

# RETROSPECTIVE IMMUNIZATION COVERAGE SURVEY

2002- 2003 Results (School Year 2006-07)



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## ACRONYMS

4-3-1-3-3	Combination of DTaP4-Polio3-MMR1-Hib3-HepB3
AAFP	American Academy of Family Physicians
AAP	American Academy of Pediatrics
ACIP	Advisory Committee on Immunization Practices
CDC	Centers for Disease Control and Prevention
CI	Confidence interval
DTaP4	4 doses of diphtheria and tetanus toxoids and acellular pertussis vaccines including diphtheria and tetanus toxoids (DTaP/DT)
HepB3	3 doses of hepatitis B vaccine
Hib3	3 doses of <i>Haemophilus influenzae</i> type b vaccine
KCI	Kansas Certificate of Immunization
KDHE	Kansas Department of Health and Environment
MMR1	1 dose of measles, mumps, and rubella vaccine
MMWR	Morbidity and Mortality Weekly Report
NIS	National Immunization Survey
PCV3	3 doses of pneumococcal conjugate vaccine
Polio3	3 doses of polio vaccine
VAR1	1 dose of varicella vaccine

# **EXECUTIVE SUMMARY**

## Overview

The Kansas Certificates of Immunization (KCI) for children enrolled in a kindergarten class in Kansas public and private schools during the 2006-2007 school year were collected and evaluated for immunization coverage rates. The children included in this survey for estimates of coverage at 24 months of age were born between September 2, 2000, and September 1, 2001, and the coverage rates refer to children who were 24 months old between September 2, 2002, and September 1, 2003. The results for this survey were measured against similar previous studies. Immunization coverage rates were also calculated for children at the time of school entry. In this cohort, children who were at least five and not older than seven years old, born between September 1, 1999 and August 31, 2001, were included. In total, there were 814 schools, 712 public and 102 private, included in the analysis. The 15,267 complete and useable KCIs are a representative sample of the population enrolled in kindergarten at both public and private schools. This was the first year that private schools were surveyed.

## Coverage at 24 Months of Age

The statewide coverage rate for the 4-3-1-3-3 series (that is, DTaP4, Polio3, MMR1, Hib3, HepB3) for children by 24 months of age was 51%. This rate was below the Healthy People 2010 goal of at least 80%. Vaccination for hepatitis B and varicella have been required for school entry since the 2004-2005 school year. By 24 months of age, the coverage rate was 85% for HepB3, 73% for varicella, and 35% for PCV3.

Counties were grouped into 3 categories based on population density. Coverage rates were compared among these groups. Counties that were “sparsely populated” had higher coverage rates for the 4-3-1-3-3 series than moderately populated and urban counties.

Six counties reached the Healthy People goal of at least 80% coverage for the 4-3-1-3-3 series. These counties were all “sparsely populated” and widely distributed throughout the state. For DTaP4, one county had at least 90% coverage and 19 counties had at least 80% coverage. For IPV3, 47 counties had at least 90% coverage. For MMR1, 70 counties had 90% coverage or better. Four counties had at least 90% coverage for VAR1. For HepB3, 37 counties had 90% coverage or better. Four counties achieved 90% or better for VAR1, and 17 counties had at least 80% coverage.

## Coverage at School Entry

By school entry, the immunization rates reached at least 90% for DTaP4, Polio3, MMR1, and HepB3. For varicella, 87% of the children were vaccinated. Immunization coverage rates for Hib3 and PCV3 were the lowest of the single vaccines and are not required for school entry.

## Trends

Immunization coverage rates of children by 24 months of age increased each year from 1990-91 through 2000-01 and remained elevated for most single vaccines. Significant decreases in rates for DTaP4, Hib3, and 4-3-1-3-3 series occurred in 2001-02. Decreases in DTaP4 and the 4-3-1-3-3

series were due primarily to a shortage of the DTaP vaccine that occurred during 2001-2002. The rates for most single antigens have decreased and continue to decrease. Continued assessment and evaluation of the immunization rates are necessary to monitor progress toward the Healthy Kansas 2010 goal of 90% immunization coverage. Immunization is an important public health issue to increase herd immunity, reduce disease incidence and limit outbreaks.

# RETROSPECTIVE IMMUNIZATION COVERAGE SURVEY 2002-2003 (SCHOOL YEAR 2006-2007)

## INTRODUCTION

### **Objective**

This study was designed to estimate the immunization coverage rates of children at 24 months of age in Kansas by using kindergartners enrolled in public and private schools in the 2006-07 class. This study was also designed to estimate the immunization coverage rates of kindergartners at time of school entry.

### **Study Population**

The study population included all kindergarten students enrolled in both public and private schools in the 2006-07 school year. This is the first year that private schools were surveyed.

### **Study Design**

The study was a stratified, cross-sectional survey, with each county representing a stratum. The characteristics of interest, or outcome variables, were the percentages of children who were fully immunized against diphtheria, tetanus, pertussis, polio, measles, mumps, rubella, *H. influenzae* type b, hepatitis B virus, varicella, and pneumococcal disease. Coverage rates were assessed for these children at two points in time: 1) at 24 months of age; and 2) at school entry into kindergarten.

Immunization coverage rates were measured for single vaccines and combinations of vaccines according to the recommended immunization schedule for children by 24 months of age.<sup>1</sup> The schedule for 2001 is in Appendix 4. *The results of the survey refer to children who were born between September 2, 2000, and September 1, 2001. The coverage rates refer to the point in time at which these children turned 24 months old, between September 2, 2002, and September 1, 2003. Immunization coverage rates were also assessed at time of school entry for all kindergartners who were at least five years old and not older than seven upon entering school on September 1, 2006.*

## METHODS

### **Sampling Techniques**

A probability sample of all children enrolled in kindergarten in Kansas public schools was drawn. To ensure an adequate sample size in each county and to maximize the efficiency of the sampling process, a different sampling ratio was established for each county, and a probability sample was selected using a systematic sample technique.<sup>2</sup> Due to the small size of the private school population in Kansas, all records from private schools were solicited.

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<sup>1</sup> The Recommended Immunization Schedule used, as reference for ages and immunization in this paper was the schedule approved by the Advisory Committee on Immunization Practices (ACIP), the American Academy of Pediatrics (AAP) and the American Academy of Family Physicians (AAFP) for the year 2001.

<sup>2</sup> The sample ratio was the ratio between the total enrollment in a school and the sample size, and it represents the proportion of enrolled children who are sampled.

## Data Collection

All Kansas public and private schools with a kindergarten class received a letter co-signed by officials representing the Kansas Department of Health and Environment and the Kansas State Department of Education, requesting them to participate in the survey. For the public schools the letter specified the number of records required to generate estimates of county-specific coverage rates (i.e., sample size) and outlined the process of systematically selecting a probability sample of records. Depending on the calculated sampling ratio for their county, the study coordinator at each school (typically the school nurse) was instructed to start with the first record, then select all, every other, every third, every sixth, every seventeenth, or every nineteenth immunization record regardless of the size of the kindergarten class at that school. The private schools were instructed to select all immunization records. School administrators and school nurses were also advised to remove all personal identifiers, except date of birth, to ensure confidentiality of children. Date of birth was requested to calculate vaccine timing for each child. Copies of the immunization records and the current total number of kindergarten enrollees in each school were forwarded to KDHE.

## Data Analysis

For the 2006-07 Retrospective Survey, the data analysis methods were changed from previous years. In the 2006-07 analysis, all children who had a date of birth recorded on the Kansas Certificate of Immunization (KCI) and were the appropriate age for each analysis were included in the denominator. Point estimates of coverage rates and 95% confidence intervals (95% CI) for DTaP4, Polio3, MMR1, Hib3, HepB3, 4-3-1-3-3 combination, VAR1, and PCV3 vaccines were calculated. A child was considered “up-to-date” for single vaccines if, at age 24 months, he or she had received at least four doses of DTaP (DTaP4), three doses of Polio (Polio3), one dose of MMR (MMR1), three doses of *H. influenzae* type b (Hib3), three doses of hepatitis B (HepB3), one dose of varicella (VAR1) vaccine, and three doses of PCV3, respectively. A child was considered “up-to-date” for the 4-3-1-3-3 series if he or she was up-to-date for all: DTaP4, Polio3, MMR1, Hib3, and HepB3 vaccines. All children who indicated history of varicella were included in the denominator, but only those who reported history of vaccination were included in the numerator. The reason for this approach was that date of disease was not recorded so it could not be determined if the child had the disease before two years of age. The statewide estimates account for the complex sample design effect because of the stratification process and the differences in sampling ratios among counties.<sup>3</sup> Sample weights were calculated using the number of kindergartners enrolled in a county and the number of records analyzed for that county. These weights were applied during analysis of statewide and county-level estimates.

Population densities were calculated based on population from the 2000 census to categorize counties.<sup>4</sup> The 2000 census data correspond to the data in the current retrospective survey. For the purpose of this analysis, counties were grouped by population density into Urban, Moderately Populated, and Sparsely-Populated. (Appendix 1) Immunization coverage rate estimates were compared among these groups.

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<sup>3</sup> Complex survey design effect was accounted for by using the SAS Procedure PROC SURVEYFREQ.

<sup>4</sup> <http://www.census.gov/>

## **RESULTS**

### **Data Collection**

Letters of invitation to participate in the survey were sent to 836 Kansas public and private schools. There were 735 public schools and 102 private schools. Two schools reported not having a kindergarten class for the 2006-2007 school year and 44 did not respond. Data were received from and analyzed for 814 schools, 712 public schools and 102 private schools with kindergarten classes, corresponding to a school participation rate of 97.4%.

The number of children enrolled in kindergarten at the participating public and private schools was 37,422, which is 94% of the 38,832 children in that birth cohort.<sup>5</sup> The number of immunization records received was 16,083. This is equivalent to a sampling ratio of 2.3, meaning that one child was selected for every 2.3 children enrolled. The range of the sample size by county was from 11 to 1,175 records while the range of student enrollment was from 11 to 7,498.<sup>6</sup>

Of the 16,083 immunization records returned and examined, 15,267 (95%) were complete and had usable information regarding immunization history. The remaining excluded records had missing birth dates making them unusable. Of the records received, 13,362 (83 %) children were included in the 24 month old analysis because they were 5 years of age between September 2, 2000, and September 1, 2001. Of the records used in the analysis, less than 0.5% indicated that the child did not have vaccinations because of either medical or religious exemptions. For the analysis at kindergarten entry, 15,265 (95%) records were included for the children who were at least five and not older than seven years on August 31, 2006.

The number of records examined by population density includes: 4,357 (29% of all records) Sparsely-populated, 7,222 (47% of all records) Moderately-populated, and 3,688 (24% of all records) Urban categories. The birth cohort across the state of Kansas is 12% sparsely-populated, 32% moderately-populated and 55% urban.

### **Statewide Immunization Coverage by Age 24 Months**

The immunization coverage rates for the single vaccines significantly changed compared to the coverage rates of the previous year except for DTaP4 and MMR1. Polio3, Hib3, HepB3, and the 4-3-1-3-3 series all significantly decreased. VAR1 coverage rates have increased significantly each year since the analysis began and was the only coverage rate that significantly increased. The number of children protected from varicella did not statistically increase when history of varicella disease was included. Immunization coverage rates rose each year from 1990-91 through 2000-01 and then decreased significantly in 2001-02 and decreased again in 2002-03 for DTaP4, Hib3 and 4-3-1-3-3 as displayed in Figure 1. PCV3, which was measured for the first time, was 34.5% (Table 1).

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<sup>5</sup>2000 Annual Summary of Kansas Vital Statistics. (<http://www.kdheks.gov/ches>)

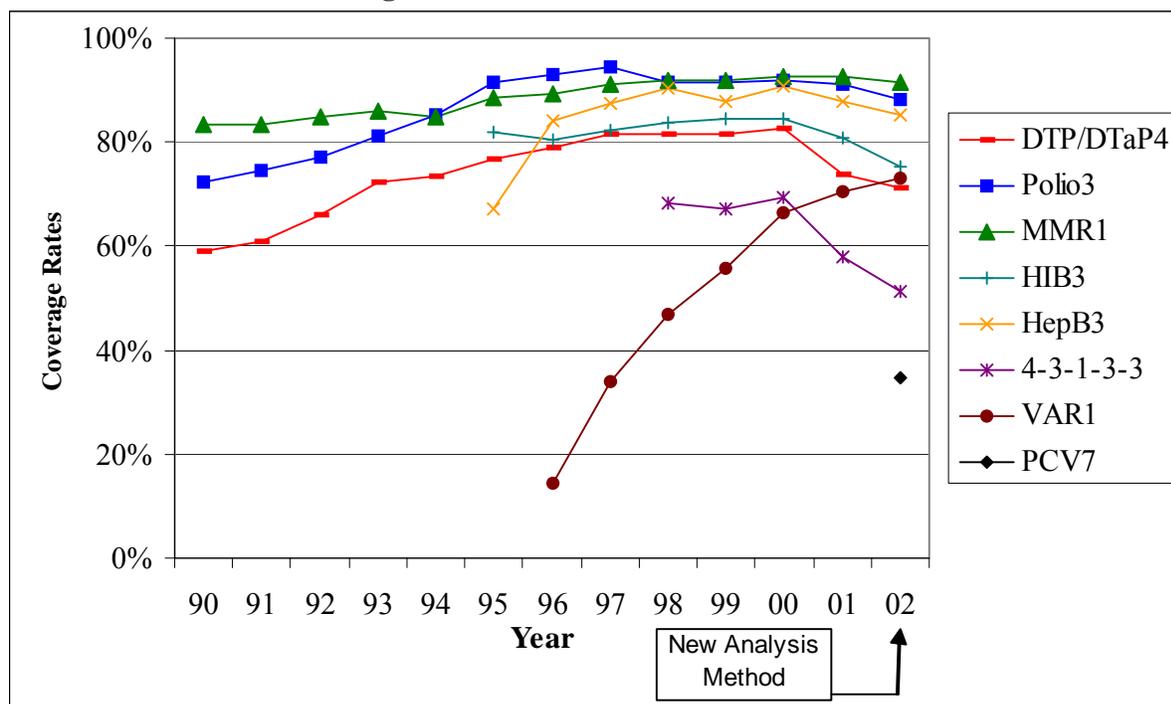
<sup>6</sup> Estimates from counties with small sample size (<50) may be unstable and changes over time should be interpreted with caution

**TABLE 1 Kansas immunization coverage rates at the age of 24 months by vaccine for 2002-2003.** \* Percentage up-to-date and 95% confidence interval

	Percent (%)	95% CI
DTaP4	71.4	70.1 – 72.7
Polio3	88.3	87.4 – 89.3
MMR1	91.4	90.6 – 92.2
Hib3	75.4	74.0 – 76.8
HepB3	85.4	84.4 – 86.5
4-3-1-3-3 Series	51.1	49.6 – 52.6
VAR1	73.2	71.9 – 74.4
PCV3	34.5	33.2 – 36.1

\* Based on retrospective surveys from school years starting in 2006.

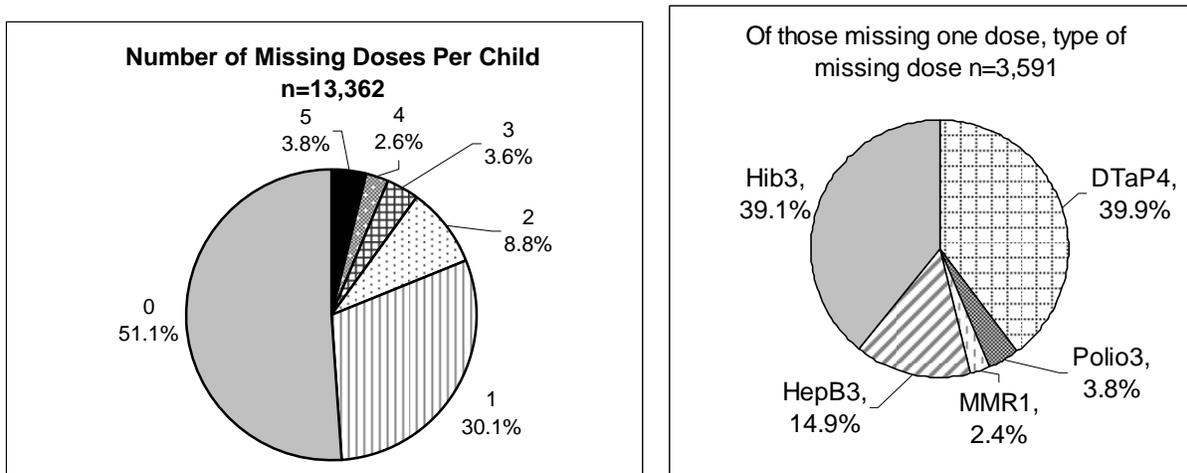
**FIGURE 1 Kansas immunization coverage rates at the age of 24 months by vaccine from 1990-91 through 2002-2003.** \*



\* Based on retrospective surveys from school years starting in 1994 through 2006.

Of children not up-to-date at 24 months of age, 62% (30% of total population studied) needed one additional immunization in order to be up-to-date for the 4-3-1-3-3 series (Figure 2). If these children had received one additional immunization, the coverage rates for the 4-3-1-3-3 series would have increased from 51.1% to 81.2%. Among children who needed one additional immunization, 40% needed DTaP4 (Figure 2). Among children not up-to-date at 24 months of age (2 years), 8% (4% of total population) were missing DTaP4, Polio3, MMR1, HepB3 and Hib3.

**FIGURE 2: Number and type of immunizations kindergartners needed to be up-to-date at the age of 24 months, Kansas 2001 - 2002. \***



\*Based on the retrospective survey for the school year starting 2006.

### County-level Immunization Coverage of 24 Month Olds

Immunization coverage was also analyzed at the county level. Immunization coverage by county for all vaccines and the 4-3-1-3-3 series is shown in Appendix 2.

Six counties reached the Healthy People goal of at least 80% coverage for the 4-3-1-3-3 series. These counties were all “sparsely populated” (Appendix 3). For DTaP4, one county had at least 90% coverage and 19 counties had at least 80% coverage. For IPV3, 47 counties had at least 90% coverage. For MMR1, 70 counties had 90% coverage or better. Four counties had at least 90% coverage for VAR1. Pockets of need were identified for DTaP4, MMR1, VAR1 and Hib3. Those counties with less than 90% coverage were primarily in the eastern half of the state.

Counties were categorized based on their population densities. Coverage rates of the densities were compared among three categories (Table 2). Counties that were “sparsely populated” had higher coverage rates for the 4-3-1-3-3 series than counties with greater population densities. (Moderately populated, Urban)

**TABLE 2 Kansas immunization coverage rates by peer group for 2002-2003**

Counties by Population Density – Condensed Groups n=13,362			
	Sparsely Populated (n=3,648)	Moderately Populated (n=6,411)	Urban (n=3,303)
DTaP4	70.4	66.9	74.2
Polio3	89.9	87.8	88.3
MMR1	92.1	91.1	91.4
Hib3	87.6	80.3	70.1
HepB3	87.8	85.8	84.7
4-3-1-3-3 Series	60.5	51.9	48.8
VAR1	67.6	68.1	77.2
PCV3	39.4	35.5	33.2

\* Based on retrospective surveys from school years starting in 2006.

### Statewide Immunization Coverage of Children at School Entry for Kindergarten

Immunization rates of kindergartners when they entered school were calculated (Table 3 and Figure 3). Of the 16,083 immunization records returned and examined, 15,265 (95%) were used to calculate immunization rates at kindergarten entry. To be included in the analysis a kindergartner had to be at least five years of age and not older than seven years by August 31, 2006.

By time of school entry, at least 90% of the children were up-to-date for DTaP4, Polio3, MMR1, and HepB3 (Table 3). The vaccination coverage rate for VAR1 was 91.5%, significantly up from last year's 88.5%. Three percent of the children had indicated history of varicella disease. Compared to last year's study, Polio3, Hib3, HepB3 and the 4-3-1-3-3 series were all significantly lower.

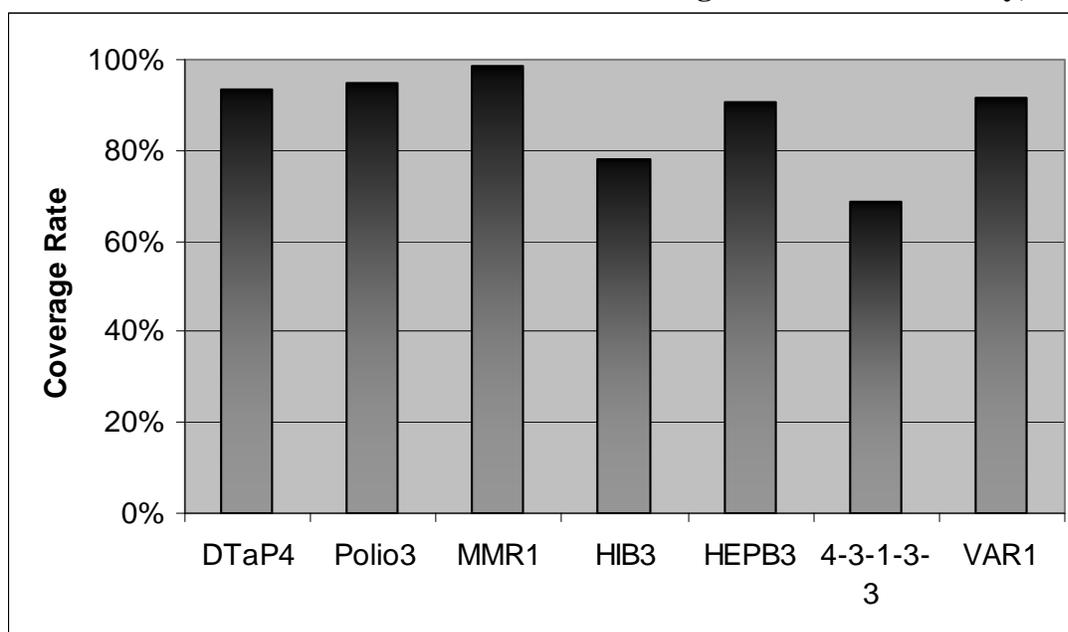
**Table 3 Immunization rates of Kansas kindergartners at school entry, 2006-07.**

\* Percentage up-to-date and 95% confidence interval

	2005-06		2006-07	
	%	95% CI	%	95% CI
DTaP4	94.0	94.4-96.7	93.6	92.9-94.2
Polio3	97.4	96.9-97.9	95.0	94.4-95.6
MMR1	97.6	97.0-98.1	98.5	98.1-98.8
HIB3	81.1	79.7-82.5	78.0	76.7-79.2
HEPB3	93.1	92.2-94.0	90.8	90.0-91.6
4-3-1-3-3	75.5	74.0-77.0	68.5	67.1-69.9
VAR1	88.5	87.5-89.5	91.5	90.8-92.2

\* Based on retrospective surveys from school years starting in 2006.

**FIGURE 3 Immunization rates of Kansas kindergartners at school entry, 2006-07. \***



\*Based on the retrospective survey for the school year starting 2006

## DISCUSSION

Statewide immunization coverage rates by age 24 months statistically decreased from last year for Polio3, Hib3, HepB3 and the 4-3-1-3-3 series in the current 2006-2007 Retrospective Survey. Despite only 73% coverage for VAR1, rates have significantly increased each year since analysis began in 2000. Since the children were five years old when this study was carried out, the results of the survey indicate the immunization coverage rates that were effective about three years earlier. Only immunization coverage rates for MMR1 reached the Healthy People 2010 (HP2010) goal of at least 90% coverage. The coverage rates for Polio3 and HepB3 were less than 10 percentage points from meeting this goal.<sup>7</sup> Immunizations against *H. influenzae* type B (Hib3) were not required for school entry for the 2006-2007 school year and thus not always recorded in the KCI. For this reason the immunization coverage rates might actually be higher than those represented in the data.

The immunization coverage rates for the 2006-07 Retrospective Survey are lower than the previous few years due to a few key factors. Possible reasons for the change in immunization rates include: change in methodology, DTaP deferral because of vaccine shortage, and the addition of private schools. The change in methodology and the DTaP deferral were the two factors that lowered the rates. The addition of private schools did not negatively affect the coverage rates. When analyzed separately, the rates at private schools were higher than in public schools.

The deferral period of the 4th dose of DTaP was from March 2001 - July 2002. Included in this study were children born September 2000- September 2001, so there is a small time period of overlap. As seen in deferrals of other vaccines (e.g., the birth dose of HepB, which took over 1 year to return to similar coverage levels) the reinstatement of the vaccine does not always happen quickly after the cause of the deferral has abated.

For the 2006-07 Retrospective Survey, the methodologies were changed. Previously, children were included in the analysis only if they had all of the following: four doses of DTaP, three doses of Polio, one dose of MMR, if the dates for these three vaccine series were in chronological order, their vaccination dates were after their date of birth, and if they were five years old while in kindergarten. To be included in the numerator for the old method, a child had to have received all (DTaP4, Polio3, MMR1) of the vaccinations by 24 months of age. For the 2006-07 Retrospective, all of the children who were five years old while in kindergarten were included in the denominator and each of the vaccines was analyzed separately. This method had a larger denominator, which would decrease the rates alone. However, when analyzed with the previously used method, the rates were still lower than last year. The new method is a more accurate representation of the vaccination rates among all young children in Kansas and does not select out only those for whom there is complete information.

Six counties reached the Healthy People goal of at least 80% coverage for the 4-3-1-3-3 series. These counties were all “sparsely populated” (Appendix 3). For Polio3, 47 counties had 90% or greater coverage. For MMR1, 70 counties had 90% coverage or better. For HepB3, 37 counties had 90% coverage or better. Four counties achieved 90% or better for VAR1, and 17 counties had at least 80% coverage. Those counties that had less than 90% coverage rates were clustered in the eastern half of Kansas.

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<sup>7</sup>Healthy People 2010 set goals of 90% coverage for DTaP4, Polio3, MMR1, HIB3, HepB3, and VAR1 and 80% coverage for 4-3-1-3-3 series among children aged 19 to 35 months.

County designations are used to create categories by population. The coverage rate estimates are compared to determine if differences exist among the counties of different population densities. For the 4-3-1-3-3 series, the coverage rate of the “sparsely populated” counties was statistically higher compared to the “moderately populated” and “urban” counties. The moderately populated and urban rates were not statistically different from each other. The “sparsely populated” counties account only for 12% of the population surveyed. Compared to the coverage rate estimates of the other two categories (moderately populated, urban), the coverage rate estimate for the “sparsely populated” category was highest for the 4-3-1-3-3 series, Polio3, MMR1, Hib3, HepB3 and PCV3. “Sparsely populated” had the lowest rate for Var1. The “moderately populated” category, which covers 32% of the population surveyed, had the lowest coverage estimates for DTaP4, Polio3 and MMR1. The moderately populated counties did not have the highest rate for any vaccine or series. “Urban”, which includes the most densely populated counties and represents 55% of the population surveyed, had the lowest coverage rate estimate for Hib3, HepB3, the 4-3-1-3-3 series and PCV3. The Urban category had the highest rate for DTaP4 and Var1. Targeting the population in the 5 urban counties in order to increase vaccination coverage would increase the statewide coverage rate since 55% of the population lives in these five counties.

The results from this survey were compared with the results from the 2003 National Immunization Survey (NIS), which refers to the same time period in this retrospective survey.<sup>8</sup> The results were compared to confirm the coverage rates in the retrospective survey and to compare coverage rates in Kansas to the rest of the US. Data for the population-based NIS are collected by the Centers for Disease Control and Prevention (CDC) through a telephone survey of randomly selected households. For accuracy, the healthcare providers of the children included in the survey are contacted by mail. The coverage rate for the 4-3-1-3-3 series was statistically lower in the Retrospective survey (51.2 [95% CI 49.6 – 52.6]) when compared to the NIS result (75.7 [95%CI 69.6 – 81.8]) for Kansas. Possible reasons for the difference in rates are that Hib3 is not required for school entry and may not be routinely recorded on the KCIs, and differences in sampling methodologies. The NIS also covers children between 19-35 months of age, while this study stops at 24 months. The extended period of time for the NIS could account for the difference in rates.

Immunization coverage rates were also examined for kindergartners when they entered school and were at least five years old but not older than seven years. By school entry, at least 90% of the children had received DTaP4, Polio3, MMR1, and HepB3. For varicella, 91.5% of the children had been immunized by school entry. School entry requirements are the most likely reason for this increase. Hib3 and PCV3 are age sensitive vaccines, meaning that if a child does not receive the vaccine by age five years they do not need to receive the vaccine. They are also not required for school entry, so rates are potentially lower due to lack of reporting on the KCI.

Vaccine coverage is important for public health reasons. By increasing vaccination rates the herd immunity also increases. With a higher herd immunity incidence rates decrease, outbreaks are easier to stop and do not become as large. In 2006, a widespread outbreak of mumps happened in Kansas and across the United States. The outbreak came after historical lows and rates of infection were still lower than pre-vaccine era. Due to high vaccine coverage rates, tens or hundreds of thousands of cases were possibly prevented.

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<sup>8</sup> *Morbidity and Mortality Weekly Report*; July 30, 2004 / 53(29);658-661.

**Limitations**

Limitations of this survey include: the survey reports data that refer to immunization coverage rates that occurred three years before the survey. Also, no descriptive data are collected about sex, race, or ethnicity.

**Strengths**

Despite the limitations, the retrospective immunization survey provides a good estimation of the early childhood immunization coverage rates for Kansas. It allows state and local officials to identify and focus on the counties with low coverage rates. Recognition and focus on problem areas such as age and location can aid in Kansas achieving the 90% coverage rate goal. To this purpose, a similar survey is planned for next year.

**Appendix 1:** Kansas counties categorized based on population density, 2000.

<b>Sparsely Populated</b>	
Anderson	Marion
Barber	Marshall
Brown	Morris
Chase	Morton
Chautauqua	Nemaha
Cheyenne	Ness
Clark	Norton
Clay	Osborne
Cloud	Ottawa
Coffey	Pawnee
Comanche	Phillips
Decatur	Pratt
Edwards	Rawlins
Elk	Republic
Ellsworth	Rice
Gove	Rooks
Graham	Rush
Grant	Russell
Gray	Scott
Greeley	Sheridan
Greenwood	Sherman
Hamilton	Sherman
Harper	Smith
Haskell	Stafford
Hodgeman	Stanton
Jackson	Stevens
Jewell	Thomas
Kearny	Trego
Kingman	Wabaunsee
Kiowa	Wallace
Lane	Washington
Lincoln	Wichita
Linn	Wilson
Logan	Woodson

<b>Moderately Populated</b>
Allen
Atchison
Barton
Bourbon
Butler
Cherokee
Cowley
Crawford
Dickinson
Doniphan
Ellis
Finney
Ford
Franklin
Gearly
Harvey
Jefferson
Labette
Leavenworth
Lyon
McPherson
Miami
Montgomery
Neosho
Osage
Pottawatomie
Reno
Riley
Saline
Seward
Sumner

<b>Urban</b>
Douglas
Johnson
Sedgwick
Shawnee
Wyandotte

Persons per Square Mile in Peer Groups  
 Sparsely Populated = <6 – 19.9  
 Moderately Populated = 20 – 149.9  
 Urban = ≥ 150.0



**APPENDIX 2:** Immunization Coverage Rates of Children 24 Months of Age for Kansas Counties 2006-2007.\*

COUNTY	DTP4	IPV3	MMR1	HIB3	HEPB3	4-3-1-3-3	VAR1	PCV3
<b>KS</b>	<b>71.4</b>	<b>88.3</b>	<b>91.4</b>	<b>75.4</b>	<b>85.4</b>	<b>51.1</b>	<b>85.4</b>	<b>34.5</b>
ALLEN	60.5	85.5	86.8	84.2	82.9	48.0	55.3	22.4
ANDERSON	53.7	84.2	85.3	85.3	81.1	44.2	66.3	35.8
ATCHISON	74.9	86.3	85.7	86.9	82.3	61.1	46.3	8.6
BARBER	81.4	100.0	93.0	93.0	95.3	67.4	74.4	53.5
BARTON	71.2	93.5	96.0	77.3	88.8	58.6	81.3	22.3
BOURBON	72.5	85.7	91.8	91.2	89.0	62.6	58.8	55.5
BROWN	73.6	91.2	86.8	86.8	89.0	62.6	37.4	4.4
BUTLER	71.0	88.0	89.5	85.4	85.2	60.4	69.6	27.3
CHASE	75.8	90.9	90.9	84.8	87.9	69.7	42.4	18.2
CHAUTAUQUA	60.0	86.7	86.7	80.0	80.0	53.3	60.0	6.7
CHEROKEE	56.1	77.2	90.0	79.4	79.4	47.8	71.7	36.7
CHEYENNE	86.2	96.6	96.6	96.6	93.1	82.8	79.3	75.9
CLARK	69.6	87.0	82.6	91.3	95.7	60.9	56.5	56.5
CLAY	67.1	84.2	93.4	80.3	82.9	50.0	81.6	46.1
CLOUD	69.9	97.6	96.4	89.2	92.8	60.2	84.3	72.3
COFFEY	74.3	87.6	95.6	92.0	90.3	69.9	72.6	46.9
COMANCHE	84.6	92.3	92.3	92.3	92.3	80.8	76.9	46.2
COWLEY	47.9	89.5	90.8	48.3	88.9	22.0	48.1	18.2
CRAWFORD	62.2	86.6	88.3	85.0	81.2	50.5	46.7	9.9
DECATUR	36.4	81.8	86.4	81.8	81.8	36.4	36.4	31.8
DICKINSON	78.4	85.2	93.6	90.0	92.4	66.4	80.8	71.6
DONIPHAN	77.1	86.7	90.4	84.3	85.5	59.0	59.0	15.7
DOUGLAS	68.6	88.8	90.5	84.8	86.0	54.4	79.3	37.2
EDWARDS	76.7	96.7	96.7	93.3	96.7	73.3	90.0	73.3
ELK	68.4	89.5	89.5	84.2	84.2	63.2	73.7	47.4
ELLIS	80.7	90.0	94.8	83.0	91.5	68.1	73.3	35.9
ELLSWORTH	62.7	89.6	97.0	88.1	83.6	52.2	76.1	58.2
FINNEY	62.0	88.2	89.0	84.1	89.0	53.7	73.2	51.2
FORD	68.7	89.1	94.8	88.2	65.0	42.1	72.1	43.6
FRANKLIN	55.4	85.3	95.9	86.8	83.6	42.8	77.7	43.1
GEARY	64.2	84.8	87.6	80.9	83.3	50.0	78.0	29.4
GOVE	73.9	78.3	82.6	87.0	73.9	56.5	47.8	39.1
GRAHAM	76.9	92.3	100.0	100.0	92.3	76.9	84.6	46.2
GRANT	63.4	85.5	88.5	85.5	87.0	60.3	61.1	49.6
GRAY	66.7	88.5	93.1	87.4	95.4	62.1	71.3	19.5
GREELEY	70.0	100.0	100.0	100.0	90.0	60.0	70.0	100.0
GREENWOOD	64.2	87.7	82.7	80.2	80.2	43.2	61.7	19.8
HAMILTON	84.2	94.7	92.1	92.1	89.5	73.7	78.9	71.1
HARPER	62.7	91.5	91.5	96.6	78.0	50.8	64.4	15.3
HARVEY	75.0	90.8	88.8	73.2	88.2	49.1	63.2	41.9
HASKELL	59.2	87.8	89.8	89.8	83.7	59.2	79.6	22.4

COUNTY	DTP4	IPV3	MMR1	HIB3	HEPB3	4-3-1-3-3	VAR1	PCV3
HODGEMAN	81.8	90.9	90.9	90.9	81.8	72.7	72.7	81.8
JACKSON	80.3	86.6	93.7	78.7	82.7	59.1	48.8	14.2
JEFFERSON	71.3	87.6	92.3	88.5	88.0	56.9	71.8	50.7
JEWELL	35.7	92.9	92.9	78.6	92.9	28.6	71.4	35.7
JOHNSON	82.3	93.5	94.7	61.1	90.0	46.6	84.6	38.6
KEARNY	67.3	83.7	87.8	91.8	91.8	61.2	71.4	59.2
KINGMAN	69.9	88.0	86.7	86.7	79.5	56.6	68.7	31.3
KIOWA	80.6	93.5	93.5	87.1	87.1	71.0	64.5	38.7
LABETTE	66.4	86.2	85.7	41.9	91.2	32.7	68.7	26.3
LANE	93.8	100.0	100.0	87.5	93.8	81.3	100.0	87.5
LEAVENWORTH	64.2	81.5	85.9	59.3	80.2	34.8	75.2	23.8
LINCOLN	59.3	100.0	100.0	96.3	14.8	11.1	14.8	11.1
LINN	70.7	86.2	94.0	82.8	80.2	56.0	59.5	13.8
LOGAN	74.1	92.6	92.6	92.6	92.6	74.1	29.6	37.0
LYON	63.7	95.0	96.4	90.3	88.5	51.5	38.8	14.2
MARION	81.7	91.5	92.7	86.6	95.1	65.9	65.9	13.4
MARSHALL	76.7	91.3	95.1	93.2	89.3	71.8	59.2	63.1
MCPHERSON	59.4	92.3	92.6	45.8	83.7	26.8	78.2	20.6
MEADE	67.5	87.5	92.5	85.0	90.0	62.5	72.5	75.0
MIAMI	70.5	85.4	92.2	84.1	87.2	59.3	66.1	18.3
MITCHELL	52.5	93.2	98.3	94.9	94.9	49.2	66.1	72.9
MONTGOMERY	64.7	89.0	91.9	88.2	84.3	55.4	76.5	33.8
MORRIS	59.1	89.4	89.4	87.9	87.9	50.0	69.7	37.9
MORTON	74.4	86.0	97.7	95.3	95.3	67.4	88.4	23.3
NEMAHA	79.1	89.9	90.6	84.9	91.4	67.6	46.0	23.7
NEOSHO	65.8	84.8	96.2	51.9	84.8	34.2	62.0	10.1
NESS	71.4	95.2	95.2	85.7	95.2	66.7	90.5	33.3
NORTON	84.7	89.8	94.9	79.7	93.2	66.1	78.0	57.6
OSAGE	75.5	93.2	93.2	68.0	88.4	50.3	60.5	24.5
OSBORNE	88.0	96.0	100.0	100.0	92.0	80.0	80.0	32.0
OTTAWA	62.1	93.1	94.8	86.2	96.6	55.2	72.4	60.3
PAWNEE	86.4	98.3	98.3	98.3	94.9	83.1	93.2	81.4
PHILLIPS	81.5	94.4	96.3	94.4	92.6	72.2	64.8	51.9
POTTAWATOMI	75.0	82.9	88.6	85.1	85.5	67.1	64.9	45.6
PRATT	63.9	93.3	89.9	89.1	87.4	58.0	67.2	16.0
RAWLINS	71.4	92.9	92.9	71.4	85.7	64.3	71.4	57.1
RENO	75.1	86.4	91.7	87.2	87.1	61.1	76.6	59.5
REPUBLIC	63.6	93.2	100.0	95.5	93.2	61.4	75.0	86.4
RICE	64.4	84.6	87.5	77.9	84.6	51.0	67.3	24.0
RILEY	66.4	86.0	89.6	82.9	88.2	52.9	81.6	43.6
ROOKS	85.0	97.5	97.5	95.0	97.5	82.5	80.0	12.5
RUSH	75.0	83.3	83.3	66.7	83.3	58.3	50.0	
RUSSELL	72.4	81.0	84.5	77.6	75.9	60.3	55.2	1.7
SALINE	71.8	90.1	92.3	85.4	89.6	60.6	81.3	54.3

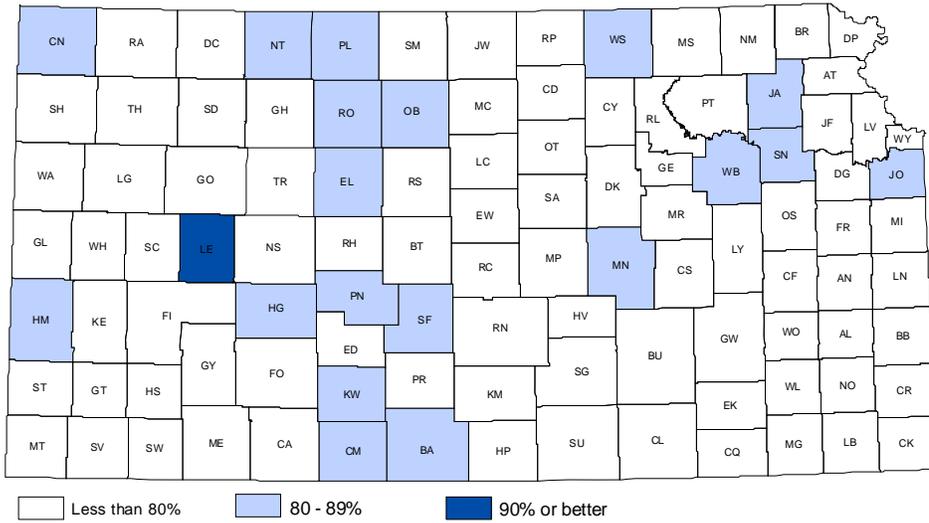
COUNTY	DTP4	IPV3	MMR1	HIB3	HEPB3	4-3-1-3-3	VAR1	PCV3
SCOTT	73.5	97.1	94.1	100.0	100.0	73.5	88.2	70.6
SEDGWICK	72.5	85.0	89.4	76.7	80.9	52.1	71.3	31.6
SEWARD	59.5	86.8	90.5	79.5	88.4	53.2	71.6	45.3
SHAWNEE	81.2	91.2	92.4	85.4	84.5	63.4	72.0	35.9
SHERIDAN	71.4	85.7	92.9	78.6	78.6	42.9	50.0	35.7
SHERMAN	64.8	83.1	93.0	87.3	91.5	52.1	80.3	35.2
SMITH	65.6	90.6	87.5	87.5	87.5	46.9	84.4	68.8
STAFFORD	81.3	95.8	95.8	89.6	97.9	75.0	83.3	70.8
STANTON	48.6	97.3	97.3	100.0	94.6	45.9	81.1	64.9
STEVENS	66.2	76.1	85.9	71.8	87.3	52.1	56.3	15.5
SUMNER	54.3	84.6	91.3	83.9	89.4	39.8	36.2	16.9
THOMAS	66.7	87.5	97.2	94.4	90.3	56.9	72.2	38.9
WABAUNSEE	86.0	98.0	92.0	92.0	88.0	74.0	70.0	48.0
WALLACE	69.6	91.3	91.3	87.0	82.6	60.9	73.9	39.1
WASHINGTON	80.3	95.5	95.5	93.9	92.4	71.2	80.3	53.0
WICHITA	59.3	100.0	100.0	100.0	85.2	55.6	70.4	81.5
WILSON	64.7	87.9	88.8	77.6	82.8	50.0	63.8	17.2
WOODSON	67.7	90.3	87.1	90.3	87.1	64.5	77.4	35.5
WYANDOTTE	54.1	81.3	88.3	62.9	81.2	35.2	76.1	20.9

\* Based on the retrospective survey for the school year starting 2006.

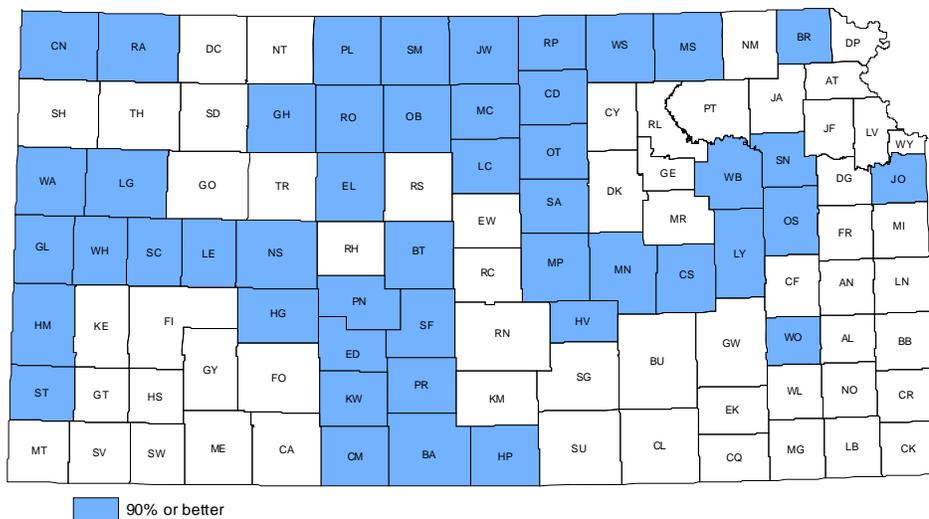
\*\*No schools reported data from Trego county.

**Appendix 3:** Kansas maps of counties with at least 90% or better immunization coverage by age 24 months for individual vaccines and 80% for 4-3-1-3-3 Series, 2006-07 Retrospective Survey.

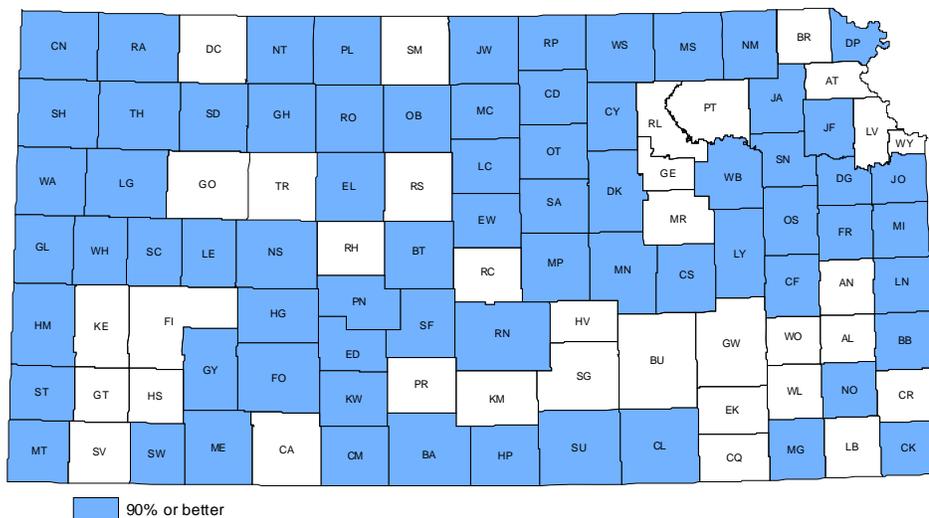
DTP4 Series for Retrospective Survey 2006-07



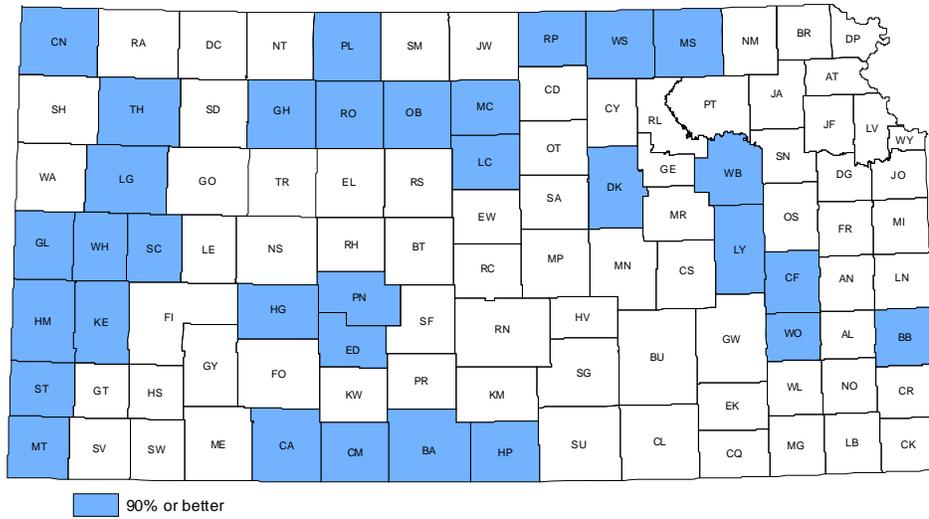
### Polio3 Series for Retrospective Survey 2006-07



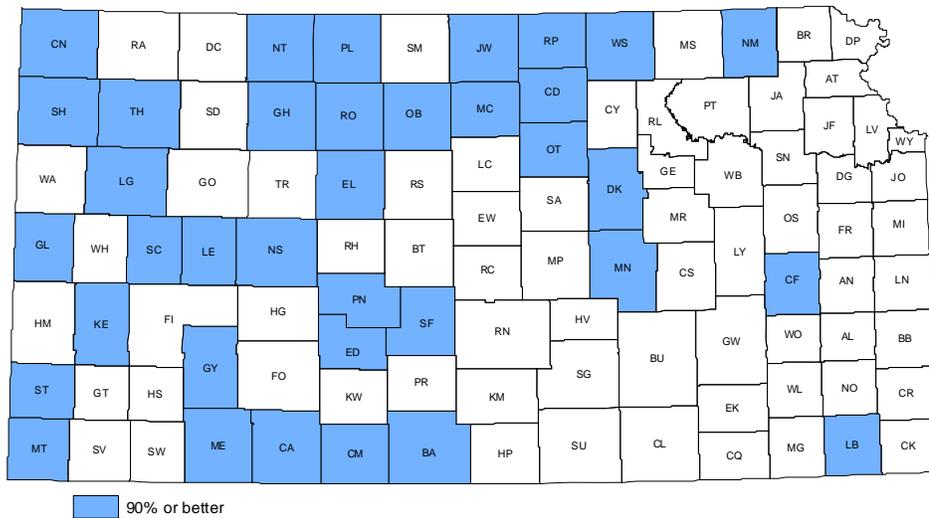
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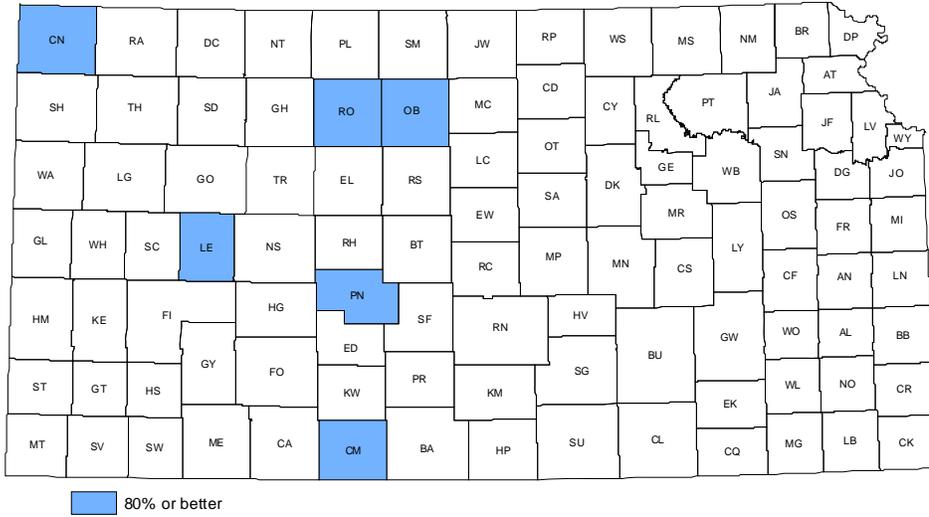
### Hib3 Series for Retrospective Survey 2006-07



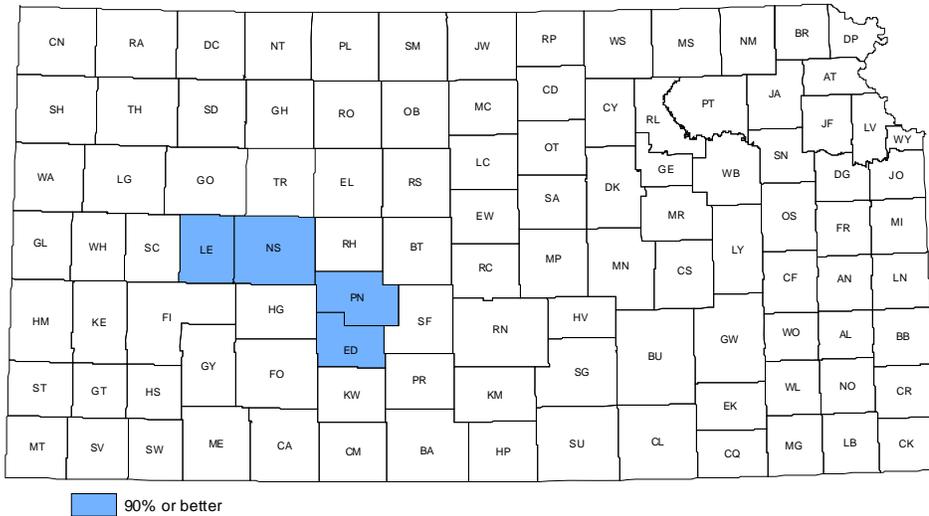
### HepB3 Series for Retrospective Survey 2006-07



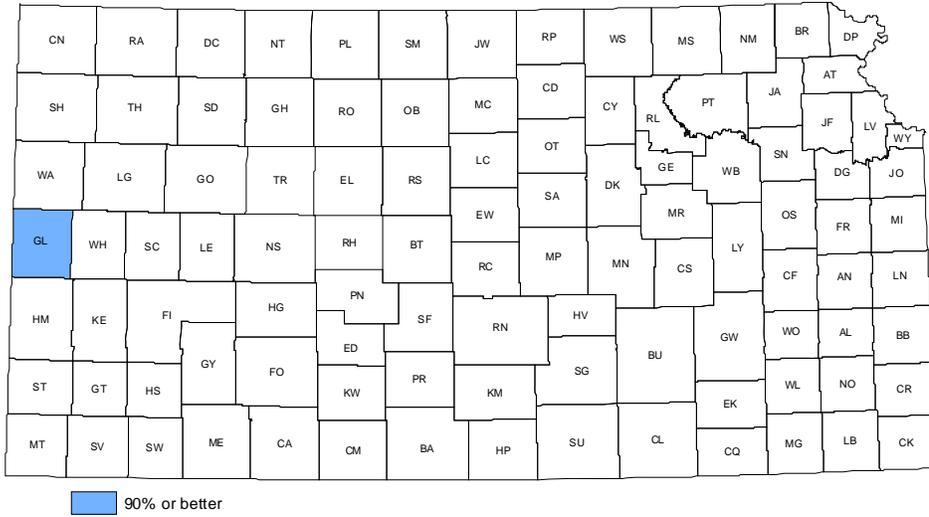
### 4-3-1-3-3 Series for Retrospective Survey 2006-07



### Var1 Series for Retrospective Survey 2006-07



### PCV3 Series for Retrospective Survey 2006-07



## Appendix 4: CDC's Advisory Committee on Immunization Practices (ACIP) Recommendations <<http://www.cdc.gov/mmwr/preview/mmwrhtml/mm5001a3.htm>>

FIGURE 1. Recommended childhood immunization schedule\* – United States, January–December 2001

Vaccine	Age											
	Birth	1 mo	2 mos	4 mos	6 mos	12 mos	15 mos	18 mos	24 mos	4–6 yrs	11–12 yrs	14–18 yrs
Hepatitis B <sup>f</sup>	Hep B #1		Hep B #2		Hep B #3							Hep B
Diphtheria and tetanus toxoids and pertussis <sup>g</sup>		DTaP	DTaP	DTaP			DTaP			DTaP		Td
H. Influenzae type b <sup>f</sup>		Hib	Hib	Hib		Hib						
Inactivated Polio <sup>h</sup>		IPV	IPV	IPV					IPV			
Pneumococcal conjugate		PCV	PCV	PCV		PCV						
Measles-mumps-Rubella <sup>i</sup>						MMR			MMR		MMR	
Varicella <sup>h</sup>						Var					Var	
Hepatitis A <sup>h</sup>									Hep A in selected areas			

 Range of recommended ages for vaccination.  
 Vaccines to be given if previously recommended doses were missed or were given earlier than the recommended minimum age.  
 Recommended in selected states and/or regions.

\* This schedule indicates the recommended ages for routine administration of currently licensed childhood vaccines as of November 1, 2000, for children through age 18 years. Additional vaccines may be licensed and recommended during the year. Licensed combination vaccines may be used whenever any components of the combination are indicated and the vaccine's other components are not contraindicated. Providers should consult the manufacturer's package inserts for detailed recommendations.

<sup>f</sup> **Infants born to hepatitis B surface antigen (HBsAg)-negative mothers** should receive the first dose of hepatitis B vaccine (Hep B) by age 2 months. The second dose should be administered at least 1 month after the first dose. The third dose should be administered at least 4 months after the first dose and at least 2 months after the second dose, but not before age 6 months. **Infants born to HBsAg-positive mothers** should receive Hep B and 0.5 mL hepatitis B immune globulin (HBIG) within 12 hours of birth at separate sites. The second dose is recommended at age 1–2 months and the third dose at age 6 months. **Infants born to mothers whose HBsAg status is unknown** should receive Hep B within 12 hours of birth. Maternal blood should be drawn at delivery to determine the mother's HBsAg status; if the HBsAg test is positive, the infant should receive HBIG as soon as possible (no later than age 1 week). **All children and adolescents (through age 18 years)** who have not been immunized against hepatitis B should begin the series during any visit. Providers should make special efforts to immunize children who were born in or whose parents were born in areas of the world where hepatitis B virus infection is moderately or highly endemic.

<sup>g</sup> The fourth dose of diphtheria and tetanus toxoids and acellular pertussis vaccine (DTaP) may be administered as early as age 12 months, provided 6 months have elapsed since the third dose and the child is unlikely to return at age 15–18 months. Tetanus and diphtheria toxoids (Td) is recommended at age 11–12 years if at least 5 years have elapsed since the last dose of diphtheria and tetanus toxoids and pertussis vaccine (DTP), DTaP, or diphtheria and tetanus toxoids (DT). Subsequent routine Td boosters are recommended every 10 years.

<sup>h</sup> Three *Haemophilus influenzae* type b (Hib) conjugate vaccines are licensed for infant use. If Hib conjugate vaccine (PRP-OMP) [PedvaxHIB or ComVax (Merck)] is administered at ages 2 and 4 months, a dose at age 6 months is not required. Because clinical studies in infants have demonstrated that using some combination products may induce a lower immune response to the Hib vaccine component, DTaP/Hib combination products should not be used for primary immunization in infants at ages 2, 4 or 6 months unless approved by the Food and Drug Administration for these ages.

<sup>h</sup> An all-inactivated poliovirus vaccine (IPV) schedule is recommended for routine childhood polio vaccination in the United States. All children should receive four doses of IPV at age 2 months, age 4 months, between ages 6 and 18 months, and between ages 4 and 6 years. Oral poliovirus vaccine should be used only in selected circumstances (7).

<sup>i</sup> The heptavalent pneumococcal conjugate vaccine (PCV) is recommended for all children age 2–23 months. It is also recommended for certain children age 24–59 months (2).

<sup>i</sup> The second dose of measles, mumps, and rubella vaccine (MMR) is recommended routinely at age 4–6 years but may be administered during any visit, provided at least 4 weeks have elapsed since receipt of the first dose and that both doses are administered beginning at or after age 12 months. Those who previously have not received the second dose should complete the schedule no later than the routine visit to a health-care provider at age 11–12 years.

<sup>h</sup> Varicella vaccine (Var) is recommended at any visit on or after the first birthday for susceptible children, (i.e., those who lack a reliable history of chickenpox [as judged by a health-care provider] and who have not been immunized). Susceptible persons aged ≥13 years should receive two doses given at least 4 weeks apart.

<sup>h</sup> Hepatitis A vaccine (Hep A) is recommended for use in selected states and/or regions, and for certain high-risk groups. Information is available from local public health authorities (3).

Additional information about the immunization schedule is available on the National Immunization Program World-Wide Web site, <http://www.cdc.gov/nip>, or by telephone, (800)232-2522 (English) or (800)232-0233 (Spanish).