Once included, the infant’s birth year (rather than the year of EDD) is utilized for each infant in Table 2 and Figures 9, 10a, 10b, and 11.

For Missouri and the United States

- Data from the 2013 to 2016 Peritables are included in this report
 - The Peritables were provided to the Saint Louis County DPH by the U.S. Centers for Disease Control and Prevention, through the Missouri Department of Health and Senior Services.

- At the time of completion of this report, data from the 2017 Peritable were not available to the Saint Louis County DPH.

Notes

- Infants who transfer into the jurisdiction of the Saint Louis County PHBPP (and remain in that jurisdiction) are included in the Saint Louis County sample.
 - Similarly, infants who transfer into any jurisdiction within the Missouri PHBPP (and remain in that jurisdiction) are included in the Missouri PHBPP.
 - The Saint Louis County sample is nested within the Missouri sample (and the Missouri sample is nested within the U.S. sample).
- Infants who transfer out of the jurisdiction of the Saint Louis County PHBPP (and are officially transferred into another jurisdiction within Missouri or to a different U.S. state/territory) are not included in the Saint Louis County sample.
 - Similarly, infants who transfer from Missouri into another state's/territory's jurisdiction are not included in the Missouri sample.
- Infants who are lost to follow-up or move out of the United States while in the receiving case management from the Saint Louis County PHBPP are included in the Saint Louis County sample.
 - Similarly, infants who are lost to follow-up or move out of the United States while in the jurisdiction of any Missouri PHBPP are included in the Missouri sample. Children who are lost to follow-up or move out of the United States from any jurisdiction within the U.S. PHBPP are included in the U.S. sample.
 - The Saint Louis County sample is nested within the Missouri sample (and the Missouri sample is nested within the U.S. sample).
 - The Saint Louis County sample includes four children who were lost to follow-up (location unknown), 6 additional children who moved out of the U.S., and 2 children who refused PVST testing.
 - Children are evaluated as “no” for any metrics for whom data are unavailable (e.g., if a child moved out of the country after dose 2 of the hepatitis B vaccine, that child would be counted as “no” for Figures 10a, 10b, and 11).
 - This applies to the Missouri and U.S. samples as well.

Appendix D: CDC Global Regions

The Saint Louis County Department of Public Health utilizes global regions developed by the Centers for Disease Control and Prevention (CDC) to further de-identify report data. The countries/territories included in each CDC region are provided below.

CDC Region	Countries/Territories Included
Africa	Algeria, Angola, Botswana, Benin, Bassas Da India, Burundi, Chad, Congo, Cameroon, Comoros, Central African Republic, Cape Verde, Djibouti, Dahomey [Benin], Egypt, Equatorial Guinea, Eritrea, Ethiopia, Europa Island, French Territory of The Affairs and Issas, The Gambia, Gabon, Ghana, Glorioso Islands, Guinea, Cote D' Ivoire, Kenya, Liberia, Lesotho, Libya, Madagascar, Spanish North Africa, Mayotte, Malawi, Mali, Morocco, Mauritius, Mauritania, Mozambique, Niger, Nigeria, Guinea-Bissau, Reunion, Southern Rhodesia, Rwanda, Seychelles, South Africa, Senegal, Saint Helena, Sierra Leone, Somalia, South Sudan, Spanish Sahara, Sudan, Tromelin Island, Togo, Sao Tome and Principe, Tunisia, Tanzania, Uganda, Burkina Faso, Namibia, Western Sahara, Swaziland, Zambia, Zimbabwe
East Asia	China, Hong Kong, Japan, North Korea, South Korea, Macau, Mongolia, Taiwan, Southern Ryukyu Islands
South Asia	Bangladesh, Bhutan, Sri Lanka, India, Maldives, Nepal, Pakistan, Sikkim
Southeast Asia	Burma, Brunei, Cambodia, Indonesia, Laos, Malaysia, Paracel Islands, Spratly Islands, Papua New Guinea, Timor, Philippines, Singapore, Thailand, East Timor, Vietnam, North Vietnam, South Vietnam
West/Central Asia	Afghanistan, Azerbaijan, Armenia, Georgia, Kyrgyzstan, Kazakhstan, Tajikistan, Turkmenistan, Uzbekistan
Australia/Oceania	Australia, Ashmore and Cartier Islands, Cocos (Keeling) Islands, Coral Sea Islands, Norfolk Island, New Zealand
Caribbean (except Haiti)	Aruba, Antigua And Barbuda, Anguilla, Barbados, Bermuda, The Bahamas, Cayman Islands, Cuba, Dominica, Dominican Republic, Grenada, Guadeloupe, Jamaica, Martinique, Montserrat, Netherlands Antilles, Saint Kitts And Nevis, Saint Lucia, Swan Islands, Trinidad And Tobago, Turks And Caicos Islands, Saint Vincent and the Grenadines, British Virgin Islands
Eastern Europe	Belarus, Bulgaria, Czechoslovakia, Estonia, Czech Republic, Hungary, Latvia, Lithuania, Slovakia, Moldova, Poland, Romania, Russia, Ukraine, and Union Of Soviet Socialist Republics
Southern Europe	Albania, Andorra, Bosnia And Herzegovina, Gibraltar, Greece, Croatia, Italy, F.Y.R.O. Macedonia, Malta, Portugal, Slovenia, San Marino, Spain, Holy See (Vatican City), Yugoslavia
Western and Northern Europe	Austria, Belgium, Denmark, East Berlin, Ireland, Finland, France, Guernsey, Germany, Iceland, Isle Of Man, Jersey, Jan Mayen, Liechtenstein, Luxembourg, Monaco, Netherlands, Norway, Svalbard, Sweden, Switzerland, United Kingdom, West Berlin
Haiti	Haiti
Mexico & Central America	Belize, Costa Rica, El Salvador, Guatemala, Honduras, Mexico, Nicaragua, Panama, Panama Canal Zone
Middle East	United Arab Emirates, Bahrain, Cyprus, Gaza Strip, Iran, Israel, Iraq, Jordan, Kuwait, Lebanon, Oman, Qatar, Saudi Arabia, Syria, Turkey, West Bank, Yemen
North America	Canada, Greenland, and Saint Pierre and Miquelon
Pacific Islands	Solomon Islands, Central And Southern Line Islands, Cook Islands, Jarvis Island, Canton And Enderberry Islands, Fiji, Federated States Of Micronesia, Faroe Islands, French Polynesia, Gilbert and Ellice Islands, Gilbert Islands, Heard Island And Mcdonald Islands, Howland Island, Clipperton Island, U.S. Miscellaneous Pacific Islands, Johnston Island, Juan De Nova Island, Kiribati, Christmas Island, Palmyra Atoll, Midway Island, New Caledonia, Niue, Vanuatu, Nauru, Pitcairn Island, Palau, Marshall Islands, Tokelau, Tonga, Tuvalu, Trust Territory Of The Pacific Islands, Wallis And Futuna, Wake Island, and Samoa
South America	Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, French Guiana, Falkland Islands, Guyana, Suriname, Paraguay, Peru, Uruguay, Venezuela
Other/Unknown	Antarctica, Bouvet Island, French Southern and Antarctic Lands, British Indian Ocean Territory, South Georgia and The South Sandwich Islands, and unknown countries

References

1. Hepatitis B. World Health Organization. <http://www.who.int/news-room/fact-sheets/detail/hepatitis-b>. Accessed September 13, 2019.
2. Viral Hepatitis. Centers for Disease Control and Prevention. <https://www.cdc.gov/hepatitis/hbv/hbvfaq.htm>. Accessed September 13, 2019.
3. Immunization Schedules. Centers for Disease Control and Prevention. <https://www.cdc.gov/vaccines/schedules/hcp/imz/child-adolescent.html>. Accessed September 16, 2019.
4. Terrault NA, Bzowej NH, Chang KM, Hwang JP, Jonas MM, Murad MH; American Association for the Study of Liver Diseases. AASLD guidelines for treatment of chronic hepatitis B. *Hepatology*. 2016; 63:261-83.
5. Smith EA, Jacques-Carroll L, Walker TY, Sirotkin B, Murphy TV. The National Perinatal Hepatitis B Prevention Program, 1994-2008. *Pediatrics*. 2012; 129(4):609-616.