



Department of  
**Health**



# **RESULTS OF THE 2017 IMMUNIZATION STATUS SURVEY OF 24 MONTH OLD CHILDREN IN TENNESSEE**

Tennessee Department of Health | Tennessee Immunization Program | December 2017  
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# 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 1,594 children was selected from birth certificates of children born in the first three months of 2015 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 101 children for the above reasons, 1,493 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) 2017 results alongside national Health People (HP) 2020 objectives for this age group:

Diseases	Healthy People 2020 Objective (19-35 months)	TN 2017 (24 months)
Diphtheria, Tetanus, Pertussis	90%	81.2%
Poliomyelitis	90%	93.0%
Measles, Mumps, Rubella	90%	90.5%
Hepatitis B	90%	93.8%
Hepatitis B, birth dose	85%	84.2%
<i>Haemophilus influenzae</i> , type B	90%	79.8%
Varicella (Chickenpox)	90%	90.7%
Pneumococcus	90%	82.7%
All of above	80%	73.5%
Hepatitis A	60% 2-dose	1 dose: 89.9%
Rotavirus	80%	77.3%
Influenza	70%	2 doses: 45.9% 3 doses: 25.6%

\*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:**

Racial disparities: Significant racial disparities were detected in this survey in three different individual vaccines, DTaP, PCV and influenza:

- Black children’s completion rates for the 4-dose series of DTaP and PCV were significantly lower than those in white children and contributed to a statistically significant disparity in 4:3:1:FS:3:1:4 completion between these groups: in 2017, 64.8% of black children were 4:3:1:FS:3:1:4 complete vs. 75.1% of white children.
- Since it was first measured in 2007, a large disparity in influenza vaccination rates between black and white children has been measured in this survey. In 2017, 28.1% of black children had received at least 2 doses of influenza vaccine by age two vs, 49.7% of white children.

Vaccine refusal: Of the 1,493 children, parents of 37 with no immunizations (2.5%) stated that they did not vaccinate their children for religious (n =14), philosophical (n = 21), or medical (n = 2) reasons.

Another 15 children had received one or more dose of vaccine had parents who cited a religious (n=4), philosophical (n=10), or medical (n=1) reason for discontinuing their immunizations. These parents who intentionally did not immunize or incompletely immunized their children represented 3.5% (52 of 1,493) of those surveyed, up from 1.6% of children in the 2016 survey.

No immunization records: Nine more children did not have any immunizations in the Tennessee immunization information system and could not be located. Including the 37 children whose parents claimed a religious, philosophical or medical reason for not vaccinating their child, this brings the percentage of children with no recorded vaccinations to 3.1%.

TennCare: The 2017 survey continues the trend since 2015 that 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 and were less likely to be completely vaccinated with DTaP, Hib, rotavirus and influenza vaccines.

Birth Hepatitis B dose: Tennessee moved up to 84.2% of infants receiving a birth dose of hepatitis B in the 2017 survey from 81.1% in the 2016 survey, close to the HP2020 target of 85%.

### **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 hospitals, clinics and pharmacies, and includes a suite of tools that can help improve immunization rates in children and adults.
- New 2017 standards require clinics participating in the federal Vaccines for Children (VFC) Program to report all immunizations administered to children under 19 years to TennIIS, enabling them to use the features designed to improve patient immunization services, such as vaccine forecasting and practice-based patient reminders and immunization coverage rate reports.
- Reporting all immunizations to an IIS improves healthcare by establishing a permanent immunization record available to all of a patient’s healthcare providers. Any authorized user can access the TennIIS web portal; in addition, TennIIS is linked to the electronic health record (EHR) systems of hundreds of medical facilities and pharmacies statewide, with seamless electronic immunization reporting from those systems.
- 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 2017 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 2015 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:

Disease(s)	Possible complications of disease	Vaccination	# of doses*
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 2017 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.

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 24-month-old 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 24<sup>th</sup> months of age 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 2017 sample population:***

The 2017 statewide sample consisted of 1,594 children born in the first three months of 2015. 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 2015 in that region. Twenty-one (21) additional black children were randomly selected for inclusion in the racial disparity analysis.

Of the 1,594 sampled births, 101 records were excluded from the final analysis: one child had died; parents of 18 refused to participate; 77 had moved out of state; and 5 had been adopted, put in foster care or were in state custody. Four of the 21 records of oversampled black children were excluded (2 had moved out of state and 2 refused participation).

The analyzed sample contained 1,493 children (1,476 + 17 oversampled records = 1,493 total records). Appendix 1 contains a table of the 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 1,493 children included in the survey, 34 had incomplete information in the Tennessee Immunization Information System (TennIIS), but could not be located or confirmed as having moved out of state. Thirty of 34 had demographic data but no immunizations recorded in TennIIS; four had at least one immunization was available in TennIIS. By protocol, any available immunization records for these children are included in the analysis.

When considering racial disparities, it is notable that 14 or 267 (5.2%) of black children were unable to be located, compared to 20 of 1199 (1.7%) of white children. Two-thirds (23/34) of those unable to be located were in Shelby and Madison counties, accounting for about 10% of each county's sample. See Appendix 1 for the regions of residence of these children.

TDH uses Accurant, 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 1,493 children, parents of 37 with no immunizations (2.5%) stated that they did not vaccinate their children for religious (n =14), philosophical (n = 21), or medical (n = 2) reasons. Parents of 5 additional children who had received at least one immunization reported refusing additional immunizations for philosophical (n = 2) or religious (n = 3) reasons. These parents represented 2.8% (42 of 1,493) of those surveyed.

Vaccine refusal ranged from zero to 8.3% 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 intervals as defined by CDC.

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

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

In this survey, a birth dose of hepatitis B vaccine is defined as a dose given within the first three days of life. In 2016, the CDC revised its guidance to recommend routine administration of a hepatitis B birth dose to each newborn within 24 hours of life (rather than prior to discharge). Birth dose hepatitis B is a key strategy to eliminate transmission of the hepatitis B virus. Survey results are shown in Figures 5a and 5b.

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

Children born in the first quarter of 2015 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, including 3-dose coverage, are provided in Appendix 2.

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

Two 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 1420 children who received any HIB doses, 935 required 4 doses (733 were complete); 485 received the 3-dose product alone or in combination with unknown doses (445 were complete). This classification by different HIB products administered reduces 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 2017, 897 received at least one dose of Rotateq<sup>®</sup> and would have required 3 doses to be considered completely immunized. Of the 451 that could have been complete after receiving two doses of RTV, 343 had received two doses of Rotarix<sup>®</sup>, 6 had received Rotarix<sup>®</sup> and a dose of an unknown brand, 66 had received 2 doses of unknown brand, and 36 were incompletely immunized by their second birthday with one dose of Rotarix<sup>®</sup> or an unknown brand. Charts specific to rotavirus are located in Appendix 2.

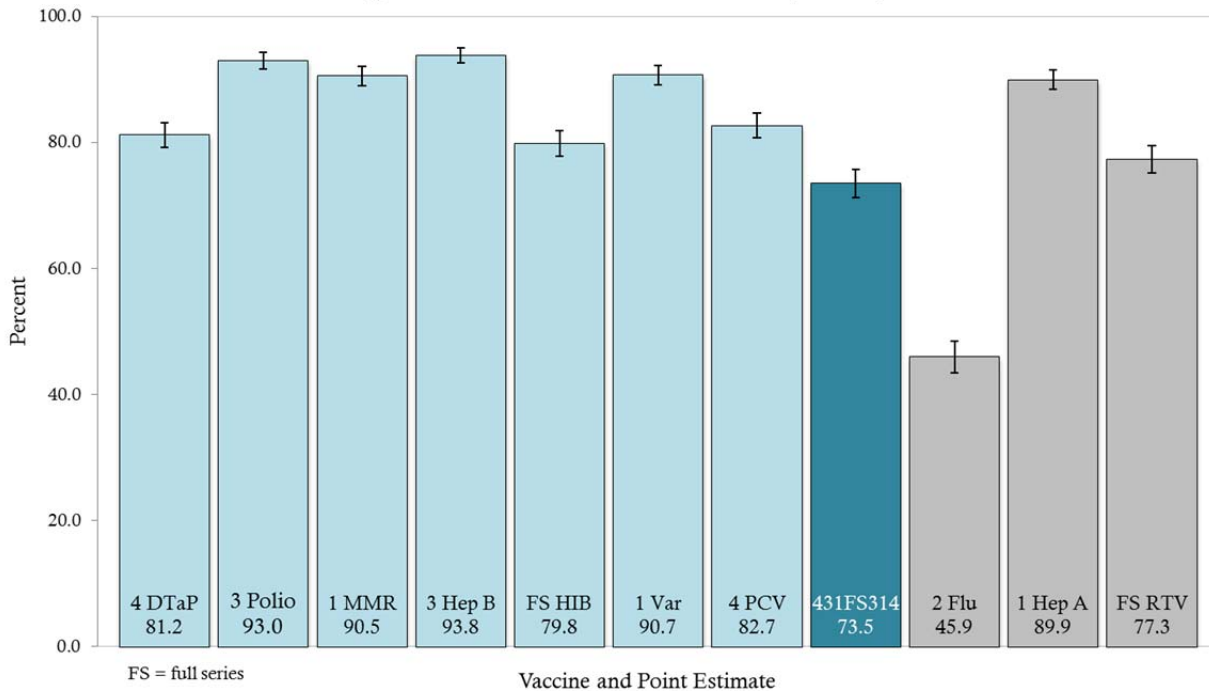
## Statewide Results and Trend Analysis:

### Vaccine specific on-time immunization coverage:

**Figure 1** shows the coverage estimates for each of the recommended vaccines measured by this survey. The HP2020 objective of 90% on time coverage was met for polio, MMR, Hep B and varicella, which are 4 of the 7 vaccines that comprise the 4:3:1:FS:3:1:4 series (pale blue columns). Coverage was significantly lower for all three vaccines that require a fourth or final dose after 12 months of age, specifically DTaP, PCV and Hib. The overall coverage estimate for the full, recommended 4:3:1:FS:3:1:4 series was 73.5% (95% CI, 71.3, 75.8).

**Figure 1**

**2017 Immunization Status of 24-Month-Old Children in Tennessee:  
Statewide percentage of children with age-appropriate immunization levels by vaccine**  
(point estimates and 95% confidence intervals, n=1476)



Additional details of DTaP and PCV completion are instructive (see Appendix 2):

- 93.7% of children had received 3 DTaP doses.
- 92.8% of children had received 3 doses of PCV.

Completion rates are higher for brand options that require fewer doses:

- 66% of surveyed children received Hib vaccine requiring four doses to be complete on time. Among children on the 4-dose Hib schedule, 78.4% (733 of 935) were complete on time vs. 91.8% (445 of 485) that completed a 3-dose schedule.
- RTV vaccines also require either 2 or 3 doses, depending on brand. Among children on a 3-dose schedule, 80.9% (726 of 897) were complete, vs. 92.0% (415 of 451) of children who required 2 doses.

For hepatitis A vaccine, 89.9% had received the first dose of vaccine by 24 months of age; although not on the graph, 58.1% had completed the 2-dose series (HP2020 objective: 60% complete by the 3<sup>rd</sup> birthday).

Influenza vaccine remains the least used recommended immunization. Just 45.9% of children had received at least 2 doses of influenza vaccine and, although not displayed, only 25.6% had received three doses. The HP2020 objective is for 70% of children to be appropriately immunized against influenza.

**Figure 2** compares the 2016 and 2017 statewide coverage rates by individual vaccine and show small decreases in each of the individual estimates though none were statistically-significant. As a result, the 0.7% decline in the overall on-time completion rate for the 4:3:1:FS:3:1:4 vaccine series represents no significant change from 2016.

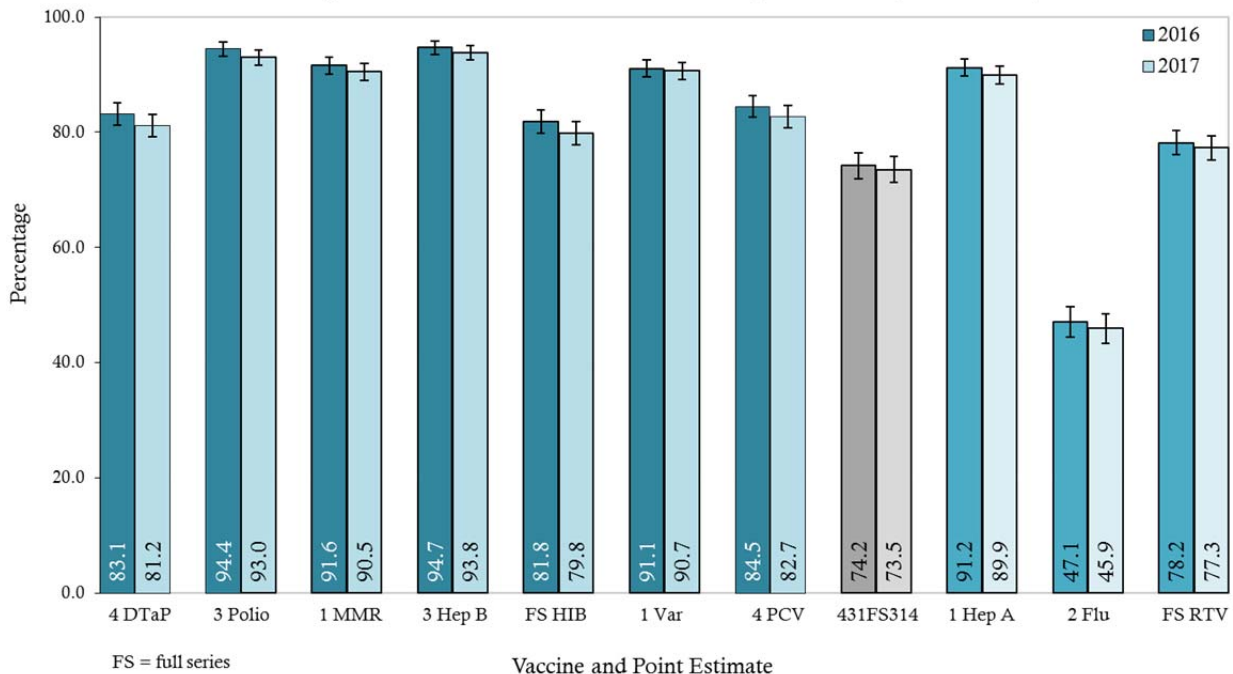
Contributing to the small differences is the fact that the percentage of children included in the survey whose parents refused some or all immunizations was higher in 2017 (3.5%) than in 2016 (1.6%). There was also a higher percentage of children who could not be located in 2017 (2.3%) vs. 2016 (1.6%). See Appendix 1.

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

**Figure 2**

**2017 Immunization Status of 24-Month-Old Children in Tennessee:  
Statewide percentage of children with age-appropriate immunization levels  
by vaccine in 2016 and 2017**

(point estimates and 95% confidence intervals, 2016 n=1436, 2017 n=1476)



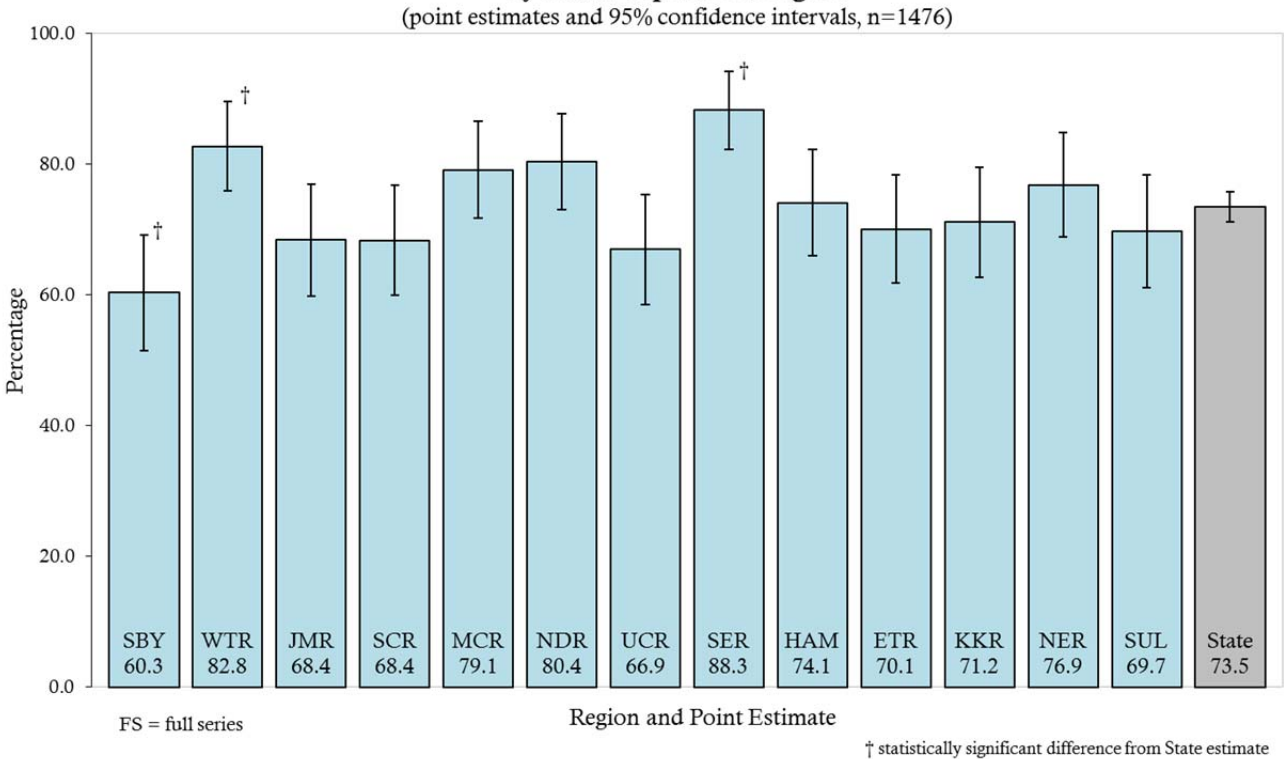
**Complete immunization levels statewide and by public health region:**

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 3**. Statewide complete coverage was 73.5% (95% CI, 71.3, 75.8). Memphis-Shelby County (SBY) was significantly lower than the state, while West Tennessee Region (WTR) and Southeast Region (SER) were significantly higher than the state and exceeded the HP2020 objective of 80%. Nashville-Davidson County (NDR) also met the 80% HP2020 objective.

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

**Figure 3**

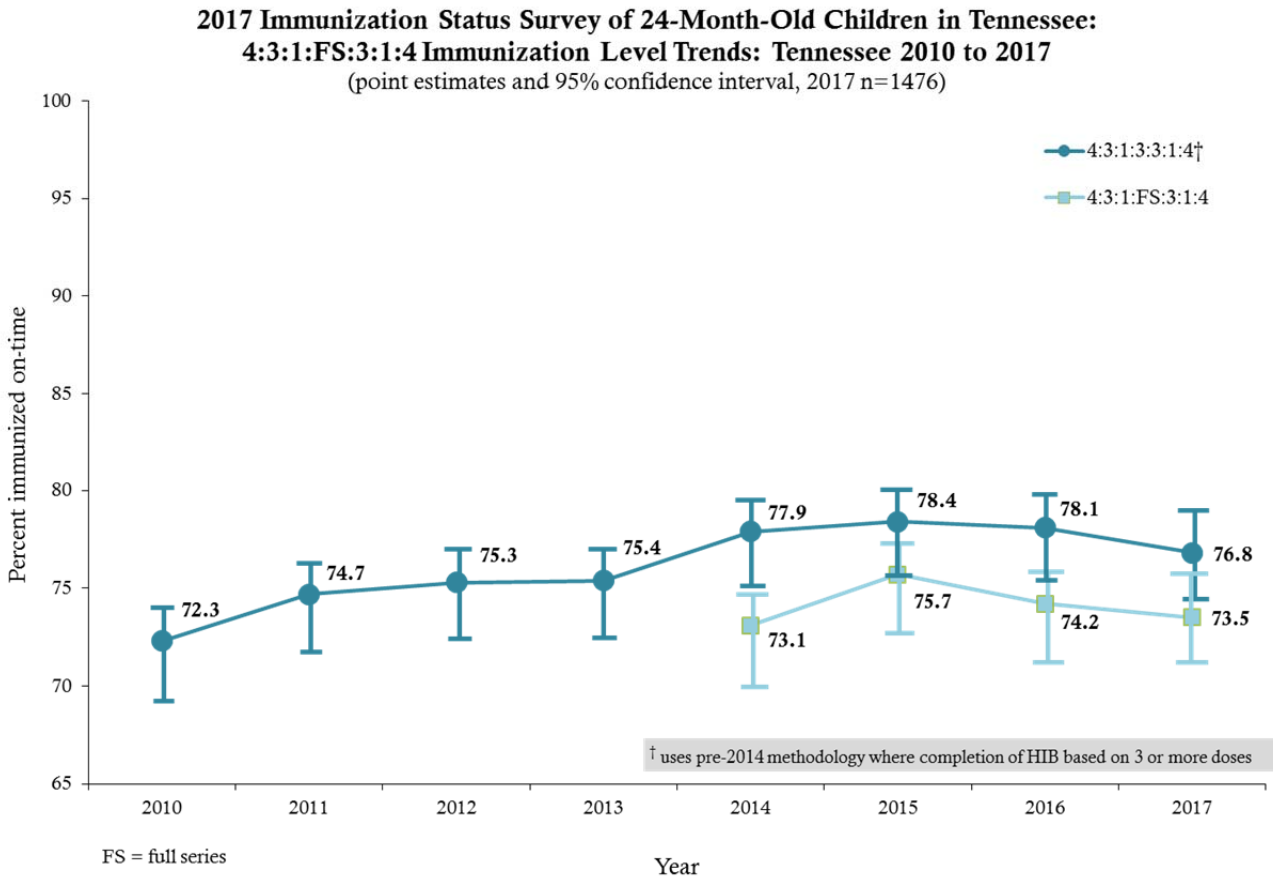
**2017 Immunization Status Survey of 24-Month-Old Children in Tennessee:  
Percentage of 24-month-old children with on-time immunization (4:3:1:FS:3:1:4)  
by health department region**



**Series completion trends over time:**

**Figure 4** below shows the 4:3:1:3:3:1:4 series completion rate from 2010 to 2017 and the 4:3:1:FS:3:1:4 series for 2014 to 2017. Both have fluctuated over time, but no significant changes have been observed.

**Figure 4**





**Hepatitis B vaccine birth dose:**

Exposure to hepatitis B virus at the time of birth or in early infancy results in chronic, life-long infection for most infants. The HP2020 objective is for 85% of infants to receive a birth dose of HBV, defined as a dose given by day 3 of life. In 2016, CDC began recommending administration of the birth dose within 24 hours of life, but that was not the recommendation at the time these children were born.

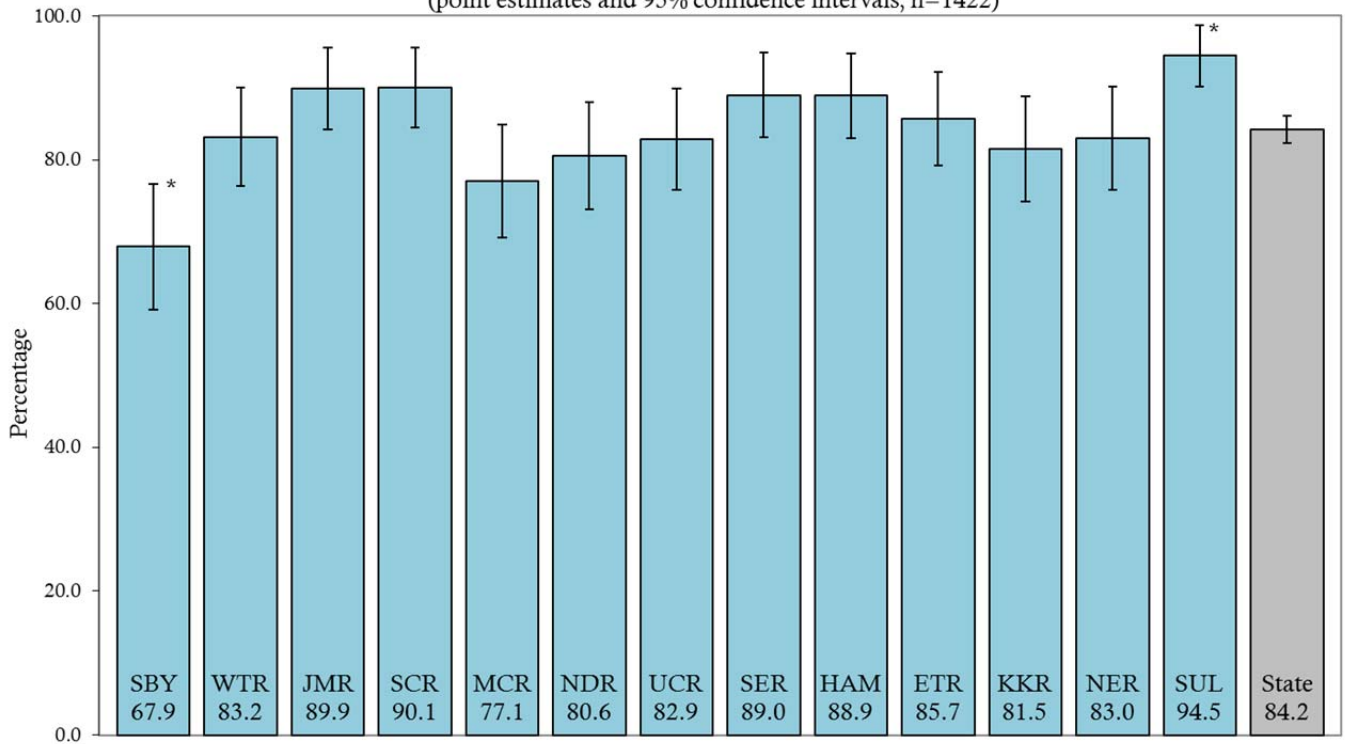
The percentage of children in each public health region who received a birth dose of HBV is shown below in **Figure 5a**. In 2017, 84.2% (95% CI: 82.3, 86.1) received a birth dose. This represents a 3.1 percentage point increase over 2016, though the change did not quite reach statistical significance (2016: 81.1%, 95% CI: 79.0, 83.1). In 2017, Sullivan County (SUL) exceeded the HP2020 objective and was significantly better than the statewide estimate. Five other regions (Jackson-Madison [JMR], South Central [SCR], Southeast [SER], Chattanooga-Hamilton [HAM], and East Tennessee [ETR]) exceeded the HP2020 objective. Memphis-Shelby County (SBY) was significantly lower than the 2017 statewide rate.

**Figure 5b** shows statistically insignificant but upward trends in most regions from 2016 to 2017. The best way to improve birth dose rates is strong enforcement of a written birth dose policy at all delivery hospitals and birthing centers.

**Figure 5a**

**2017 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=1422)

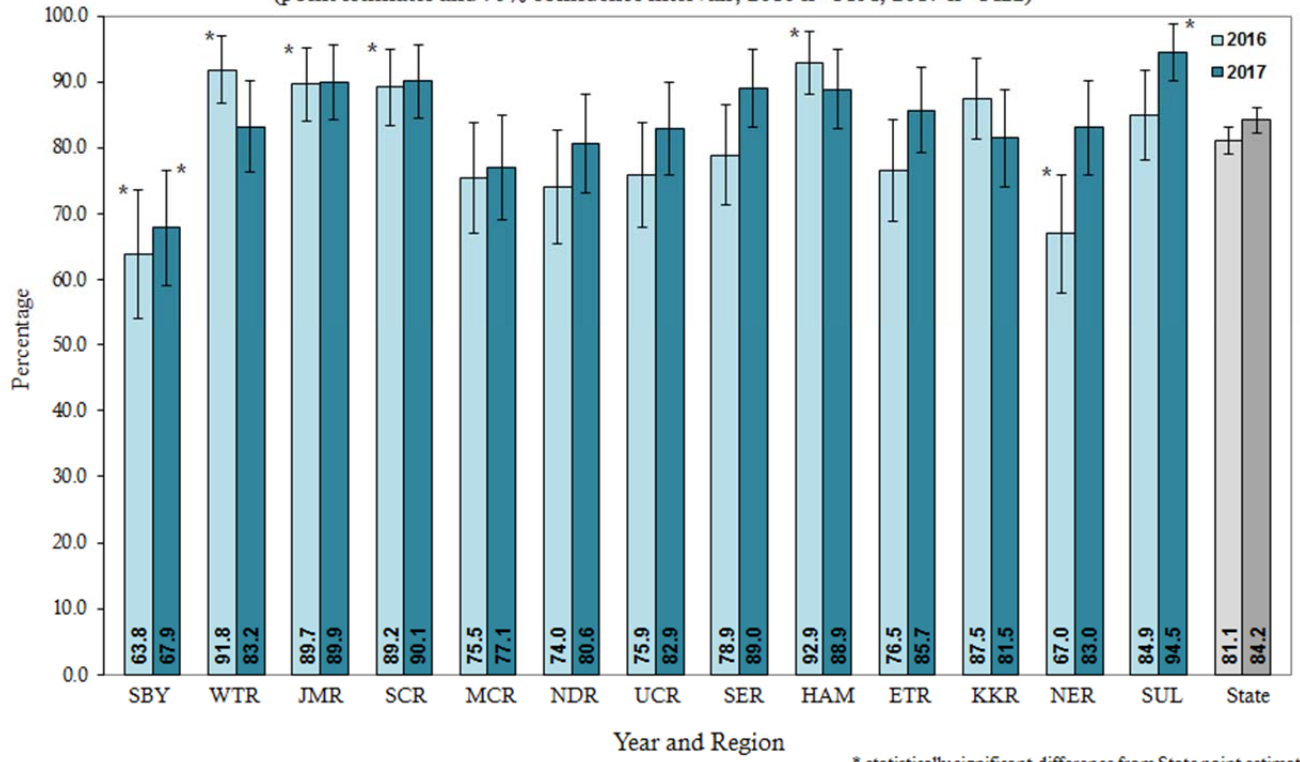


\*statistically significant difference from State point

**Figure 5b**

**2017 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 2016 and 2017**

(point estimates and 95% confidence intervals; 2016 n=1404, 2017 n=1422)



\* statistically significant difference from State point estimate

**Racial disparities:**

**Figure 6** shows the rates of on-time immunization of black and white children for each vaccine assessed. The 2017 survey included 267 black and 1,199 white children. Due to small numbers, children of other races (n=27) are excluded from this analysis. Among black children, 14 (5.2%) were included with records available in TennIS although they were unable to be located for additional records, compared to 1.7% (20) of white children; we evaluated the impact of this difference and found that exclusion of these children would not meaningfully narrow the coverage differences measured.

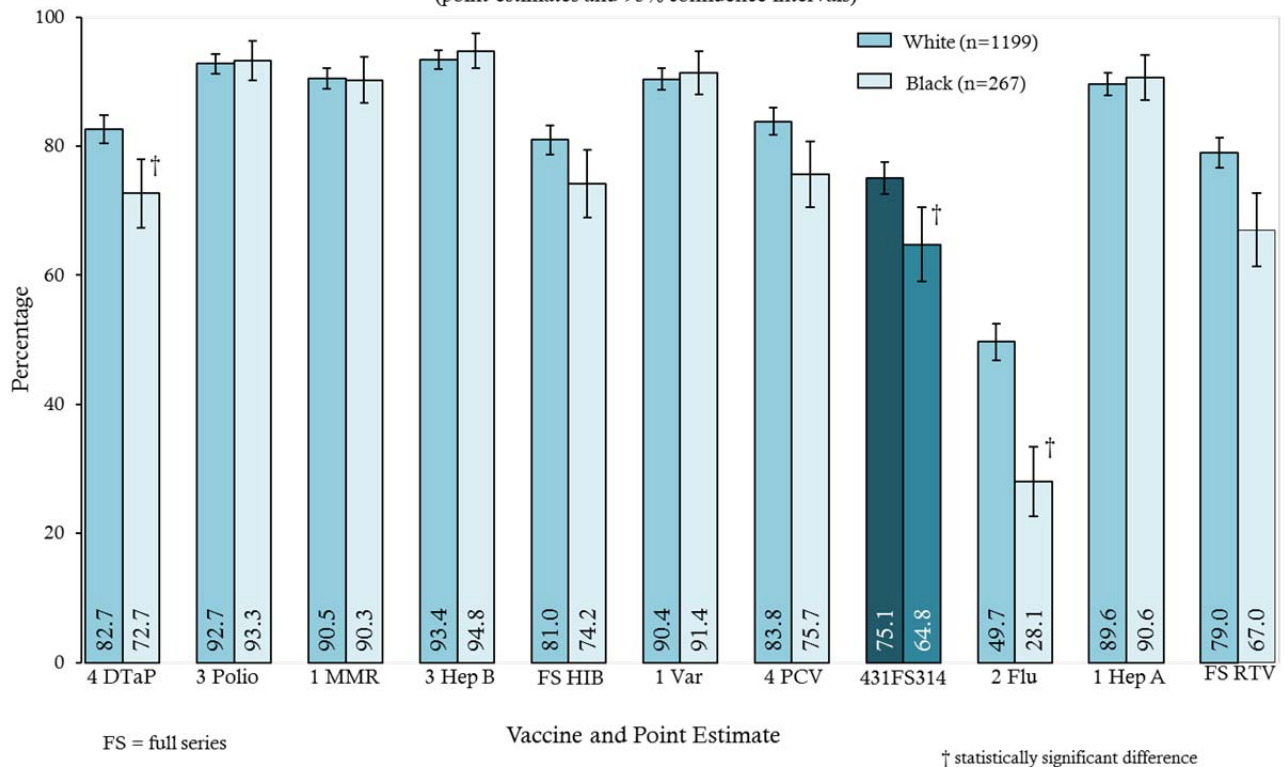
Black children were significantly less likely than white children to be fully immunized with the recommended 4:3:1:FS:3:1:4 vaccine series. Among black children, 64.8% (95%CI: 59.1, 70.5) were 4:3:1:FS:3:1:4 complete vs. 75.1% of white children (95% CI: 72.6, 77.5).

An examination of individual vaccines shows that the lower rates of completion of the 4-dose vaccines (DTaP and PCV) contributed to the racial disparity in the overall 4:3:1:FS:3:1:4 series. Black children were significantly less likely to be fully immunized on time with DTaP (72.7% black vs. 82.7% white) and PCV (75.7% black vs. 83.8% white). Appendix 4 contains an additional chart showing trends in on-time series completion by race from 2010-2017, show a gradual, increasing disparity over the last four survey years.

Influenza vaccine remains the individual vaccine with the most significant racial disparity. This difference has been documented annually since the first assessment of influenza coverage rates in this survey in 2007. In 2017, 28.1% of black children had received at least 2 doses of influenza vaccine vs. 49.7% of white children.

**Figure 6**

**2017 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 are consistently 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. Race is a less consistent predictor of risk, with the exception of influenza immunization.

The survey also 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. Children are counted under TennCare or WIC if they were ever enrolled in these programs. 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.

Vaccines administered at local public health department clinics are classified as “public” sources of vaccine in this survey; other vaccinators are considered “private”. Because so few children (n=67) received immunizations exclusively in a public health department or receive their first dose of vaccine older than 120 days (n=34), these coverage rate estimates are imprecise.

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, just 34 children received their first routine vaccination other than rotavirus or birth dose HBV after 120 days of age and only 11 caught up to complete the series. **Table 1** below summarizes the 2017 on-time completion rates in these groups.

**Table 1**

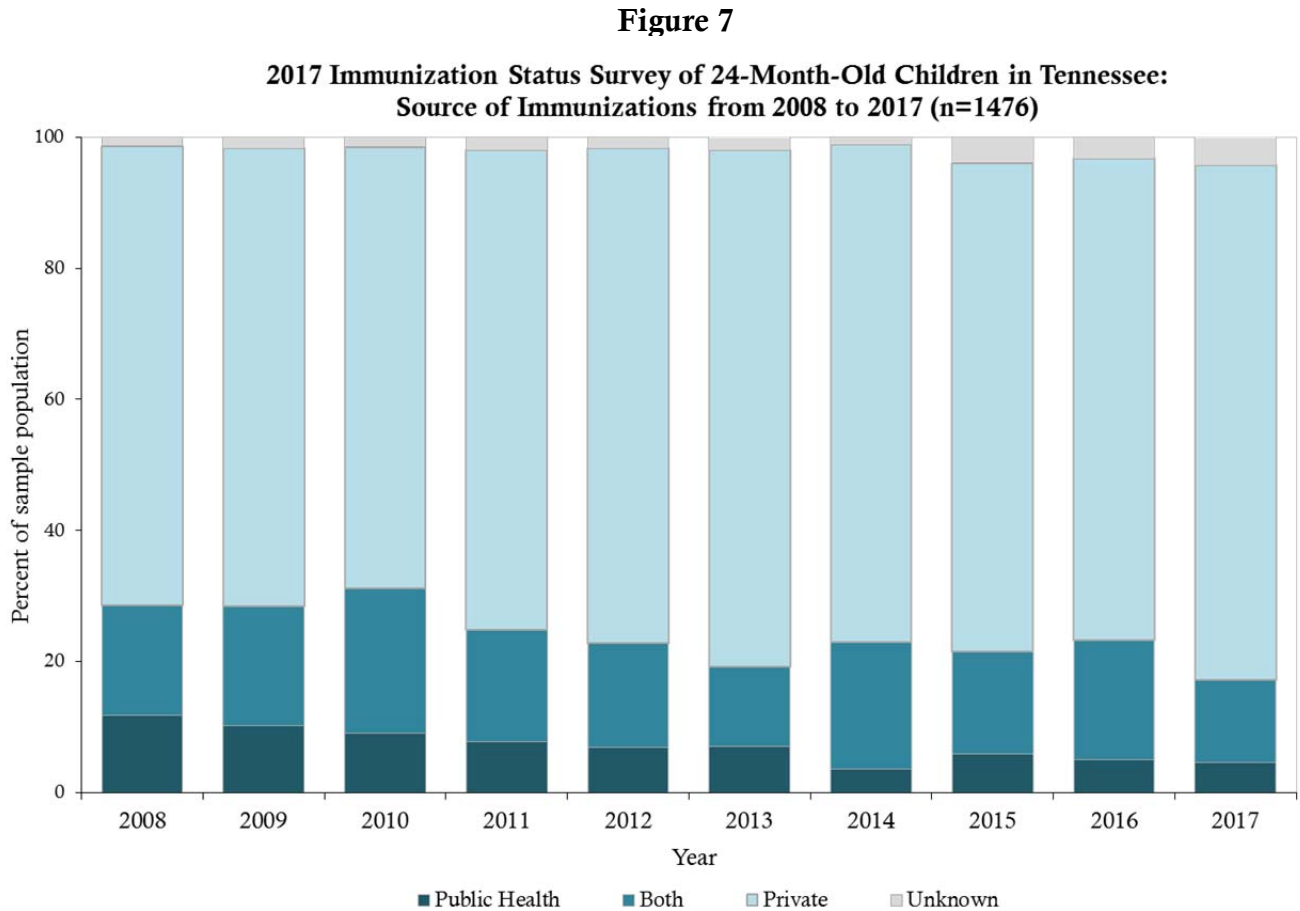
<b>4:3:1:FS:3:1:4* Completion Levels in the 2017 Survey of 24 Month Old Children: Selected Characteristics (point estimate +/- 95 percent confidence intervals)</b>			
<b>Provider Type</b>	Public n=39/67	Private N=909/1158	Both n=126/187
	<b>58.2% ± 11.81</b>	<b>78.5% ± 2.37</b>	<b>67.4% ± 6.72</b>
<b>TennCare Enrollment</b>	Enrolled n=629/890	Not Enrolled n=456/586	
	<b>70.7% ± 2.99</b>	<b>77.8% ± 3.36</b>	
<b>WIC Enrollment</b>	Enrolled n=615/850	Not Enrolled n=470/626	
	<b>72.4% ± 3.01</b>	<b>75.1% ± 3.39</b>	
<b>Other Siblings</b>	None n=459/559	One n=336/471	Two or more n=285/440
	<b>82.1% ± 3.18</b>	<b>71.3% ± 4.08</b>	<b>64.8% ± 4.46</b>
<b>Age at First Immunization**</b>	≤120 days n=1074/1391	120 days n=11/34	
	<b>77.2% ± 2.20</b>	<b>32.4% ± 15.73</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 2017 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.



Children immunized in health departments were more likely to have risk factors for failure to complete immunization. **Table 2** provides the proportion of children surveyed by provider type who have risk factors, including black race, having two or more siblings and receipt of a first dose of any vaccine\* after the 120th day of life.

**Table 2**

<b>Prevalence of three risk factors for delayed immunizations in the survey population by provider type</b>			
<b>Risk Factor</b>	<b>Health Department</b>	<b>Both Private and Public</b>	<b>Private Only</b>
Black	28.4% (19/67)	25.1% (47/187)	15.4% (178/1158)
2 or more siblings	44.8% (30/67)	32.6% (61/187)	28.0% 322/1152)
Age at first dose >120 days*	9.0% (6/67)	5.4% (10/187)	1.6% (18/1158)
Any of above risk factors	58.2% (39/67)	54.0% (101/187)	38.3% (444/1158)

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

**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 2017 (24 months)
Complete 4:3:1:FS:3:1:4 series	80%	73.5%
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> Below 90% for: 4 doses of DTaP (81.2%) Full series of HIB (79.8%) 4 doses of PCV (82.7%)
3 doses DTaP and PCV	<i>None: this is a process measure</i>	3 DTaP (93.7%) and 3 PCV (92.8%)
Hepatitis A vaccine	60% 2 doses by 35 months	2 HAV (58.1%); 1 HAV (89.9%): <i>not comparable to HP2020</i>
Influenza vaccine	70% appropriately immunized	45.9% with 2 doses 25.6% with 3 doses
Rotavirus vaccine	80% with 2 doses	77.3%
Hepatitis B birth dose	85%	84.2%

- Complete on-time immunization would exceed HP2020 coverage goals if all children with three doses could have one more immunization visit in the second year of life and receive the needed booster doses of DTaP, PCV and HIB.
- Black children were more likely than white children to be incompletely immunized. This disparity is significant in completion of influenza vaccination (a large and stable finding for a decade) and in the booster doses of the three vaccines that require booster doses in the second year of life. As a result, a significant disparity was measured in 4:3:1:FS:3:1:4 series completion.
- For the third consecutive year, children ever covered by TennCare were significantly less likely to be fully immunized on time when compared to children never on TennCare. See Appendix 4 for details.
- Children ever enrolled in WIC had mixed results compared to children never on WIC. Coverage was lower for influenza and rotavirus, but higher for polio and hepatitis B vaccines. See Appendix 4 for details.
- Although numbers were small, 3.5% of surveyed parents reported refusing some or all immunizations, compared to 1.6% of parents in 2016. Many of the parents cited personal, rather than medical or religious reasons for this decision. This trend, also observed in some other states, is of concern due to the increased risk of vaccine preventable disease among groups of under-immunized children. In order to keep schools a safe and healthy learning environment, Tennessee recognizes only religious or medical exemptions to immunization requirements for daycare or school attendance.

## **Next Steps:**

The following steps can help on-time immunization of Tennessee children:

1. Practices should focus patient reminder and recall efforts on young children in the second year of life who are due or overdue for booster doses of DTaP, Hib and PCV. Most children who fell short of complete immunization could have achieved it with just one additional immunization visit. Minority children are especially vulnerable to falling short at this age.
2. Strict adherence to the early infant schedule of immunizations at 2-, 4-, and 6-months will enable clinicians to administer the 4<sup>th</sup> DTaP and all other needed vaccines as early as the first birthday, maximizing the number of opportunities to vaccinate the child on time.
3. The Tennessee Immunization Information System, TennIIS, maintains patient immunization records and special tools that can help clinicians that consistently report all immunizations to TennIIS improve the quality of their immunization services. Coaching, user guides and other resources on how to use TennIIS and these features are available through the training information posted at [www.TennesseeIIS.gov](http://www.TennesseeIIS.gov).
  - a. When a child's record is opened in TennIIS, the top of the record displays vaccine due or overdue dates for each routine vaccine the child needs, based on the child's immunization history.
  - b. Practices that use TennIIS can generate patient reminders of vaccination appointments and recall children due or overdue for vaccines using manual, autodialer, text or other reminder methods.
  - c. Practices may run their own practice level immunization coverage reports based on their active patients in TennIIS. Coaching on the use of these reports is available in the training section of TennIIS.
  - d. In order to improve the quality of immunization services, all ~650 clinics that participate in the Vaccines for Children Program (VFC) must report to TennIIS all vaccines administered to children younger than 19 years of age, regardless of VFC-eligibility. Since all TennCare children receive VFC vaccine, this new 2017 requirement will support their healthcare providers' efforts to improve their lagging immunization coverage rates.
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. The TIP director meets quarterly with the leadership of TennCare and Tennessee Academy of Pediatrics (TNAAP) to update them on areas for improvement in immunization services provided to TennCare-eligible children and to engage support for efforts 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 broadly communicate the results of this survey to public health leaders, VFC program participants and professional organizations of immunization providers. The annual VFC Immunization Review in September 2018 will provide immunization education and information about improving immunization coverage to the staff of clinics across the state that participate in the VFC Program.
8. The VFC Quality Assurance team and immunization field staff in each regional and metro public health department will provide practice level quality assessments and feedback to VFC participating clinics, with all clinics receiving a quality review and educational site visit at least every 24 months. These visits require individualized quality improvement efforts targeting weaknesses identified by practice staff.
9. TIP staff will watch kindergarten immunization compliance rates for evidence of trends in increasing vaccine refusal to determine whether this small increase in refusal persists or if parents immunize late.

# Appendix 1

## 2017 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 (2)	2	2	0	0	1.8%	1	0.9%
East TN	117 (0)	3	0	2	1	2.6%	4	3.4%
Southeast TN	111 (0)	3	0	3	0	2.7%	0	-
Upper Cumberland	120 (2)	10	5	5	0	8.3%	1	0.8%
Mid-Cumberland	115 (0)	7	0	6	1	6.0%	0	-
South Central	120 (3)	6	5	1	0	5.0%	0	-
West TN	120 (4)	3	2	1	0	2.5%	4	3.3%
Shelby County	116 (0)	2	1	1	0	1.7%	11	9.5%
Davidson County	115 (3)	4	2	2	0	3.5%	1	3.5%
Knox County	111 (0)	4	0	3	1	3.6%	0	-
Hamilton County	115 (3)	5	1	4	0	4.3%	0	-
Madison County	114 (0)	3	0	3	0	2.6%	12	10.5%
Sullivan County	109 (0)	0	0	0	0	-	0	-
<b>TOTAL</b>	<b>1493 (17)</b>	<b>52 of 1493</b>	<b>18</b>	<b>31</b>	<b>3</b>	<b>3.5%</b>	<b>34 of 1493</b>	<b>2.3%</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 21 oversampled records, two children had moved out of state and parents of two refused to participate. Records for these children were excluded from the analysis. All of the remaining 17 oversampled children were located and none of their parents claimed an exemption from vaccinating their child.

<sup>3</sup>Fifteen of the 52 children whose parents gave a reason for not vaccinating were partially immunized (range 1-21 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 34 had  $\geq 12$  doses documented.



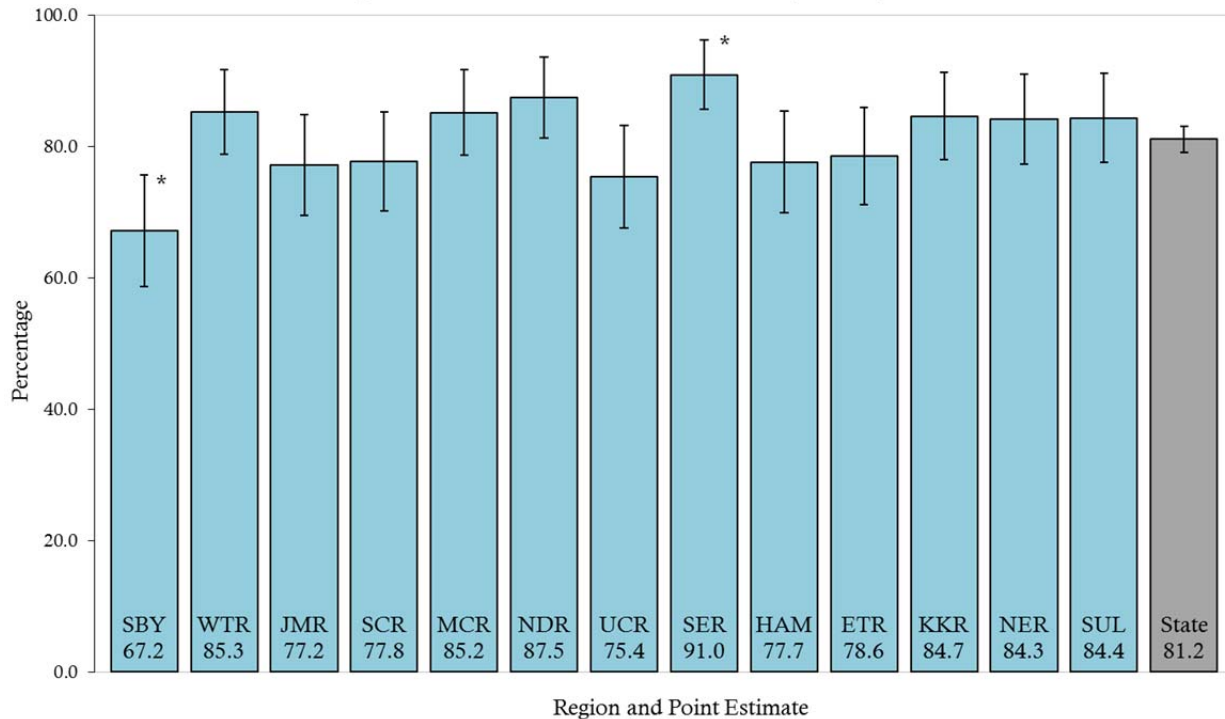
# Appendix 2

## 2017 Immunization Status Survey of 24 Month Old Children in Tennessee

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

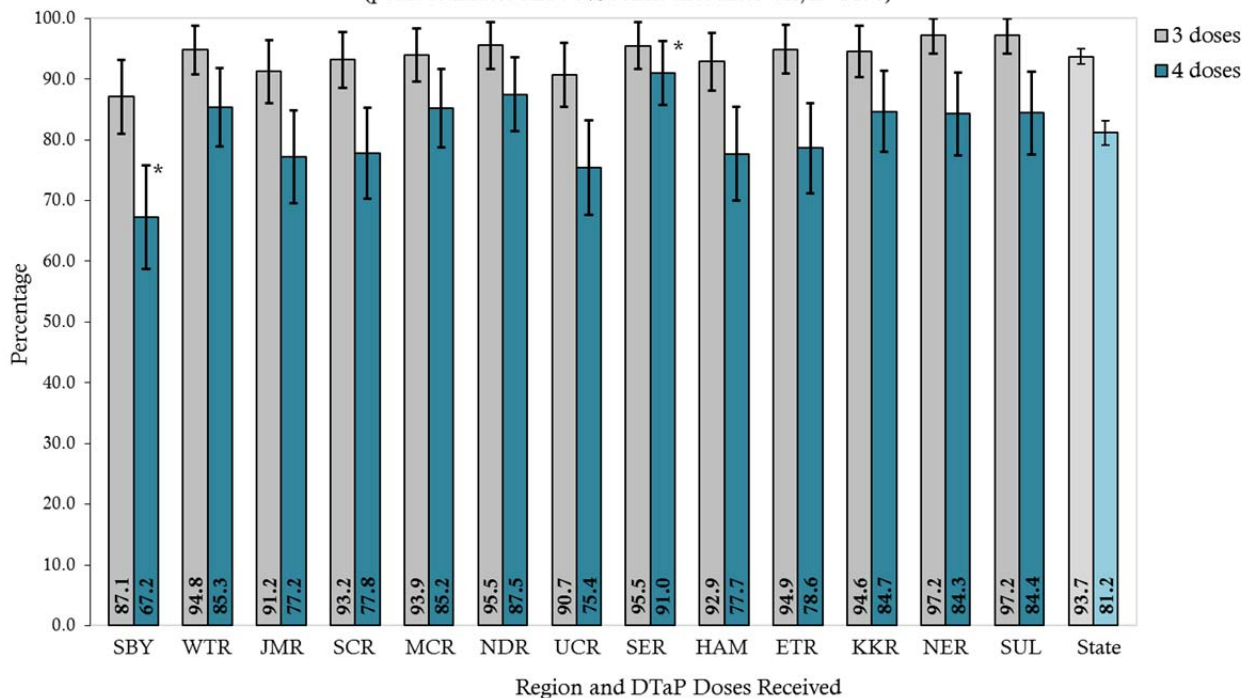
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DTaP (4-dose and 3-dose coverage)	... 26
<i>Haemophilus influenzae</i> type b & Hepatitis A (1-dose coverage)	... 27
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Pneumococcus (PCV) (4-dose vs. 3-dose coverage) & Polio	... 31
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**2017 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=1476)



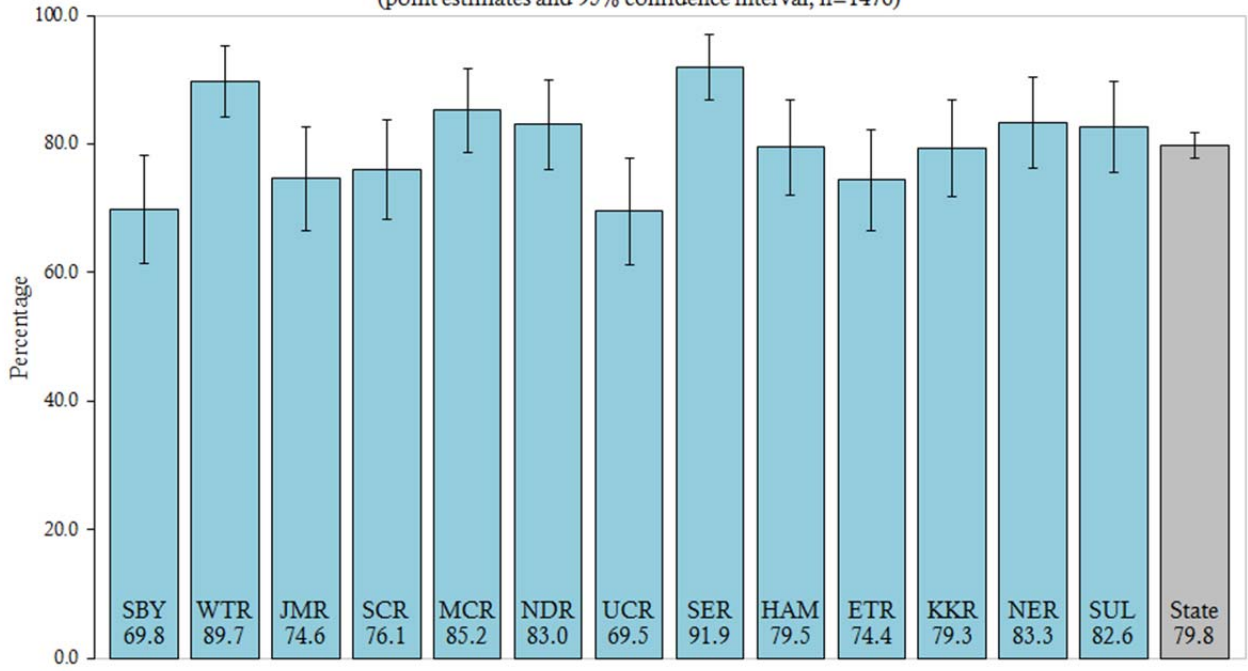
\* statistically significant difference from State point estimate

**2017 Immunization Status Survey of 24-Month-Old Children in Tennessee: Percentage of children with 3 or 4 doses of diphtheria, tetanus and acellular pertussis (DTaP) by health department region**  
(point estimates and 95% confidence intervals, n=1476)



\* statistically significant difference from State point estimate

**2017 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 interval, n=1476)**

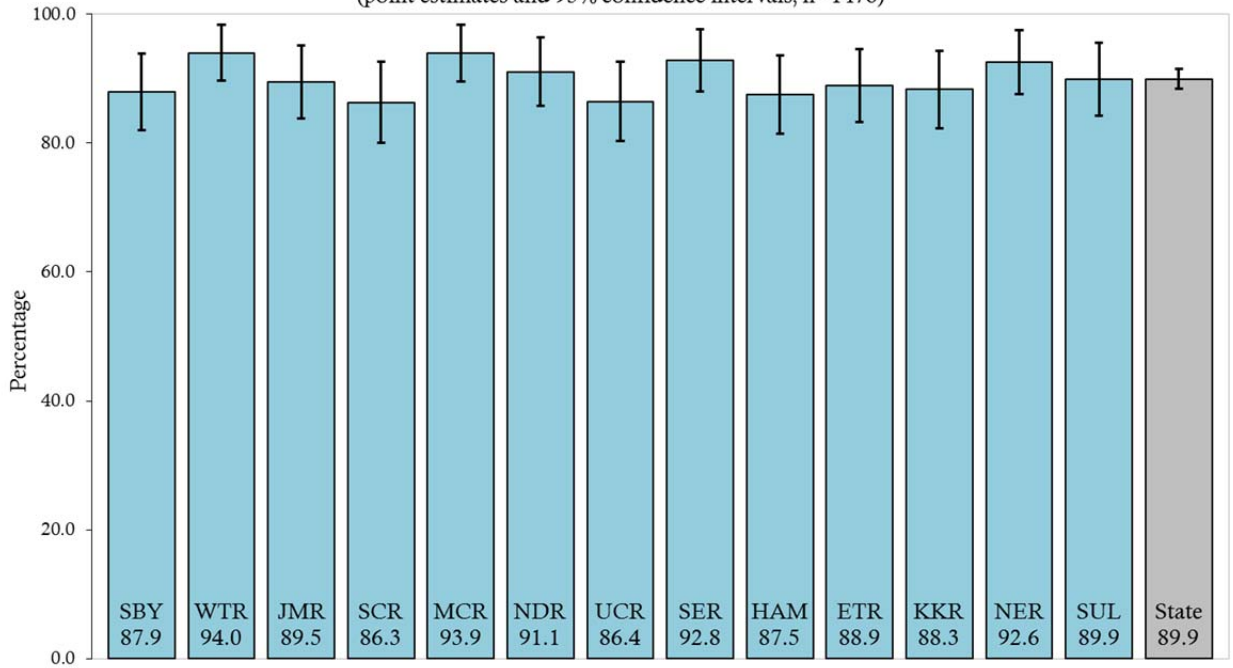


Region and Point Estimate

\*statistically significant difference from State point estimate

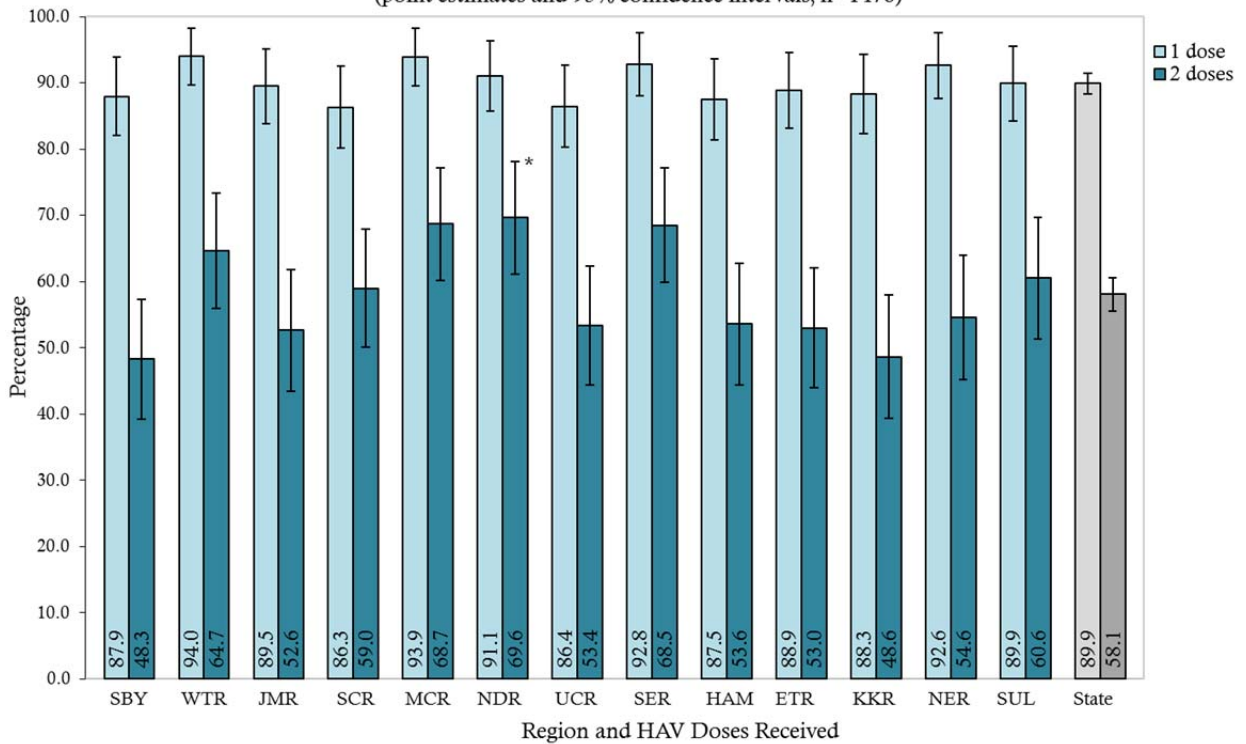
**2017 Immunization Status Survey of 24-Month-Old Children in Tennessee:  
 Percentage of children with at least one dose of Hepatitis A (HAV)  
 by health department region**

(point estimates and 95% confidence intervals, n=1476)

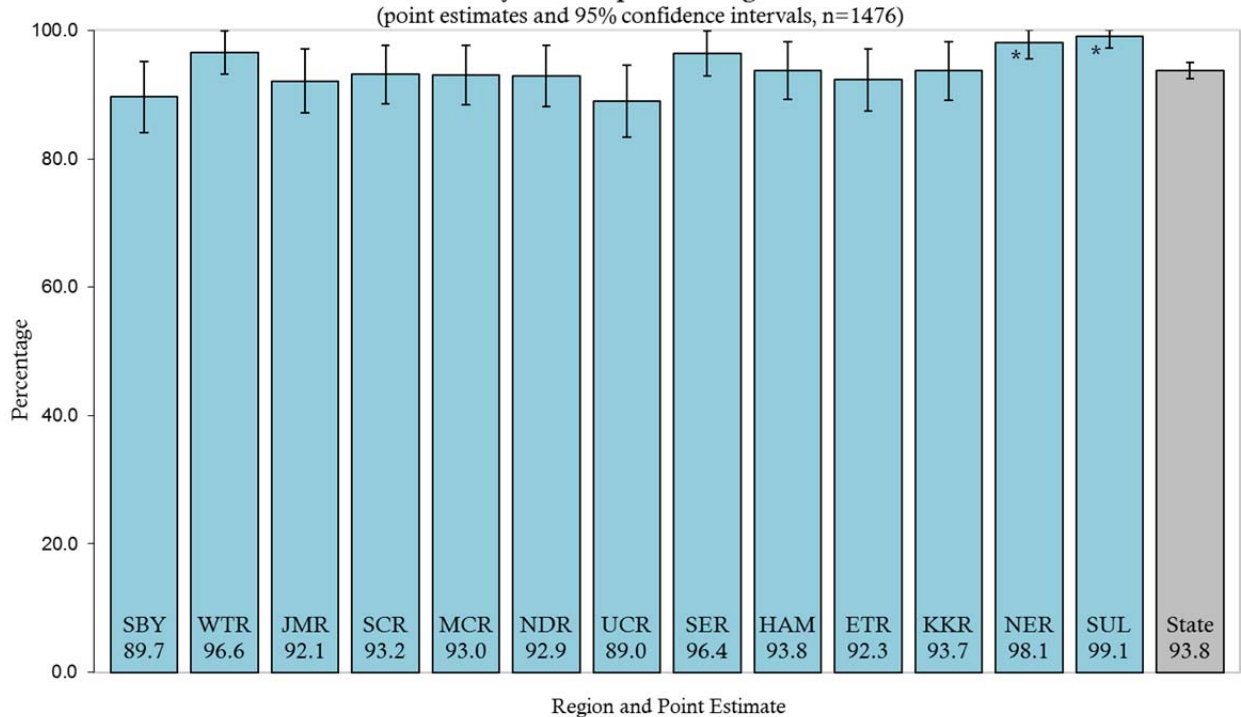


Region and Point Estimate

**2017 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=1476)

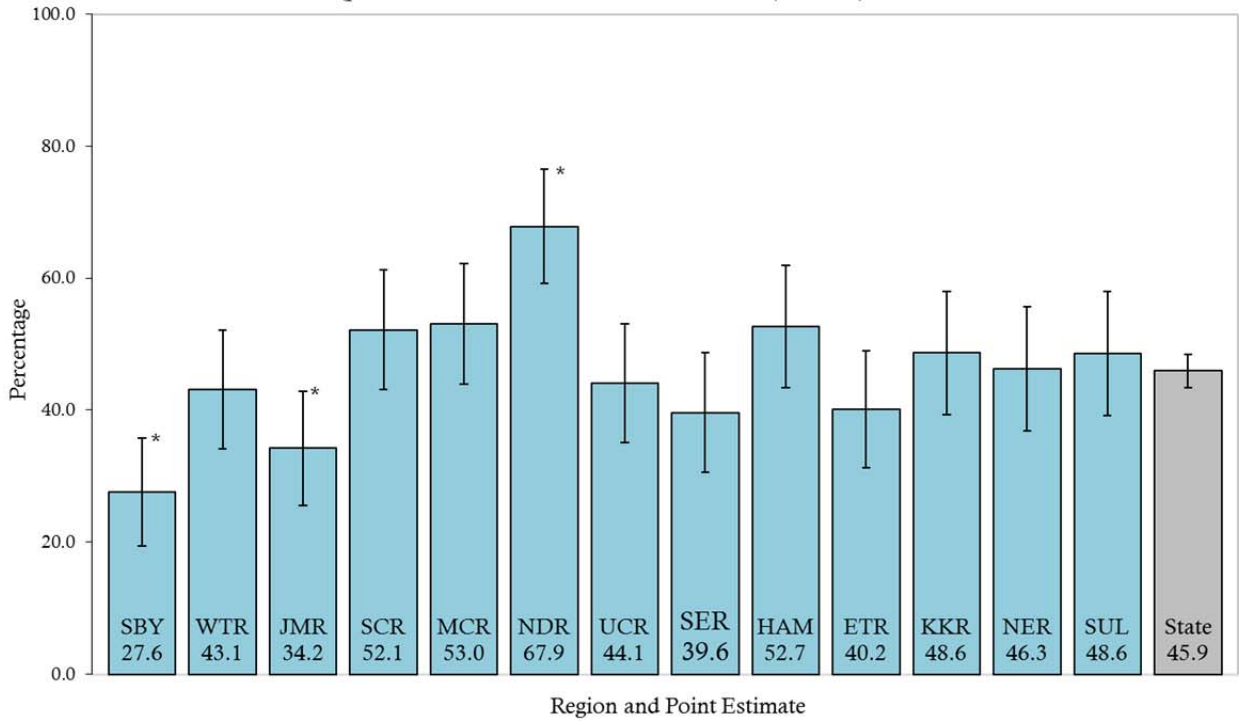


**2017 Immunization Status Survey of 24-Month-Old Children in Tennessee:  
Percentage of children with complete Hepatitis B (HBV) series ( $\geq 3$  doses)  
by health department region**  
(point estimates and 95% confidence intervals, n=1476)



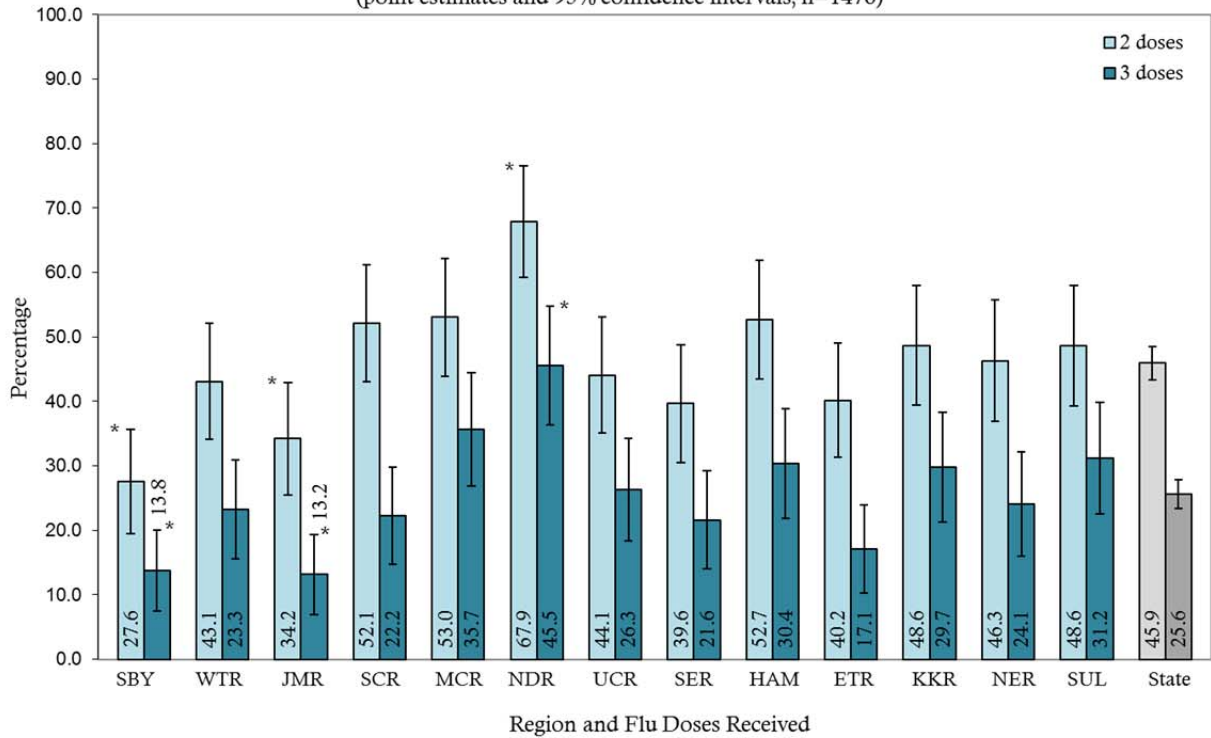
\*statistically significant difference from State point estimate

**2017 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=1476)



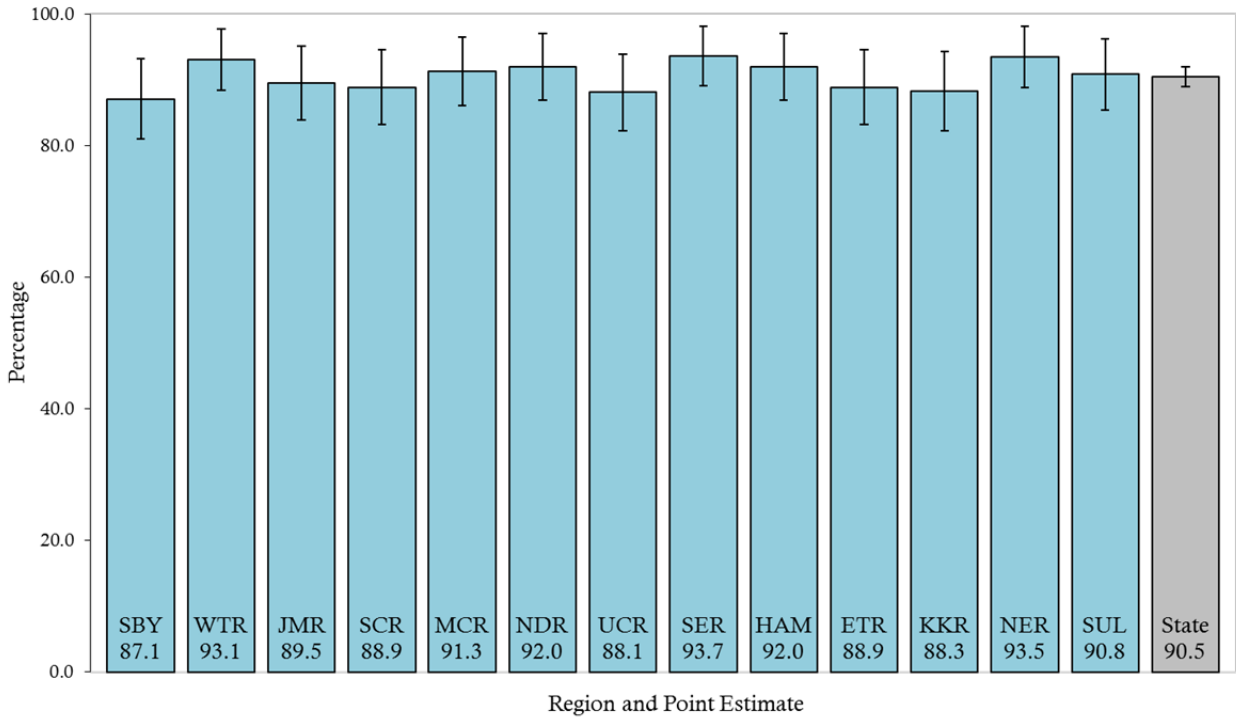
\*statistically significant difference from State point estimate

**2017 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=1476)

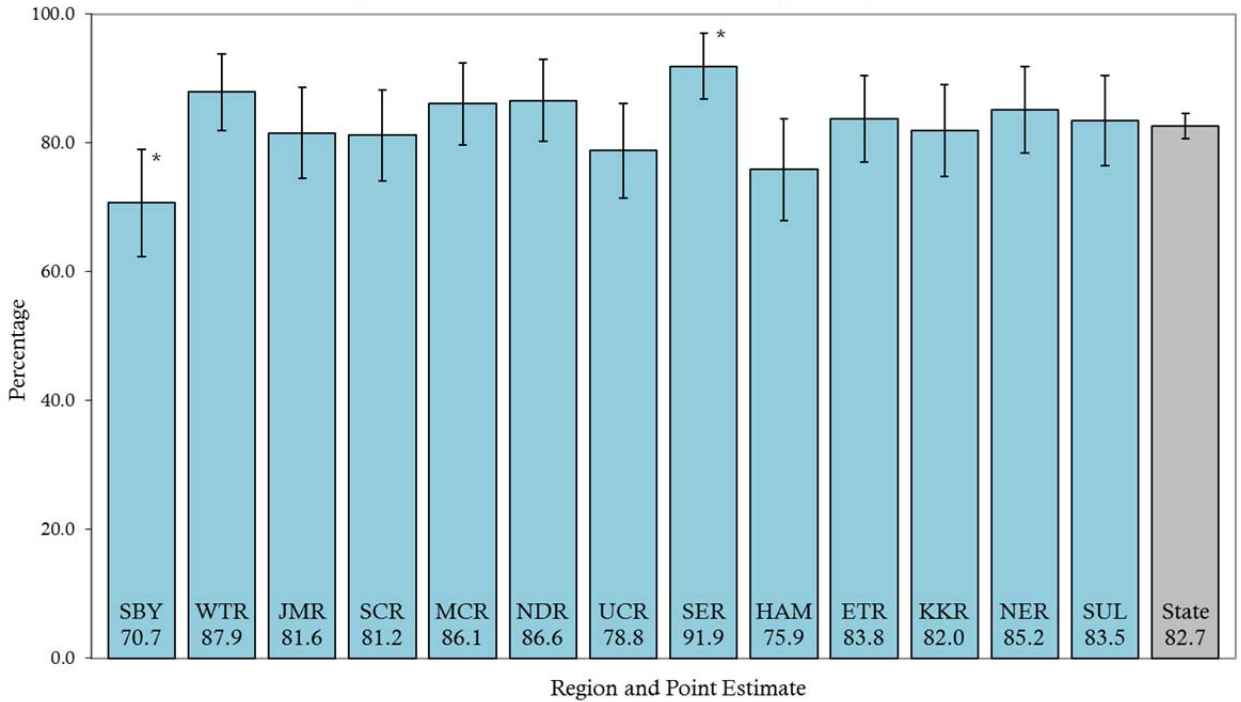


\*statistically significant difference from State point estimate

**2017 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=1476)

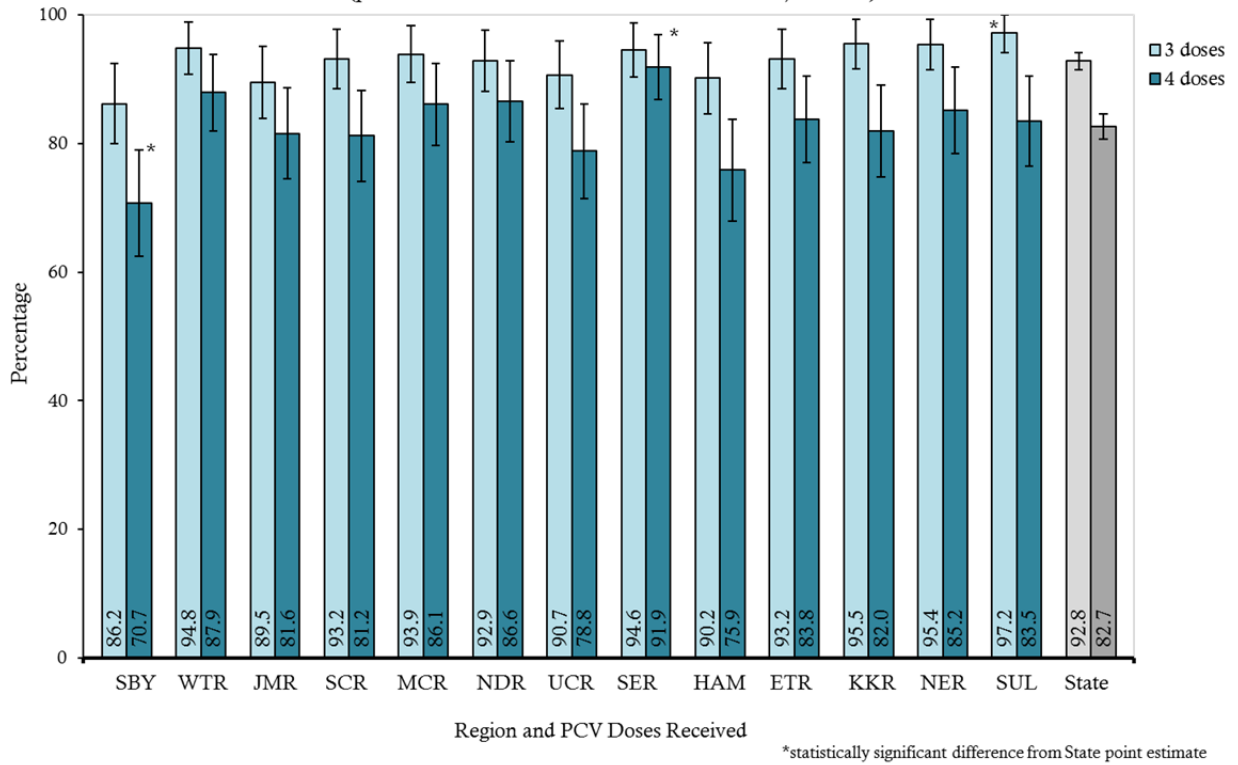


**2017 Immunization Status Survey of 24-Month-Old Children in Tennessee:  
 Percentage of children with complete PCV series (4 doses) by health department region**  
 (point estimates and 95% confidence intervals, n=1476)

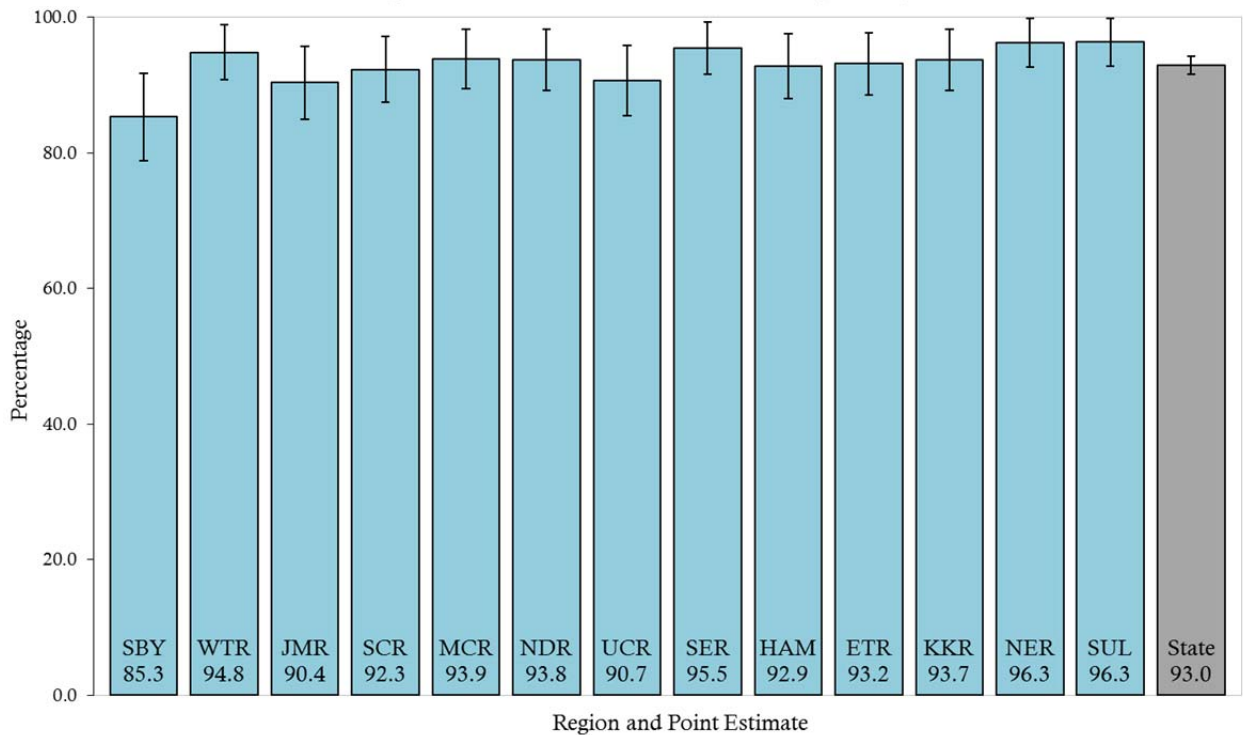


\* statistically significant difference from State point estimate

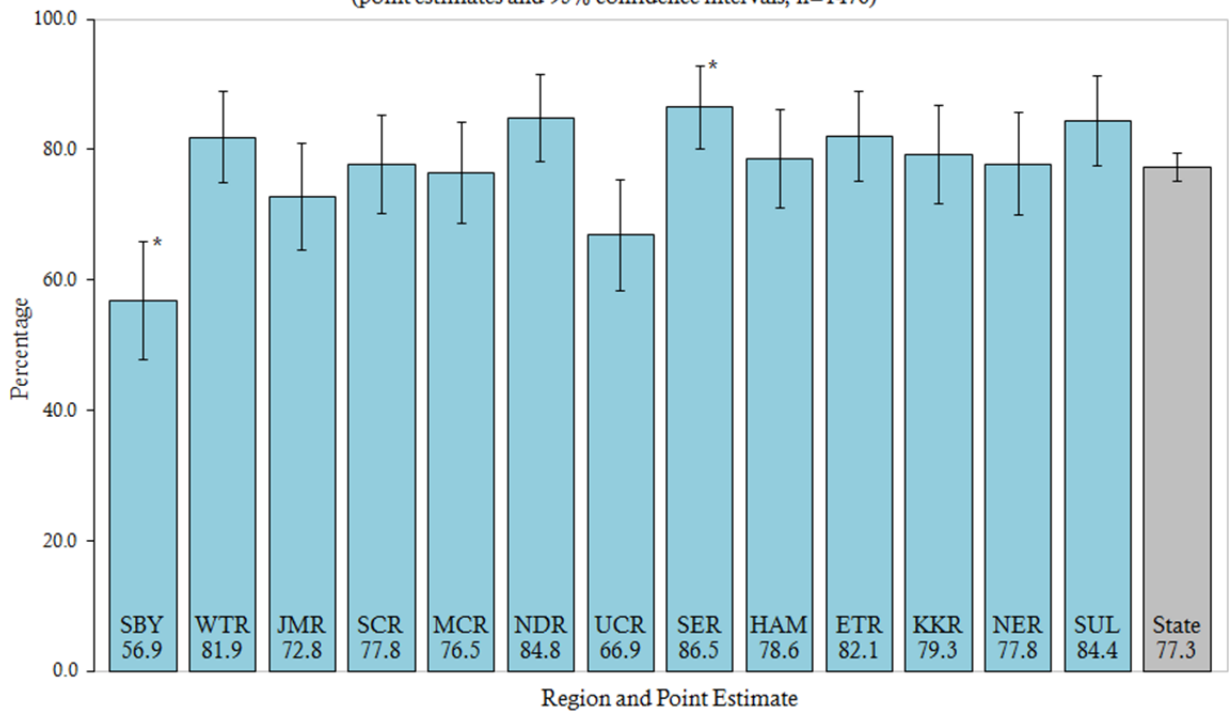
**2017 Immunization Status Survey of 24-Month-Old Children in Tennessee:**  
**Percentage of children with 3 or 4 doses of PCV by health department region**  
 (point estimates and 95% confidence intervals, n=1476)



**2017 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=1476)

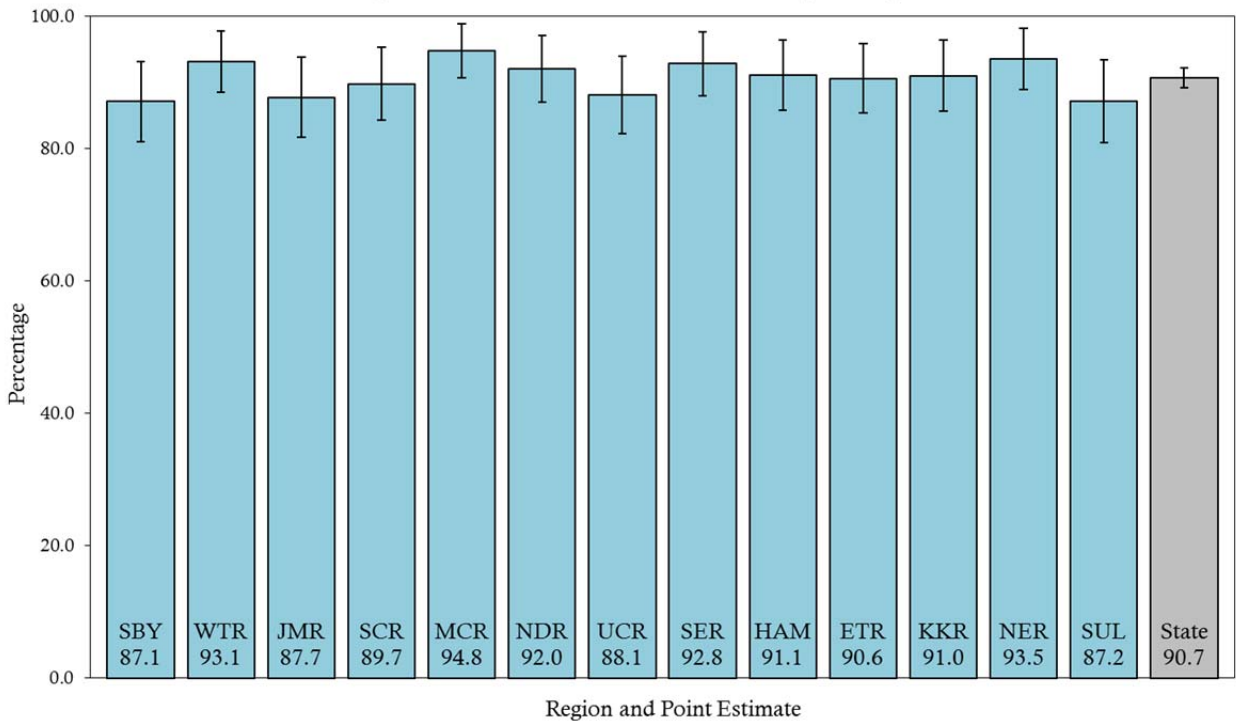


**2017 Immunization Status Survey of 24-Month-Old Children in Tennessee:  
 Percentage of children with complete Rotavirus (RTV) series  
 (either  $\geq 2$  or  $\geq 3$  doses depending on brand) by health department region  
 (point estimates and 95% confidence intervals, n=1476)**



\*statistically significant difference from State point estimate

**2017 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=1476)**





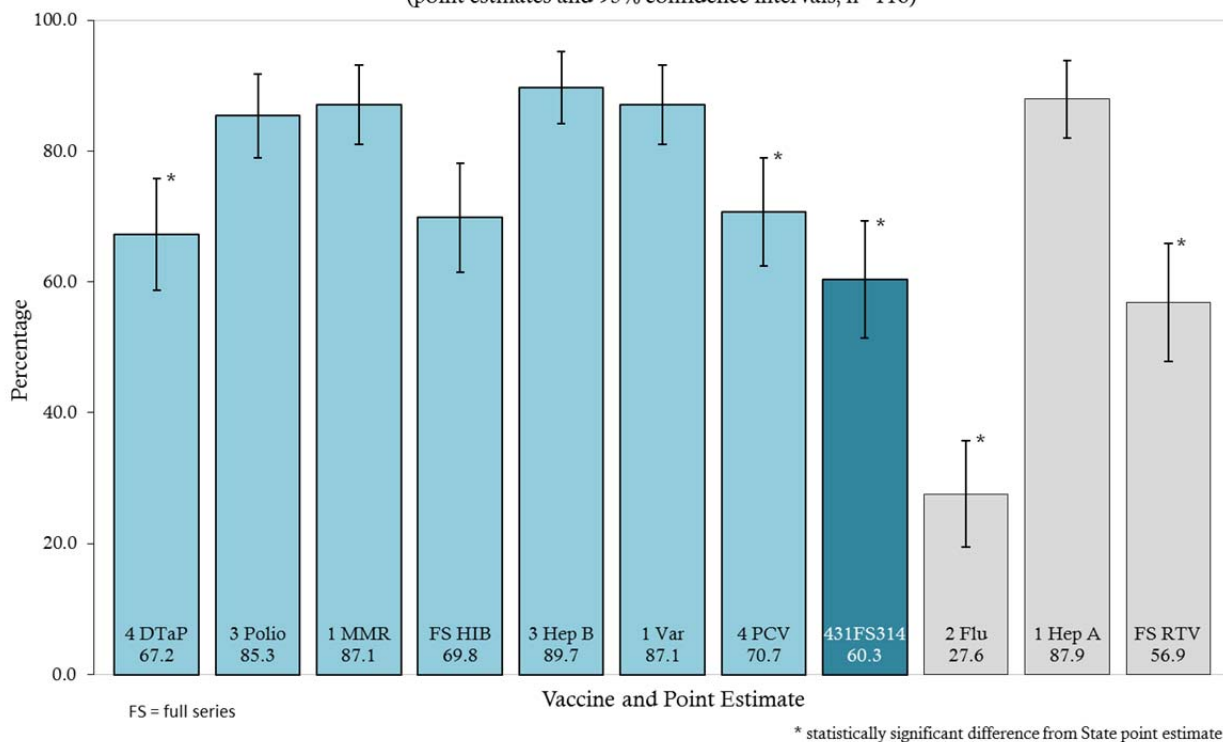
# Appendix 3

## 2017 Immunization Status Survey of 24 Month Old Children in Tennessee

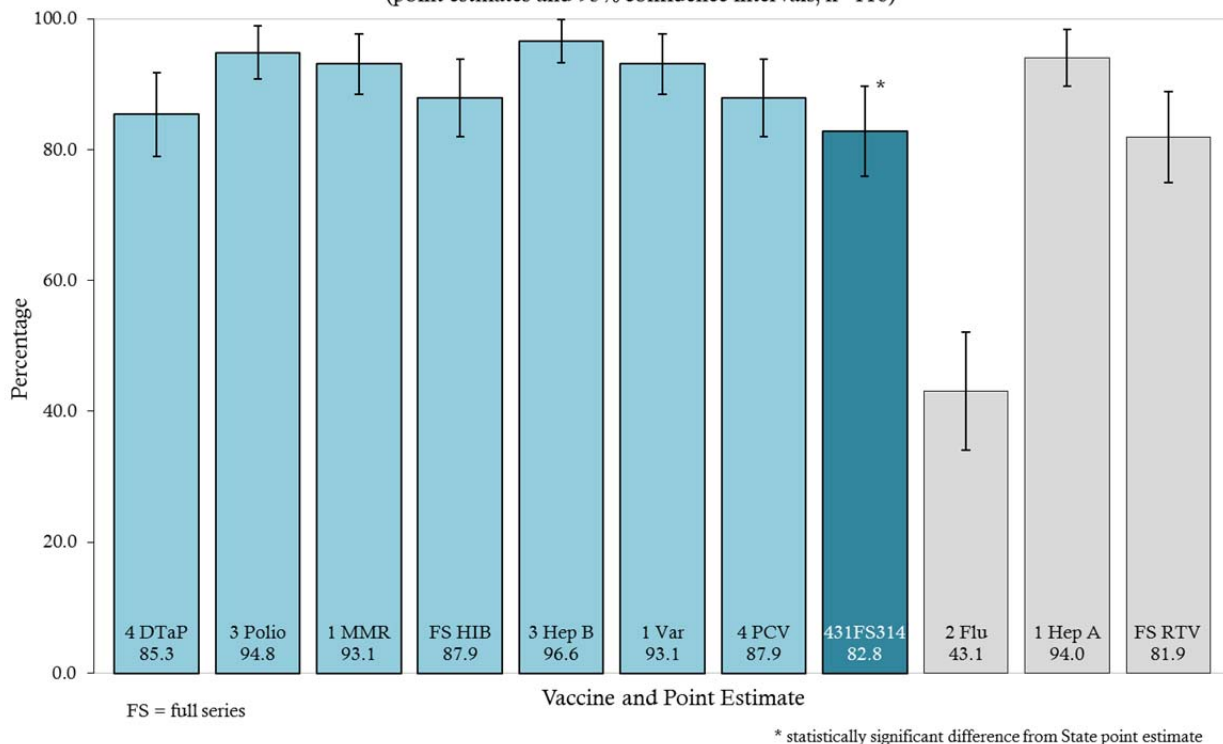
### Individual Health Department Region Charts with Coverage Rates for All Vaccines Assessed

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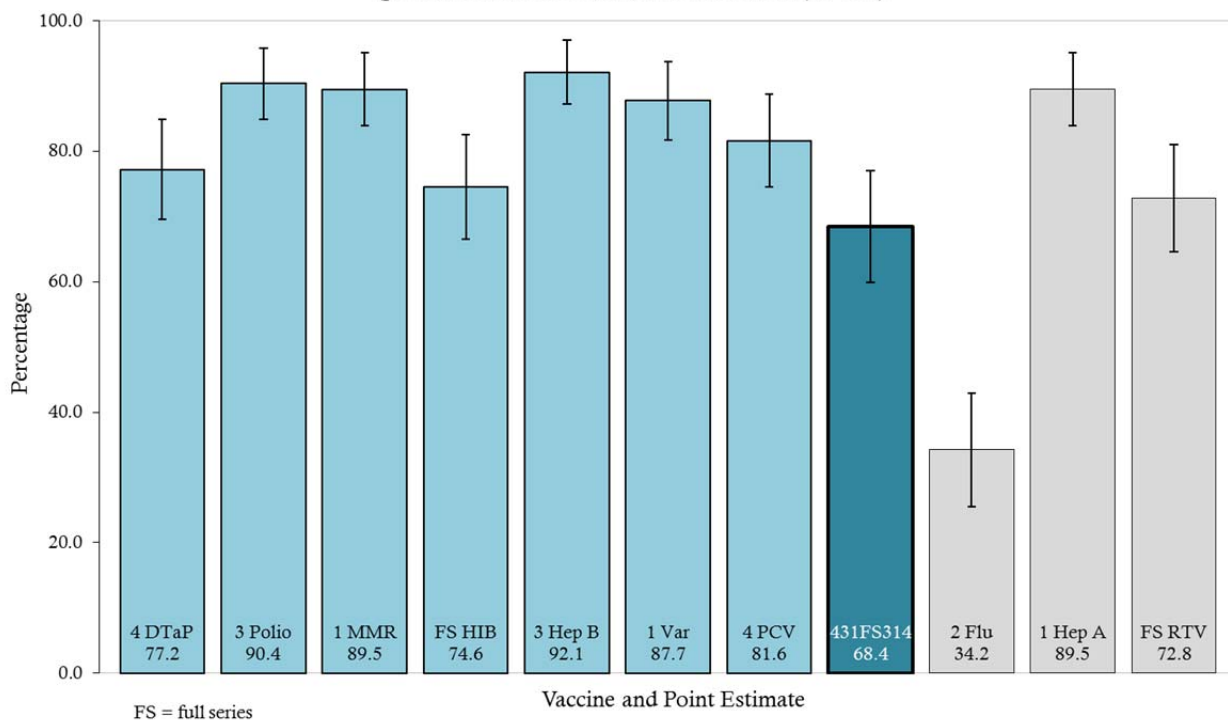
**2017 Immunization Status Survey of 24-Month-Old Children in Tennessee:  
Percentage of children complete in Shelby County (SBY) by vaccine**  
(point estimates and 95% confidence intervals, n=116)



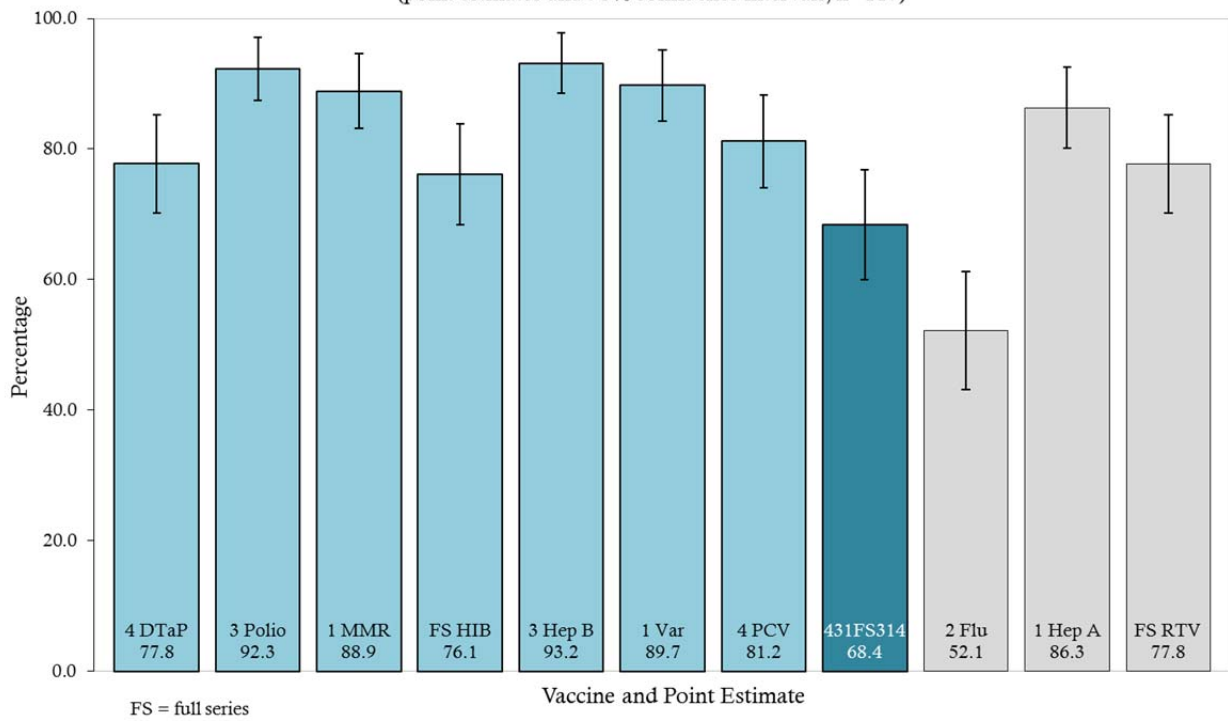
**2017 Immunization Status Survey of 24-Month-Old Children in Tennessee:  
Percentage of children complete in West Tennessee Region (WTR) by vaccine**  
(point estimates and 95% confidence intervals, n=116)



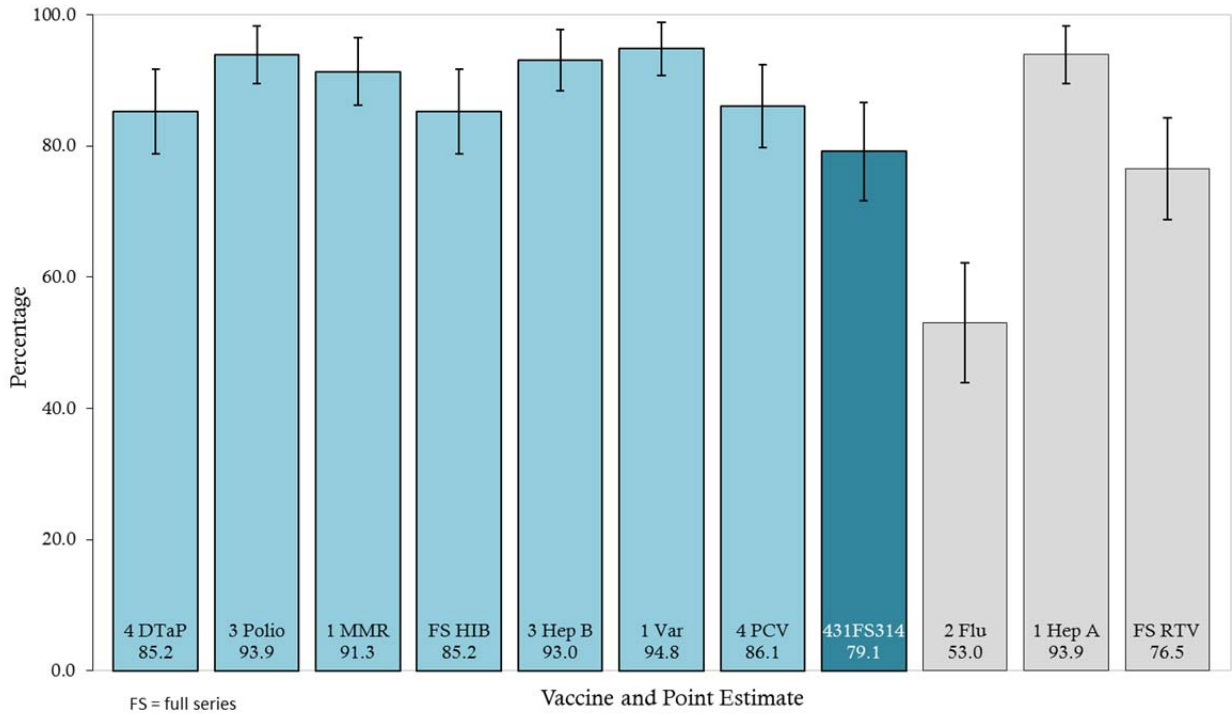
**2017 Immunization Status Survey of 24-Month-Old Children in Tennessee:  
Percentage of children complete in Jackson-Madison Region (JMR) by vaccine**  
(point estimates and 95% confidence intervals, n=114)



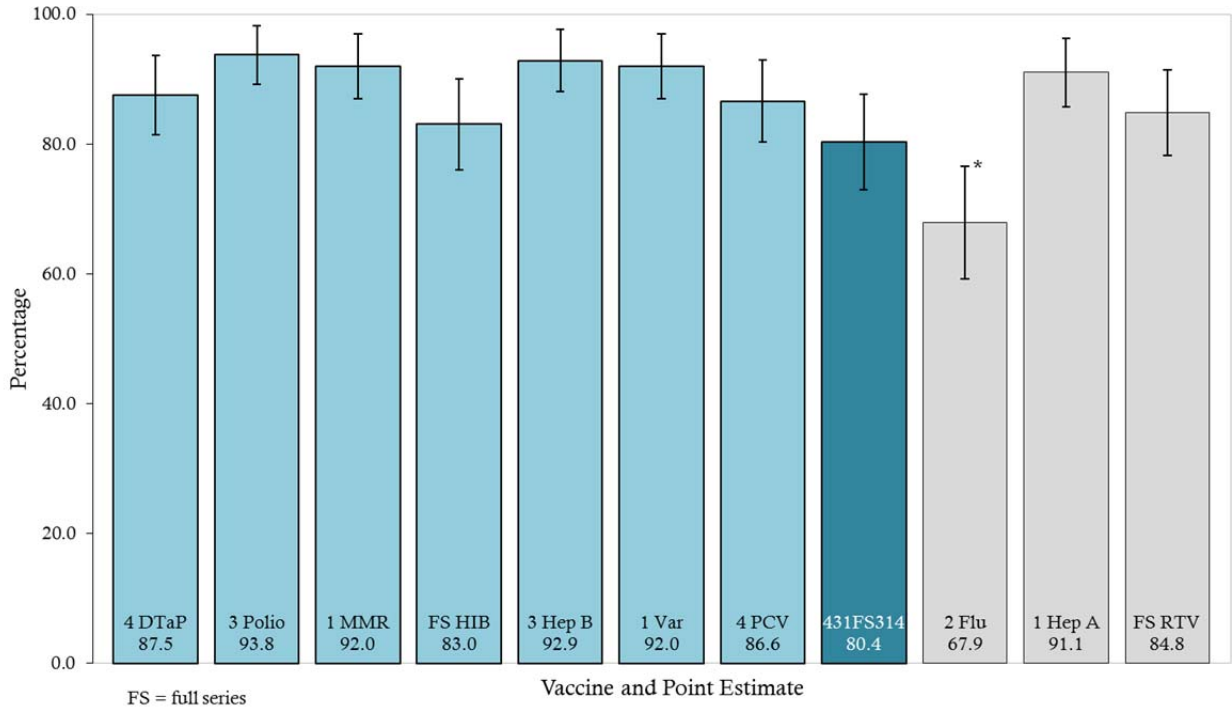
**2017 Immunization Status Survey of 24-Month-Old Children in Tennessee:  
Percentage of children complete in South Central Region (SCR) by vaccine**  
(point estimates and 95% confidence intervals, n=117)



**2017 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=115)

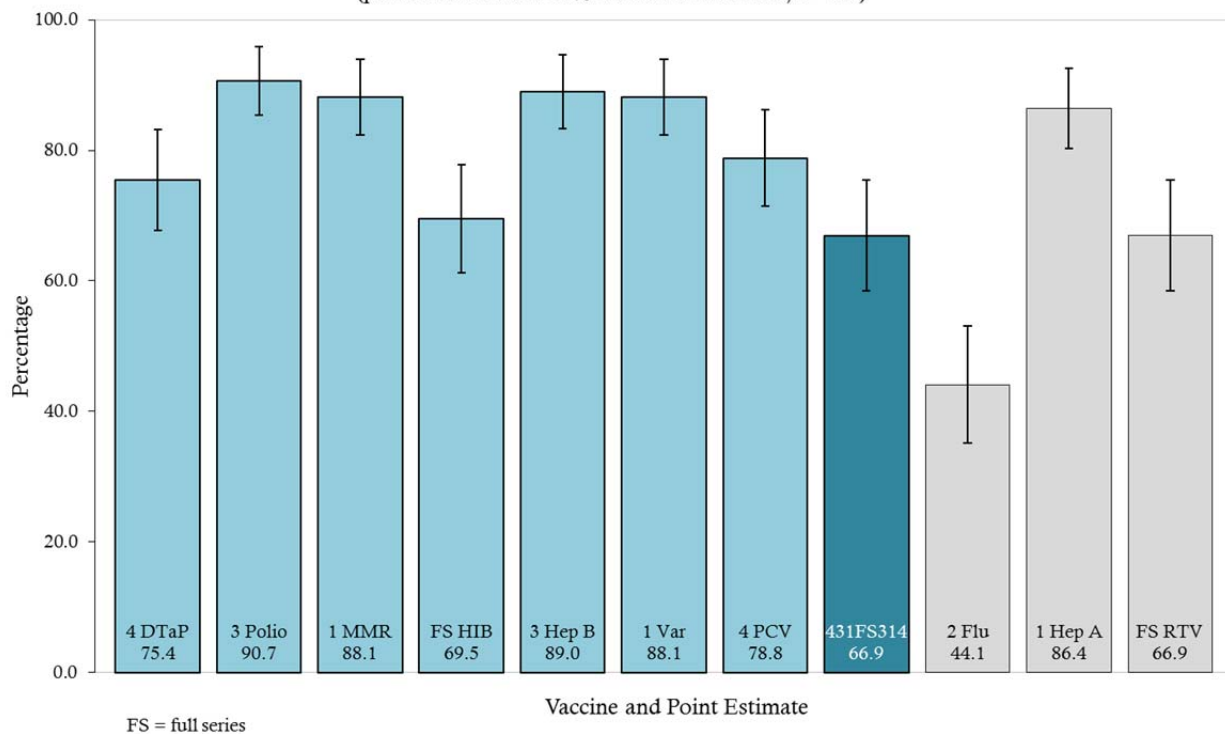


**2017 Immunization Status Survey of 24-Month-Old Children in Tennessee:  
Percentage of children complete in Nashville-Davidson Region (NDR) by vaccine**  
(point estimates and 95% confidence intervals, n=112)

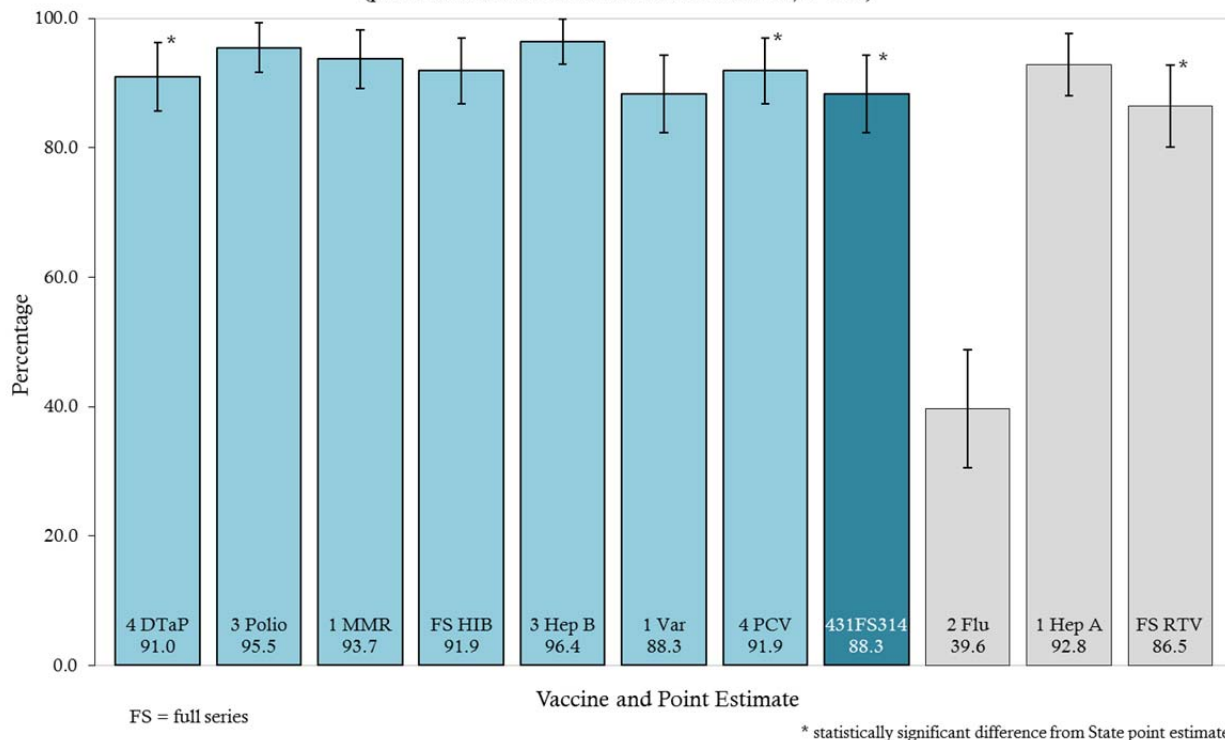


\* statistically significant difference from State point estimate

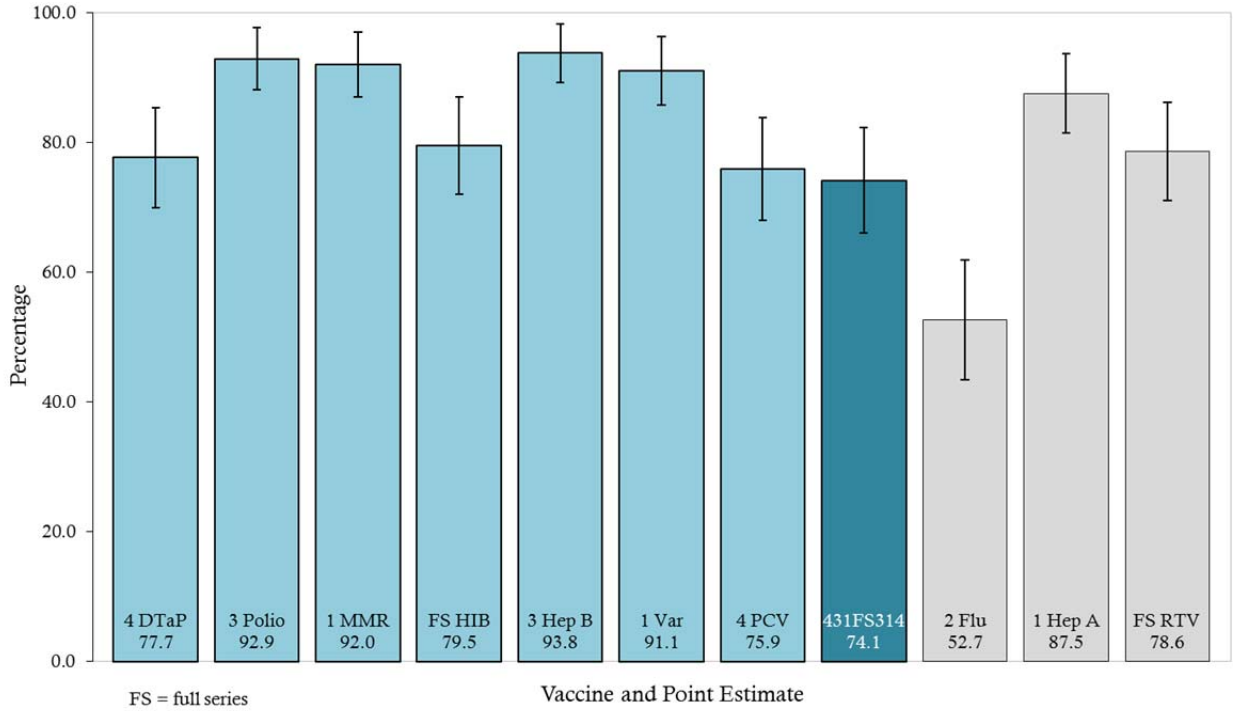
**2017 Immunization Status Survey of 24-Month-Old Children in Tennessee:  
Percentage of children complete in Upper Cumberland Region (UCR) by vaccine**  
(point estimates and 95% confidence intervals, n=118)



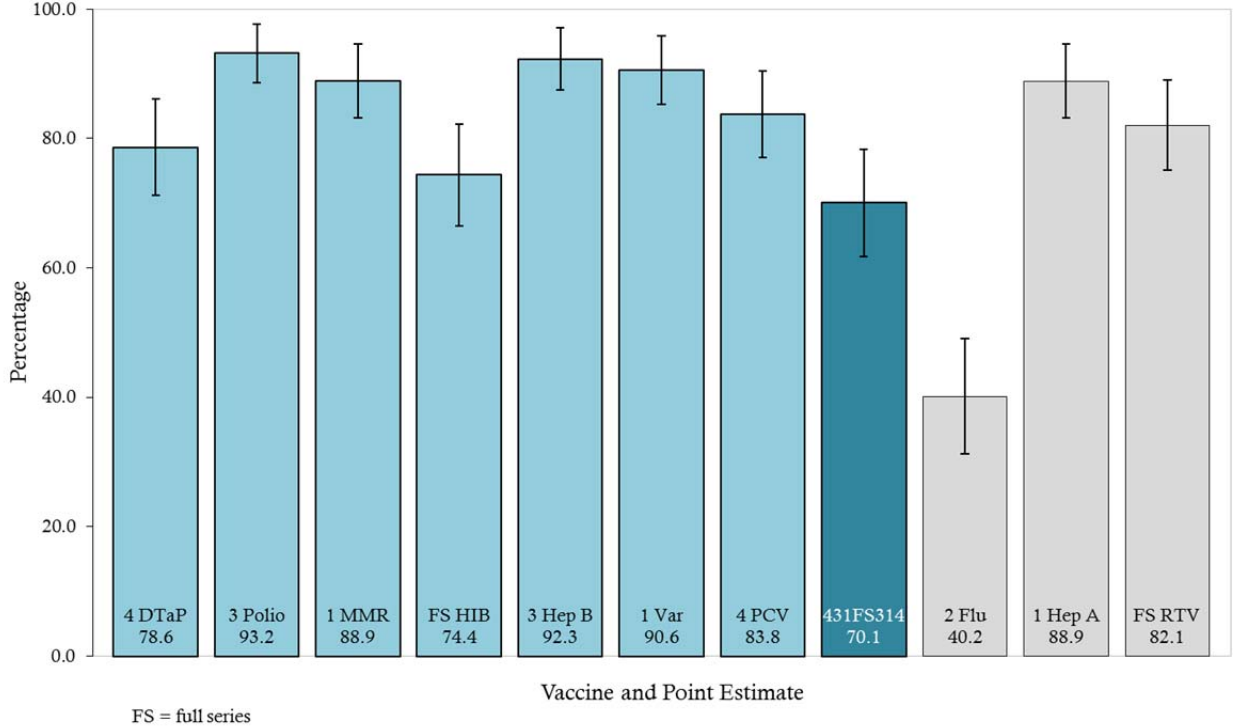
**2017 Immunization Status Survey of 24-Month-Old Children in Tennessee:  
Percentage of children complete in Southeast Region (SER) by vaccine**  
(point estimates and 95% confidence intervals, n=111)



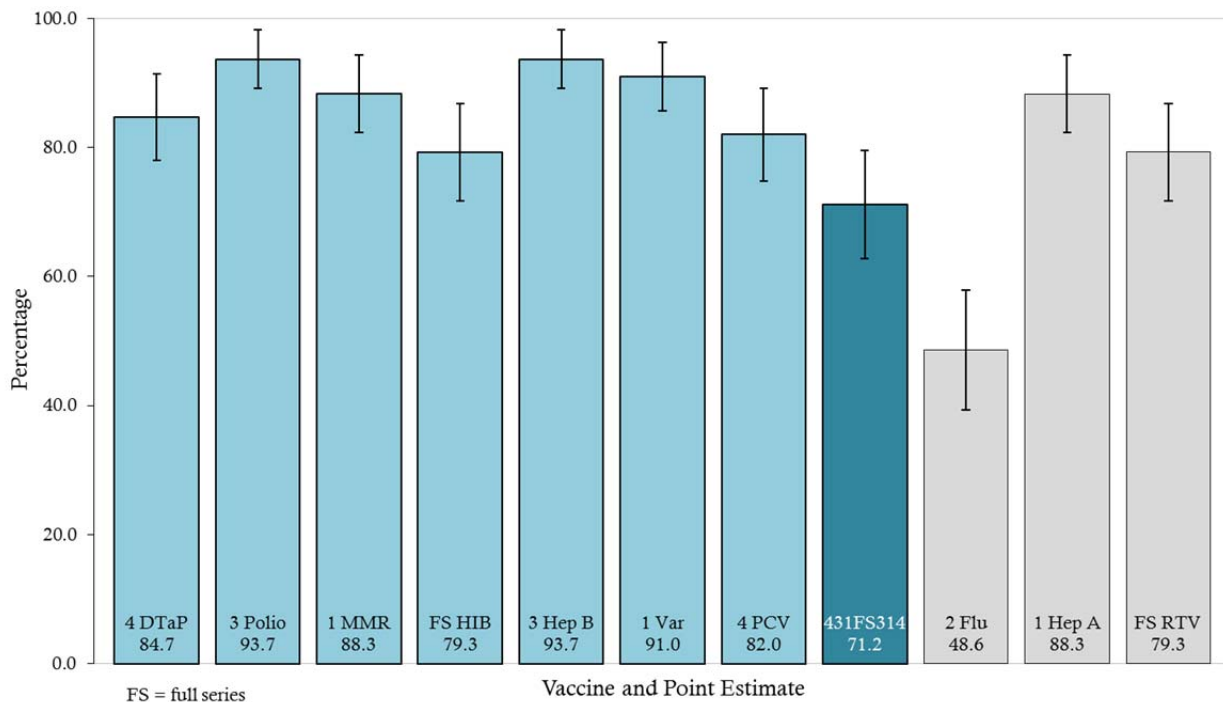
**2017 Immunization Status Survey of 24-Month-Old Children in Tennessee:  
 Percentage of children complete in Hamilton County (HAM) by vaccine**  
 (point estimates and 95% confidence intervals, n=112)



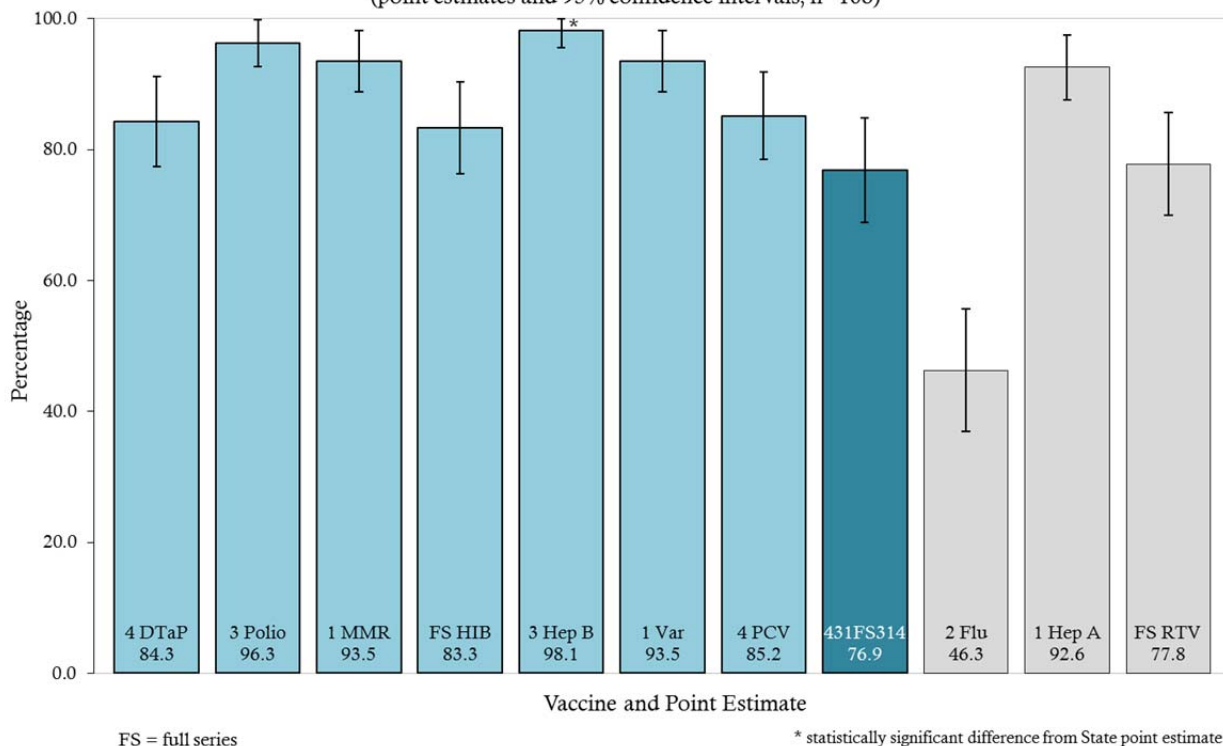
**2017 Immunization Status Survey of 24-Month-Old Children in Tennessee:  
 Percentage of children complete in East Tennessee Region (ETR) by vaccine**  
 (point estimates and 95% confidence intervals, n=117)



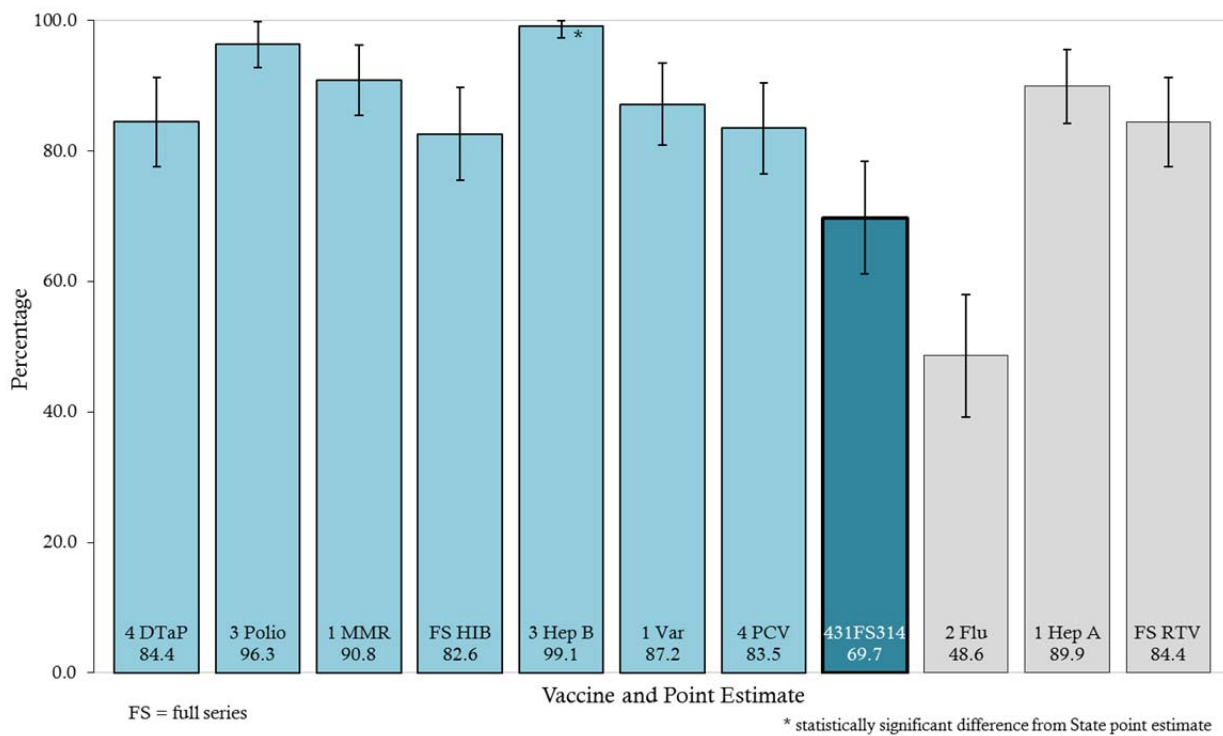
**2017 Immunization Status Survey of 24-Month-Old Children in Tennessee:  
Percentage of children complete in Knoxville-Knox Region (KKR) by vaccine**  
(point estimates and 95% confidence intervals, n=111)



**2017 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=108)



**2017 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=109)





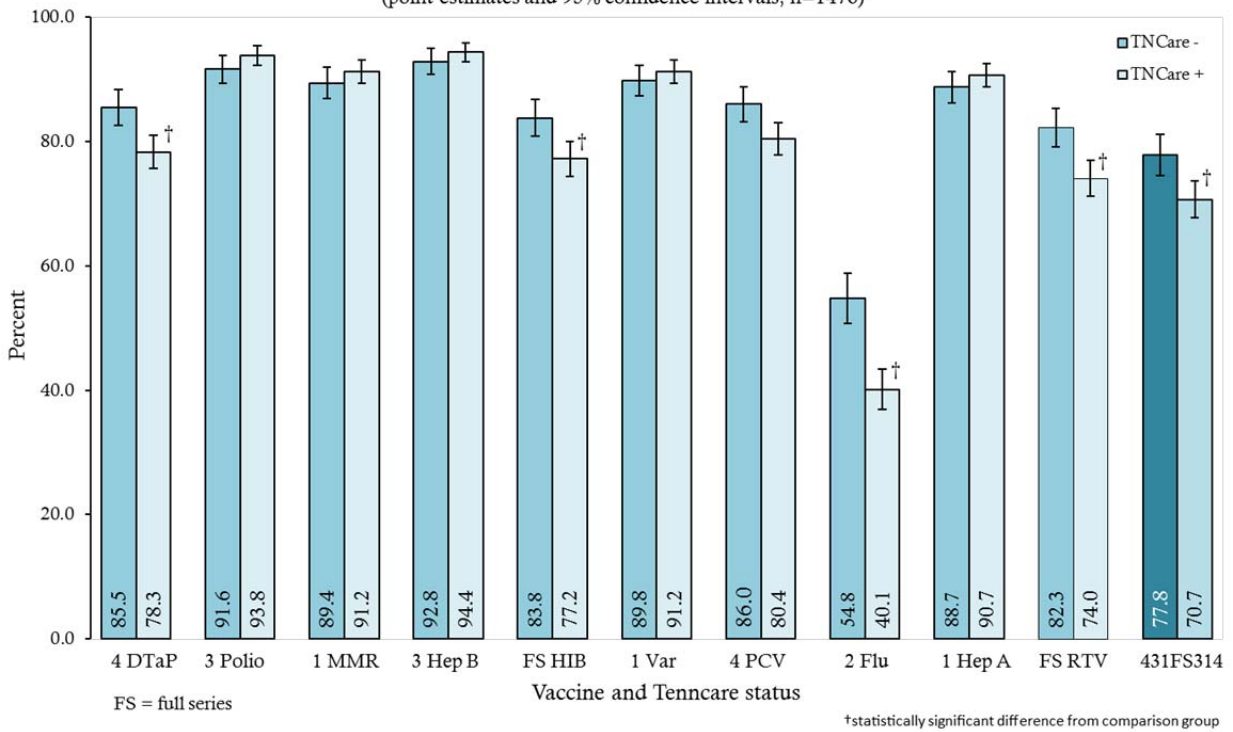
# Appendix 4

## 2017 Immunization Status Survey of 24 Month Old Children in Tennessee

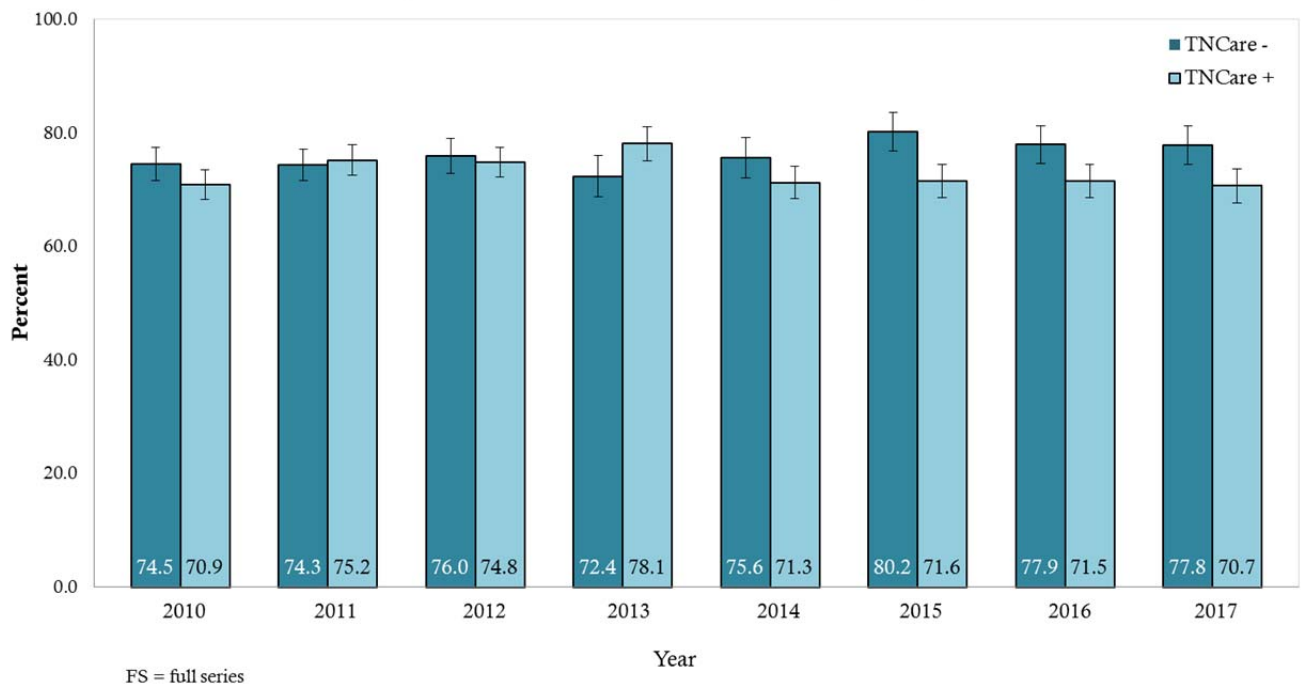
### Additional Statewide Charts for Specific Groups

	Page
Immunization levels by vaccine and TennCare enrollment status	... 42
On-time 4:3:1:FS:3:1:4 completion by TennCare enrollment status, 2010-2017	... 42
Immunization levels by vaccine and WIC enrollment status	... 43
On-time 4:3:1:FS:3:1:4 completion by WIC enrollment status, 2010-2017	... 43
Trends in on-time immunization coverage disparities (Black vs. White, 2010-2017)	... 44

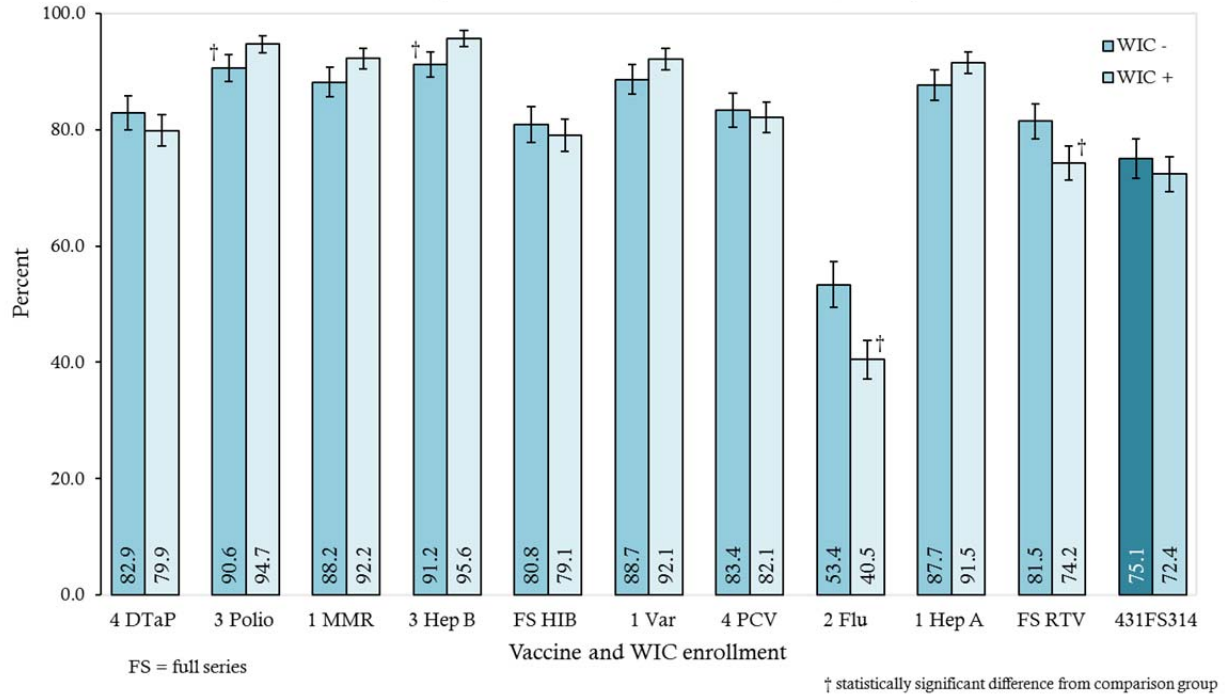
**2017 Immunization Status of 24-Month-Old Children in Tennessee:**  
**Statewide percentage of children with age-appropriate immunization levels**  
**by vaccine and TennCare enrollment status**  
 (point estimates and 95% confidence intervals, n=1476)



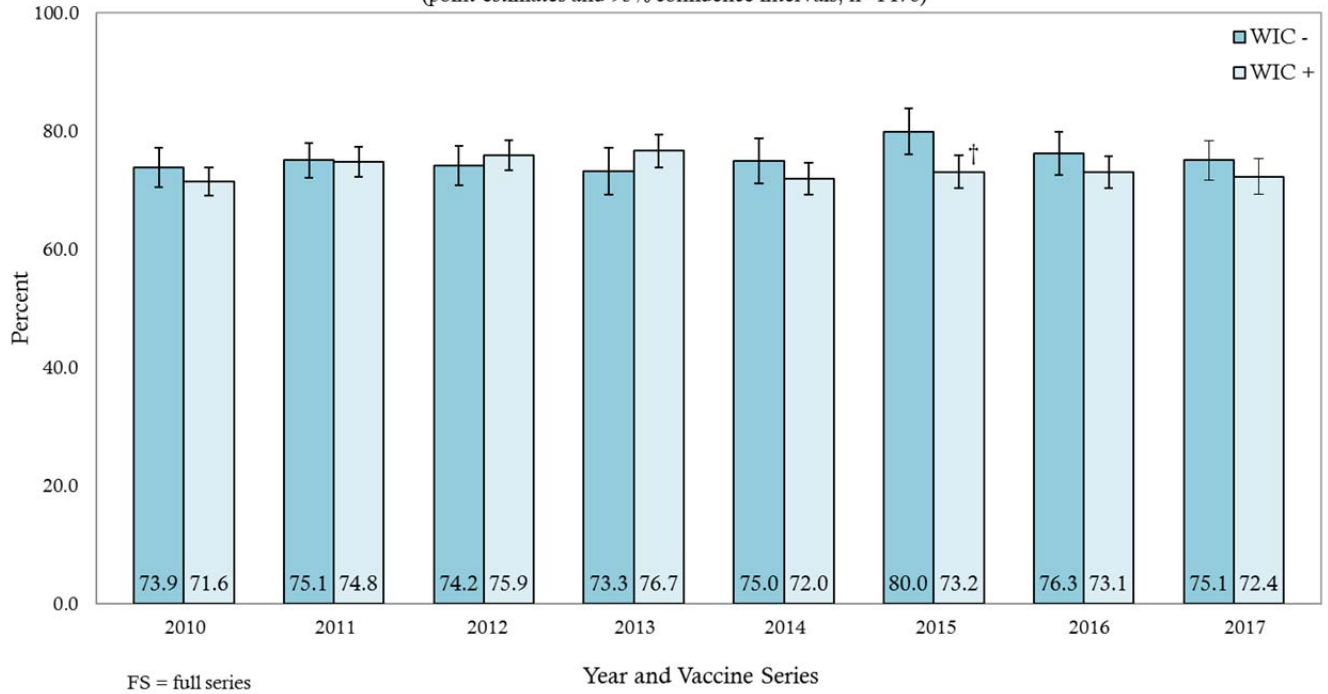
**2017 Immunization Status of 24-Month-Old Children in Tennessee:**  
**On-time 4:3:1:FS:3:1:4 completion by TennCare status, 2010-2017**  
 (point estimates and 95% confidence intervals, n=1476)



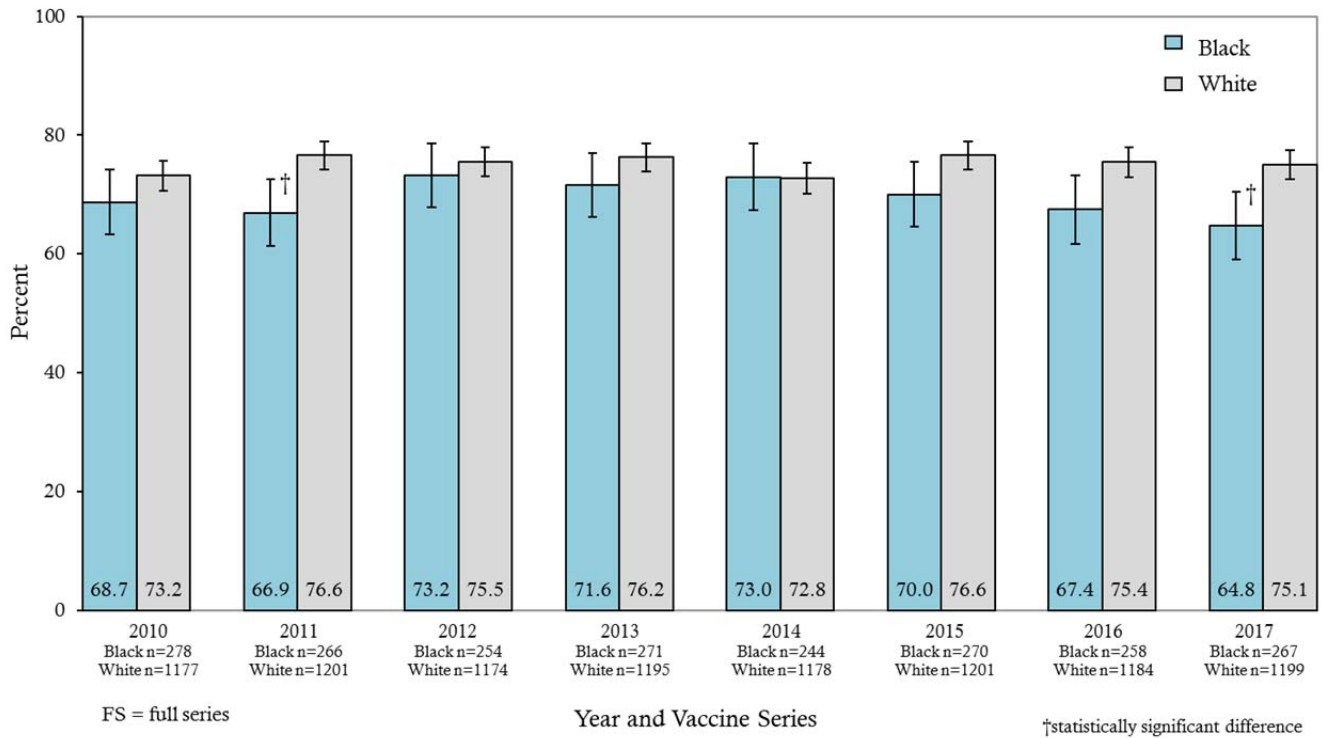
**2017 Immunization Status of 24-Month-Old Children in Tennessee:  
Statewide percentage of children with age-appropriate immunization levels  
by vaccine and WIC enrollment status**  
(point estimates and 95% confidence intervals, n=1476)



**2017 Immunization Status of 24-Month-Old Children in Tennessee:  
On-time 4:3:1:FS:3:1:4 immunization coverage by WIC status, 2010-2017**  
(point estimates and 95% confidence intervals, n=1476)



**2017 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

## 2017 Immunization Status Survey of 24 Month Old Children in Tennessee

### Data Tables for Selected Analyses

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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=	%	
Northeast TN	83	76.9%	25	23.1%	108
East TN	82	70.1%	35	29.9%	117
Southeast TN	98	88.3%	13	11.7%	111
Upper Cumberland	79	67.0%	39	33.0%	118
Mid-Cumberland	91	79.1%	24	20.9%	115
South Central	80	68.4%	37	31.6%	117
West TN	96	82.8%	20	17.2%	116
Shelby County	70	60.3%	46	39.7%	116
Davidson County	90	80.4%	22	19.6%	112
Knox County	79	71.2%	32	28.8%	111
Hamilton County	83	74.1%	29	25.9%	112
Madison County	78	68.4%	36	31.6%	114
Sullivan County	76	69.7%	33	30.3%	109
Total	1085	73.5%	391	26.5%	1476

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

Region	Public			Private			Both		
	Yes	Total	%	Yes	Total	%	Yes	Total	%
Northeast TN	3	5	60.0%	66	83	79.5%	14	18	77.8%
East TN	0	1	0.0%	76	100	76.0%	6	11	54.6%
Southeast TN	3	5	60.0%	77	83	92.8%	16	19	84.2%
Upper Cumberland	4	6	66.7%	63	88	71.6%	12	17	70.6%
Mid-Cumberland	0	0	-	84	101	83.2%	7	8	87.5%
South Central	3	5	60.0%	68	93	79.5%	8	13	61.5%
West TN	9	16	56.2%	65	71	91.6%	18	22	81.8%
Shelby County	6	14	42.9%	58	79	73.4%	5	13	38.5%
Davidson County	0	0	-	84	102	82.4%	3	5	60.0%
Knox County	4	4	100.0%	70	93	75.3%	5	10	50.0%
Hamilton County	0	2	0.0%	77	96	80.2%	6	10	60.0%
Madison County	6	8	75.0%	52	71	73.2%	20	31	64.5%
Sullivan County	1	1	100.0%	69	98	70.4%	6	10	60.0%
Total	39	67	58.2%	909	1158	78.5%	126	187	67.4%

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

Region	White			Black			Other		
	Yes	Total	%	Yes	Total	%	Yes	Total	%
Northeast TN	82	105	78.1%	2	3	66.7%	0	2	0.0%
East TN	77	110	70.0%	3	4	75.0%	2	3	66.7%
Southeast TN	91	103	88.4%	6	7	85.7%	1	1	100.0%
Upper Cumberland	79	118	67.0%	1	2	50.0%	0	0	-
Mid-Cumberland	76	99	76.8%	12	13	92.3%	3	3	100.0%
South Central	76	111	68.5%	5	8	62.5%	1	1	100.0%
West TN	83	100	83.0%	14	19	73.7%	1	1	100.0%
Shelby County	25	36	69.4%	43	78	55.1%	2	2	100.0%
Davidson County	64	75	85.3%	22	34	64.7%	5	6	83.3%
Knox County	66	93	71.0%	12	16	75.0%	1	2	50.0%
Hamilton County	67	88	76.1%	16	24	66.7%	2	3	66.7%
Madison County	40	55	72.7%	35	56	62.5%	3	3	100.0%
Sullivan County	74	106	69.8%	2	3	66.7%	0	0	-
Total	900	1199	75.1%	173	267	64.8%	21	27	77.8%

### 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	38	41	92.7%	19	25	76.0%	25	41	61.0%
East TN	35	42	83.3%	25	41	61.0%	22	34	64.7%
Southeast TN	46	48	95.8%	34	41	82.9%	18	22	81.8%
Upper Cumberland	40	50	80.0%	22	32	68.8%	17	36	47.2%
Mid-Cumberland	39	46	84.8%	31	42	73.8%	20	26	76.9%
South Central	42	57	73.7%	22	34	64.7%	16	26	61.5%
West TN	41	47	87.2%	32	38	84.2%	23	31	74.2%
Shelby County	29	38	76.3%	13	28	46.4%	28	50	56.0%
Davidson County	31	37	83.8%	27	34	79.4%	29	37	78.4%
Knox County	34	44	77.3%	27	38	71.1%	18	29	62.1%
Hamilton County	26	30	86.7%	32	45	71.1%	25	37	67.6%
Madison County	33	42	78.6%	21	31	67.7%	24	41	58.5%
Sullivan County	25	37	67.5%	31	42	73.8%	20	30	66.7%
Total	459	559	82.1%	336	471	71.3%	285	440	64.8%

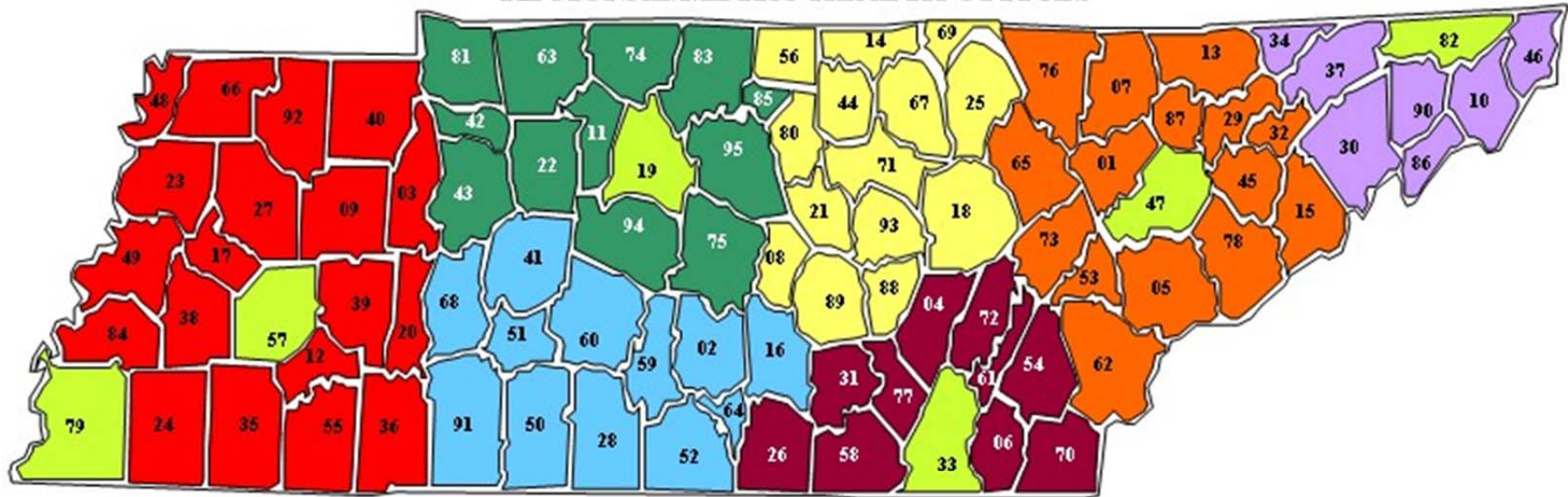
## Series Complete (4:3:1:FS:3:1:4) by TennCare Enrollment

Region	Enrolled			Not Enrolled		
	Yes	Total	%	Yes	Total	%
Northeast TN	46	61	75.4%	37	47	78.7%
East TN	60	81	74.1%	22	36	61.1%
Southeast TN	57	62	91.9%	41	49	83.7%
Upper Cumberland	56	88	63.6%	23	30	76.7%
Mid-Cumberland	37	50	74.0%	54	65	83.1%
South Central	51	78	65.4%	29	39	74.4%
West TN	65	77	84.4%	31	39	79.5%
Shelby County	45	80	56.3%	25	36	69.4%
Davidson County	44	58	75.9%	46	54	85.2%
Knox County	37	58	63.8%	42	53	79.3%
Hamilton County	41	60	68.3%	42	52	80.8%
Madison County	50	80	62.5%	28	34	82.4%
Sullivan County	40	57	70.2%	36	52	69.2%
Total	629	890	70.7%	456	586	77.8%



## 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	Cooke	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	Overtton	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		<b>METROS</b>
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												