



**TN**

Department of  
**Health**

# Results of the 2016 Immunization Status Survey of 24 Month Old Children in Tennessee

Tennessee Department of Health | Tennessee Immunization Program | December 2016

<http://tn.gov/health/article/cedep-reports>

Phone: 615-741-7247

## Acknowledgements

Birth data were provided by the Tennessee Department of Health, Division of Policy, Planning and Assessment, Office of Health Statistics.

Immunization data were collected by county and regional health department nurses, immunization representatives and disease investigation staff. Data entry, analysis and reporting were conducted by staff of the Tennessee Immunization Program.

Survey data were collected using REDCap electronic data capture tools hosted at the Tennessee Department of Health. REDCap (Research Electronic Data Capture, <http://projectredcap.org/>) is a secure web-based application designed to support data capture.

## Table of Contents

	Page
<b>Executive Summary</b>	<b>... 5</b>
<b>Definitions of Abbreviations in Charts</b>	<b>... 8</b>
<b>General Information and Results:</b>	<b>... 9</b>
Fig. 1. Statewide percentage of children with age-appropriate immunization levels by vaccine	... 13
Fig. 2. Percentage of children with on-time 4:3:1:FS:3:1:4 immunization by region	... 14
Fig. 3. Statewide percentage of age-appropriate vaccinations by vaccine, 2015 and 2016	... 15
Fig. 4. 4:3:1:FS:3:1:4 and 4:3:1:3:3:1 Immunization Level Trends: Tennessee 2010 to 2016	... 15
Fig. 5a. Percentage of children with birth dose of hepatitis B vaccine by third day of life by region	... 16
Fig. 5b. Percentage of children with birth dose of hepatitis B vaccine, 2015 and 2016	... 17
Fig. 6. Statewide percentage of children with age-appropriate immunization by vaccine and race	... 18
Table 1. 4:3:1:FS:3:1:4 Completion in 24-Month-Old Children: Selected Characteristics	... 19
Fig. 7. Source of Immunizations from 2000 to 2016	... 20
Table 2. Prevalence of risk factors for delayed immunizations by provider type	... 20
Summary of Key Findings and Next Steps	... 21
<b>Appendix 1:</b>	
Details of Regional Samples (oversampled, vaccine refusal, child not located)	... 23
<b>Appendix 2: Vaccine Series and Individual Vaccine Charts</b>	<b>... 24</b>
On-time 4:3:1:FS:3:1 and 4:3:1:FS:3:1:4 vaccine series	... 25
DTaP (4-dose and 3-dose coverage)	... 26
<i>Haemophilus influenzae</i> type b & Hepatitis A (1-dose coverage)	... 27
Hepatitis A (2-dose coverage) & Hepatitis B	... 28
Influenza (2-dose and 3-dose coverage)	... 29
MMR & Pneumococcus (4-dose coverage)	... 30
Pneumococcus (PCV) (4-dose vs. 3-dose coverage) & Polio	... 31
Rotavirus & Varicella	... 32
<b>Appendix 3: Individual Health Department Region Charts (West→East)</b>	<b>... 33</b>
Shelby County	... 34
West Tennessee Region	... 34
Jackson-Madison County	... 35
South Central Region	... 35
Mid-Cumberland Region	... 36
Nashville-Davidson County	... 36
Upper Cumberland Region	... 37
Southeast Region	... 37
Hamilton County	... 38
East Tennessee Region	... 38
Knoxville-Knox County	... 39
Northeast Region	... 39
Sullivan County	... 40

<b>Appendix 4: Additional Statewide Charts for Specific Groups</b>	<b>... 41</b>
Immunization levels by vaccine and TennCare enrollment status	... 42
On-time 4:3:1:FS:3:1:4 completion by TennCare enrollment status, 2010-2016	... 42
Immunization levels by vaccine and WIC enrollment status	... 43
On-time 4:3:1:FS:3:1:4 completion by WIC enrollment status, 2010-2016	... 43
Trends in on-time immunization coverage disparities (black vs. white) for 2010-2016	... 44
46	
<b>Appendix 5: Data Tables for Selected Analyses</b>	<b>... 45</b>
Series Complete (4:3:1:FS:3:1:4)	... 46
Series Complete (4:3:1:FS:3:1:4) by Provider Type	... 46
Series Complete (4:3:1:FS:3:1:4) by Race	... 47
Series Complete (4:3:1:FS:3:1:4) by Number of Older Siblings	... 47
Series Complete (4:3:1:FS:3:1:4) by TennCare Enrollment	... 48
<b>Appendix 6: Regional Health Department Map</b>	<b>... 49</b>

# Executive Summary

The Tennessee Department of Health (TDH) conducts an annual survey of the on-time immunization status of 24 month old children. The Tennessee Immunization Program (TIP) uses the results to track progress toward achieving the national Healthy People (HP) 2020 objectives for immunization coverage with routinely recommended early childhood vaccines. HP2020 is a national framework established by the Department of Health and Human Services (HHS) for meeting health goals by the year 2020. This survey assesses the status of children as of their second birthday. For best results, vaccines need to be administered as recommended by pediatricians and the Centers for Disease Control and Prevention (CDC).

## Value of vaccination:

Timely routine vaccination of children saves money, health and lives. The federal Vaccines for Children (VFC) Program, implemented in 1994, assures affordable access to all routine vaccines for children without private insurance coverage. The CDC reported that the routine vaccines already given to U.S. children born between 1994 and 2013 will prevent an average of 4.1 illnesses per child, prevent the hospitalization of one in four and prevent the premature death of nearly one in 100 of these children over their lifetimes.<sup>1</sup> The CDC calculates that vaccination of U.S.-born children each year with the current immunization schedule yields a net savings of nearly \$14 billion in direct costs and \$69 billion in total costs to society.<sup>2</sup> With roughly 2 percent of the U.S. population, this suggests Tennessee has benefitted from the prevention of about 480,000 cases of disease in the past decade, with *annual savings* of \$280 million in direct medical costs and \$1.38 billion in total costs to society.

## Methods:

A random sample of 1,602 children was selected from birth certificates of children born in the first three months of 2014 in each of six metropolitan counties and in the 7 rural multi-county TDH regions. Local or state public health staff attempted to locate each child and confirm immunization histories with parents or guardians and healthcare providers.

Children were excluded from the survey if:

- they were determined to have moved out of state
- their birth record was sealed (e.g. through adoption or placement in foster care)
- the parents or guardians refused to participate in the survey
- the child died

After exclusion of 138 children for the above reasons, 1,464 children's immunization records were collected. Immunization rates are provided statewide, for the 6 major metropolitan counties and for 7 rural multi-county regions. County rates within the rural regions are not calculated because of the small number of children sampled in each county.

Beginning in 2014, a change in method was introduced to provide a more accurate assessment of *Haemophilus influenzae* type B (HIB) vaccination and rotavirus vaccination (RTV) rates: different vaccines against these diseases require different numbers of doses. This survey now takes into account the vaccine brand, if known, and classifies a child as complete only if the appropriate number of doses has been administered. As a result, point estimates for HIB and RTV coverage rates are lower than previous estimates, but also more accurate and more consistent with methods used

by the CDC. Since HIB is part of the core vaccine series, the vaccine series is labeled 4:3:1:FS:3:1:4, with FS indicating a “full series” of HIB.

**Results:**

The table below summarizes Tennessee’s (TN) 2016 results alongside national Health People (HP) 2020 objectives for this age group:

<b>Diseases</b>	<b>Healthy People 2020 Objective (19-35 months)</b>	<b>TN 2016 (24 months)</b>
Diphtheria, Tetanus, Pertussis	90%	83.1%
Poliomyelitis	90%	94.4%
Measles, Mumps, Rubella	90%	91.6%
Hepatitis B	90%	94.7%
Hepatitis B, birth dose	85%	81.1%
<i>Haemophilus influenzae</i> , type B	90%	81.8%
Varicella (Chickenpox)	90%	91.1%
Pneumococcus	90%	84.5%
All of above	80%	74.2%
Hepatitis A	60% 2-dose	1 dose: 91.2%
Influenza	70%	47.1%
Rotavirus	80%	78.2%

\*TN measures 1 dose of hepatitis A because children who receive 1 dose by the 2<sup>nd</sup> birthday may wait up to 18 months to receive dose 2.

**Other Key Findings:**

Unvaccinated children: Twenty-seven (1.8%) of 1,464 children surveyed had no record of any dose of vaccine; of these, 8 were children whose parents could not be located and who had no immunizations recorded in the Tennessee Immunization Information System (TennIIS). The nineteen parents who could be located stated they had a religious, personal or medical reason for not vaccinating their child. In total, 24 (1.6%) of those surveyed with incomplete records cited a religious (11), personal (12) or medical (1) reason for not vaccinating or discontinuing vaccination of their child.

Influenza racial disparity: As long as influenza vaccination has been measured in this survey, a significant racial disparity has been present. In 2016, 50.0% of white children had received at least 2 doses of influenza vaccine by age two, compared to 29.8% of black children.

TennCare: In the 2016 survey, children who had ever been enrolled in TennCare were *less* likely than children never enrolled in TennCare to have completed the full 4:3:1:FS:3:1:4 series by their second birthday.

## **Key strategy for improving rates: effective use of the Tennessee Immunization Information System (TennIIS)**

- The Tennessee immunization information system, “TennIIS”, [www.TennesseeIIS.gov](http://www.TennesseeIIS.gov), is available to all immunization providers, including pharmacies. Comprehensive reporting to an IIS improves the quality of patient care by establishing a permanent and complete immunization record available to all the patient’s healthcare providers.
- TennIIS helps healthcare providers immunize children on time by providing them with a list of immunizations due or overdue for the child (“forecasting”). The system can produce patient immunization reminders for a practice and can produce immunization coverage reports for practices so they can track their own quality improvement efforts. Such tools have helped improve immunization rates elsewhere.
- Any authorized user may access records in TennIIS through the website. In addition, TDH also has linked the electronic health record (EHR) systems of hundreds of medical facilities and pharmacies to TennIIS, automating and simplifying immunization reporting.
- In 2017, all clinics participating in the federal Vaccines for Children (VFC) Program will be required to report all immunizations administered to children under the age of 19 years to TennIIS. Almost all of them already report some immunizations to TennIIS. In addition to clinical benefits listed above, the TennIIS immunization certificate feature makes it easy for families of young children to get state immunization certificates for daycare and school.

<sup>1</sup> CDC. Benefits from Immunization During the Vaccines for Children Program Era — United States, 1994–2013. Morbidity and Mortality Weekly Report. 63(16);352-355.

<sup>2</sup> CDC. Ten Great Public Health Achievements – United States 2001—2011. Morbidity and Mortality Weekly Report. 60(19);619-623.

## Definitions of Abbreviations in Charts

### 1. Vaccines

- a. **DTaP:** diphtheria, tetanus, acellular pertussis
- b. **IPV:** inactivated polio vaccine
- c. **HAV:** hepatitis A vaccine
- d. **HBV:** hepatitis B vaccine
- e. **HIB:** *Haemophilus influenzae*, type B vaccine
- f. **MMR:** measles, mumps, rubella
- g. **VAR:** varicella (chickenpox) vaccine
- h. **PCV:** pneumococcal conjugate vaccine
- i. **FLU:** influenza vaccine
- j. **HAV:** hepatitis A vaccine
- k. **RTV:** rotavirus vaccine

### 2. Public Health Regions

- a. **Rural, multi-county regions**
  - i. **NER:** Northeast Region
  - ii. **ETR:** East Tennessee Region
  - iii. **SER:** Southeast Region
  - iv. **UCR:** Upper Cumberland Region
  - v. **SCR:** South Central Region
  - vi. **MCR:** Mid-Cumberland Region
  - vii. **WTR:** West Tennessee Region
- b. **Metropolitan, single county regions**
  - i. **SUL:** Sullivan County
  - ii. **KKR:** Knoxville-Knox County
  - iii. **HAM:** Hamilton County (Chattanooga area)
  - iv. **NDR:** Nashville-Davidson County
  - v. **JMR:** Jackson-Madison County
  - vi. **SBY:** Shelby County (Memphis area)

# Results of the 2016 Immunization Status Survey of 24 Month Old Children in Tennessee

## General:

An annual survey of the immunization status of 24 month old children is conducted by the Tennessee Department of Health (TDH) Immunization Program (TIP) to track progress toward achieving at least 90% on-time immunization with each routinely recommended vaccine for that population. The survey is composed of random, statistically-valid samples drawn from birth certificates of infants born during the first quarter of 2014 in each of the 13 health department regions. Regional samples are aggregated to give statewide statistics on immunization coverage levels in Tennessee.

## ***Introduction:***

This survey assesses the on-time immunization status of young children against the following 14 diseases:

<b>Disease(s)</b>	<b>Possible complications of disease</b>	<b>Vaccination</b>	<b># of doses*</b>
Diphtheria, tetanus, pertussis	<i>Diphtheria</i> : upper airway obstruction, pneumonia, respiratory failure, death <i>Tetanus</i> : spasms of respiratory and skeletal muscles, death <i>Pertussis</i> : outbreaks; severe, long-term cough, vomiting, breathlessness, death in infants	DTaP	4
Poliomyelitis	Paralysis, death	IPV	3
Measles, mumps, rubella	<i>Measles</i> : outbreaks; ear infections, pneumonia, cardiac and neurologic problems, encephalitis, death <i>Mumps</i> : outbreaks; sterility, meningitis, arthritis, hearing impairment <i>Rubella</i> : arthritis, encephalitis, birth defects	MMR	1
<i>Haemophilus influenzae</i> type B	Pneumonia, meningitis, neurologic problems, death	HIB	3 or 4 <sup>†</sup>
Hepatitis B	Fulminant hepatitis, jaundice, liver cancer, cirrhosis, premature death	HBV	3
Varicella (chickenpox)	Rash illness, severe disease in immunocompromised	VAR	1
Pneumococcus (certain strains)	Ear infections, pneumonia, meningitis, blood stream infections, death	PCV	4
Hepatitis A	Outbreaks: fever, nausea, jaundice, rare death	HAV	1
Influenza	Outbreaks: secondary pneumonia, exacerbation of chronic diseases, hospitalizations, deaths	FLU	2
Rotavirus	Outbreaks in daycare settings, dehydration, hospitalization	RTV	2 or 3 <sup>†</sup>

\* # of doses for on-time completion, according to the published CDC Recommended Childhood Immunization Schedule

<sup>†</sup> Number of doses in a full series (FS) varies by brand of vaccine

This survey uses the same vaccine series definitions as the Centers for Disease Control and Prevention (CDC) National Immunization Survey (NIS), which assesses 19-35 month old children. Complete on-time immunization in the 2016 survey of Tennessee 24 month olds is defined as having received four doses of DTaP, three doses of IPV, one dose of MMR, three *or* four doses of HIB (4 doses required if any dose is the 4-dose brand), three doses of HBV, one dose of VAR and four doses of PCV (abbreviated hereafter as the **4:3:1:FS:3:1:4** series) before turning 25 months old.

Tennessee surveys conducted from 2002-2009 reported coverage rates for the **4:3:1:3:3:1** series; PCV (4) was added in 2010. Before 2014, Hib vaccination was counted as complete with 3 doses because brand information was unavailable. From 2014 forward, if any documented Hib dose was the 4-dose product, then only 4 doses was considered complete; otherwise, 3 doses of Hib was classified as complete.

Recommended vaccines not included in the 4:3:1:FS:3:1:4 series are reported individually:

- Influenza vaccine (FLU) is given annually at age 6 months and older; 2 doses should be given the first season the vaccine is administered. Because protection is conferred only after 2 doses; this survey measures the proportion of children with 2 or more doses by their second birthday.
- Hepatitis A vaccine (HAV) is complete with 2 doses, starting on or after the first birthday; the recommended dose spacing of 6-18 months means that children who have only 1 dose by the second birthday are still on schedule. For this reason, this survey reports children as up to date with 1 dose of HAV.
- Rotavirus vaccine (RTV) is complete with 2 doses of Rotarix<sup>®</sup> or with 3 doses, if any dose in the series was known to be Rotateq<sup>®</sup>. If no brand information was available, 2 doses of rotavirus vaccine given before this time were considered complete.

### ***Healthy People 2020 objectives:***

Healthy People (HP) 2020 objectives are established by the federal Department of Health and Human Services (HHS) to provide national targets for population health. These objectives include vaccine coverage levels among children 19-35 months of age and are tracked nationally through the NIS. TDH aims to reach or exceed each of these.

The following objectives for the percentage of children immunized by 19-35 months of age have been established by HP2020 and are relevant comparisons to the results of this survey:

- 80% complete the 4:3:1:FS:3:1:4 series
- 90% complete each individual vaccine included in the 4:3:1:FS:3:1:4 series
- 60% complete hepatitis A vaccination
- 80% complete rotavirus vaccination with 2 or more doses
- 70% appropriately immunized against influenza
- 85% of all children receive their first dose of hepatitis B vaccine within 3 days of life

### ***The 2016 sample population:***

The 2016 statewide sample consisted of 1,602 children born in the first three months of 2014. Oversampling for black children was done in each region where the random sample contained fewer black children than the actual proportion of black children born in the first quarter of 2014 in that region. Twenty-nine (29) additional children of black race were randomly selected for inclusion in the racial disparity analysis.

Of the 1,602 sampled births, none had died; 138 were excluded for one of the following reasons: parents refused to participate (n = 35), the child had moved out of state (n = 99) or the child had been adopted, put in foster care or was in state custody (n = 4). One of the 29 records of oversampled black children was excluded.

The analyzed sample contained 1,464 children (1,436 + 28 oversampled records = 1,464 total records). Appendix 1 is a table showing details of numbers of children who refused vaccines, children who could not be located and the number of oversampled records in each region.

**Unable to locate:**

Of the 1,464 children, 24 with incomplete vaccination information in the Tennessee Immunization Information System (TennIIS) could not be located or confirmed as having moved out of state. Sixteen had only demographic data but no immunizations recorded in TennIIS; a partial immunization record was available in TennIIS for the other 8 children. By protocol, these children are included in the analysis with any available immunization records. See Appendix 1 for the regions of residence of these children.

The method of locating children included the use of Accurint, a subscription-based database compiling publicly available address information, to generate contact details for parents of each child. These were provided to local and regional health department staff at the beginning of the survey period.

**Vaccine refusal:**

Of the 1,464 children, parents of 19 with no immunizations (1.3%) stated that they did not vaccinate their children for religious (n = 7), philosophical (n = 11), or medical (n = 1) reasons. Parents of 5 additional children who had received at least one immunization reported refusing additional immunizations for philosophical (n = 4) or religious (n = 1) reasons. These parents represented 1.6% (24 of 1,464) of those surveyed.

Vaccine refusal impacted regional coverage rates variably, ranging from zero to 4.1% of each region's sample. See Appendix 1 for details.

**Statistical notes:**

The survey is designed to allow valid statistical comparisons of the populations in each of the 13 health department regions defined in Appendix 6; however, the sample size within multi-county regions is too small for meaningful results at the county level or useful comparisons among subpopulations within a region.

Ninety-five percent confidence intervals (CI) were calculated and are displayed as whisker plots on graphs in this report to permit readers to visualize the statistical significance (or absence of significance) of differences in point estimates. Confidence intervals that do not overlap indicate that the point-estimate differences being compared have at least a 95% chance of representing true differences in the populations being compared. If CIs overlap, then differences are not considered to be statistically significant. CIs were not calculated for surveys before 2007.

**Minimum intervals limitation:**

This survey may overestimate appropriate immunization because analysis is based on numbers of doses in a series: doses are not excluded if given before minimum acceptable intervals as defined by CDC.

## **Additional information on specific vaccines:**

### ***Hepatitis B vaccine (HBV) birth dose:***

This report shows the proportion of children receiving a birth dose of hepatitis B vaccine, defined as a dose given within the first three days of life. Routine administration of a hepatitis B birth dose to each newborn prior to discharge from a delivery hospital is a key strategy in national efforts to eliminate transmission of hepatitis B virus. Charts showing results are provided in Figures 5a and 5b.

### ***Influenza vaccine (FLU):***

Children born in the first quarter of 2014 who received every influenza vaccine on time could have received 3 doses of seasonal influenza vaccine; however, the numbers of children who received 3 doses in this survey are very small. This reports the percentage of children who received at least 2 doses of seasonal influenza vaccine by their second birthday. Influenza-specific charts are provided in Appendix 2.

### ***Haemophilus influenzae type B vaccine (HIB):***

Two different HIB schedules exist depending upon the vaccine used. The full series (FS) of the Merck product requires 3 doses; the FS of the Sanofi Pasteur product requires 4 doses. Any mixed-brand schedule requires 4 doses.

Any child that received one or more doses of the 4-dose product had to have 4 doses before the 25<sup>th</sup> month of life to be classified as complete on-time; all others required 3 doses to classify as complete. Of the 1407 children who received any HIB doses, 940 required 4 doses (748 were complete); 467 received the 3-dose product alone or in combination with unknown doses (427 were complete). Ninety-four children had documentation of at least one dose of the 3-dose HIB product and other doses where the brand name unknown. Of those, 74 of them had no brand name for any of their documented HIB doses. This classification reduces, but does not completely eliminate, the degree of overestimation in on-time completion in past reports. Charts specific to HIB completion are located in Appendix 2.

### ***Rotavirus vaccine (RTV):***

Like HIB vaccine, two products are available with different dose schedules. Rotateq<sup>®</sup> (Merck), requires 3 doses; Rotarix<sup>®</sup> (GSK) requires 2 doses. RTV is unique among vaccines because the series must be initiated no later than 15 weeks of life and no doses should be given after 8 months of age.

Of the children surveyed in 2016, 894 received at least one dose of Rotateq<sup>®</sup> and were classified as complete only if they had received 3 doses. Of the 406 classified as complete on-time after receiving two doses of RTV, 339 had received 2 doses of Rotarix<sup>®</sup> or Rotarix<sup>®</sup> and an unknown dose, and 80 had received 2 doses of unknown brand. Coverage rate charts specific to rotavirus are located in Appendix 2.

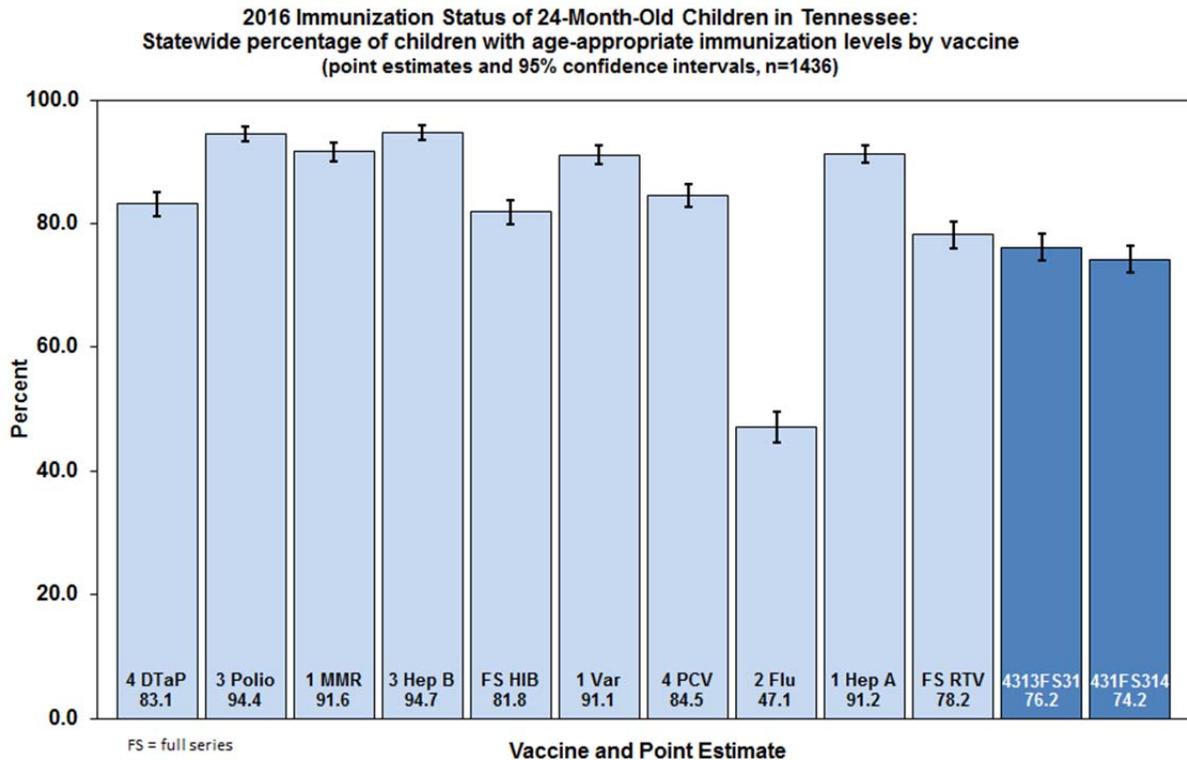
## Statewide Results and Trend Analysis:

### Vaccine specific on-time immunization coverage

The HP2020 objective of 90% on time coverage was met for 4 out of 7 vaccines in the 4:3:1:FS:3:1:4 series (Figure 1). The 4:3:1:FS:3:1:4 vaccine series on-time completion rate of 74.2% (95% CI, 72.0, 76.5) was not significantly different from the results of 2015.

The measurements for HIB, DTaP and PCV, the three vaccines that require a final booster dose during the second year of life, failed to reach 90%. In the case of DTaP and PCV, the percentages of children who had received at least 3 of the 4 required doses were 94.9% for DTaP and 94.1% for PCV (Appendix 2).

Figure 1



Only 81.8% of children completed HIB on time. HIB has a 3- or 4-dose schedule, depending upon brand used, and both schedules require a booster after the first birthday. The majority, 67%, of children were on a 4-dose schedule. On-time completion among children on the 4-dose schedule (748 of 940, or 79.6%) was lower than on-time completion among those requiring 3 doses (427 of 467, or 91.4%).

Like HIB, RTV has a 2- or 3-dose schedule, depending on brand. Three doses are required if at least one dose is the 3-dose product. Among children with a 2-dose schedule, 406 of 440 (92.3%) were complete; 717 of 894 (80.2%) children who required 3 doses of RTV were complete on-time. Overall, 78.2% of children were classified as completely vaccinated against rotavirus by two years of age.

For hepatitis A vaccine, 91.2% had received the first dose of vaccine by 24 months of age; 59.1% had already completed the 2-dose series (HP2020 objective: 60% complete by the 3<sup>rd</sup> birthday).

Just 47.1% of children had received at least 2 doses of influenza vaccine.

Appendix 2 contains charts of on-time immunization coverage for each vaccine in each public health region.

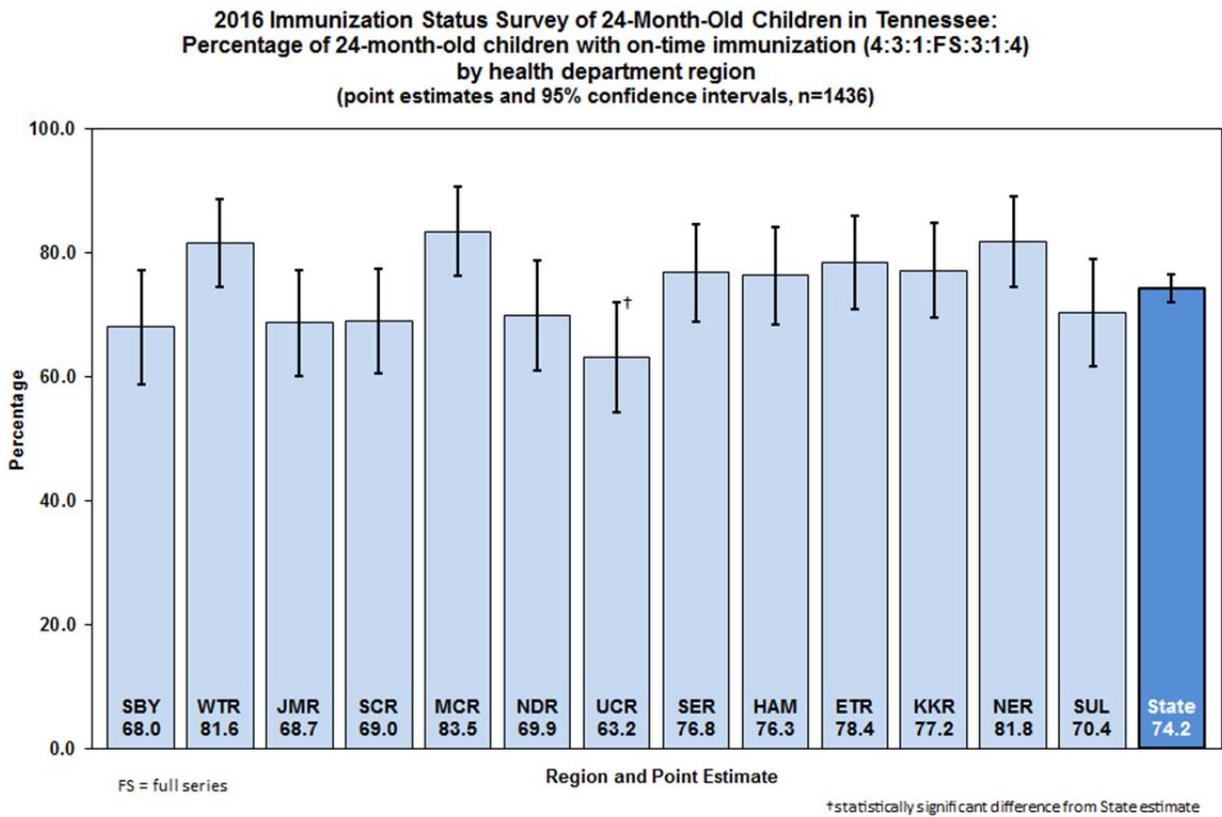
**Complete immunization levels statewide and by public health region**

The statewide and regional percentages of children immunized on time with all vaccines in 4:3:1:FS:3:1:4 series are shown in Figure 2. Statewide complete coverage was 74.2% (95% CI, 72.0, 76.5). One regional 4:3:1:FS:3:1:4 point estimates was significantly lower than the state coverage rate (Upper Cumberland Region [UCR]). The point estimates in three public health regions (West Tennessee Region [WTR], Mid-Cumberland [MCR] and Northeast Region [NER]) exceeded the HP2020 objective of 80% on-time completion of the entire series.

Figure 3 compares the 2015 and 2016 statewide coverage rates by individual vaccine. No statistically-significant differences were identified.

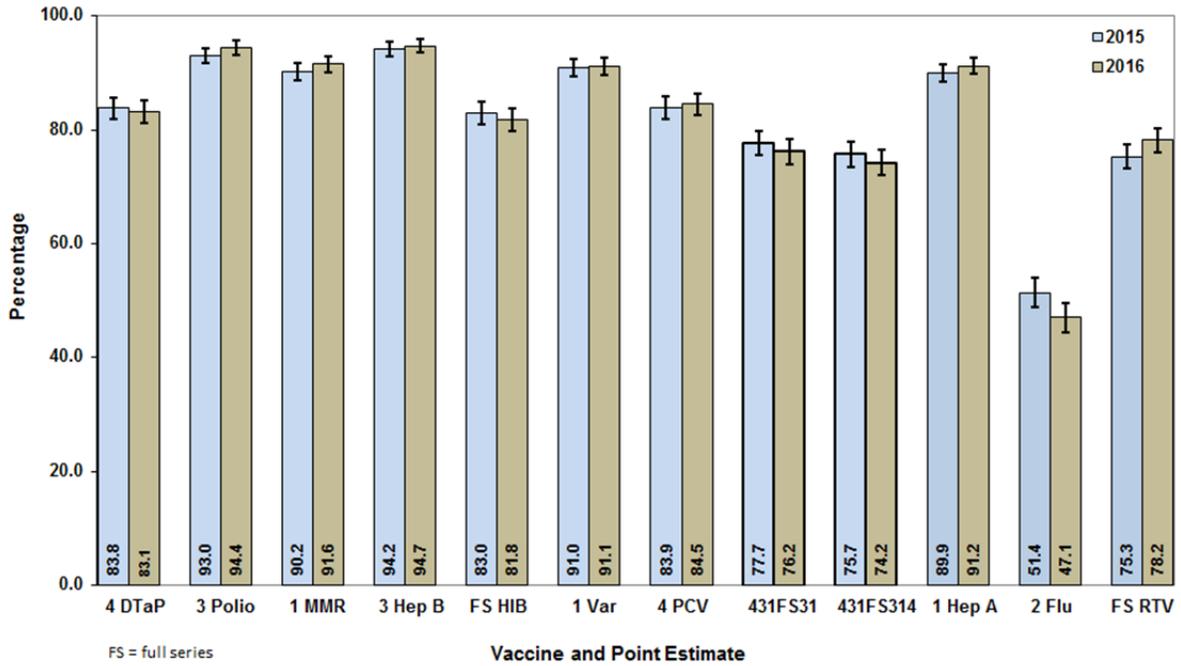
Appendix 3 contains region-specific charts of coverage rates for each vaccine and the 4:3:1:FS:3:1:4 series.

**Figure 2**



**Figure 3**

**2016 Immunization Status of 24-Month-Old Children in Tennessee:**  
 Statewide percentage of children with age-appropriate immunization levels  
 by vaccine in 2015 and 2016  
 (point estimates and 95% confidence intervals, 2015 n=1451, 2016 n=1436)

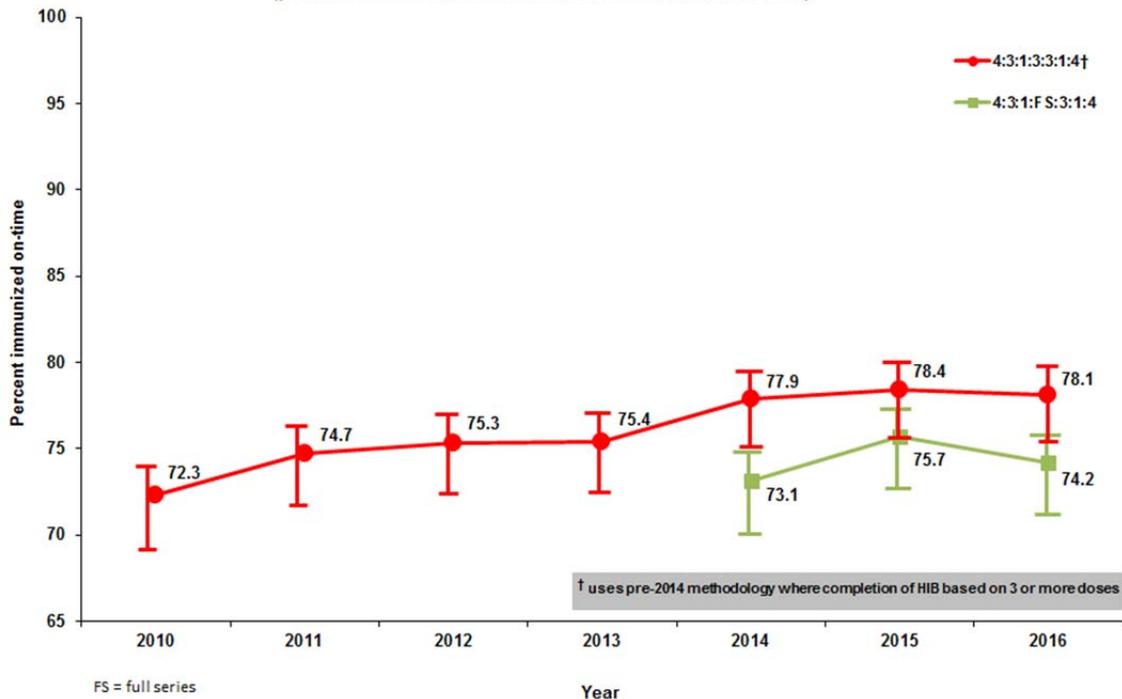


**Series completion trends over time**

Figure 4 below shows the trend over time of the 4:3:1:3:3:1 series completion rate from 2002 to 2016, as well as the 4:3:1:3:3:1:4 completion rate from 2010 to 2013 and 4:3:1:FS:3:1:4 in 2014-2016.

**Figure 4**

**2016 Immunization Status Survey of 24-Month-Old Children in Tennessee:**  
 4:3:1:FS:3:1:4 Immunization Level Trends: Tennessee 2002 to 2016  
 (point estimates and 95% confidence interval, 2016 n=1436)



### Hepatitis B vaccine birth dose

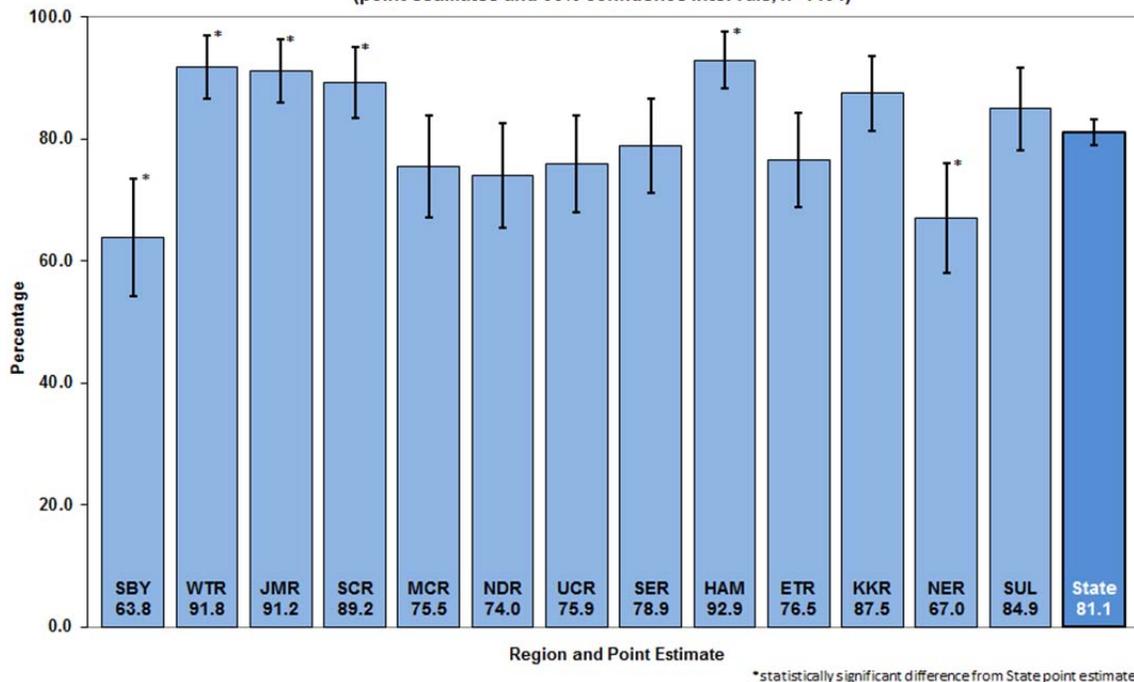
The percentage of children in each public health region who received a birth dose of HBV, defined as a dose given by day 3 of life, is shown below in Figure 5. Exposure to hepatitis B virus at the time of birth or in early infancy results in chronic, life-long infection for most infants. CDC recommends that *all* newborns be vaccinated before discharge from the delivery hospital.

The HP2020 objective is for 85% of infants to receive a birth dose of HBV. In 2016, 81.1% (95% CI: 79.0, 83.1) received a birth dose, an estimate that is statistically unchanged from the 2015 measurement (81.8%, 95% CI: 79.8, 83.8). As Figure 5a shows, two public health regions, Northeast (NER) and Shelby County (SBY) were significantly lower than the 2016 statewide rate. Five regions (West Tennessee [WTR], Jackson-Madison [JMR], South Central [SCR], Hamilton [CHR] and Knox [KKR]) exceeded the HP2020 objective.

Figure 5b shows no statistically significant changes between 2016 and 2015 in any region. The best way to improve birth dose rates is strong enforcement of a written hospital birth dose policy.

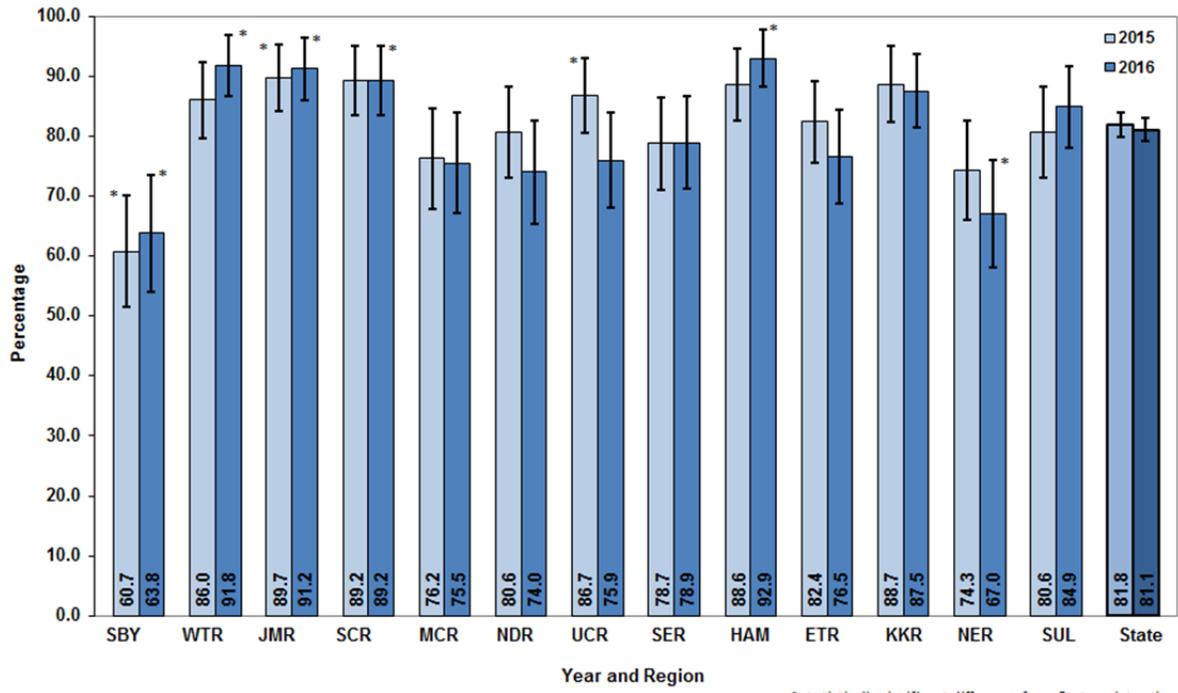
**Figure 5a**

**2016 Immunization Status Survey of 24-Month-Old Children in Tennessee:  
Percentage of children with birth dose of Hepatitis B (HBV) by third day of life  
by health department region  
(point estimates and 95% confidence intervals, n=1404)**



**Figure 5b**

**2016 Immunization Status Survey of 24-Month-Old Children in Tennessee:  
 Percentage of children with birth dose of Hepatitis B (HBV) by third day of life  
 by health department region in 2015 and 2016  
 (point estimates and 95% confidence intervals; 2015 n=1406, 2016 n=1404)**



\*statistically significant difference from State point estimate

**Racial disparities**

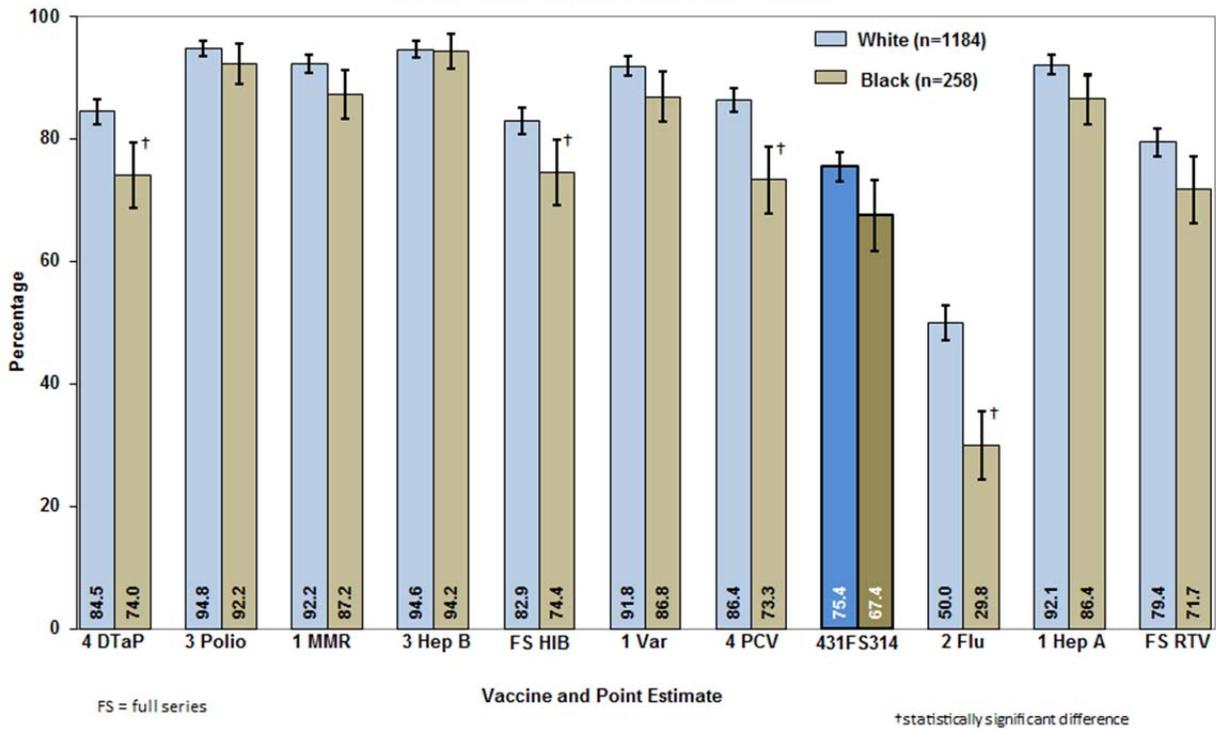
The difference in on-time completion of the recommended 4:3:1:FS:3:1:4 vaccine series among black and white children approached statistical significance. The 2016 survey included 258 black and 1,184 white children. Due to small numbers, children of other races (n=22) are excluded from this analysis. Figure 6 shows the rates of on-time immunization of black and white children for each vaccine assessed.

Among the vaccines in the 4:3:1:FS:3:1:4 series, black children were significantly less likely to have received the full series of the three vaccines that require a booster dose in the second year of life. This includes DTaP (74.0% in black vs. 84.5% in white children), PCV (73.3% vs. 86.4%) and HIB (74.4% vs 82.9%). Trends in on-time series completion by race from 2010-2016 can be found in Appendix 4.

The most significant racial disparity is influenza vaccine coverage, which has been documented annually in this report since influenza was first assessed in 2008. In 2016, a significantly smaller proportion of black children received 2 or more doses of influenza vaccine by their second birthday: 29.8% vs. 50.0%.

**Figure 6**

**2016 Immunization Status of 24-Month-Old Children in Tennessee: Statewide percentage of children with age-appropriate immunization levels by vaccine and race (point estimates and 95% confidence intervals)**



**Immunization among selected sub-populations**

Certain risk factors consistently are associated with failure to complete the recommended series of immunizations on time, such as starting routine immunizations late (>120 days of age), or having two or more siblings. In the past, racial disparities were predictive of delayed immunizations, although in recent years this is most consistently predictive for influenza vaccination.

The survey captures the immunization provider type (public, private or both), TennCare (Medicaid) participation, and enrollment in the Women, Infants and Children (WIC) nutrition program for each child in the

survey. Only local public health department clinics are counted as “public” in this survey. Children are counted under TennCare or WIC if they were ever enrolled. Because only 71 of 1,388 children with a known source of vaccination received all shots in a public clinic, the estimate of coverage among patients in this setting is imprecise.

Infants in WIC have immunization records reviewed at WIC visits. Targeted education and telephone follow-up are the primary tools used to encourage catch-up immunization of WIC infants behind schedule.

Children who begin routine immunizations after 4 months (120 days) of age are at very high risk of failing to catch up. In this sample, 44 children received their first routine vaccination other than rotavirus or birth dose HBV after 120 days of age; completion is low in this group. Table 1 below summarizes the 2016 on-time completion rates for 4:3:1:FS:3:1:4 in these groups.

**Table 1**

<b>4:3:1:FS:3:1:4* Completion Levels in the 2016 Survey of 24 Month Old Children: Selected Characteristics (point estimate +/- 95 percent confidence intervals)</b>			
<b>Provider Type</b>	Public n=42/71	Private N=818/1055	Both n=189/262
	<b>59.2% ± 11.43</b>	<b>77.5% ± 2.52</b>	<b>72.1% ± 5.43</b>
<b>TennCare Enrollment</b>	Enrolled n=593/829	Not Enrolled n=473/607	
	<b>71.5% ± 3.07</b>	<b>77.9% ± 3.30</b>	
<b>WIC Enrollment</b>	Enrolled n=680/930	Not Enrolled n=386/506	
	<b>73.1% ± 2.85</b>	<b>76.3% ± 3.71</b>	
<b>Other Siblings</b>	None n=466/575	One n=350/478	Two or more n=249/381
	<b>81.0% ± 3.20</b>	<b>73.2% ± 3.97</b>	<b>65.4% ± 4.78</b>
<b>Age at First Immunization**</b>	≤120 days n=1050/1364	120 days n=16/44	
	<b>77.0% ± 2.23</b>	<b>36.4% ± 14.21</b>	

\*4:3:1:FS:3:1:4: FS means that a full series (3 or 4 doses) of Hib has been completed.

\*\*Excludes oral rotavirus vaccine or a birth dose of hepatitis B vaccine

**Immunization provider types and patient populations**

Of children in the 2016 survey, 73.5% were immunized only by private providers, 18.3% in a combination of private and public health clinics, and 4.9% were immunized only at a public health department. Data were unavailable for 3.3% of children. Figure 7 shows the trends in these proportions over time.

Those immunized in health departments had a higher prevalence of risk factors for failure to complete immunization. Table 2 shows the prevalence of risk factors for incomplete immunization among populations immunized in a public health department, private clinic or a combination of settings.

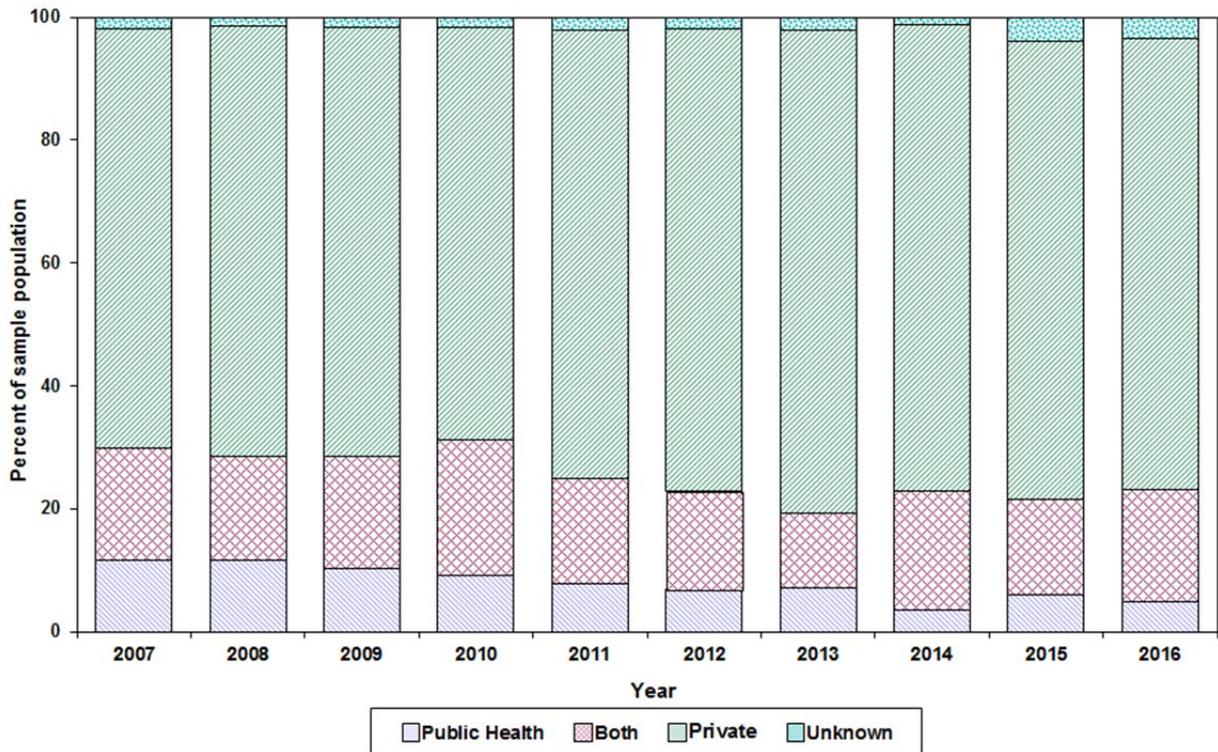
**Table 2**

Prevalence of risk factors for delayed immunizations in the survey population by provider type			
Risk Factor	Health Department	Both Private and Public	Private Only
Black ( <i>risk for influenza</i> )	19.7% (14/71)	16.8% (44/262)	15.6% (164/1055)
2 or more siblings	45.7% (32/70)	32.8% (86/262)	23.2% (244/1054)
Age at first dose >120 days*	8.5% (6/71)	3.1% (8/262)	2.8% (30/1055)
Any of above risk factors	56.3% (40/71)	45.8% (120/262)	35.1% (370/1055)

\*excluding oral rotavirus vaccine or birth dose hepatitis B vaccine

**Figure 7**

**2016 Immunization Status Survey of 24-Month-Old Children in Tennessee:  
Source of Immunizations from 2007 to 2016 (n=1436)**



**Summary of Key Findings:**

1. Below is the summary of coverage rates in this report relative to Health People (HP) 2020 objectives:

Measurement	HP2020 Objective (19-35 months)	TN 2016 (24 months)
Complete 4:3:1:FS:3:1:4 series	80%	74.2%
Each vaccine in 4:3:1:FS:3:1:4 (DTaP, IPV, MMR, Hib, HBV, VAR, PCV)	90% rate for each of the 7 vaccines	<b>Exceeded 90% for 4 of 7</b> , except: 4 doses of DTaP (83.1%), full series of HIB (81.8%) and 4 doses of PCV (84.5%)
3 doses DTaP and PCV	<i>None: this is a process measure</i>	3 DTaP (94.8%) and 3 PCV (94.1%)
Hepatitis A vaccine	60% 2 doses by 35 months	2 HAV (59.1%); 1 HAV (91.2%): <i>not comparable to HP2020</i>
Influenza vaccine	70% appropriately immunized	47.1%
Rotavirus vaccine	80% with 2 doses	78.2%
Hepatitis B birth dose	85%	81.1%

2. Completion of the booster dose of three vaccines during the second year of life (DTaP, PCV, HIB) continues to be the primary barrier in achieving the HP2020 target of 80% coverage for the 4:3:1:FS:3:1:4 series. Effective strategies that focus additional efforts on reminding and recalling children for their booster doses could achieve complete on-time immunization with one additional immunization visit for almost all children who are incompletely immunized for reasons other than parental refusal.
3. This survey indicated that black children were more likely than white children to fall short of completion of the three vaccines requiring a booster dose, as described above. In addition, no measurable progress has been made in closing the longstanding, wide gap in influenza vaccine coverage.
4. Children ever on TennCare had lower immunization rates compared to children never on TennCare for influenza and HIB vaccines, and for the overall 4:3:1:FS:3:1:4 series. See Appendix 4 for details.
5. Children ever enrolled in WIC had lower influenza vaccine coverage than those never enrolled. See Appendix 4.
6. Tennessee is close to achieving the HP2020 objective for HBV birth dose. Enforcement of delivery hospital birth dose policies and strong recommendations by caregivers of neonates will help achieve the goal.
7. Adequate influenza vaccination is an important area for improvement in infants and toddlers, due to the significant risk of serious influenza illness in this age group. Because the large majority of infants and toddlers are vaccinated in a medical home and not in a health department or pharmacy, substantial increases in coverage will require changes in routine practices in the medical home.

## **Next Steps:**

The following steps should continue to improve on-time immunization of Tennessee children:

1. Most children who reach their second birthday with incomplete immunizations could have been completed with just one more immunization visit in the second year of life. This visit would ensure administration of the booster doses of DTaP, PCV and HIB. It is important for immunization providers to conduct patient reminders and recalls focusing on children who are overdue for the DTaP booster beginning at 19 months of age.
2. TIP will continue to encourage providers to give the third DTaP at 6 months of age so the fourth DTaP may be administered at the 12-month visit, along with PCV and HIB boosters. Because visits to medical clinics occur less frequently after the first birthday, it helps to complete the series as early as possible.
3. A state immunization registry with enhanced features launched in November 2014. The Tennessee Immunization Information System, TennIIS, ([www.TennesseeIIS.gov](http://www.TennesseeIIS.gov)), has features designed to improve immunization completion rates:
  - a. When a child's record is opened, the screen displays each vaccine due or overdue for the child.
  - b. Practices that use TennIIS can generate patient reminders of vaccination appointments and recall children behind on vaccines.
  - c. In 2017, TennIIS will add enhanced immunization coverage rate reports, enabling practices that use it to run practice-level immunization coverage reports for quality improvement, as well as patient reminder and recall reports.
  - d. The effectiveness of TennIIS tools depends upon practices using it and reporting administered immunizations to it. To that end, in 2017, reporting of immunizations given to children under 19 years will be required as a condition of participation in the Vaccines for Children (VFC) Program. As of the end of 2016, almost 1,700 clinics and pharmacies routinely send electronic record updates from their EHR systems to TennIIS.
4. TIP provides local health departments (LHDs) with lists of children aged 20-24 months who have received immunizations in a LHD and whose records show they are incompletely immunized with DTaP vaccine. These reports facilitate LHD efforts to recall these children for overdue immunizations.
5. TIP shares survey findings with WIC and TennCare leadership to inform their work to improve coverage among children they serve.
6. Patients enrolled in WIC will continue to receive immunization education and follow-up phone calls.
7. TIP will review these results and highlight key findings during its annual VFC Immunization Spring Review in May 2017 which will be held in Memphis, Nashville, Chattanooga and Knoxville. This educational conference is free to healthcare providers in the over 650 clinics that participate in VFC. In addition, the Director of TIP reviews these findings with professional health organizations annually.
8. A key component of TIP's work with participants in the VFC program is quality improvement. TIP staff located in each public health region will conduct site visits in 2017 to at least 50% of healthcare provider offices that participate in VFC. These visits include vaccine education and many include an assessment of clinic-level immunization coverage and individualized practice quality improvement efforts.

## Appendix 1

### 2016 Immunization Status Survey of 24 Month Old Children in Tennessee

Details of Regional Samples: Oversampled Records, Vaccine Refusal and Children not Located

Region	Records analyzed <sup>1</sup> (oversampled) <sup>2</sup>	Total vaccine refusals <sup>3</sup>	Reason given for refusing vaccine <sup>3</sup>			% Refusal	Number not located <sup>4</sup>	% not located
			Religious	Philosophical	Medical			
Northeast TN	110 (0)	3	1	2	0	2.7%	0	-
East TN	117 (1)	1	0	1	0	0.9%	0	-
Southeast TN	112 (0)	3	1	1	1	2.7%	1	0.9%
Upper Cumberland	115 (1)	0	0	0	0	-	2	1.7%
Mid-Cumberland	103 (0)	0	0	0	0	-	1	1.0%
South Central	116 (0)	4	2	2	0	3.4%	0	-
West TN	122 (8)	5	4	1	0	4.1%	0	-
Shelby County	107 (10)	1	0	1	0	0.9%	5	4.5%
Davidson County	108 (5)	3	3	0	0	2.8%	3	2.8%
Knox County	114 (0)	2	0	2	0	1.8%	0	-
Hamilton County	115 (1)	1	0	1	0	0.9%	0	-
Madison County	115 (0)	0	0	0	0	-	10	8.7%
Sullivan County	110 (2)	1	0	1	0	0.9%	2	1.8%
<b>TOTAL</b>	<b>1464 (28)</b>	<b>24 of 1464</b>	<b>11</b>	<b>12</b>	<b>1</b>	<b>1.6%</b>	<b>24 of 1464</b>	<b>1.6%</b>

<sup>1</sup>Total records included in analysis, excluding children in the original sample who had moved out of state, refused to participate or were adopted, in foster care or in state custody

<sup>2</sup>Number in parentheses is the number of oversampled records of black children. Oversampling was done in regions where the proportion of black children in the original sample was smaller than the proportion of black children born in the region during the period when the sample was drawn. These additional records were included only in the statewide analysis of racial disparities in immunization rates. Among the 29 oversampled records, one child had moved out of state and was excluded from the analysis. Of the remaining 28 oversampled records, 25 were located and none had refused vaccine.

<sup>3</sup>Five of the 24 children whose parents gave a reason for not vaccinating were partially immunized (range 1-22 total doses).

<sup>4</sup>Children with incomplete records in the state immunization registry (TennIIS) who could not be located for further information. These children were included in the analysis with any vaccinations recorded in TennIIS. Fourteen of 24 had  $\geq 10$  doses documented.

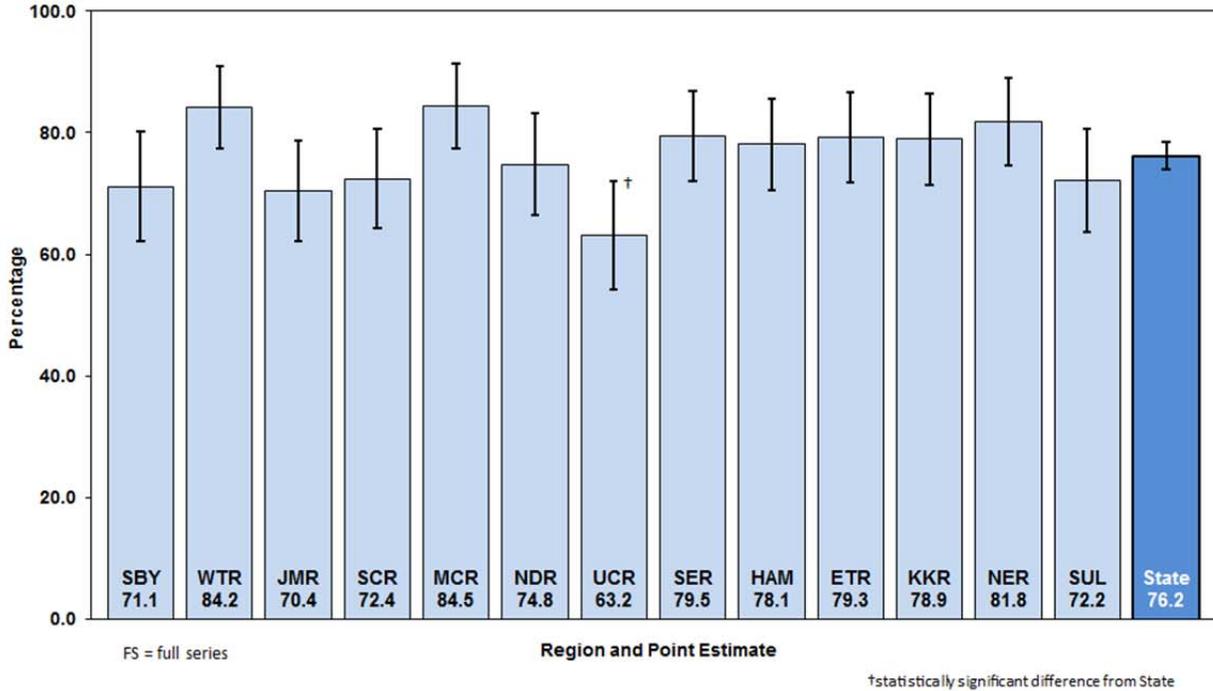
# Appendix 2

## 2016 Immunization Status Survey of 24 Month Old Children in Tennessee

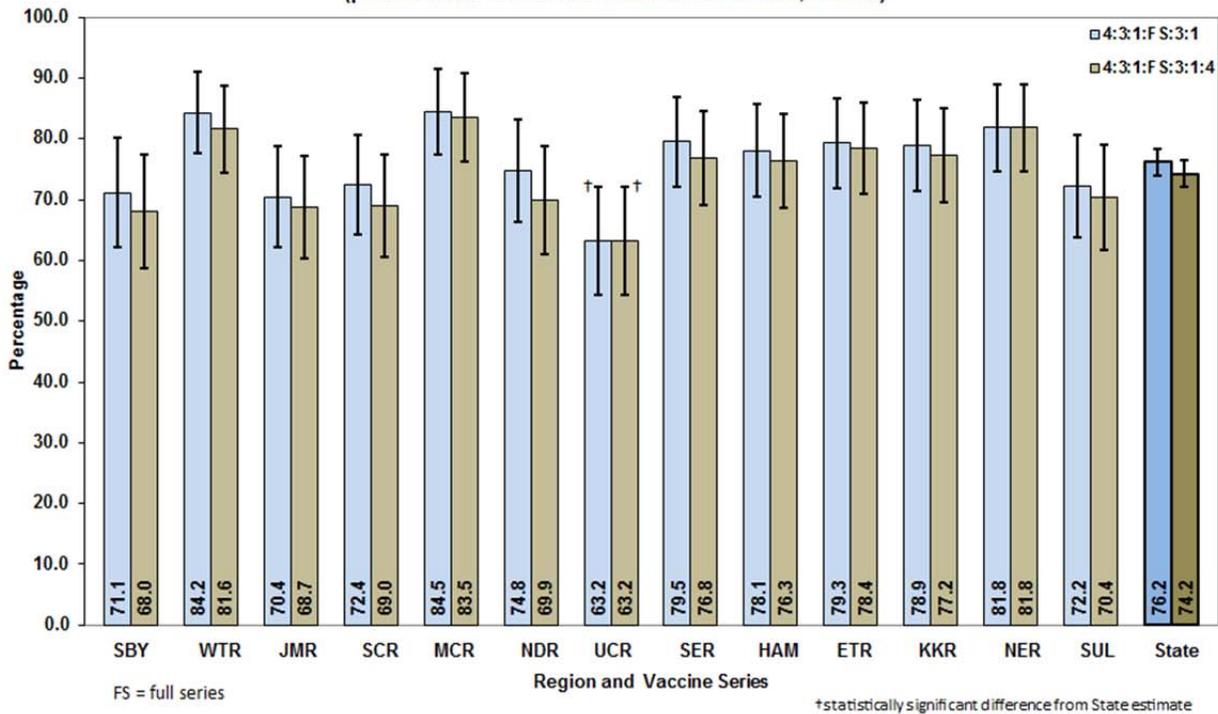
### Individual Vaccine Charts, with Coverage Rates Measured in Each Health Department Region and Statewide

	Page
On-time 4:3:1:FS:3:1 and 4:3:1:FS:3:1:4 vaccine series	... 25
DTaP (4-dose and 3-dose coverage)	... 26
<i>Haemophilus influenzae</i> type b & Hepatitis A (1-dose coverage)	... 27
Hepatitis A (2-dose coverage) & Hepatitis B	... 28
Influenza (2-dose and 3-dose coverage)	... 29
MMR & Pneumococcus (4-dose coverage)	... 30
Pneumococcus (PCV) (4-dose vs. 3-dose coverage) & Polio	... 31
Rotavirus & Varicella	... 32

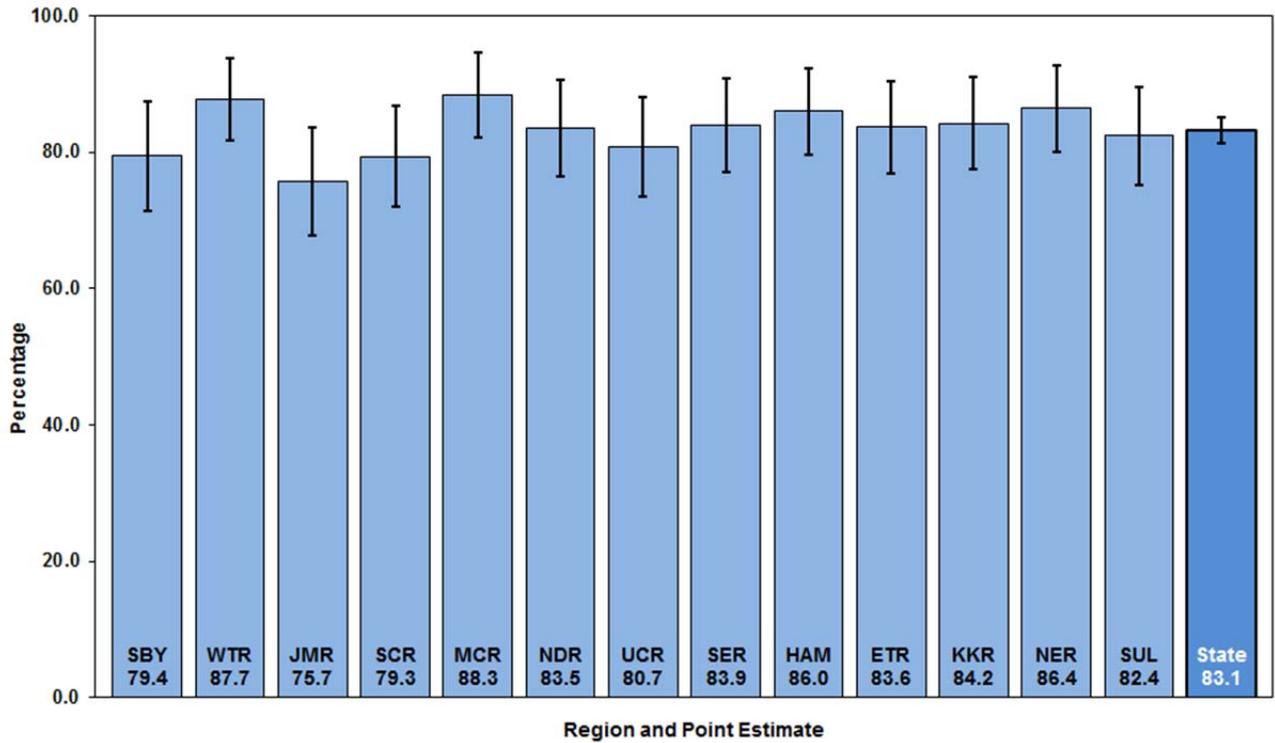
2016 Immunization Status Survey of 24-Month-Old Children in Tennessee:  
 Percentage of 24-month-old children with on-time immunization (4:3:1:FS:3:1)  
 by health department region  
 (point estimates and 95% confidence intervals, n=1436)



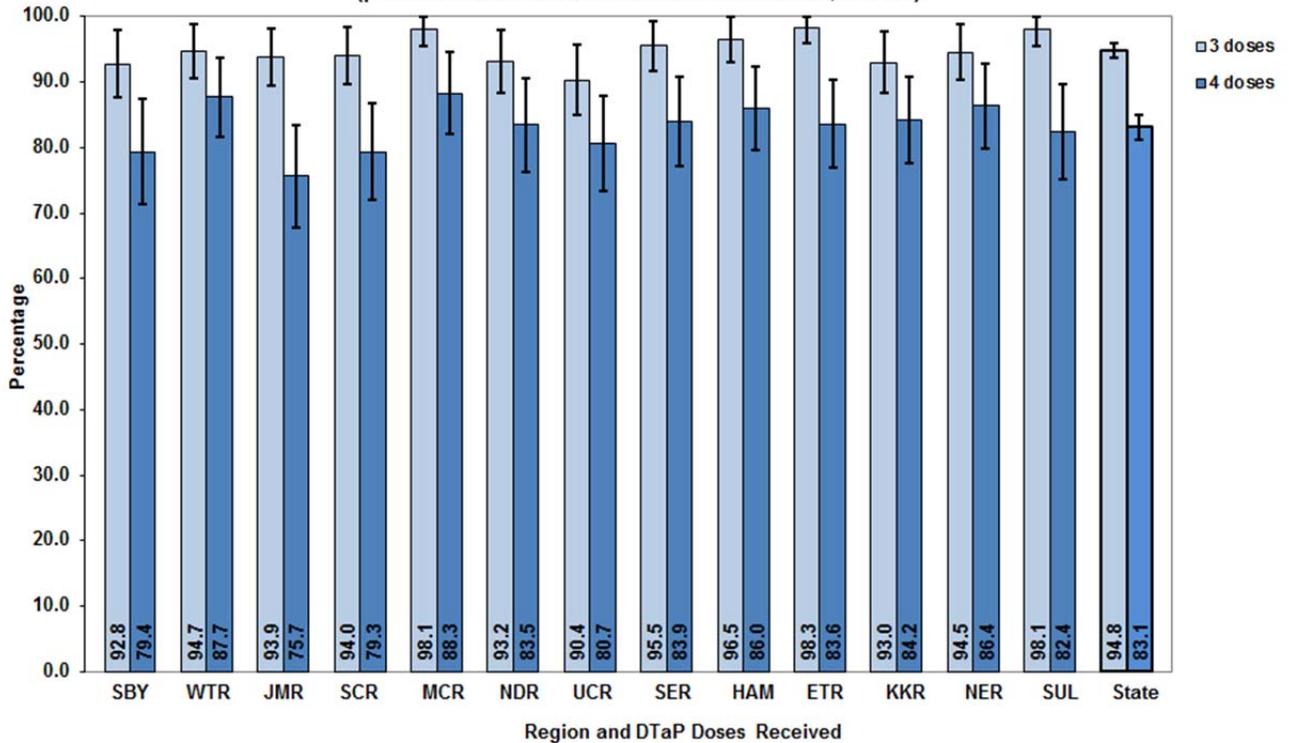
2016 Immunization Status Survey of 24-Month-Old Children in Tennessee:  
 Percentage (%) of children complete for 4:3:1:FS:3:1 and 4:3:1:FS:3:1:4 vaccine series  
 by health department region  
 (point estimates and 95% confidence intervals, n=1436)



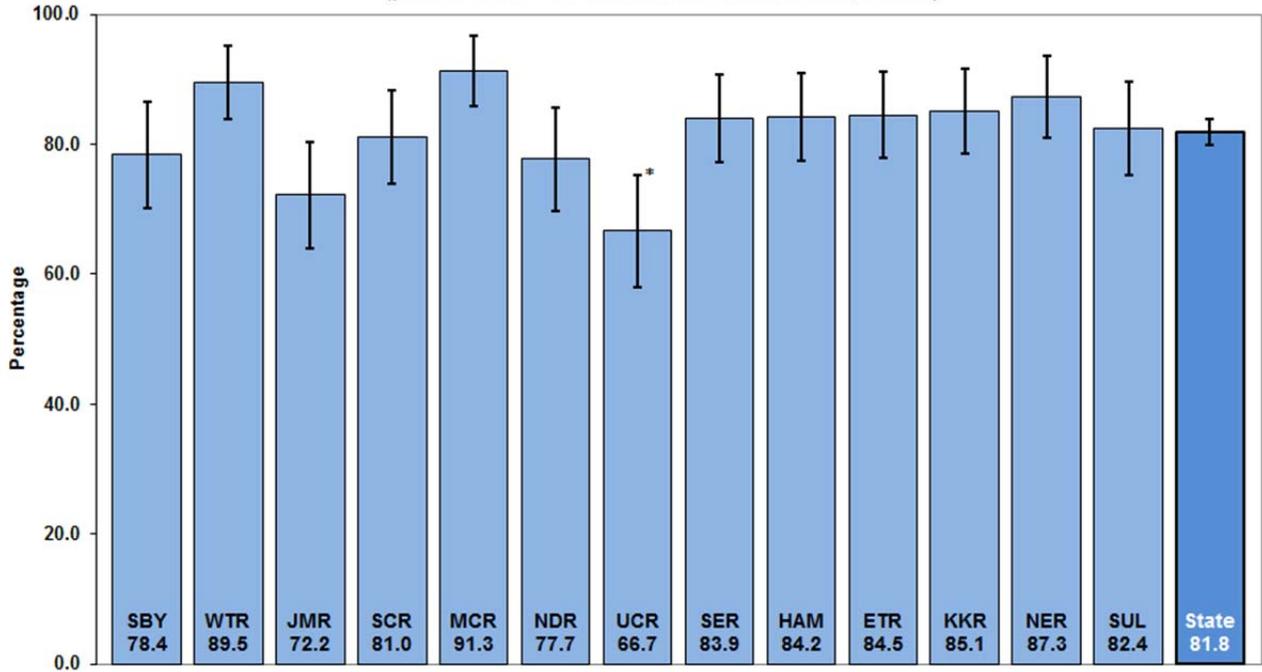
2016 Immunization Status Survey of 24-Month-Old Children in Tennessee:  
 Percentage of children with complete DTaP series (4 doses) by health department region  
 (point estimates and 95% confidence intervals, n=1436)



2016 Immunization Status Survey of 24-Month-Old Children in Tennessee: Percentage of  
 children with 3 or 4 doses of diptheria, tetanus and acellular pertussis (DTaP)  
 by health department region  
 (point estimates and 95% confidence intervals, n=1436)



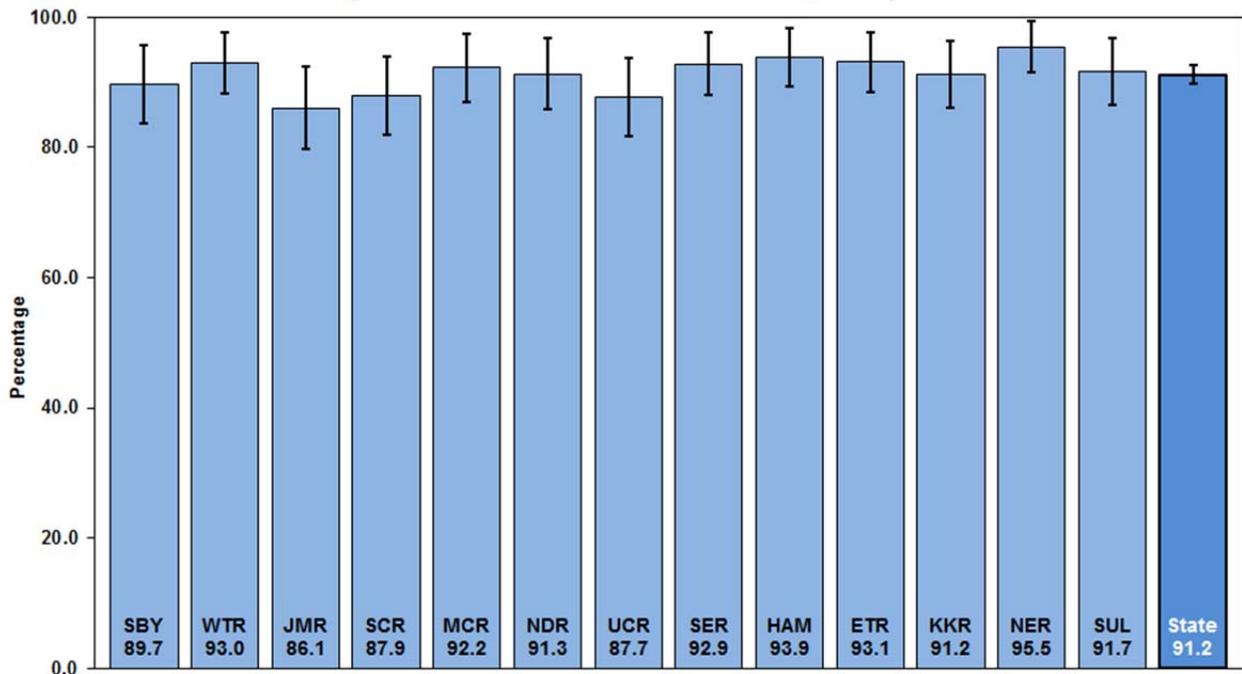
**2016 Immunization Status Survey of 24-Month-Old Children in Tennessee:  
 Percentage of children with complete *Haemophilus influenzae* type B (Hib) series  
 (either 3 or 4 doses depending on brand) by health department region  
 (point estimates and 95% confidence intervals, n=1436)**



Region and Point Estimate

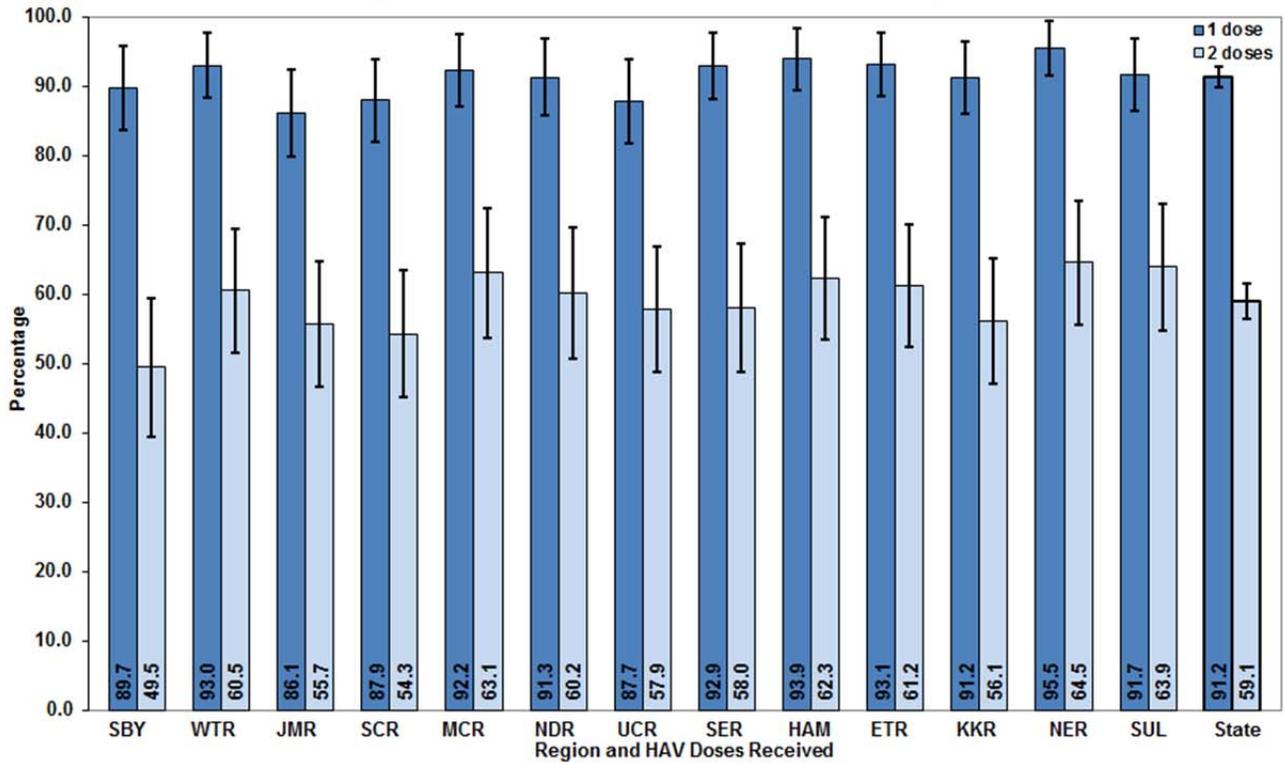
\*statistically significant difference from State point estimate

**2016 Immunization Status Survey of 24-Month-Old Children in Tennessee:  
 Percentage of children with at least one dose of Hepatitis A (HAV)  
 by health department region  
 (point estimates and 95% confidence intervals, n=1436)**

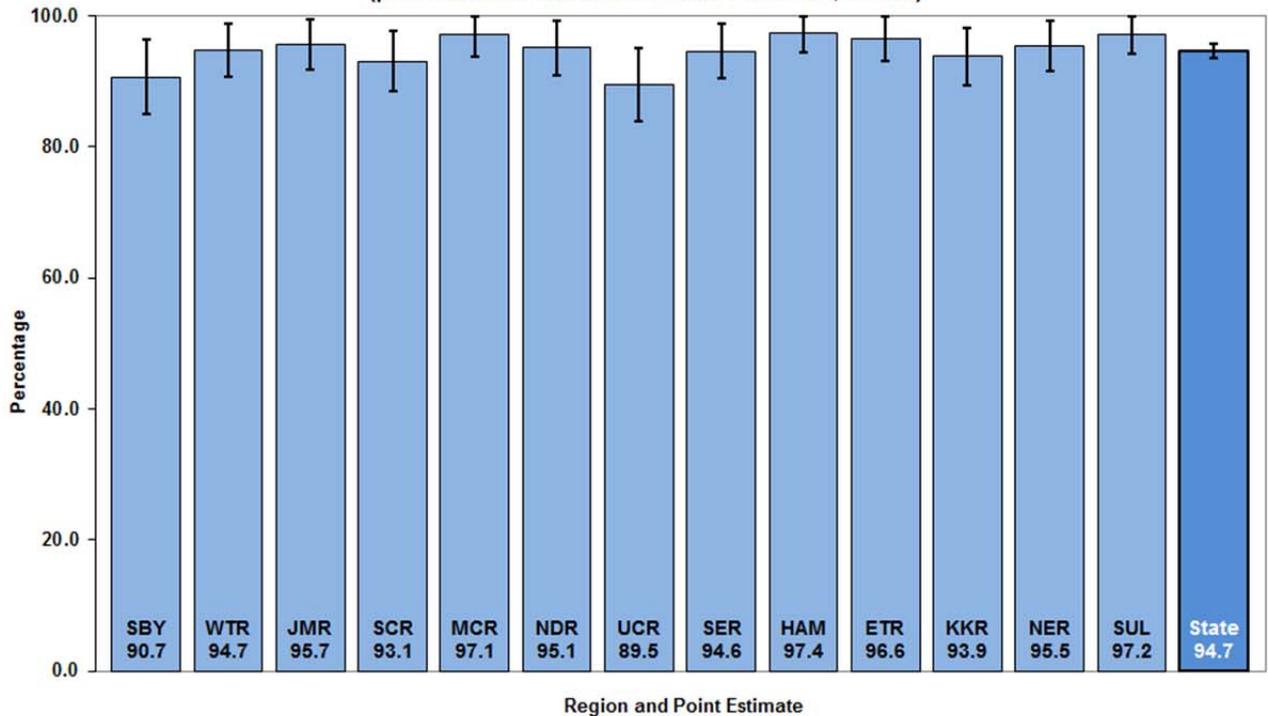


Region and Point Estimate

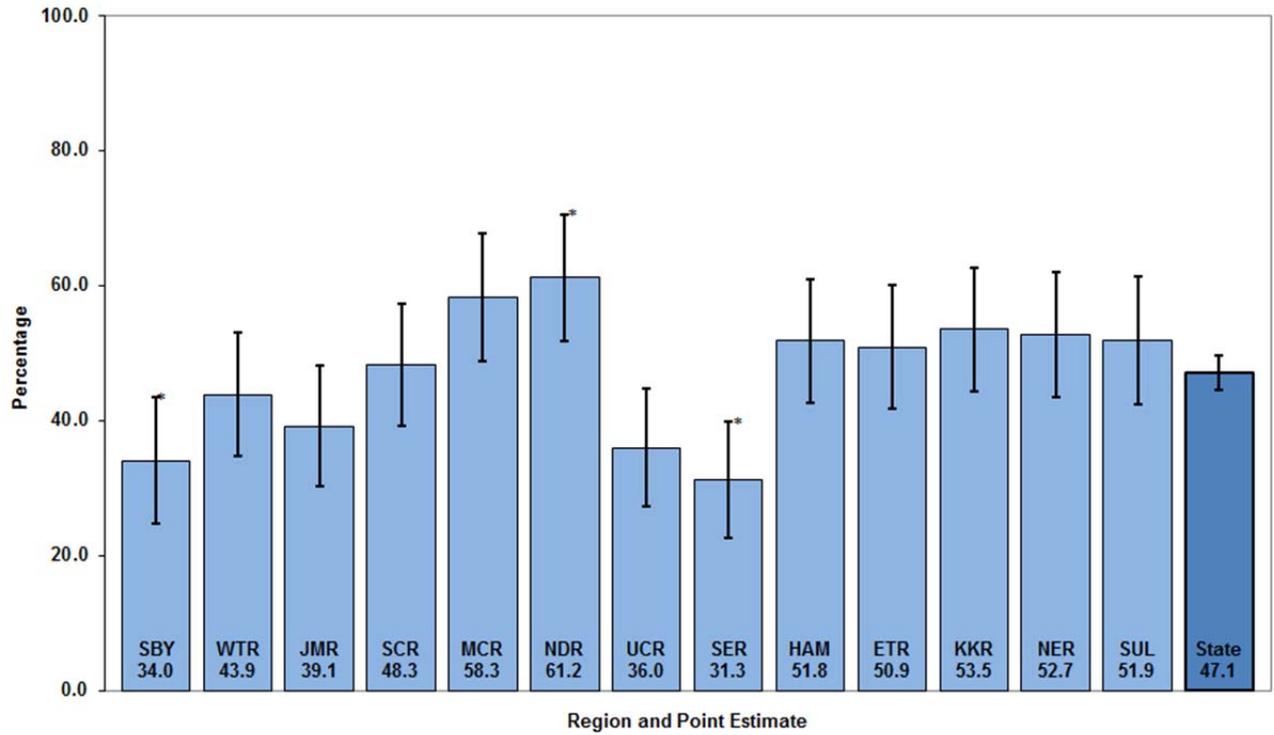
**2016 Immunization Status Survey of 24-Month-Old Children in Tennessee:  
Percentage of children with 1 or 2 doses of Hepatitis A (HAV) by health department region  
(point estimates and 95% confidence intervals, n=1436)**



**2016 Immunization Status Survey of 24-Month-Old Children in Tennessee:  
Percentage of children with complete Hepatitis B (HBV) series ( $\geq 3$  doses)  
by health department region  
(point estimates and 95% confidence intervals, n=1436)**

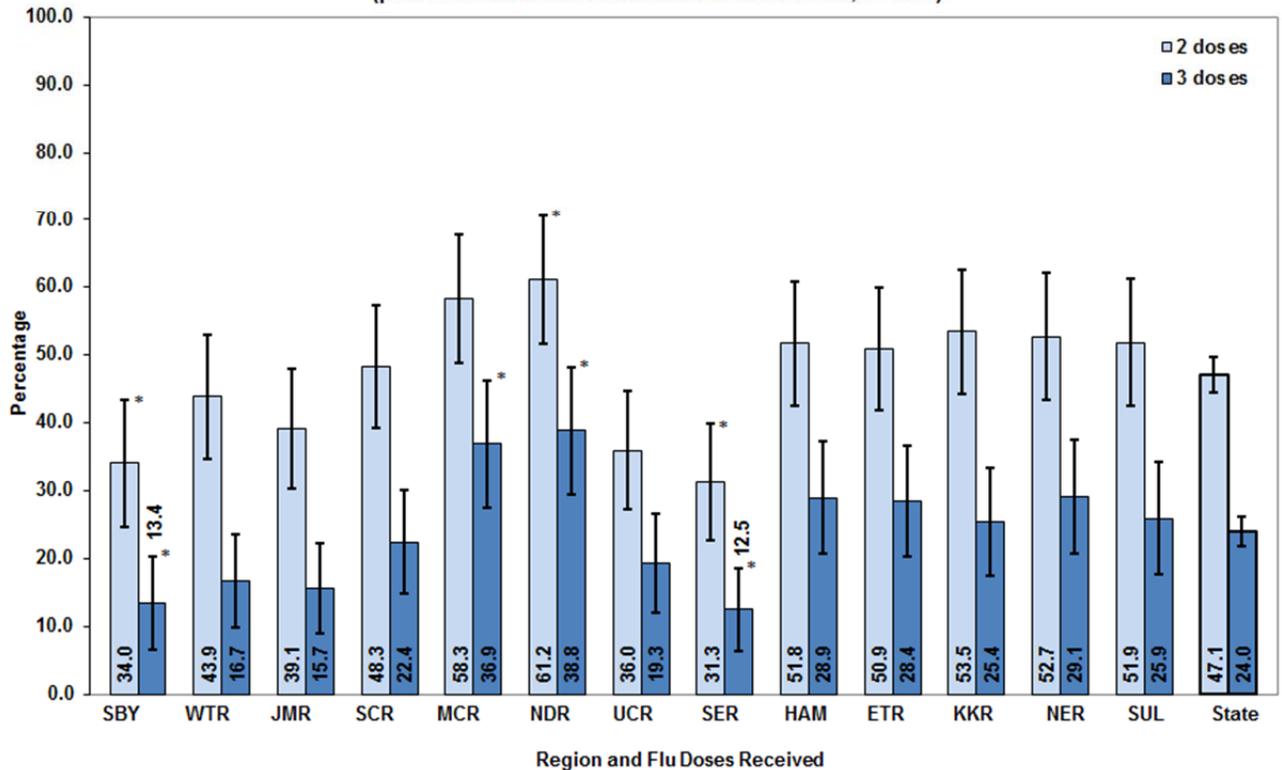


**2016 Immunization Status Survey of 24-Month-Old Children in Tennessee:  
Percentage of children with 2 doses of Influenza vaccine by health department region  
(point estimates and 95% confidence intervals, n=1436)**



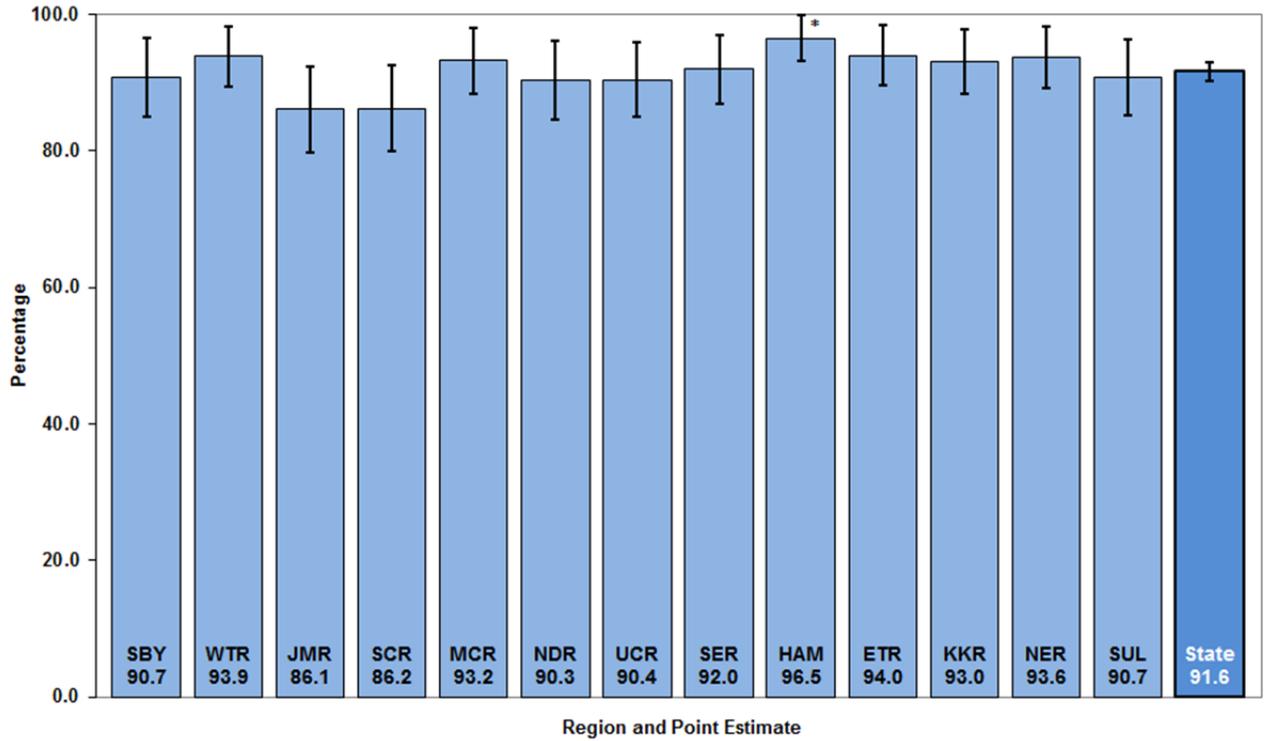
\*statistically significant difference from State point estimate

**2016 Immunization Status Survey of 24-Month-Old Children in Tennessee:  
Percentage of children with 2 or 3 doses of Influenza vaccine by health department region  
(point estimates and 95% confidence intervals, n=1436)**



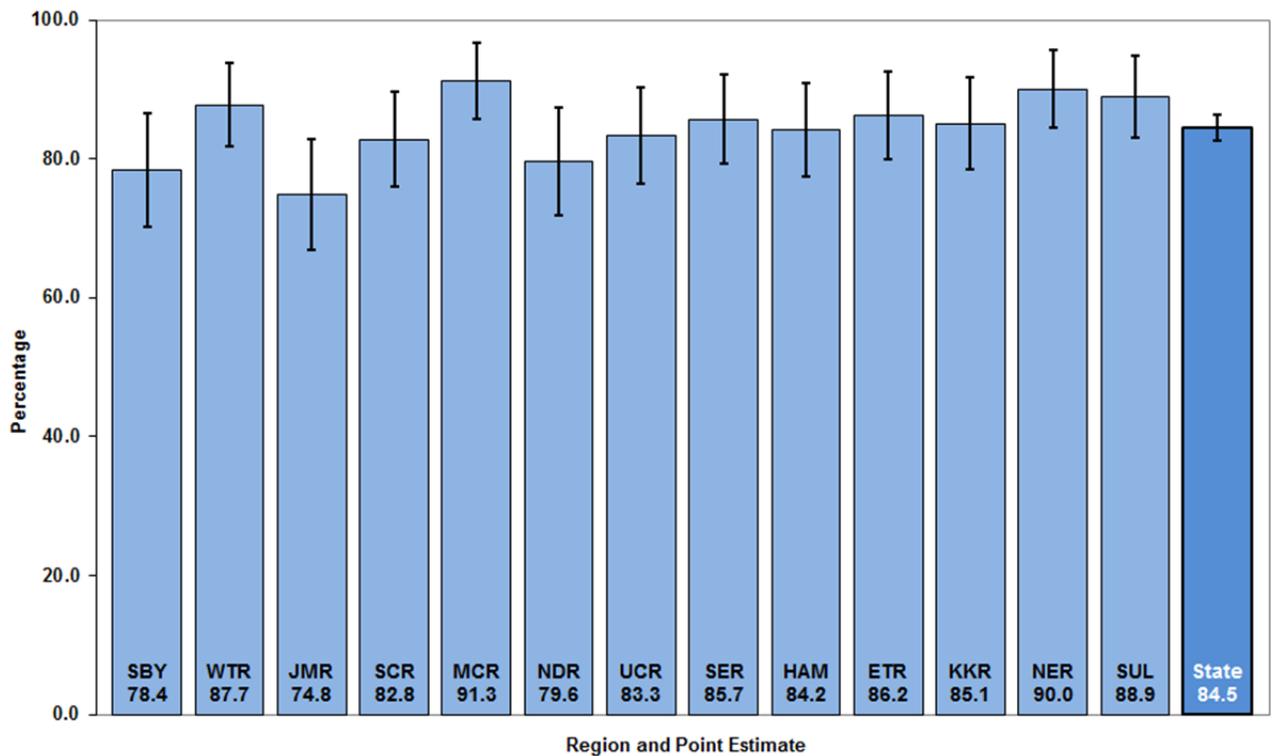
\*statistically significant difference from State point estimate

**2016 Immunization Status Survey of 24-Month-Old Children in Tennessee:  
Percentage of children with complete measles, mumps, and rubella (MMR) series (1 dose)  
by health department region  
(point estimates and 95% confidence intervals, n=1436)**

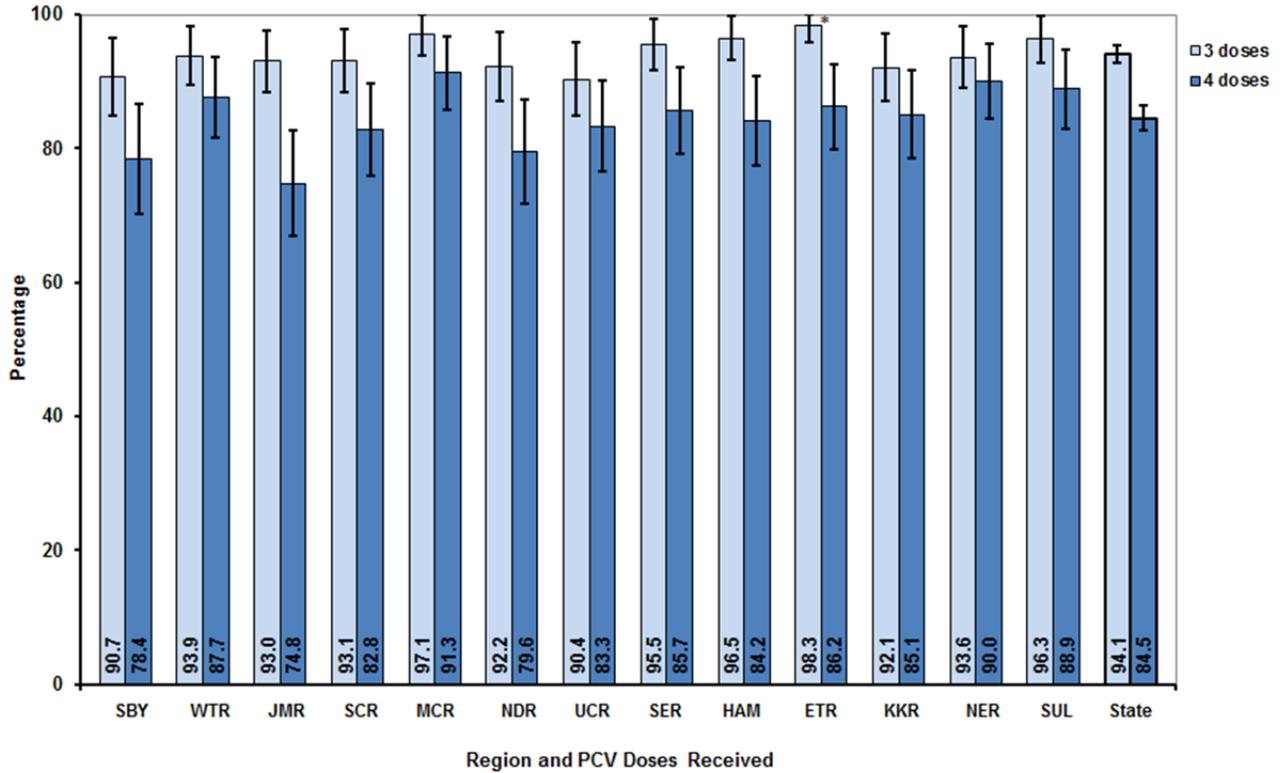


\*statistically significant difference from State point estimate

**2016 Immunization Status Survey of 24-Month-Old Children in Tennessee:  
Percentage of children with complete PCV series (4 doses) by health department region  
(point estimates and 95% confidence intervals, n=1436)**

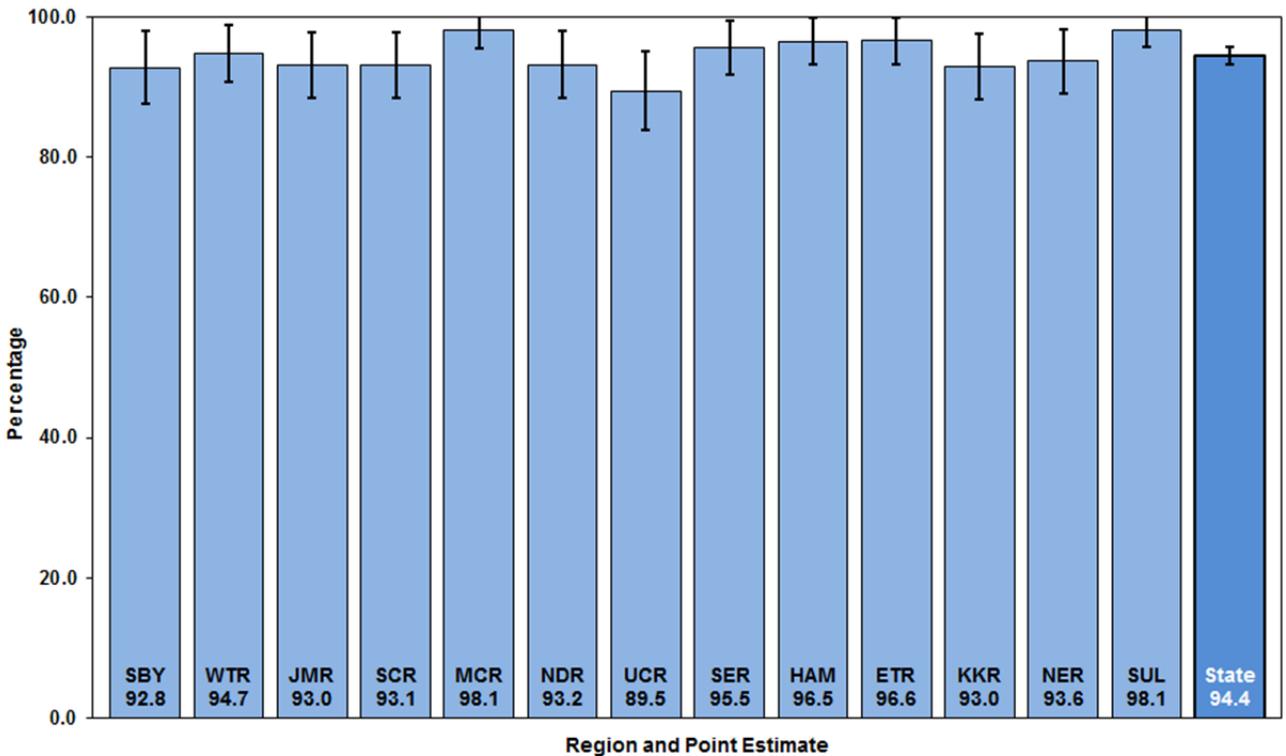


**2016 Immunization Status Survey of 24-Month-Old Children in Tennessee:  
Percentage of children with 3 or 4 doses of PCV by health department region  
(point estimates and 95% confidence intervals, n=1436)**

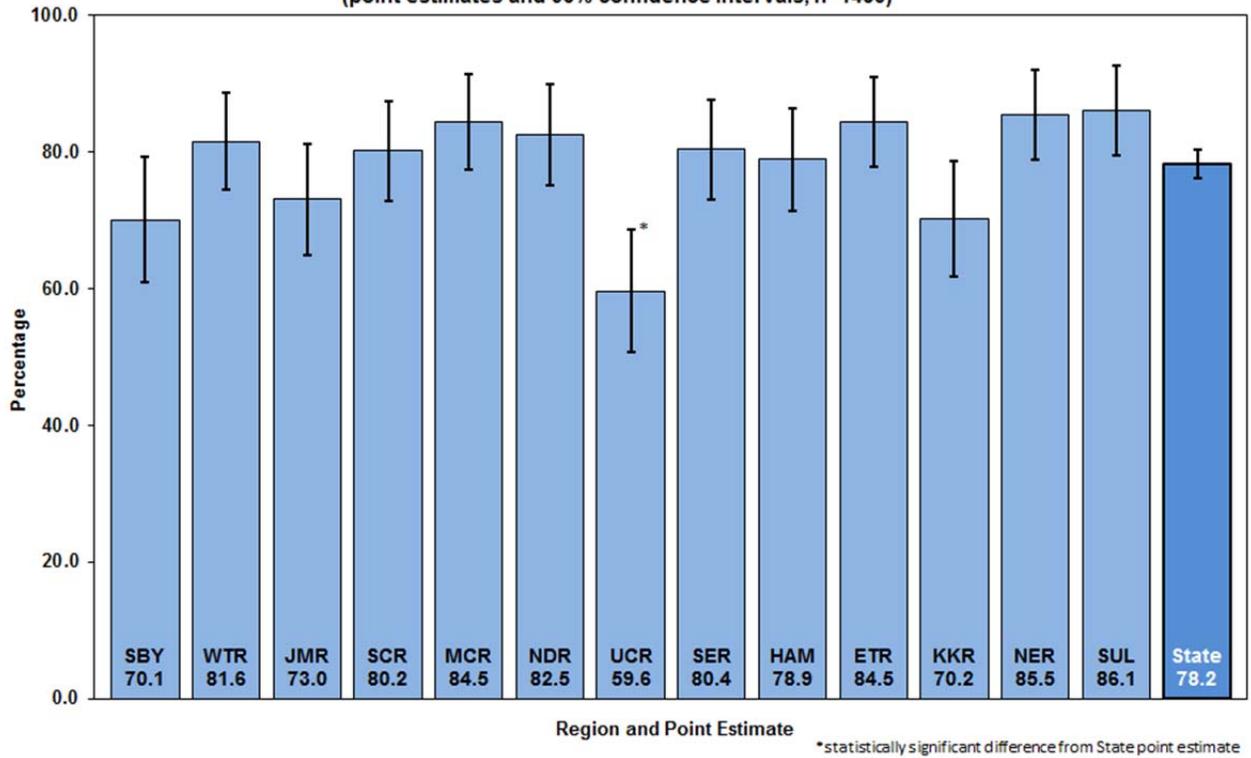


\*statistically significant difference from State point estimate

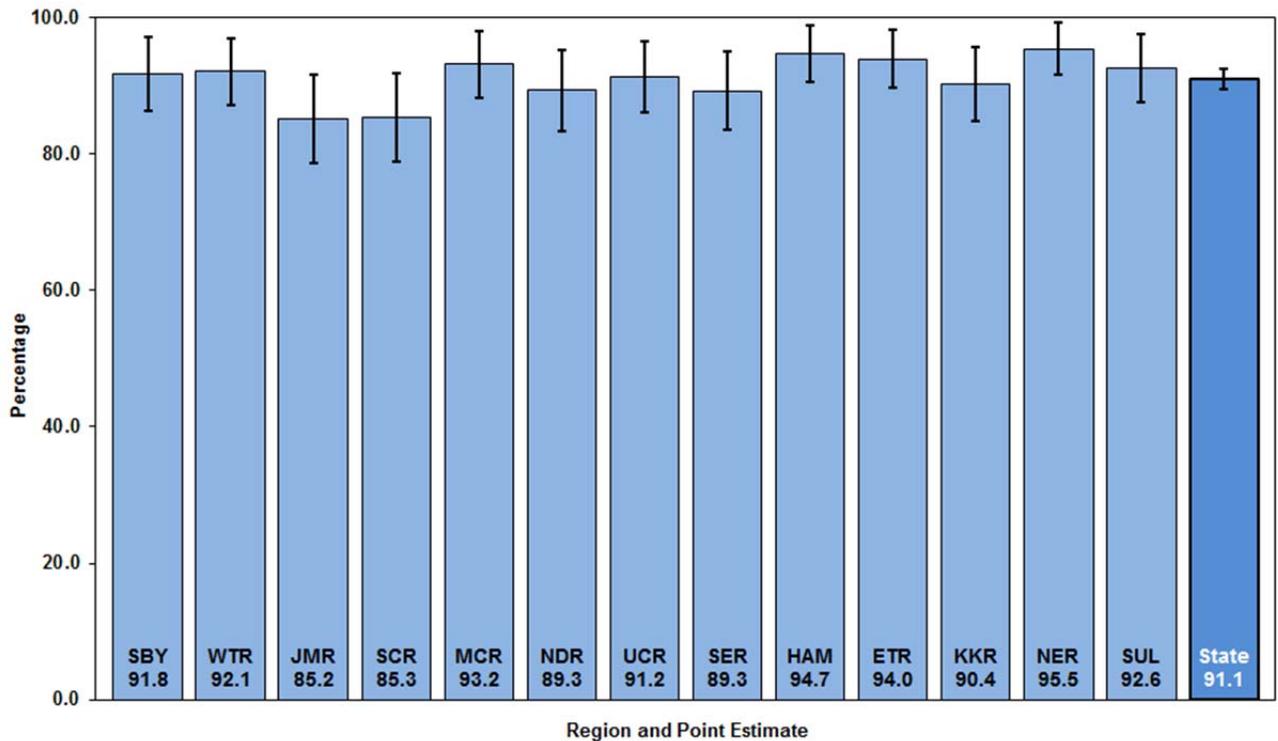
**2016 Immunization Status Survey of 24-Month-Old Children in Tennessee:  
Percentage of children with complete polio (IPV) series (3 doses) by health department region  
(point estimates and 95% confidence intervals, n=1436)**



2016 Immunization Status Survey of 24-Month-Old Children in Tennessee:  
 Percentage of children with complete Rotavirus (RTV) series  
 (either  $\geq 2$  or  $\geq 3$  doses depending on brand) by health department region  
 (point estimates and 95% confidence intervals, n=1436)



2016 Immunization Status Survey of 24-Month-Old Children in Tennessee:  
 Percentage of children with complete Varicella vaccine (1 dose) by health department region  
 (point estimates and 95% confidence intervals, n=1436)



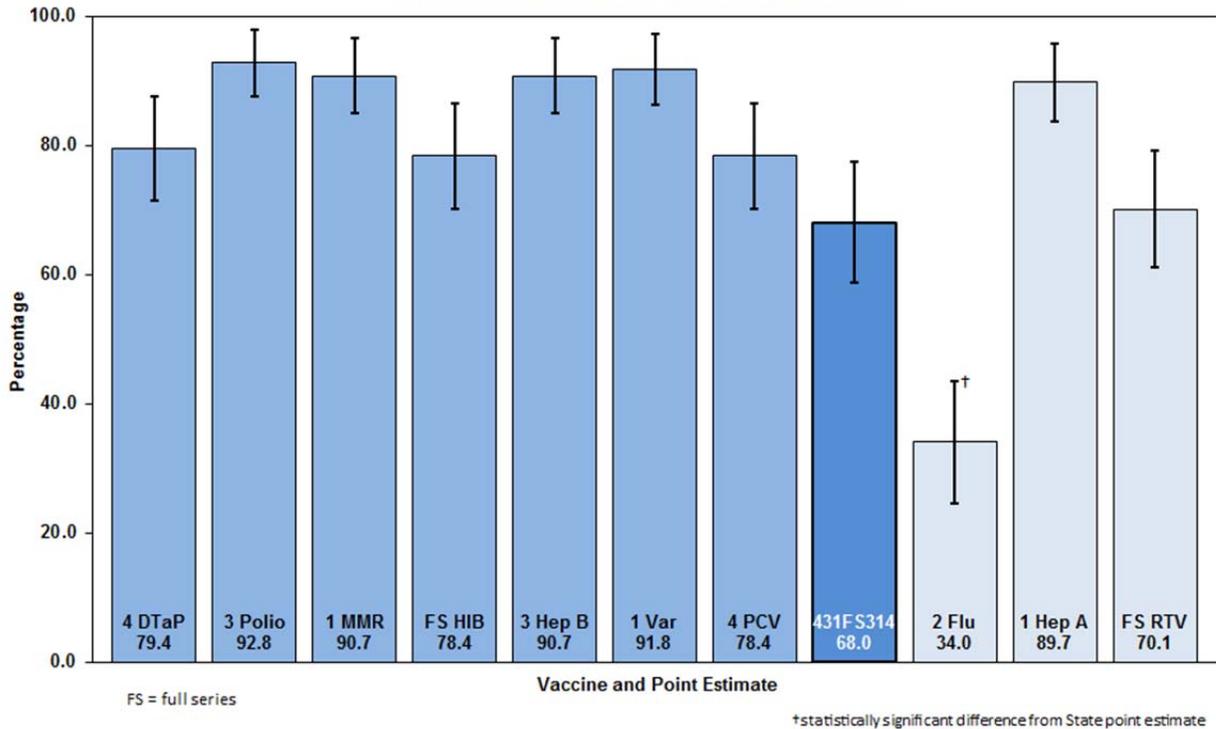
# **Appendix 3**

## **2016 Immunization Status Survey of 24 Month Old Children in Tennessee**

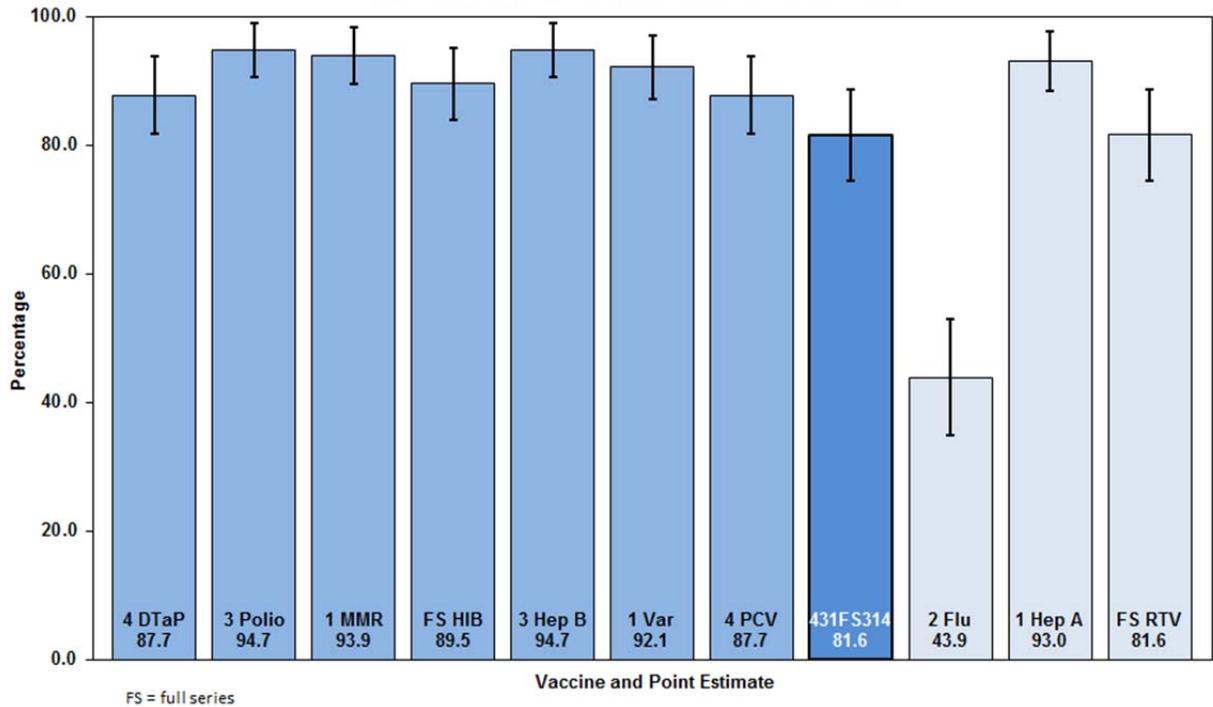
### **Individual Health Department Region Charts with Coverage Rates for All Vaccines Assessed**

	Page
Shelby County	... 34
West Tennessee Region	... 34
Jackson-Madison County	... 35
South Central Region	... 35
Mid-Cumberland Region	... 36
Nashville-Davidson County	... 36
Upper Cumberland Region	... 37
Southeast Region	... 37
Hamilton County	... 38
East Tennessee Region	... 38
Knoxville-Knox County	... 39
Northeast Region	... 39
Sullivan County	... 40

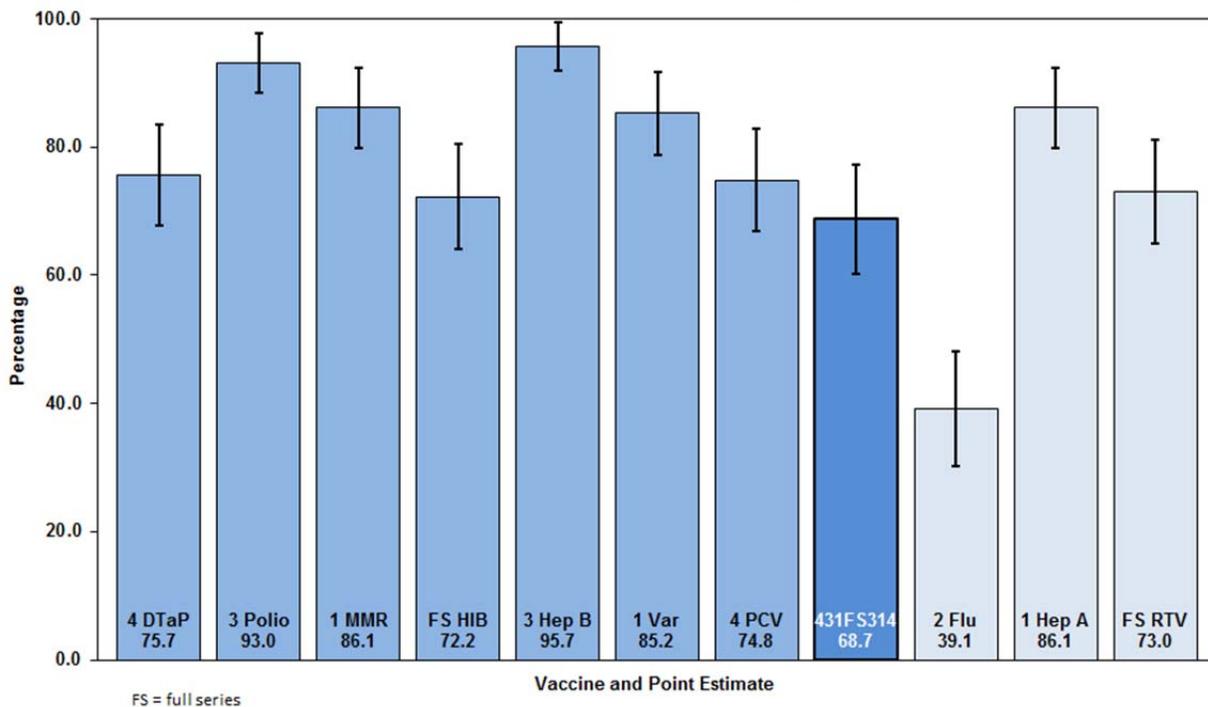
2016 Immunization Status Survey of 24-Month-Old Children in Tennessee:  
 Percentage of children complete in Shelby County (SBY) by vaccine  
 (point estimates and 95% confidence intervals, n=97)



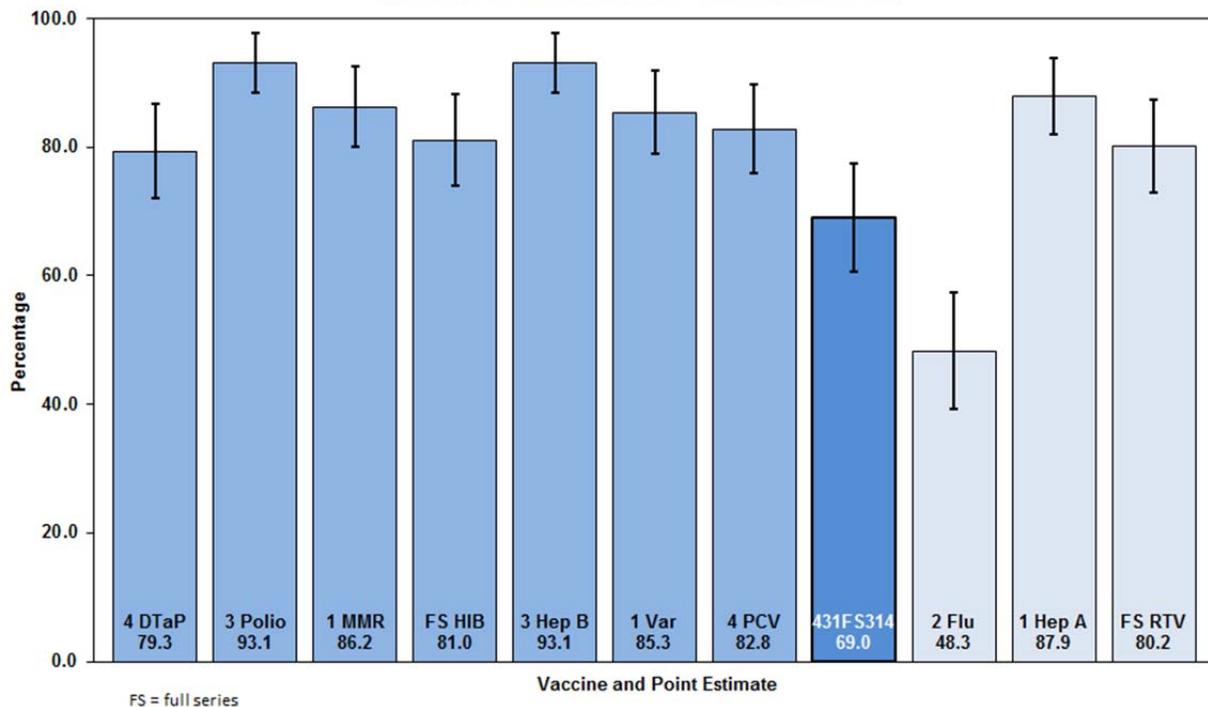
2016 Immunization Status Survey of 24-Month-Old Children in Tennessee:  
 Percentage of children complete in West Tennessee Region (WTR) by vaccine  
 (point estimates and 95% confidence intervals, n=114)



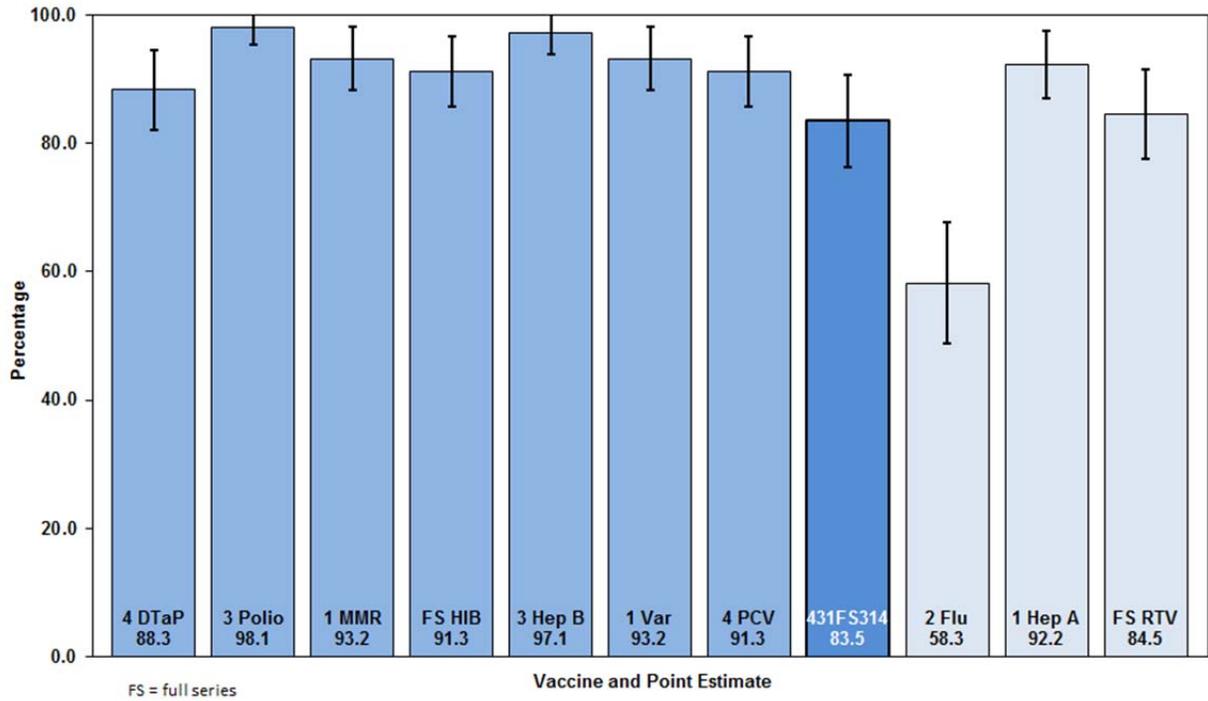
**2016 Immunization Status Survey of 24-Month-Old Children in Tennessee:  
Percentage of children complete in Jackson-Madison Region (JMR) by vaccine  
(point estimates and 95% confidence intervals, n=115)**



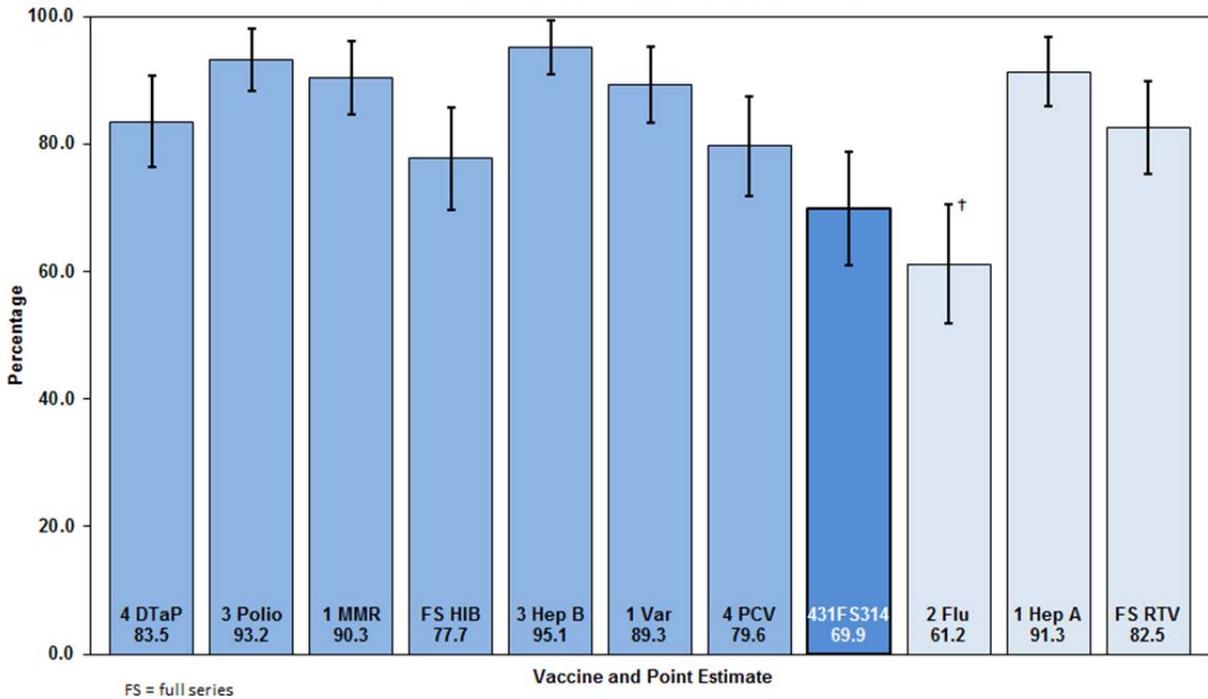
**2016 Immunization Status Survey of 24-Month-Old Children in Tennessee:  
Percentage of children complete in South Central Region (SCR) by vaccine  
(point estimates and 95% confidence intervals, n=116)**



2016 Immunization Status Survey of 24-Month-Old Children in Tennessee:  
 Percentage of children complete in Mid-Cumberland Region (MCR) by vaccine  
 (point estimates and 95% confidence intervals, n=103)

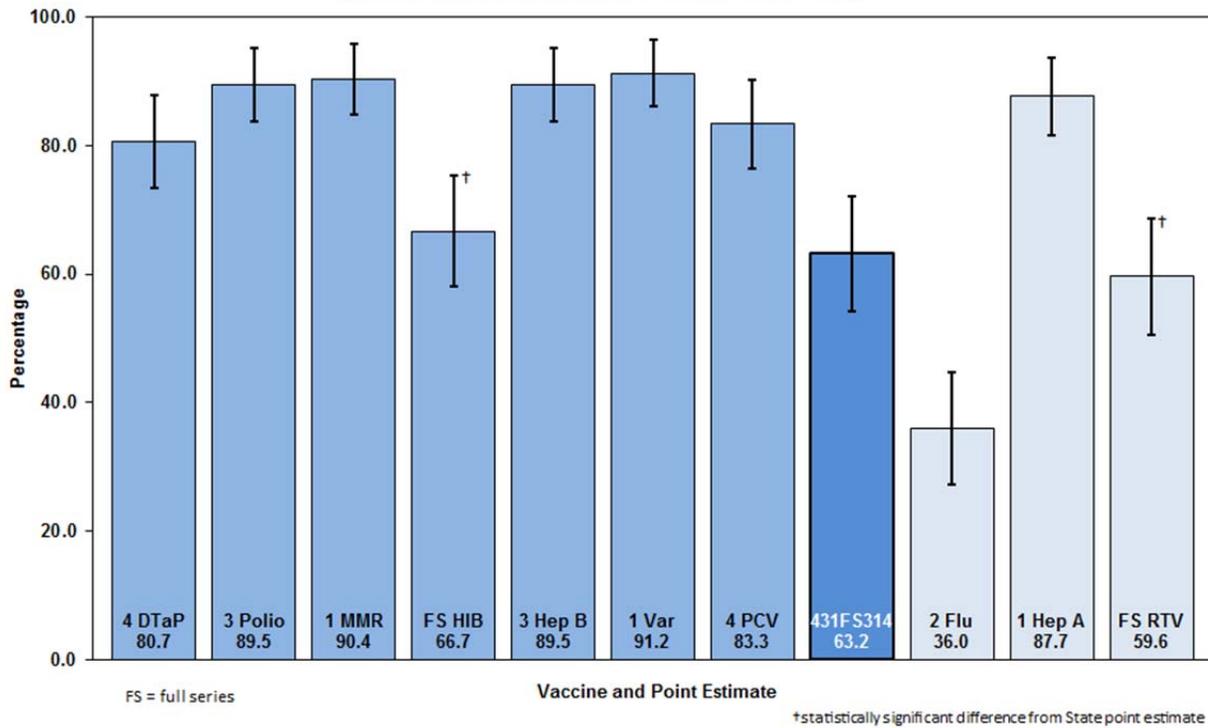


2016 Immunization Status Survey of 24-Month-Old Children in Tennessee:  
 Percentage of children complete in Nashville-Davidson Region (NDR) by vaccine  
 (point estimates and 95% confidence intervals, n=103)

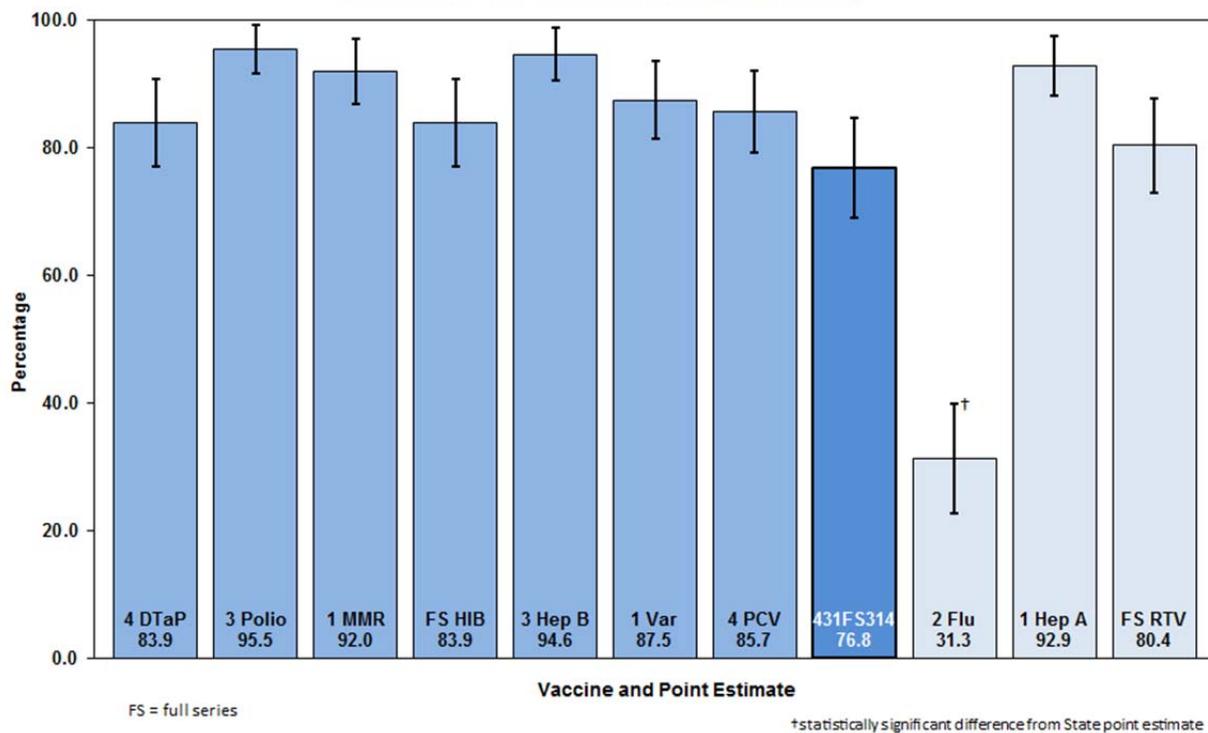


†statistically significant difference from State point estimate

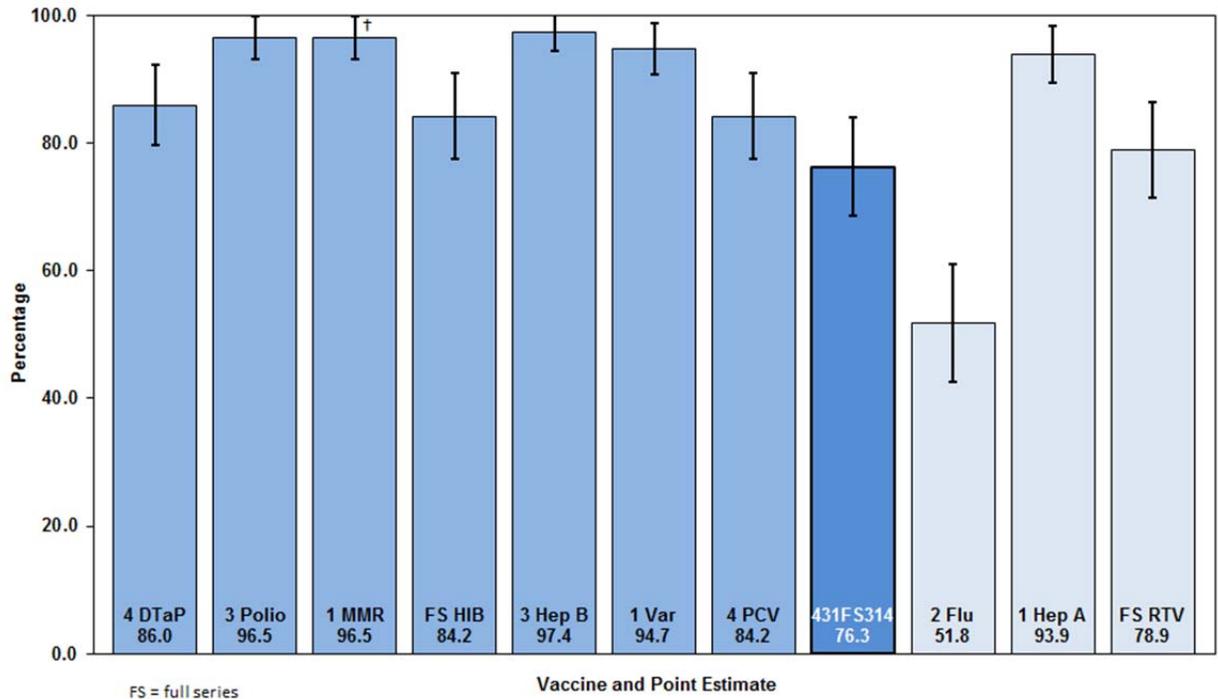
**2016 Immunization Status Survey of 24-Month-Old Children in Tennessee:  
Percentage of children complete in Upper Cumberland Region (UCR) by vaccine  
(point estimates and 95% confidence intervals, n=114)**



**2016 Immunization Status Survey of 24-Month-Old Children in Tennessee:  
Percentage of children complete in Southeast Region (SER) by vaccine  
(point estimates and 95% confidence intervals, n=112)**



**2016 Immunization Status Survey of 24-Month-Old Children in Tennessee:  
Percentage of children complete in Hamilton County (HAM) by vaccine  
(point estimates and 95% confidence intervals, n=114)**

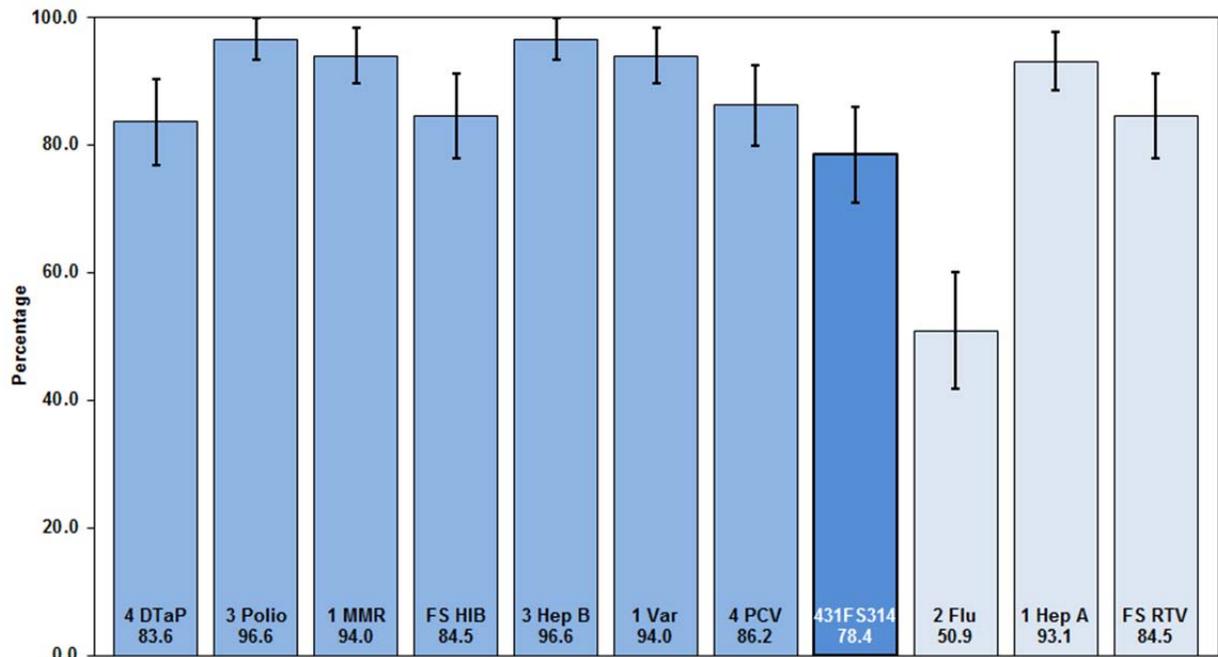


FS = full series

Vaccine and Point Estimate

<sup>†</sup>statistically significant difference from State point estimate

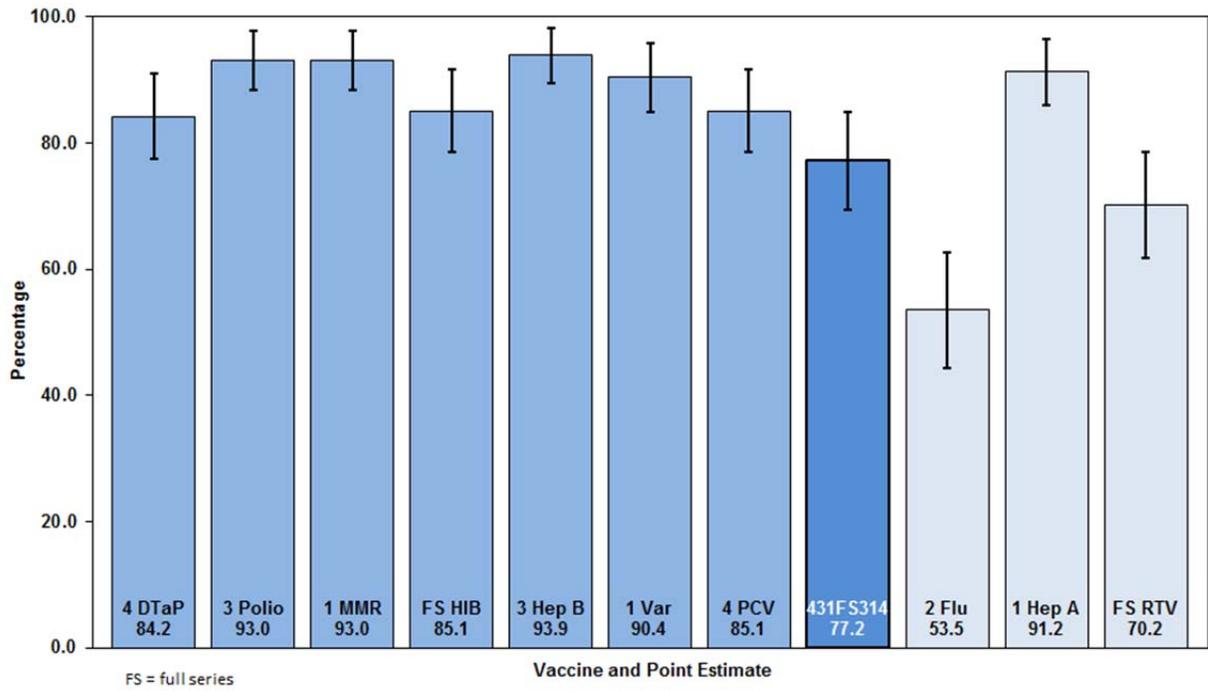
**2015 Immunization Status Survey of 24-Month-Old Children in Tennessee:  
Percentage of children complete in East Tennessee Region (ETR) by vaccine  
(point estimates and 95% confidence intervals, n=116)**



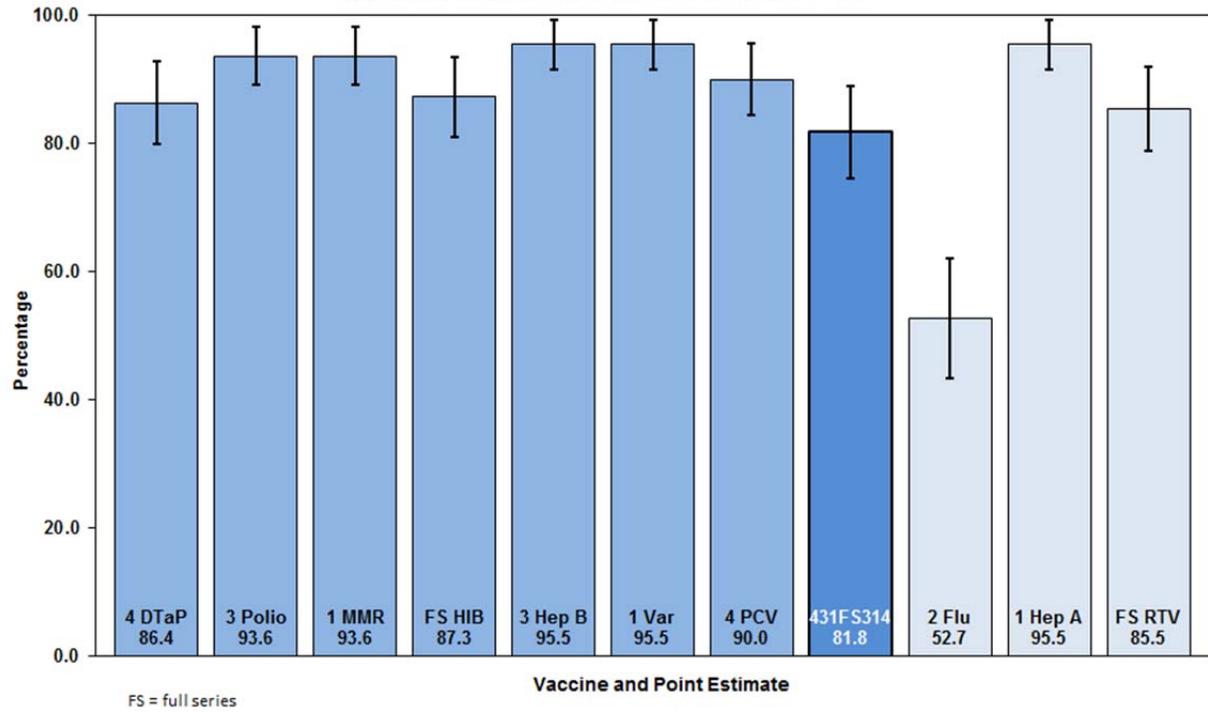
FS = full series

Vaccine and Point Estimate

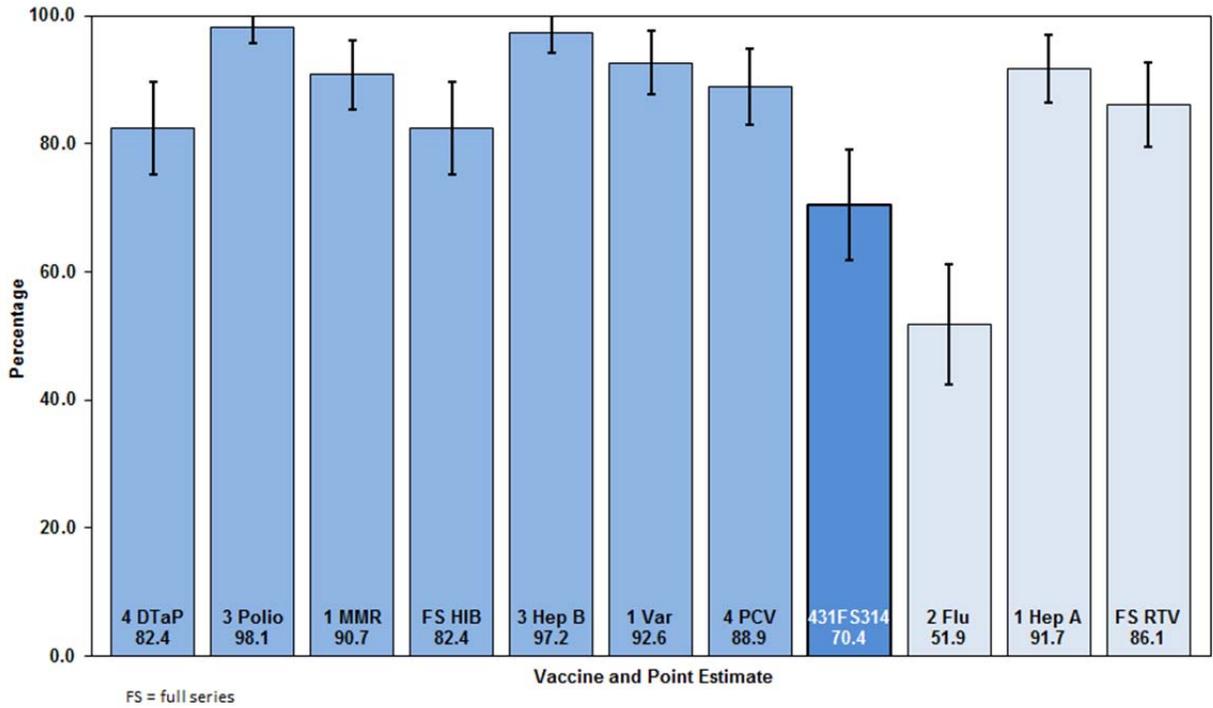
**2016 Immunization Status Survey of 24-Month-Old Children in Tennessee:  
 Percentage of children complete in Knoxville-Knox Region (KKR) by vaccine  
 (point estimates and 95% confidence intervals, n=114)**



**2016 Immunization Status Survey of 24-Month-Old Children in Tennessee:  
 Percentage of children complete in Northeast Region (NER) by vaccine  
 (point estimates and 95% confidence intervals, n=110)**



2016 Immunization Status Survey of 24-Month-Old Children in Tennessee:  
 Percentage of children complete in Sullivan County (SUL) by vaccine  
 (point estimates and 95% confidence intervals, n=108)



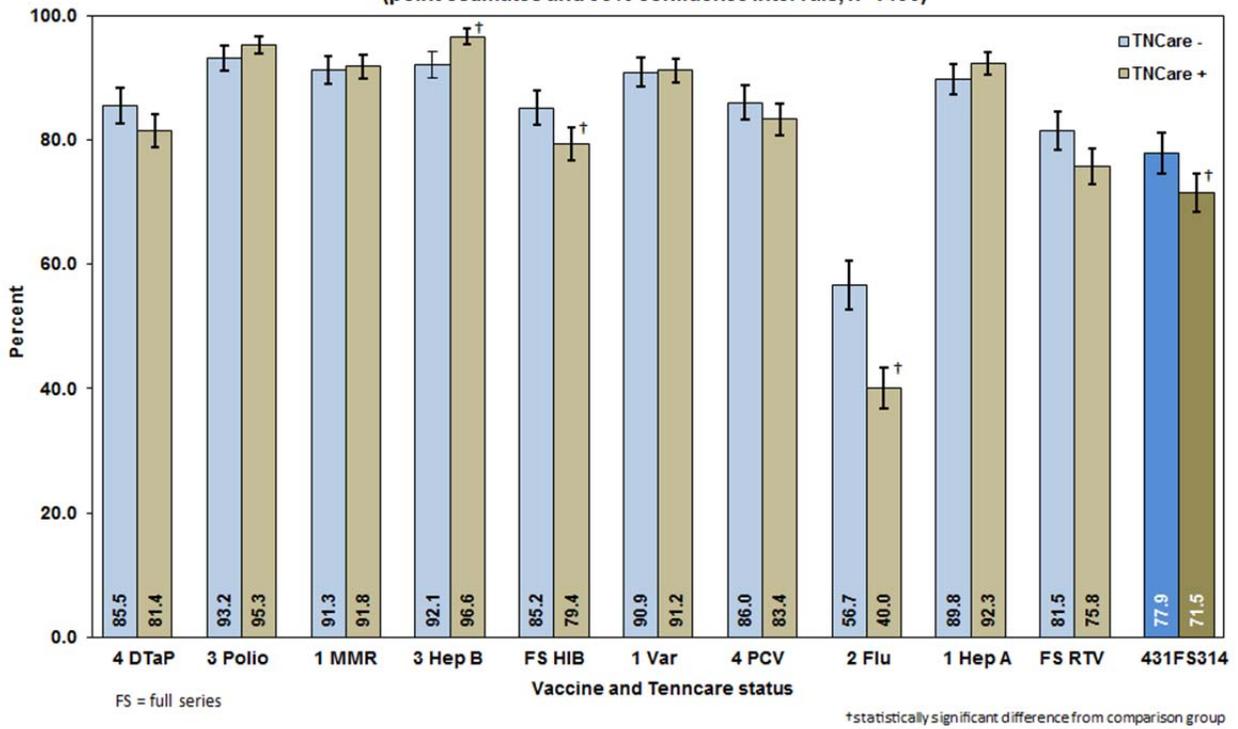
# Appendix 4

## 2016 Immunization Status Survey of 24 Month Old Children in Tennessee

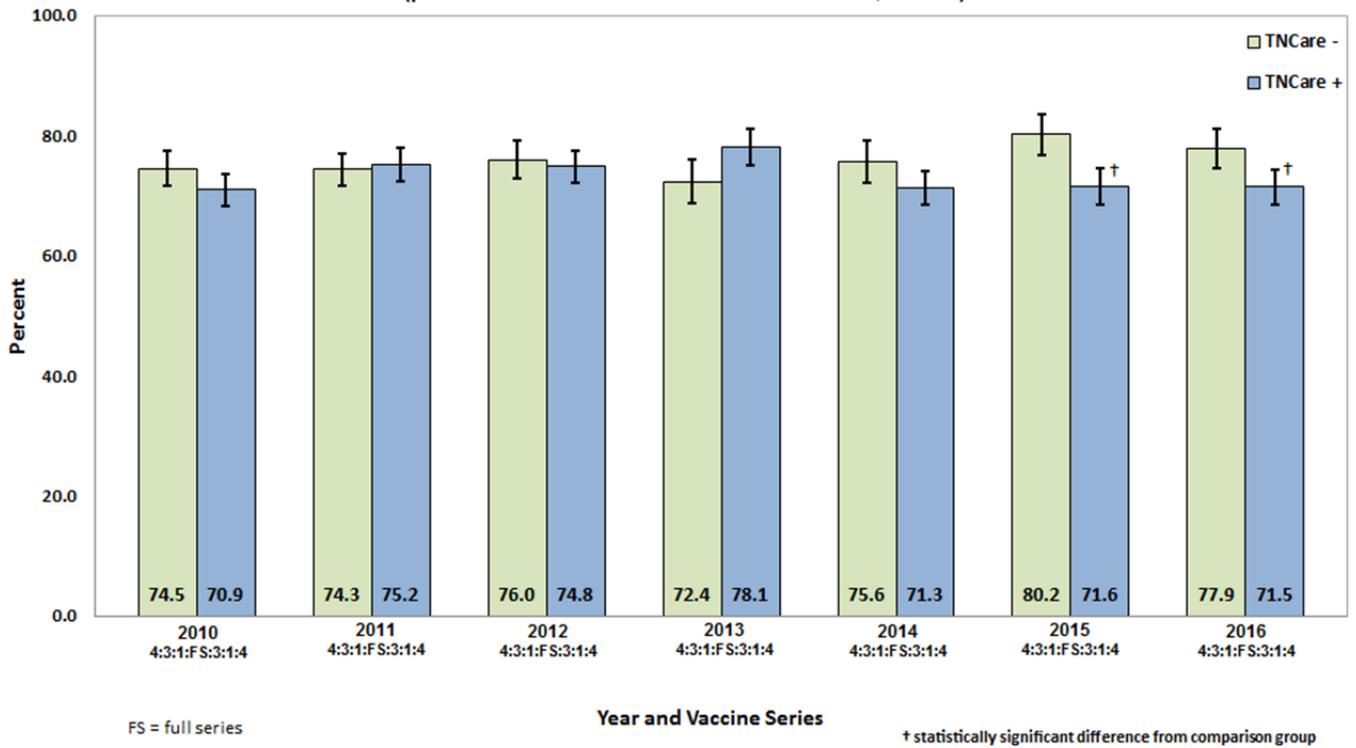
### Additional Statewide Charts for Specific Groups

	Page
Immunization levels by vaccine and TennCare enrollment status	... 42
On-time 4:3:1:FS:3:1:4 completion by TennCare enrollment status, 2010-2016	... 42
Immunization levels by vaccine and WIC enrollment status	... 43
On-time 4:3:1:FS:3:1:4 completion by WIC enrollment status, 2010-2016	... 43
Trends in on-time immunization coverage disparities (Black vs. White, 2010-2016)	... 44

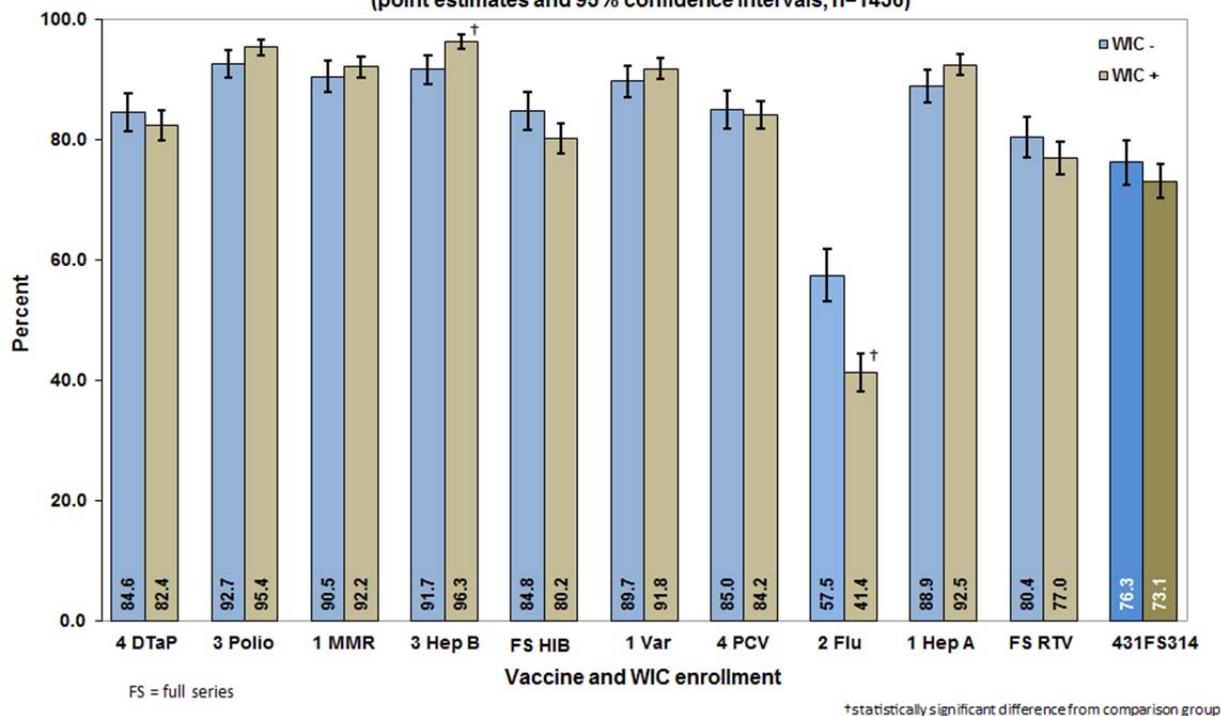
**2016 Immunization Status of 24-Month-Old Children in Tennessee:**  
**Statewide percentage of children with age-appropriate immunization levels**  
**by vaccine and TennCare enrollment status**  
 (point estimates and 95% confidence intervals, n=1436)



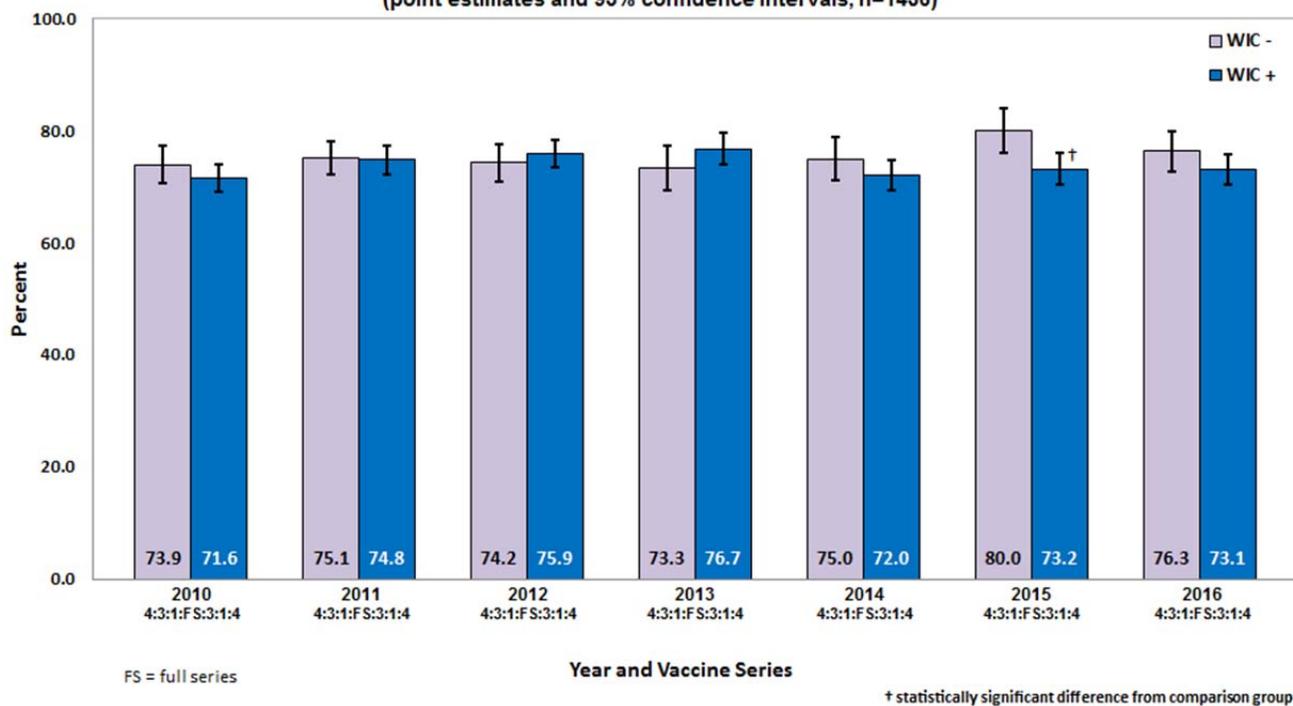
**2016 Immunization Status of 24-Month-Old Children in Tennessee:**  
**On-time 4:3:1:FS:3:1:4 completion by TennCare status, 2010-2016**  
 (point estimates and 95% confidence intervals, n=1436)



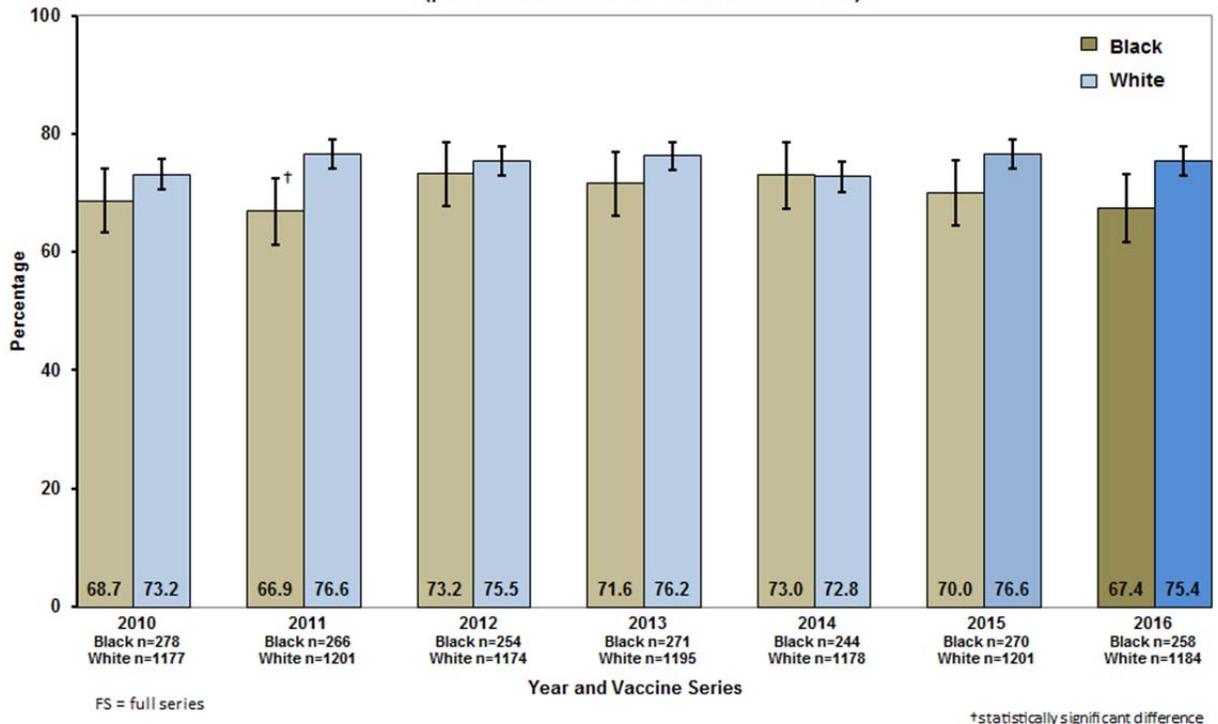
**2016 Immunization Status of 24-Month-Old Children in Tennessee:**  
**Statewide percentage of children with age-appropriate immunization levels**  
**by vaccine and WIC enrollment status**  
 (point estimates and 95% confidence intervals, n=1436)



**2016 Immunization Status of 24-Month-Old Children in Tennessee:**  
**On-time immunization coverage by WIC status, 2010-2016**  
 (point estimates and 95% confidence intervals, n=1436)



**2016 Immunization Status of 24-Month-Old Children in Tennessee:  
 Statewide percentage of children with age-appropriate 4:3:1:FS:3:1:4 immunization levels  
 by race  
 (point estimates and 95% confidence intervals)**



# Appendix 5

## 2016 Immunization Status Survey of 24 Month Old Children in Tennessee

### Data Tables for Selected Analyses

	Page
Series Complete (4:3:1:FS:3:1:4)	... 46
Series Complete (4:3:1:FS:3:1:4) by Provider Type	... 46
Series Complete (4:3:1:FS:3:1:4) by Race	... 47
Series Complete (4:3:1:FS:3:1:4) by Number of Older Siblings	... 47
Series Complete (4:3:1:FS:3:1:4) by TennCare Enrollment	... 48

### Series Complete (4:3:1:FS:3:1:4)

Region	Yes		No		Total
	n=	%	n=	%	n=
Northeast TN	90	81.8%	20	18.2%	110
East TN	91	78.4%	25	21.6%	116
Southeast TN	86	76.8%	26	23.2%	112
Upper Cumberland	72	63.2%	42	36.8%	114
Mid-Cumberland	86	83.5%	17	16.5%	103
South Central	80	69.0%	36	31.0%	116
West TN	93	81.6%	21	18.4%	114
Shelby County	66	68.0%	31	32.0%	97
Davidson County	72	69.9%	31	30.1%	103
Knox County	88	77.2%	26	22.8%	114
Hamilton County	87	76.3%	27	23.7%	114
Madison County	79	68.7%	36	31.3%	115
Sullivan County	76	70.4%	32	29.6%	108
Total	1066	74.2%	370	25.8%	1436

### Series Complete (4:3:1:FS:3:1:4) by Provider Type

Region	Public			Private			Both		
	Yes	Total	%	Yes	Total	%	Yes	Total	%
Northeast TN	2	3	66.7%	77	89	86.5%	11	15	73.3%
East TN	2	4	50.0%	71	87	81.6%	17	23	73.9%
Southeast TN	8	10	80.0%	62	80	77.5%	16	20	80.0%
Upper Cumberland	6	9	66.7%	50	82	71.9%	16	21	76.2%
Mid-Cumberland	1	1	100.0%	75	88	85.4%	10	13	76.9%
South Central	2	5	40.0%	54	77	70.1%	24	30	80.0%
West TN	8	9	88.9%	53	59	89.8%	32	41	78.1%
Shelby County	2	5	40.0%	52	70	74.3%	7	12	58.3%
Davidson County	3	6	50.0%	56	80	70.0%	4	5	80.0%
Knox County	1	4	25.0%	76	91	83.5%	9	15	60.0%
Hamilton County	1	3	33.3%	74	94	82.5%	12	16	75.0%
Madison County	4	10	40.0%	56	73	76.7%	19	31	61.3%
Sullivan County	2	2	100.0%	62	85	72.9%	12	20	60.0%
Total	42	71	59.2%	818	1055	77.5%	189	262	72.1%

### Series Complete (4:3:1:FS:3:1:4) by Race

Region	White			Black			Other		
	Yes	Total	%	Yes	Total	%	Yes	Total	%
Northeast TN	86	106	81.1%	4	4	100.0%	0	0	-
East TN	89	113	78.8%	1	2	50.0%	1	1	100.0%
Southeast TN	82	106	77.4%	4	6	66.7%	0	0	-
Upper Cumberland	72	112	64.3%	0	1	0.0%	0	1	0.0%
Mid-Cumberland	75	89	84.3%	8	11	72.7%	3	3	100.0%
South Central	73	107	68.2%	5	7	71.4%	2	2	100.0%
West TN	80	100	80.0%	13	14	92.9%	0	0	-
Shelby County	28	37	75.7%	36	57	63.2%	2	3	66.7%
Davidson County	52	71	73.2%	19	29	65.5%	1	3	33.3%
Knox County	75	95	79.0%	10	15	66.7%	3	4	75.0%
Hamilton County	62	83	74.7%	22	28	78.6%	3	3	100.0%
Madison County	44	59	74.6%	35	55	63.6%	0	1	0.0%
Sullivan County	75	106	70.8%	1	1	100.0%	0	1	0.0%
Total	893	1184	75.4%	158	230	68.7%	15	22	68.2%

### Series Complete (4:3:1:FS:3:1:4) by Number of Older Siblings

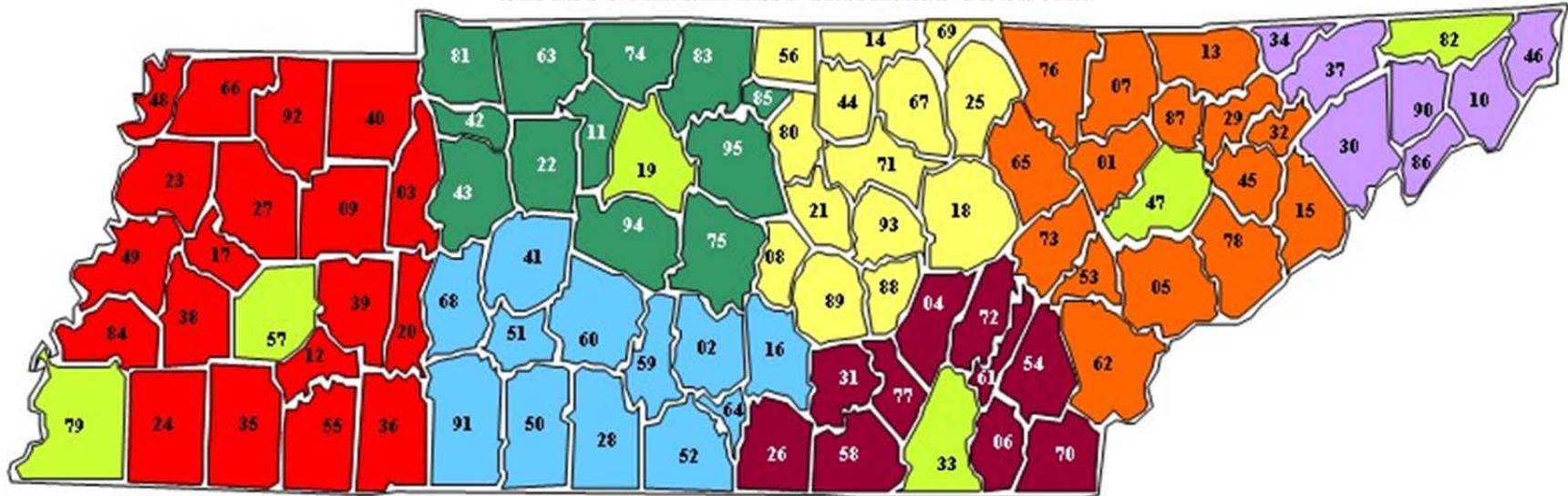
Region	0 Siblings			1 Siblings			2+ Siblings		
	Yes	Total	%	Yes	Total	%	Yes	Total	%
Northeast TN	49	54	90.7%	24	34	70.6%	17	22	77.3%
East TN	49	61	80.3%	22	27	81.5%	19	26	73.1%
Southeast TN	40	45	88.9%	28	39	71.8%	18	28	64.3%
Upper Cumberland	24	36	66.7%	32	47	68.1%	16	31	51.6%
Mid-Cumberland	33	41	80.5%	32	36	88.9%	21	26	80.8%
South Central	36	43	83.7%	27	39	69.2%	17	34	50.0%
West TN	36	42	85.7%	33	38	86.8%	24	34	70.6%
Shelby County	30	40	75.0%	19	28	67.9%	17	28	58.6%
Davidson County	31	42	73.8%	27	40	67.5%	14	21	66.7%
Knox County	35	43	81.4%	30	36	83.3%	23	35	65.7%
Hamilton County	35	38	92.1%	29	45	64.4%	23	31	74.2%
Madison County	36	48	75.0%	26	34	76.5%	17	33	51.5%
Sullivan County	32	42	76.2%	21	35	60.0%	23	31	74.2%
Total	466	575	81.0%	350	478	73.2%	249	381	65.6%

## Series Complete (4:3:1:FS:3:1:4) by TennCare Enrollment

Region	Enrolled			Not Enrolled		
	Yes	Total	%	Yes	Total	%
Northeast TN	59	72	81.9%	31	38	81.6%
East TN	64	81	79.0%	27	35	77.1%
Southeast TN	46	59	78.0%	40	53	75.5%
Upper Cumberland	45	63	71.4%	27	51	52.9%
Mid-Cumberland	46	58	79.3%	40	45	88.9%
South Central	41	60	68.3%	39	56	69.6%
West TN	61	74	82.4%	32	40	80.0%
Shelby County	40	61	65.6%	26	36	72.2%
Davidson County	30	49	61.2%	42	54	77.8%
Knox County	32	49	65.3%	56	65	86.2%
Hamilton County	43	63	68.3%	44	51	86.3%
Madison County	45	74	60.8%	34	41	82.9%
Sullivan County	41	66	62.1%	35	42	83.3%
Total	593	829	71.5%	473	607	77.9%

## Appendix 6

### TENNESSEE DEPARTMENT OF HEALTH REGIONAL/METRO HEALTH OFFICES



West		Mid Cumberland		South Central		Southeast		Upper Cumberland		East		North East	
#	County	#	County	#	County	#	County	#	County	#	County	#	County
03	Benton	11	Cheatham	02	Bedford	04	Bledsoe	08	Cannon	01	Anderson	10	Carter
09	Carroll	22	Dickson	16	Coffee	06	Bradley	14	Clay	05	Blount	30	Greene
12	Chester	42	Houston	28	Giles	26	Franklin	18	Cumberland	07	Campbell	34	Hancock
17	Crockett	43	Humphreys	41	Hickman	31	Grundy	21	DeKalb	13	Claiborne	37	Hawkins
20	Decatur	63	Montgomery	50	Lawrence	54	McMinn	25	Fentress	15	Cocke	46	Johnson
23	Dyer	74	Robertson	51	Lewis	58	Marion	44	Jackson	29	Grainger	86	Unicoi
24	Fayette	75	Rutherford	52	Lincoln	61	Meigs	56	Macon	32	Hamblen	90	Washington
27	Gibson	81	Stewart	59	Marshall	70	Polk	67	Overton	45	Jefferson		
35	Hardeman	83	Sumner	60	Maury	72	Rhea	69	Pickett	53	Loudon		
36	Hardin	85	Trousdale	64	Moore	77	Sequatchie	71	Putnam	62	Monroe		METROS
38	Haywood	94	Williamson	68	Perry			80	Smith	65	Morgan	#	County
39	Henderson	95	Wilson	91	Wayne			88	Van Buren	73	Roane	19	Davidson
40	Henry							89	Warren	76	Scott	33	Hamilton
48	Lake							93	White	78	Sevier	47	Knox
49	Lauderdale									87	Union	57	Madison
55	McNairy											79	Shelby
66	Obion											82	Sullivan
84	Tipton												
92	Weakley												