

# RETROSPECTIVE IMMUNIZATION COVERAGE SURVEY

2000- 2001 Results (School Year 2004-05)



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## **ACRONYMS**

4-3-1 Combination	DTP4-Polio3-MMR1
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
DTP4	4 doses of diphtheria, tetanus, and pertussis vaccine
HEPB3	3 doses of hepatitis B vaccine
HIB3	3 doses of <i>Haemophilus influenzae</i> type b
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
Polio3	3 doses of polio vaccine
VAR1	1 dose of varicella vaccine

# **RETROSPECTIVE IMMUNIZATION COVERAGE SURVEY 2000-2001 (SCHOOL YEAR 2004-2005)**

## **EXECUTIVE SUMMARY**

The Kansas Certificates Immunization (KCI) for children five-years of age enrolled in a kindergarten class in a Kansas public school during the 2004-2005 school year were collected and evaluated for immunization coverage rates. The children included in this survey were born between September 2, 1998, and September 1, 1999, and the coverage rates refer to when they were two years old, between September 2, 2000, and September 1, 2001. Immunization coverage rates are calculated for these children at 5 years of age. The results for this survey are measured against similar previous studies. Seven hundred and eleven schools were included in the analysis. The 9,991 KCIs are a representative sample of the five-year old enrolled kindergarten at a public school.

The statewide coverage rate for the 4-3-1 series (that is, DTP4, Polio3, MMR1) was 80%. This was the first school year in which kindergartners were required to be vaccinated for hepatitis B and varicella or have a history of having varicella. By two years of age, the coverage rate for HepB3 was 91% and for varicella 67%.

Peer groups of counties were regrouped from 5 categories to 3. Mean coverage rate estimates were compared among these groups. Counties that were “sparsely populated” had higher mean coverage rates than counties with greater population densities (Moderately populated, Urban).

Fourteen counties reached the goal of at least 90% coverage for the 4-3-1 series. These counties were clustered in the northwest portion of Kansas. All of these counties were “sparsely populated” except for 1 “moderately populated” county. For DTP4 the 18 counties that had at least 90% coverage were in the northwest and north central portions of Kansas.

By 5 years of age, the immunization rates reached at least 95% for DTP4, Polio3, MMR1, and HepB3. For varicella, 79% of the children were vaccinated. A total of 81% of 5 year old children were no longer at risk for varicella either through vaccination or previous infection of varicella.

Overall, Kansas immunization coverage rates of children by two years of age for the 4-3-1 combination have steadily increased from 57% in 1990-1991 school year to 80% in 2004-2005 school year. Continued assessment and evaluation of the immunization rates are necessary to monitor progress toward the Healthy Kansas 2010 goal of 90% immunization coverage.

# **RETROSPECTIVE IMMUNIZATION COVERAGE SURVEY 2000-2001 (SCHOOL YEAR 2004-2005)**

## **INTRODUCTION**

### **Objective**

Estimate the immunization coverage rates at the age of two years for children enrolled in the Kansas public school system during the 2004-05 school year.

### **Study Population**

The study population include all children enrolled in kindergarten in the Kansas public school system during the 2004-2005 school year.

### **Study Design**

The study is a stratified, cross-sectional survey, with each county representing a stratum. The characteristics of interest, or outcome variables, are the percentage of children who were fully immunized at two years of age against the diphtheria, tetanus, pertussis, polio, measles, mumps, rubella, *H. influenza*, hepatitis B virus, and varicella. Also, this is the first year to examine immunization coverage rates at five years of age.

Immunization coverage rates are measured for single vaccines and combinations of vaccines according to the recommended immunization schedule for children two years of age.<sup>1</sup> *The results of the survey refer to children who were born between September 2, 1998, and September 1, 1999. The coverage rates refer to the time these children were two-years-old, between September 2, 2000, and September 1, 2001 and coverage rates at five years of age upon first entering school.*

Similar studies have been performed every year since 1990, except for the 1991-92 school year. Confidence intervals (CI) have been calculated since the 1994-95 school year.

## **METHODS**

### **Sampling Techniques**

The survey is based on a probability sample of children enrolled in all Kansas public schools with a kindergarten class. To ensure an adequate sample size in each county and maximize the efficiency of the sampling process, a different sampling ratio is established for each county, and a probability sample is selected using a systematic sample technique.<sup>2</sup>

### **Data Collection**

All Kansas public schools with a kindergarten class received a letter co-signed by the Kansas Department of Health and Environment and Kansas Department of Education, requesting them

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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 1999.

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

to participate in the survey. 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, each school was instructed to select all, every other, every third, every sixth, every fourteenth, or every sixteenth immunization record regardless of the size of the kindergarten class at that school. School administrators and school nurses were also advised to remove all personal identifiers, except date of birth, to ensure confidentiality of children. Copies of the immunization records and the current total number of kindergarten enrollees in each school were forwarded to KDHE.

### **Data Analysis**

Point estimates of coverage rates and 95% confidence intervals (95% CI) for DTP4, Polio3, MMR1, 4-3-1 combination, HIB3, HEPB3, and VAR1 vaccines are calculated. A child is considered “up-to-date” for single vaccines if, at age two years, he or she had received at least four doses of DTP, (DTP4), three doses of Polio (Polio3), one dose of MMR (MMR1), three doses of *H. influenza* type b (HIB3), three doses of Hepatitis B (HEPB3), and one dose of the varicella (VAR1) vaccine. A child is considered “up-to-date” for the 4-3-1 series if he or she was up-to-date for all: DTP4, Polio3, and MMR1 vaccines. The statewide estimates account for the complex survey design effect due to the stratification process and to the differences in sampling ratios among counties.<sup>3</sup>

The rates from the 2002-03 and 2003-04 school year surveys are compared. Differences between estimates are considered significant if the 95% CI of the current year does not overlap with the 95% CI of the previous year.

Population densities are calculated based on population from the 1999 Annual Summary of Vital Statistics to categorize counties.<sup>4</sup> The 1999 vital statistics data corresponds to the data in the current retrospective survey. These categories include Urban, Semi-Urban, Densely-Populated, Rural, and Frontier. For the purpose of this analysis, these categories are regrouped into Urban (Urban), Moderately Populated (Semi-Urban, Densely-Populated) and Sparsely-Populated (Rural, Frontier). Mean immunization coverage rate estimates are compared among these groups (Appendix 1).

Coverage rates are also calculated at 4, 6, 8, 17, and 20 months of age. Each goal point coincides with a point two months after the end of the recommended age for administration of an immunization. For example at 2 months of age DTP1 and Polio1 are recommended. Therefore in order to include the two-month “grace period,” children are evaluated at 4 months of age for receipt of DTP1 and Polio1. The 4 month and 24 months goal points are used to assess the children that start their immunization series either on time or late and those who finish either on time or late. Finally, immunization coverage rates are calculated for this group of children at the time of their enrollment in kindergarten, that is, at the age of 5 years.

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

<sup>4</sup> <http://www.kdhe.state.ks.us/hci/as01/as1999.html>

## RESULTS

Letters of invitation to participate in the survey were sent to 797 Kansas public schools. Fifty-eight schools reported not having a kindergarten class for the 2004-2005 school year and 22 did not respond. Data were received from and analyzed for 717 schools with kindergarten classes.

The number of children enrolled in kindergarten at the participating public schools was 32,965, which is 85% of the 38,748 children in that birth cohort.<sup>5</sup> Approximately 15% of the birth cohort is not represented. Those not available to survey include children who attend private school, home school, or other special schools. The number of immunization records received was 12,248. This is equivalent to a sampling ratio of 3.7, meaning that one child was selected for every 3.7 children enrolled. The range of the sample size by county is from 8 to 342 records while the range of student enrollment is from 15 to 6,022.<sup>6</sup>

Of the 12,248 immunization records returned and examined, 9,991 (82%) were complete and had usable information of immunization history. This includes children who were at least five years of age but less than six years of age on September 1, 2004. Of the 2,257 records excluded, 1457 (64%) children were not 5 years of age. The remaining excluded records had incomplete or unusable KCIs. The number of records examined by population density includes: 3315 (33% of all records) Sparsely-populated, 4967 (50% of all records) Moderately-populated and 1709 (17% of all records) Urban categories.

### *Statewide Immunization Coverage*

The immunization coverage rates for the all of the single vaccines and the 4-3-1 series remained the same or increased compared to the coverage rates of the previous year. The increase in coverage rate is only statistically significant in VAR1. Coverage rates remain high for HIB3 even though it is not required for school entry (Table 1). Immunization coverage rates have risen each year from 1990-91 through 2000-01 as displayed in Figure 1. Immunization coverage rates have statistically remained the same for the past four surveys. The immunization coverage rate for the 4-3-1-3-3 series is 69.3% (95% CI; 67.7, 70.9). Coverage rates for 4-3-1-3-3 series have remained statistically the same since it was first analyzed with data from 1998-99 Retrospective Survey (unpublished).

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<sup>5</sup>1999 Annual Summary of Kansas Vital Statistics.

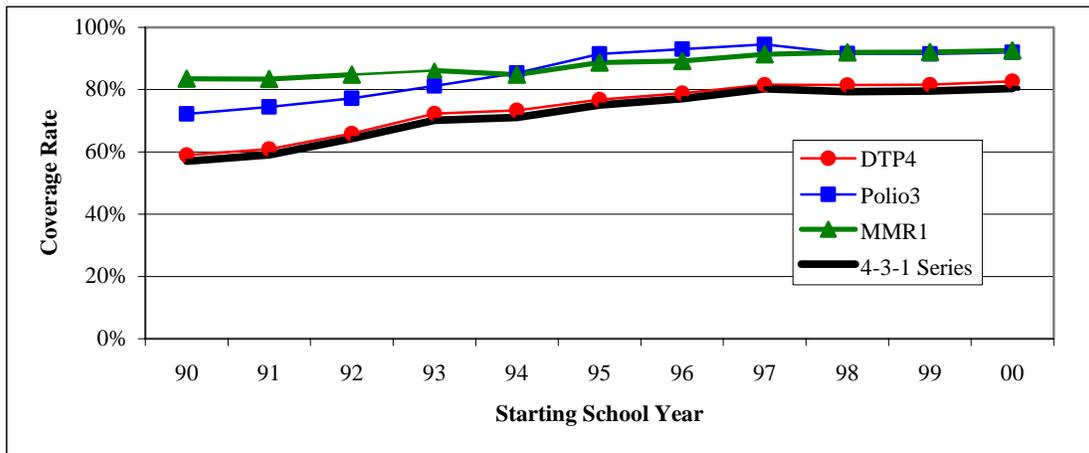
<sup>6</sup>Estimates from counties with small sample size (<50) may be unstable and changes over time should be interpreted with caution.

**TABLE 1 Kansas immunization coverage rates at the age of 2 years by vaccine for 2000-2001. \*** Percentage up-to-date and 95% confidence interval

	2000-2001	
	%	95% CI
<b>DTP4</b>	<b>82.7</b>	<b>81.4 - 83.9</b>
<b>Polio3</b>	<b>92.0</b>	<b>91.1 - 92.8</b>
<b>MMR1</b>	<b>92.6</b>	<b>91.7 - 93.5</b>
<b>4-3-1 Series</b>	<b>80.3</b>	<b>79.0 - 81.7</b>
<b>HIB3</b>	<b>84.4</b>	<b>83.1 - 85.6</b>
<b>HEPB3</b>	<b>90.7</b>	<b>89.7 - 91.7</b>
<b>VAR1</b>	<b>66.6</b>	<b>65.0 - 68.2</b>

\*Based on retrospective surveys from school years starting in 2004.

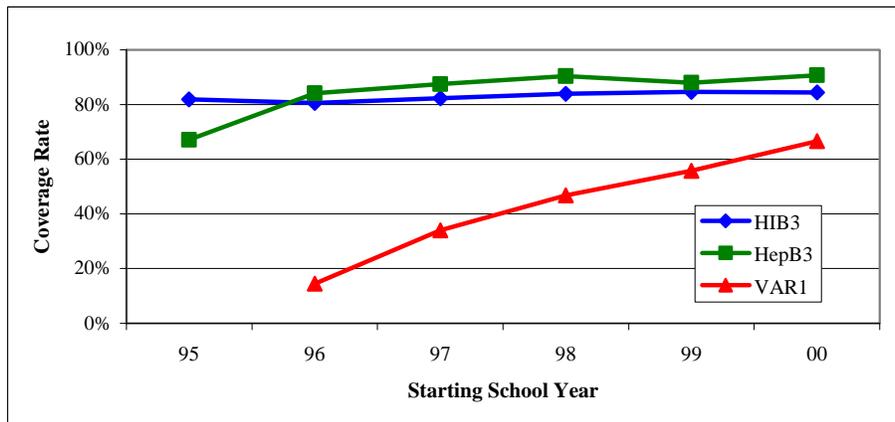
**FIGURE 1 Kansas immunization coverage rates at the age of 2 years by vaccine from 1990-91 through 2000-2001. \***



\* Based on retrospective surveys from school years starting in 1994 through 2004.

Varicella vaccine was licensed for use in March 1995 and became a required immunization for kindergartners in 2004. Coverage rates for VAR1 rose 10 percentage points from 55.8% to 66.6% in just one year. Since 1996, coverage rates among 2 year olds in Kansas have increased statistically year (Figure 2).

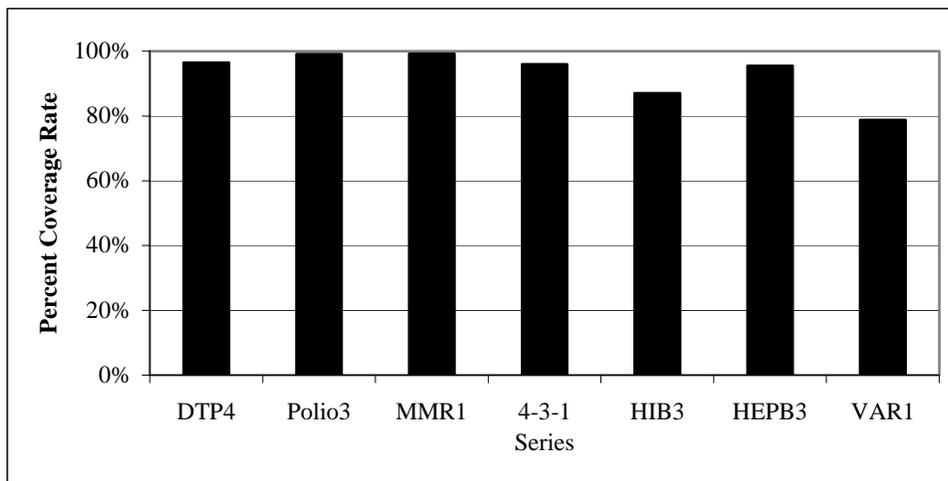
**FIGURE 2 Kansas immunization coverage rates at the age of 2 years by vaccine from 1995-96 through 2000-2001. \***



\* Based on retrospective surveys from school years starting in 1999 through 2004.

Immunization rates of kindergarteners when they were five years old are calculated (Figure 3). By age 5, at least 95% of the children are up-to-date for DTP4, Polio3, MMR1, HepB3 and the 4-3-1 series. The vaccination coverage rate for VAR1 is 79%. For kindergarten entry, history of varicella disease is accepted in place of VAR1 vaccination. When these children are included with those who were vaccinated, 81% of children at 5 year of age are no longer at risk for varicella. The greatest increases of coverage rates for single vaccines were for DTP4 and VAR1, which increase by 13.8 and 12.2 percentage points, respectively. Coverage rates for all vaccines and 4-3-1 series show a statistically significant increase including HIB3 which only increased 2.6 percentage points. These data show those immunization rates are higher when children are about to enter school than at the age of 2 years.

**FIGURE 3 Immunization rates of Kansas kindergarteners at age five years, 2004-05. \***



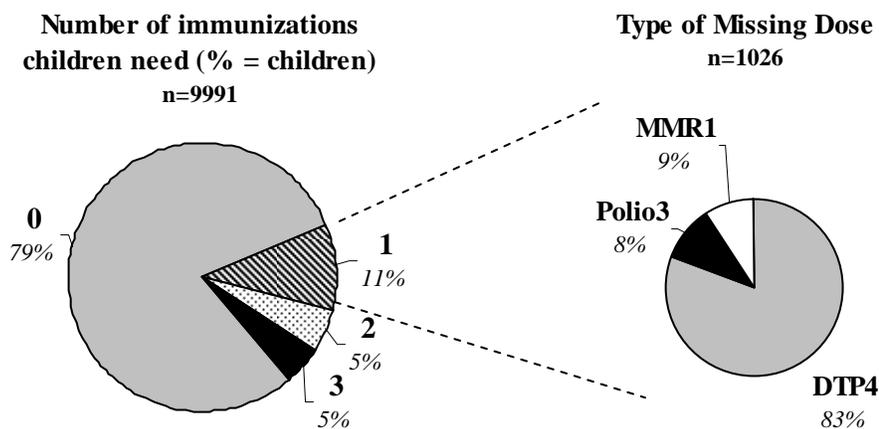
\*Based on the retrospective survey for the school year starting 2004.

Up-to-date coverage rates at 4, 6, 8, 17, and 20 months are assessed for DTP, Polio, and MMR. For reference, the coverage rates at 24 months have also been included. At 4 months of age at which only DTP1 and Polio1 are required, immunization coverage rates were at 93%. As the number of immunizations required to be up-to-date increased, coverage rates decreased. This is the same trend as observed in previous years. At 24 months of age, coverage for the 4-3-1 series was 80.3%.

Of the 9339 children in the sample who were up-to-date at 4 months of age, 7749 (83%) were still up-to-date at 24 months of age. Of the 652 children who were late at 4 months, only 220 (34%) caught up and were up-to-date at 24 months of age. This means that 66% of the children who are not up-to-date at 4 months of age do not catch up before 24 months. Children who start on time are just under 2 ½ times (relative risk ratio 2.44) more likely to complete the 4-3-1 immunization series on time when compared to children who do not begin the series on time.

Of children not up-to-date at 24 months of age, 51% (11% of total population studied) needed one additional immunization in order to be up-to-date (Figure 4). If these children had received one additional immunization the coverage rates for the 4-3-1 combination would have increased from 80.3% to 90.7%. Children needing one additional immunization, 80.6% needed DTP4, 10.1% needed Polio3, and 9.3% needed MMR1. Children not up-to-date at 24 months of age, 23% (4.7% of total population) were missing DTP4, Polio3, and, MMR1.

**FIGURE 4: Number and type of immunizations kindergarteners needed to be up-to-date at the age of 24 months, Kansas 2000 - 2001. \***



\*Based on the retrospective survey for the school year starting 2004.

#### *County-level Immunization Coverage*

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

Fourteen counties reached the goal of at least 90% coverage for the 4-3-1 series. These counties were clustered in the northwest portion of Kansas (Appendix 3). All of these counties were “sparsely populated” except for 1 “moderately populated” county. For DTP4, the 18 counties

that had at least 90% coverage were in the northwest and north central portions of Kansas. Pockets of need were identified for Polio3, MMR1, and HepB3. Those counties with less than 90% coverage were in the southeast and southwest corners.

Counties were categorized based on their population densities. Estimated mean coverage rates of the counties were compared among three categories (Table 3). Compared to the estimated mean coverage rates of the other two groups of counties, the estimated mean coverage rate for the “sparsely populated” category was highest for the 4-3-1 combination and all vaccines except HepB3 and VAR1.

**TABLE 3: Mean Immunization Coverage Rate Estimates (%) Among Categories Based on Population Density.**

Counties by Population Density - Collapsed Groups			
	Sparsely Populated (N=69)	Moderately Populated (N=30)	Urban (N=6)
DTP4	84.5	81.4	82.0
Polio3	92.8	91.0	90.9
MMR1	93.4	91.6	92.8
4-3-1 Series	82.9	79.2	79.7
HIB3	89.7	84.7	81.1
HEPB3	91.8	92.0	89.5
4-3-1-3-3 Series	76.6	69.6	65.5
VAR1	65.6	60.5	69.8

## **DISCUSSION**

Statewide immunization coverage rates remained at stable levels in the current 2004-2005 Retrospective Survey except VAR1 which had an increase of almost 11 percentage points compared to last year’s retrospective survey. This is the second consecutive year where VAR1 had a statistically significant increase. 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. Immunization coverage rates in Kansas for Polio3, MMR1, and HepB3 have reached the Healthy People 2010 (HP2010) goal.<sup>7</sup> DTP4 and HIB3 are less than 10 percentage points from meeting this goal. Immunizations against *H. influenza* type B (HIB3) are not required for school entry for the 2004-2005 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.

Immunization coverage rates were also examined for kindergarteners when they were five years old. By age 5, immunization coverage rates increase for all single vaccines. At least 95% of the children have received DTP4, Polio3, MMR1, HepB3, and 4-3-1 series. For varicella, 81% of the children had either been immunized or had the disease by 5 years of age. School entry

<sup>7</sup>Healthy People 2010 set goals of 90% coverage for DTP4, Polio3, MMR1, HIB3, HEPB3, and VAR1 and 80% coverage for 4-3-1-3-3 series among children aged 19 to 35 months.

requirements are the most likely reason for this increase, although coverage rates for non-required vaccines increased also.

Fourteen counties reached the goal of at least 90% coverage for the 4-3-1 series. These counties were clustered in the northwest portion of Kansas (Appendix 3). For Polio3, MMR1, and HepB3, counties with less than 90% coverage were in the southeast and southwest corners. For HIB3, a majority of the counties with 90% coverage were in the northwest and south central regions of Kansas. Only 2 counties achieved 90% coverage by 2 years of age for VAR1.

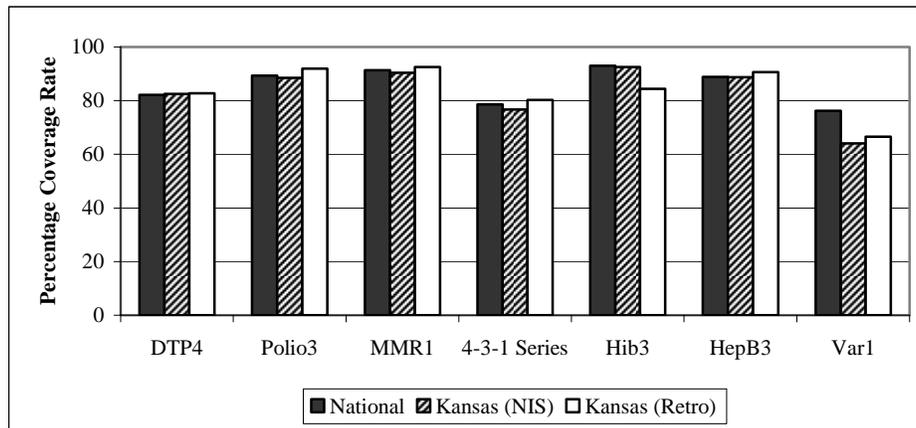
County designations are used to create categories by population. The mean coverage rate estimates are compared to determine if differences exist among the counties of different population densities. Compared to the mean coverage rate estimates of the other two categories (moderately populated, urban), the mean coverage rate estimate for the “sparsely populated” category was highest for the 4-3-1 series and all vaccines except HepB3 and VAR1. “Urban”, which includes the most densely populated counties and represents 54% of the population surveyed, had the lowest coverage rate estimate for the 4-3-1-3-3 series. Targeting the population in the 6 “urban” counties in order to increase coverage rate estimates would increase on the statewide coverage rate.

The results from this survey are compared with the results from the 2001 National Immunization Survey (NIS), which refers to the same time period in this retrospective survey (Figures 5, 6).<sup>8</sup> The results are 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 (family physicians, pediatricians, etc.) of the children included in the survey are contacted by mail. The coverage rates for HIB3 was significantly lower in the Retrospective survey when compared to the NIS results for Kansas. Possible reasons for the difference in rates are that HIB3 is required for school entry and may not be routinely recorded on the KCIs, and differences in sampling methodologies.

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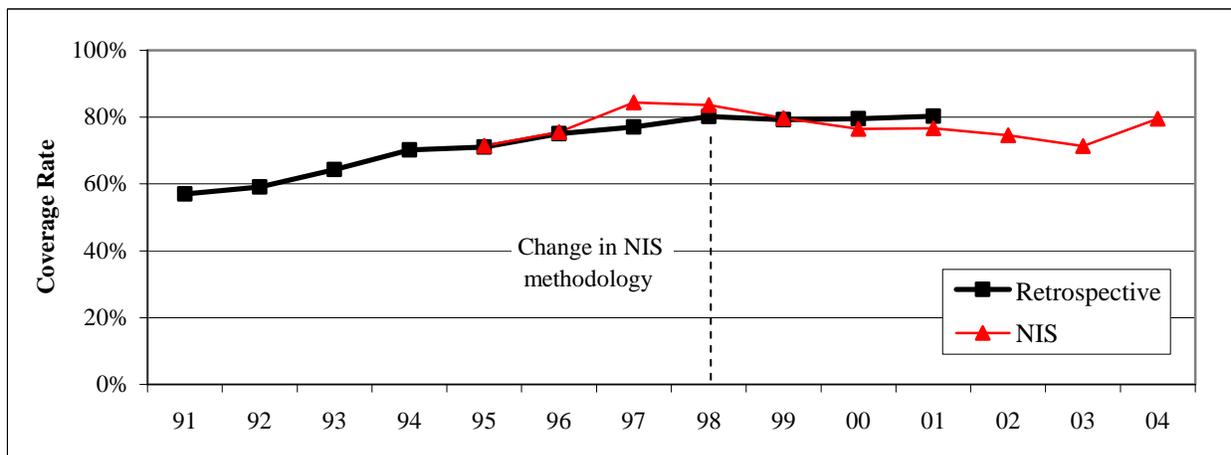
<sup>8</sup> *Morbidity and Mortality Weekly Report*; 50 (30); 637-641.

**FIGURE 5 Immunization Coverage Rates for the United States and Kansas. 2000-2001.\***



National and Kansas (NIS) rates were estimated by the National Immunization Survey 2001 and the Kansas (Retro) rates were estimated by the Retrospective Immunization Coverage Survey (2000-2001).

**FIGURE 6: Comparison of Immunization Coverage Rates for the 4-3-1 Series from the Kansas NIS and the Retrospective Survey, 1991-2004.**



**Limitations**

Limitations of this survey include: the survey reports data that refer to immunization coverage rates that occurred three years before the survey. The Retrospective Immunization Survey only include children who were enrolled in kindergarten in Kansas public schools. Children who attend a private school or are home-schooled are excluded from the survey. However, the records analyzed are representative of 85% of this birth cohort, which is likely to ensure their validity. Also, no descriptive data are collected about race, ethnicity, or religious and medical exemptions.

**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 to be repeated next year.

**Appendix 1:** Kansas counties categorized by based on population density, 1999.

**Sparsely Populated**

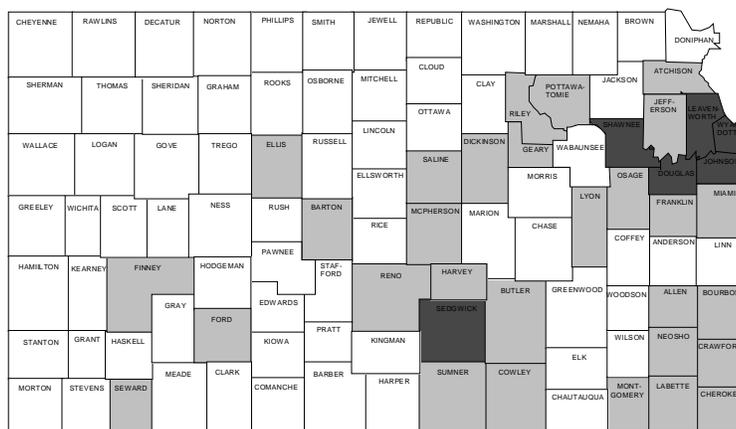
- Anderson
- Barber
- Brown
- Chase
- Chautauqua
- Cheyenne
- Clark
- Clay
- Cloud
- Coffey
- Comanche
- Decatur
- Doniphan
- Edwards
- Elk
- Ellsworth
- Gove
- Graham
- Grant
- Gray
- Greeley
- Greenwood
- Hamilton
- Harper
- Haskell
- Hodgeman
- Jackson
- Jewell
- Kearny
- Kingman
- Kiowa
- Lane
-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

**Moderately Populated**

- Allen
- Atchison
- Barton
- Butler
- Cherokee
- Cowley
- Crawford
- Dickinson
- Ellis
- Finney
- Ford
- Franklin
- Geary
- Harvey
- Jefferson
- Labette
- Leavenworth
- Lyon
- McPherson
- Miami
- Montgomery
- Neosho
- Osage
- Pottawatomie
- Reno
- Riley
- Saline
- Seward
- Sumner

**Urban**

- Douglas
- Johnson
- Sedgwick
- Shawnee
- Wyandotte



□ Sparsely Populated      ■ Moderately Populated      ■ Urban

**APPENDIX 2:** Immunization Coverage Rates Percentage of County Population <5 years Reporting Vaccination for Kansas Counties 2000-01.\*

<b>COUNTY</b>	<b>DTP4</b>	<b>Polio3</b>	<b>MMR1</b>	<b>HIB3</b>	<b>HepB3</b>	<b>Var1</b>	<b>4-3-1</b>	<b>4-3-1-3-3</b>
ALLEN	73.9	87.8	87.8	81.7	89.6	59.1	73.9	68.7
ANDERSON	79.1	88.4	89.5	88.4	90.7	61.6	77.9	74.4
ATCHISON	79.8	91.9	87.1	93.5	95.2	33.1	77.4	70.2
BARBER	89.3	92.9	92.9	96.4	96.4	46.4	89.3	89.3
BARTON	92.4	98.5	98.5	92.4	100.0	83.3	92.4	86.4
BOURBON	83.8	93.7	91.5	95.8	94.4	64.1	82.4	78.2
BROWN	79.2	91.7	90.6	64.6	89.6	35.4	77.1	57.3
BUTLER	88.1	96.8	94.2	94.2	94.6	63.9	86.6	82.7
CHASE	83.9	93.5	90.3	74.2	74.2	25.8	83.9	58.1
CHAUTAUQUA	70.4	85.2	88.9	85.2	85.2	51.9	70.4	70.4
CHEROKEE	66.7	81.7	88.1	79.0	86.3	53.9	63.9	57.5
CHEYENNE	85.7	90.5	100.0	95.2	95.2	85.7	85.7	85.7
CLARK	75.0	100.0	100.0	100.0	87.5	87.5	75.0	62.5
CLAY	84.1	85.4	91.5	79.3	95.1	70.7	75.6	65.9
CLOUD	88.6	96.2	94.9	96.2	94.9	77.2	87.3	84.8
COFFEY	81.0	94.0	94.0	93.0	96.0	74.0	81.0	80.0
COMANCHE	81.0	95.2	95.2	95.2	95.2	90.5	81.0	81.0
COWLEY	76.1	88.1	91.5	51.7	90.5	53.7	74.1	40.3
CRAWFORD	69.2	85.6	85.1	84.6	90.5	35.8	66.7	65.2
DECATUR	85.7	85.7	92.9	92.9	85.7	7.1	85.7	85.7
DICKINSON	85.0	86.0	93.8	90.7	95.9	64.2	77.7	72.5
DONIPHAN	86.5	89.2	91.9	90.5	90.5	39.2	85.1	81.1
DOUGLAS	83.3	90.6	93.6	89.5	93.0	75.1	82.2	72.8
EDWARDS	87.5	96.9	96.9	100.0	96.9	68.8	87.5	87.5
ELK	76.5	82.4	82.4	64.7	76.5	58.8	76.5	64.7
ELLIS	96.3	96.3	96.3	89.7	97.2	64.5	96.3	87.9
ELLSWORTH	91.4	98.6	95.7	94.3	98.6	72.9	88.6	82.9
FINNEY	80.6	91.7	93.8	91.7	94.4	67.4	79.9	78.5
FORD	81.7	95.0	95.0	87.1	91.3	60.8	80.8	71.7
FRANKLIN	82.6	93.8	92.5	89.4	94.4	72.7	80.7	73.9
GEARY	80.5	87.4	93.1	88.1	90.4	73.6	76.2	67.0
GOVE	96.0	96.0	96.0	92.0	100.0	64.0	96.0	92.0
GRAHAM	70.6	88.2	94.1	88.2	82.4	58.8	70.6	64.7
GRANT	83.3	92.2	91.1	91.1	90.0	68.9	77.8	75.6
GRAY	79.7	89.2	89.2	93.2	89.2	73.0	79.7	75.7
GREELEY	100.0	100.0	90.0	100.0	100.0	90.0	90.0	90.0
GREENWOOD	81.8	92.4	97.0	87.9	93.9	59.1	77.3	69.7
HAMILTON	75.9	89.7	96.6	93.1	89.7	75.9	72.4	69.0

\* Based on the retrospective survey for the school year starting 2004.

<b>COUNTY</b>	<b>DTP4</b>	<b>Polio3</b>	<b>MMR1</b>	<b>HIB3</b>	<b>HepB3</b>	<b>Var1</b>	<b>4-3-1</b>	<b>4-3-1-3-3</b>
HARPER	87.5	87.5	90.6	90.6	93.8	62.5	81.3	78.1
HARVEY	82.6	93.2	92.4	75.0	90.9	60.6	79.5	60.6
HASKELL	63.3	85.7	81.6	83.7	79.6	63.3	63.3	57.1
HODGEMAN	90.9	90.9	90.9	90.9	90.9	72.7	90.9	90.9
JACKSON	86.1	95.8	93.1	84.7	91.7	38.2	84.7	69.4
JEFFERSON	81.6	91.5	90.6	88.7	90.6	61.3	79.7	73.6
JEWELL	88.2	94.1	100.0	76.5	94.1	70.6	88.2	70.6
JOHNSON	87.8	95.4	97.3	82.1	90.5	76.3	85.9	69.5
KEARNEY	86.3	94.1	94.1	86.3	86.3	56.9	80.4	74.5
KINGMAN	76.6	85.9	90.6	95.3	93.8	68.8	75.0	73.4
KIOWA	87.5	90.6	87.5	96.9	96.9	87.5	87.5	87.5
LABETTE	81.2	87.1	92.5	60.2	95.2	70.4	78.0	49.5
LANE	85.0	100.0	95.0	95.0	100.0	80.0	85.0	80.0
LEAVENWORTH	83.5	90.4	96.8	70.2	89.0	72.9	80.3	56.9
LINCOLN	85.7	92.9	89.3	92.9	96.4	64.3	82.1	78.6
LINN	72.7	81.8	85.9	87.9	88.9	74.7	68.7	64.6
LOGAN	84.4	100.0	96.9	96.9	100.0	37.5	81.3	78.1
LYON	84.1	92.3	92.9	90.1	91.2	53.8	81.3	73.1
MARION	90.8	94.2	93.3	85.8	61.7	51.7	90.0	50.8
MARSHALL	82.1	92.3	93.6	89.7	92.3	52.6	80.8	74.4
MCPHERSON	78.6	95.2	92.1	89.7	92.1	61.9	74.6	66.7
MEADE	86.8	89.5	89.5	86.8	86.8	71.1	81.6	73.7
MIAMI	80.8	86.3	87.7	90.4	87.0	58.9	79.5	74.0
MITCHELL	90.7	95.3	95.3	93.0	97.7	55.8	88.4	88.4
MONTGOMERY	74.7	89.5	86.4	88.9	86.4	73.5	73.5	70.4
MORRIS	81.6	84.2	94.7	89.5	86.8	63.2	81.6	72.4
MORTON	78.0	87.8	90.2	85.4	87.8	80.5	75.6	65.9
NEMAHA	85.7	95.9	93.9	93.9	95.9	40.8	81.6	75.5
NEOSHO	81.0	93.7	92.1	93.7	92.1	47.6	74.6	69.8
NESS	77.8	85.2	92.6	85.2	70.4	55.6	77.8	55.6
NORTON	85.3	97.1	94.1	88.2	94.1	76.5	85.3	73.5
OSAGE	85.9	91.1	90.4	69.6	91.1	50.4	84.4	56.3
OSBORNE	88.6	94.3	97.1	91.4	94.3	77.1	88.6	88.6
OTTAWA	90.5	100.0	98.4	66.7	98.4	73.0	90.5	61.9
PAWNEE	87.1	98.4	96.8	91.9	96.8	83.9	85.5	83.9
PHILLIPS	90.0	100.0	97.5	97.5	97.5	62.5	87.5	85.0
POTTAWATOMIE	87.9	92.7	95.2	89.1	92.1	61.8	86.1	79.4
PRATT	82.6	90.2	90.2	90.2	94.6	63.0	81.5	81.5

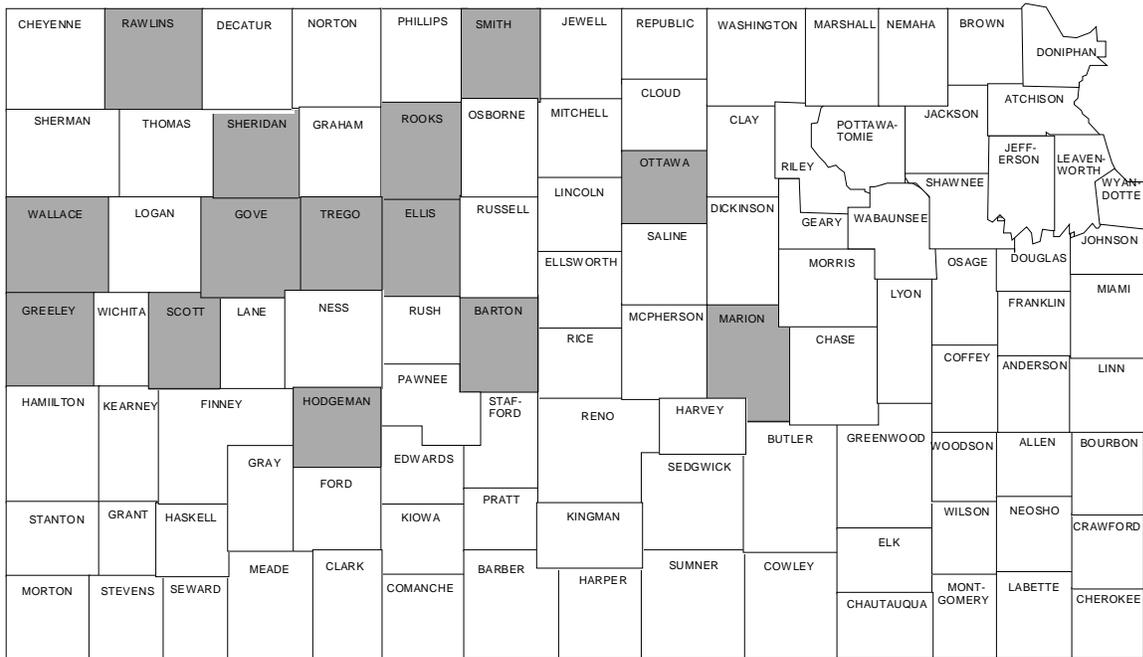
\*Based on the retrospective survey for the school year starting 2004.

<b>COUNTY</b>	<b>DTP4</b>	<b>Polio3</b>	<b>MMR1</b>	<b>HIB3</b>	<b>HepB3</b>	<b>Var1</b>	<b>4-3-1</b>	<b>4-3-1-3-3</b>
RAWLINS	100.0	100.0	100.0	94.1	100.0	58.8	100.0	94.1
RENO	78.8	95.0	93.9	93.9	90.5	73.2	77.1	72.6
REPUBLIC	82.6	100.0	95.7	91.3	91.3	56.5	82.6	73.9
RICE	69.7	82.0	85.4	64.0	86.5	66.3	68.5	51.7
RILEY	85.7	91.6	93.1	55.7	89.7	75.4	83.3	47.8
ROOKS	93.1	96.6	96.6	93.1	93.1	65.5	93.1	93.1
RUSH	87.0	91.3	91.3	95.7	95.7	47.8	87.0	87.0
RUSSELL	82.5	93.7	93.7	93.7	96.8	58.7	82.5	81.0
SALINE	82.2	90.4	91.7	87.3	96.8	72.0	79.0	72.0
SCOTT	91.1	97.8	97.8	93.3	93.3	82.2	91.1	88.9
SEDGWICK	83.1	92.3	89.9	88.3	90.3	63.7	79.4	71.8
SEWARD	76.0	91.6	90.5	83.2	88.3	65.4	73.2	67.0
SHAWNEE	84.9	93.1	92.4	91.8	90.3	62.8	84.0	77.3
SHERIDAN	95.2	90.5	100.0	95.2	100.0	52.4	90.5	90.5
SHERMAN	88.1	98.5	95.5	94.0	95.5	53.7	86.6	82.1
SMITH	100.0	100.0	100.0	87.5	95.8	87.5	100.0	87.5
STAFFORD	89.8	96.6	93.2	84.7	93.2	83.1	88.1	81.4
STANTON	78.6	96.4	96.4	89.3	96.4	71.4	78.6	75.0
STEVENS	68.9	82.4	82.4	85.1	85.1	59.5	66.2	59.5
SUMNER	78.1	85.1	87.9	85.6	90.2	40.5	77.2	73.0
THOMAS	90.2	94.1	90.2	98.0	90.2	70.6	86.3	80.4
TREGO	94.7	100.0	100.0	100.0	89.5	73.7	94.7	89.5
WABAUNSEE	81.2	84.1	88.4	88.4	91.3	72.5	79.7	73.9
WALLACE	95.0	95.0	95.0	95.0	95.0	75.0	95.0	95.0
WASHINGTON	87.3	94.4	97.2	93.0	94.4	73.2	85.9	80.3
WICHITA	77.8	96.3	96.3	88.9	92.6	77.8	77.8	77.8
WILSON	73.2	91.5	97.2	91.5	98.6	69.0	73.2	70.4
WOODSON	84.0	92.0	92.0	96.0	92.0	84.0	80.0	72.0
WYANDOTTE	69.5	83.8	86.7	64.9	84.1	67.9	66.2	44.5

\*Based on the retrospective survey for the school year starting 2004.

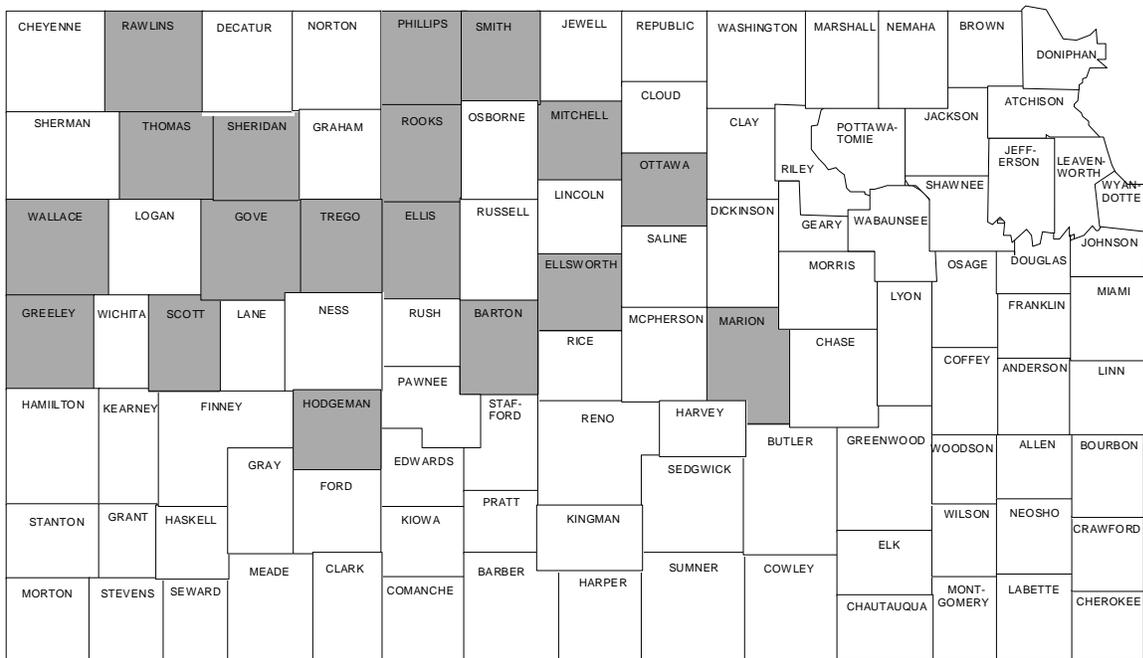
**Appendix 3:** Kansas maps of counties with at least 90% or better immunization coverage by age 2 years for the 4-3-1-series and individual vaccines and 80% for 4-3-1-3-3 Series, 2004-05 Retrospective Survey.

## 4-3-1 Series for Retrospective Survey 2004-05



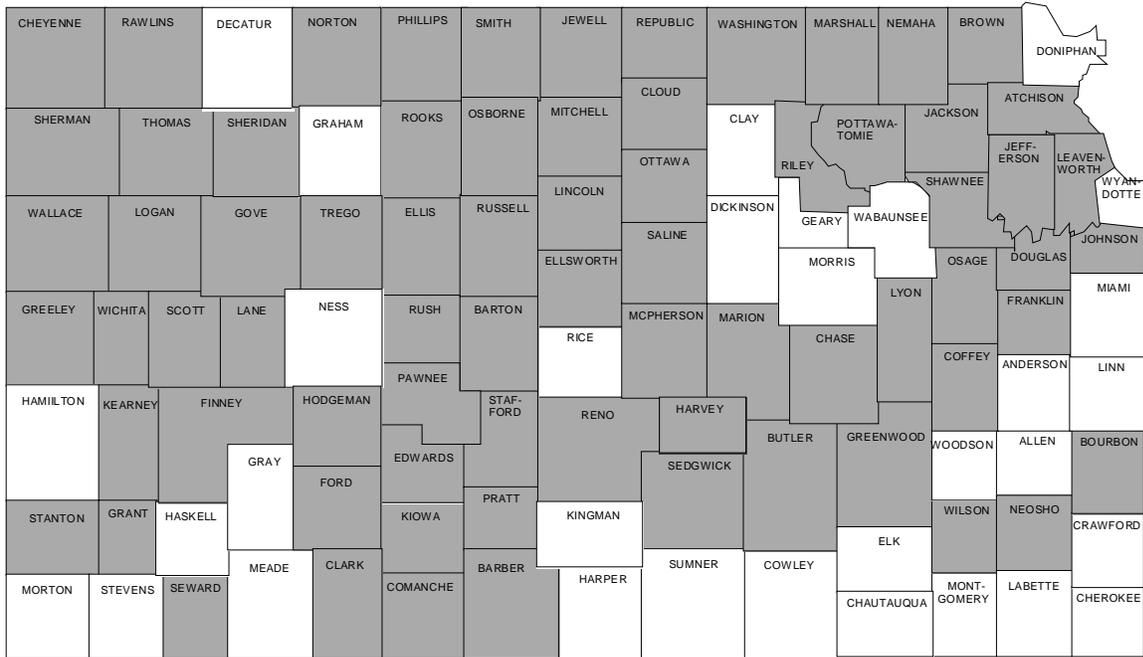
■ 90% or better coverage

## DTP4 for Retrospective Survey 2004-05



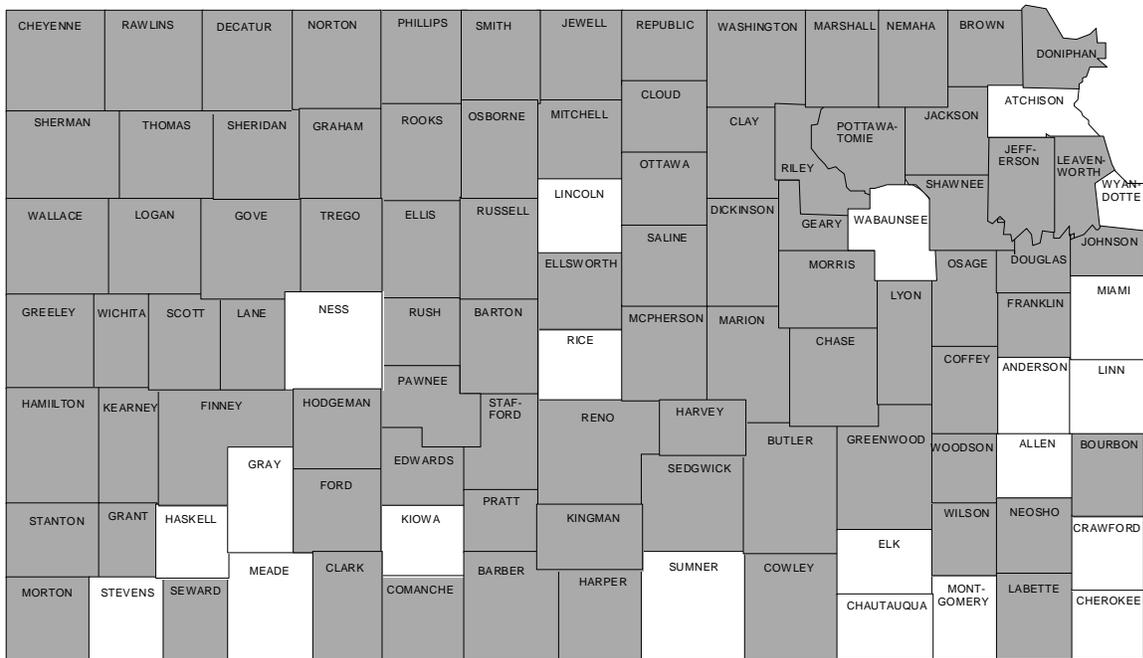
■ 90% or better coverage

## Polio3 for Retrospective Survey 2004-05



■ 90% or better coverage

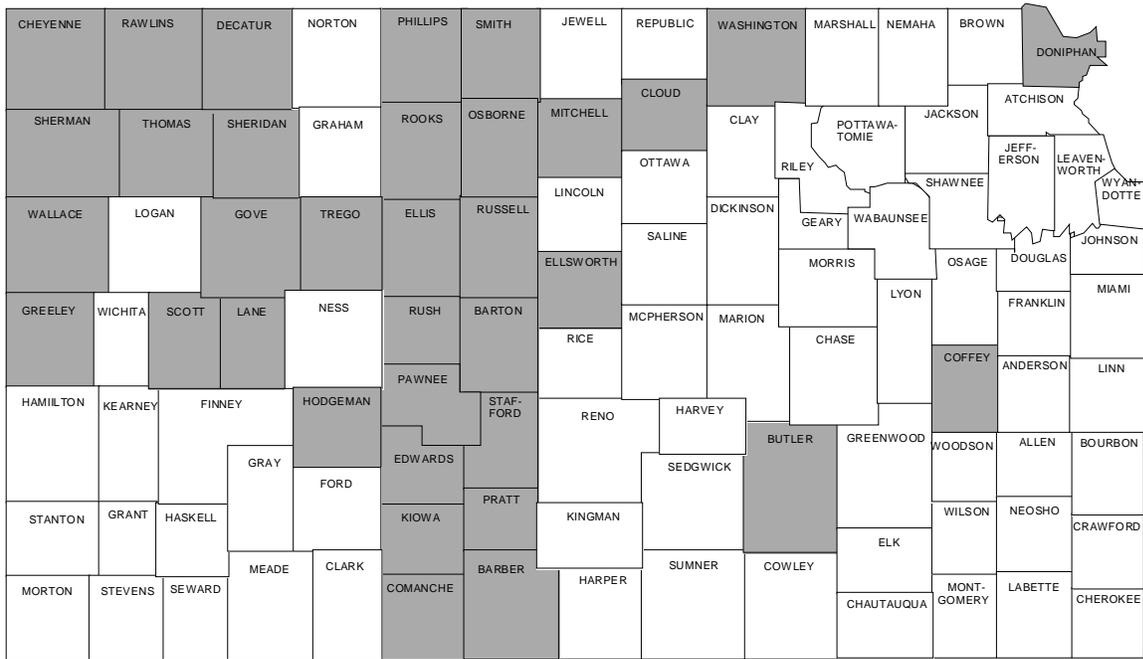
## MMR1 for Retrospective Survey 2004-05



■ 90% or better coverage



### 4-3-1-3-3 Series for Retrospective Survey 2004-05



■ 80% or better coverage