

RETROSPECTIVE IMMUNIZATION COVERAGE SURVEY

2004- 2005 Results (School Year 2008-09)



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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)
DTaP5	5 doses of diphtheria and tetanus toxoids and acellular pertussis vaccines including diphtheria and tetanus toxoids (DTaP/DT)
HepA1	1 dose of hepatitis A vaccine
HepA2	2 doses of hepatitis A vaccine
HepB3	3 doses of hepatitis B vaccine
Hib3	3 doses of <i>Haemophilus influenzae</i> type b vaccine
KCI	Kansas Certificate of Immunizations
KDHE	Kansas Department of Health and Environment
MMR1	1 dose of measles, mumps, and rubella vaccine
MMR2	2 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
Var2	2 doses of varicella vaccine

EXECUTIVE SUMMARY

Overview

The Kansas Certificates of Immunizations (KCIs) for children enrolled in a kindergarten class in Kansas public and private schools during the 2008-2009 school year were collected and evaluated for immunization coverage rates. Children born between September 2, 2002 and September 1, 2003 were included in this study, and their immunization coverage rates were evaluated for when they were 24 months of age, between September 2, 2004 and September 1, 2005. Additionally, immunization coverage rates were calculated for children at the time of school entry. In this cohort, children who were between the ages of five and seven on September 1, 2008 were included. The results for this survey were measured against similar previous studies. In total, there were 806 schools, 709 public and 97 private, included in the analysis. The 15,388 complete and useable KCIs are a representative sample of the population enrolled in kindergarten at both public and private schools.

Coverage at 24 Months of Age

The statewide coverage rate for the 4-3-1-3-3 series (DTaP4, Polio3, MMR1, Hib3, HepB3) for children by 24 months of age was 63%, which was below the Healthy People 2010 goal of at least 80%. Varicella vaccination, which has been required for school entry since the 2004-05 school year, had a coverage rate of 81% by 24 months of age. The coverage rates for PCV3 increased by more than 9 percentage points to 57% while HepA2 rates remain at 1.3%. Neither PCV3 nor HepA2 were required for school entry.

The 105 counties were grouped into 3 categories based on population density, and 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. Of the 28 counties that reached the Healthy People 2010 goal for the 4-3-1-3-3 series, 27 were sparsely populated (Appendix 3). At least 74 counties had 90% coverage for Polio3, MMR1, and HepB3. Forty-seven counties had 90% coverage or better for Hib3. Only 18 counties had DTaP4 coverage rates of at least 90% and 10 counties had a minimum of 90% coverage for Var1.

Coverage at School Entry

The immunization rates of vaccines required for school entry reached at least 80%. Among these vaccines, MMR2, HepB3, and Var1 had greater than 90% coverage rates. The single antigen vaccines that were not required for school entry, Hib3, HepA2, and PCV3, had significantly lower coverage rates.

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 and the 4-3-1-3-3 series occurred in 2001-02 due to a shortage of the DTaP vaccine. The coverage rate for the 4-3-1-3-3 series has been increasing following the reduction in coverage, however it remains more than 6 percentage points lower than it was in 2000-01. The rates for most vaccinations have decreased in recent years, but began increasing in 2003-04 and this trend continued for 2004-05 (2008-09 Retrospective Study). Continued assessment and evaluation of the immunization rates are necessary to monitor progress toward the Healthy Kansas 2010 goal of 90% immunization coverage, which will aid in increasing herd immunity, reducing disease incidence and limiting outbreaks.

RETROSPECTIVE IMMUNIZATION COVERAGE SURVEY 2004-2005 (SCHOOL YEAR 2008-2009)

INTRODUCTION

Objective

Estimate the immunization coverage rates of children at 24 months of age and at time of entry into kindergarten in Kansas public and private schools during the 2008-09 school year.

Study Population

The study population included all kindergarten students enrolled in both public and private schools in the 2008-09 school year.

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, hepatitis A virus, 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.¹ The schedule for 2003 is in Appendix 4. *The results of the survey refer to children who were born between September 2, 2002, and September 1, 2003. The coverage rates refer to the point in time at which these children turned 24 months old, between September 2, 2004 and September 1, 2005. Immunization coverage rates were also assessed at time of school entry for all kindergartners who were between the ages of five and seven upon entering kindergarten on September 1, 2008.*

METHODS

Sampling Techniques

A probability sample of all children enrolled in Kansas public school kindergartens 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.² Due to the small size of the private school population in Kansas, all records from private schools were solicited.

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

¹ 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 2003.

² 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.

Education, requesting them to participate in the survey. The letters sent to public schools 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 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. Copies of the immunization records and the current total number of kindergarten enrollees in each school were forwarded to KDHE.

Data Analysis

Starting in the 2006-07 Retrospective Survey and continuing through the 2008-09 survey, the data analysis methods were changed from previous years. In the current study, all children who had a date of birth recorded on the Kansas Certificate of Immunizations (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, DTaP5, Polio3, MMR1, MMR2, Hib3, HepB3, 4-3-1-3-3 combination, Var1, HepA1, HepA2, and PCV3 vaccines were calculated. A child was considered “up-to-date” for single vaccines if, at 24 months of age, he or she had received at least four doses of DTaP (DTaP4), three doses of polio (Polio3), one dose of measles, mumps, and rubella (MMR1), three doses of *H. influenzae* type b (Hib3), three doses of hepatitis B (HepB3), one dose of varicella (Var1) vaccine, two doses of hepatitis A (HepA2), and three doses of pneumococcal conjugate (PCV3). 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. This methodology was performed because the date of disease was not recorded, thus it could not be determined if the child had the disease before two years of age. Analyses were performed using weighted data, and the analyses accounted for the complex sample design effect due to the stratification process and differences in sampling ratios among counties.³ Sample weights were calculated using the number of kindergartners enrolled in a county and the number of records analyzed for that county.

The 105 counties were categorized based on population densities calculated from the 2000 Annual Summary of Vital Statistics.⁴ The 2000 census data corresponds 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.

RESULTS

Data Collection

Letters of invitation to participate in the survey were sent to 853 Kansas schools; of these, 743 were public schools and 110 were private. Seven schools reported not having a kindergarten class for the

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

⁴ <http://www.census.gov/>

2008-2009 school year and 40 did not respond. Data were received from and analyzed for 806 schools (709 public schools and 97 private schools) with kindergarten classes, corresponding to a school participation rate of 94.5%.

The number of children enrolled in kindergarten at the participating public and private schools was 37,034, which is 94% of the 39,353 children in that birth cohort.⁵ The children in the birth cohort that did not participate in the study include children who attend home school or other special schools. The number of immunization records received was 15,559. This is equivalent to a sampling ratio of 2.4, meaning that one child was selected for every 2.4 children enrolled. The range of the sample size by county was from 10 to 1,207 records while the range of student enrollment was from 10 to 7,348.⁶

Of the 15,559 immunization records returned and examined, 15,388 (99%) were complete and had usable information regarding birth dates and immunization history. For the 24 month old analysis, 13,422 (86%) children were included in the analysis because they were 24 months of age between September 2, 2004 and September 1, 2005. In the analysis, 0.04% of the KCIs indicated that the child did not have vaccinations because of a medical exemption and 0.3% indicated that the child did not have vaccinations because of a religious exemption. The analysis of coverage rates at kindergarten entry included 15,281 (98%) children who were between the ages of five and seven on September 1, 2008.

The number of records examined by population density includes: 3,569 (26.6% of all records used, representing 11% of the population after weighting) in sparsely populated, 6,213 (46.3% of all records used, representing 32% of the population after weighting) in moderately populated, and 3,640 (27.1% of all records used, representing 57% of the population after weighting) in urban counties. The birth cohort across the state of Kansas is 11% sparsely populated, 35% moderately populated and 55% urban.⁷

Statewide Immunization Coverage by Age 24 Months

The immunization coverage rates for several of the single vaccines significantly changed compared to coverage rates from the previous year. HepB3, MMR1, Var1, PCV3, and HepA1 coverage rates increased significantly from last year. DTaP4, Polio3, Hib3, and HepA2 coverage rates remained unchanged. The immunization rate for the 4-3-1-3-3 was 63.1%, which was not significantly different from last year's estimate. Vaccine coverage rates for DTaP4, Hib3 and 4-3-1-3-3 rose each year from 1990-91 through 2000-01, decreased significantly in 2001-02 and 2002-03, then increased significantly in 2003-04 and remained unchanged in 2004-05 as displayed in Figure 1. The coverage rate for PCV3, which was measured for the third time, was 56.6% (Table 1). Hepatitis A was measured for the second time in the 2008-09 Retrospective Survey, and the rate of coverage for one dose of hepatitis A vaccine increased by more than 11 percentage points from the previous year (from 31.0% in 2003-04 to 42.6% in 2004-05), while the rate of coverage for two doses was 1.3% (95% CI 1.0%-1.5%) (Figure 2). The number of children protected from varicella increased from last year's study; however, coverage rates did not significantly increase when history of varicella was included in the analysis.

⁵2003 Annual Summary of Kansas Vital Statistics (<http://www.kdheks.gov/ches>)

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

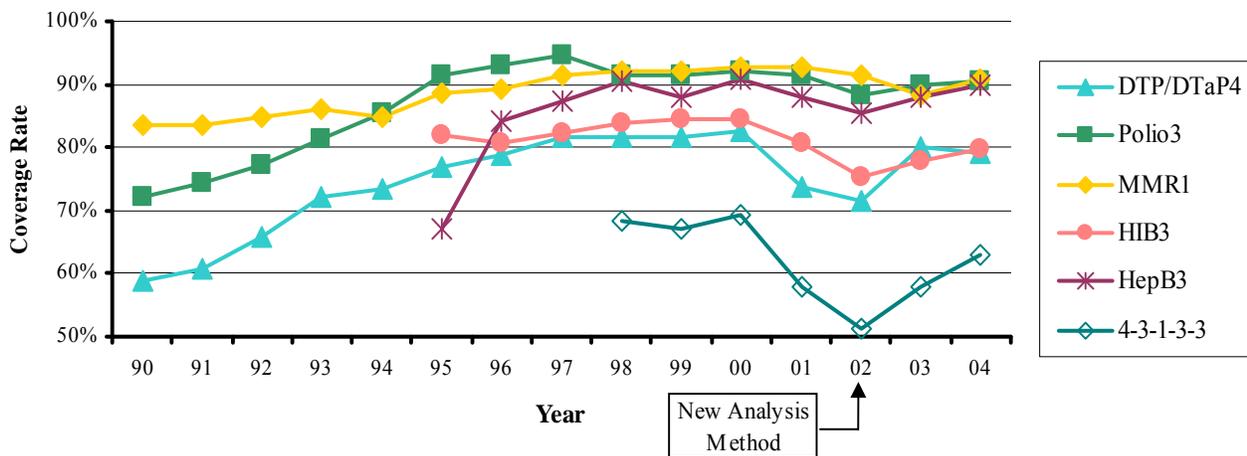
⁷ Numbers rounded to whole integers

TABLE 1 Kansas immunization coverage rates at 24 months of age by vaccine for 2004-2005.
 *Percentage up-to-date and 95% confidence interval

	Percent (%)	95% CI
DTaP4	79.0	77.8-80.1
Polio3	90.6	89.8-91.4
MMR1	90.8	90.0-91.7
Hib3	79.9	78.7-81.1
HepB3	89.9	89.0-90.7
4-3-1-3-3 Series	63.1	61.8-64.5
Var1	80.5	79.4-81.6
PCV3	56.6	55.1-58.0
HepA1	42.4	41.0-43.9
HepA2	1.3	1.0-1.5

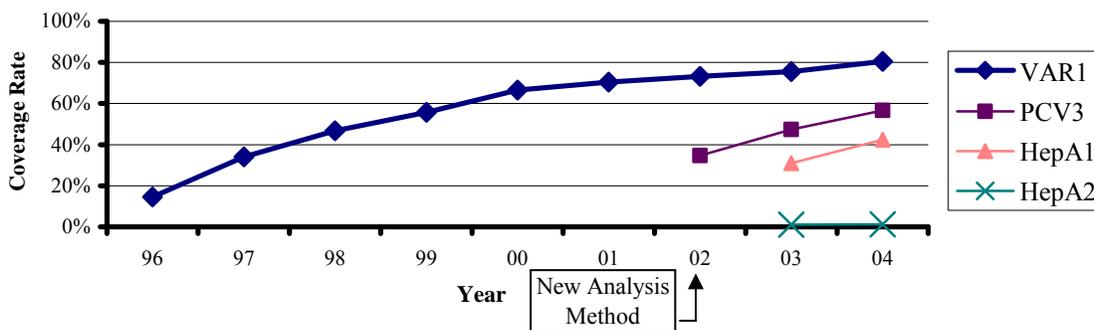
* Based on retrospective survey from school year starting in 2008.

FIGURE 1 Kansas immunization coverage rates at 24 months of age by vaccine from 1990-91 through 2004-05.*



* Based on retrospective surveys from school years starting in 1994 through 2008.

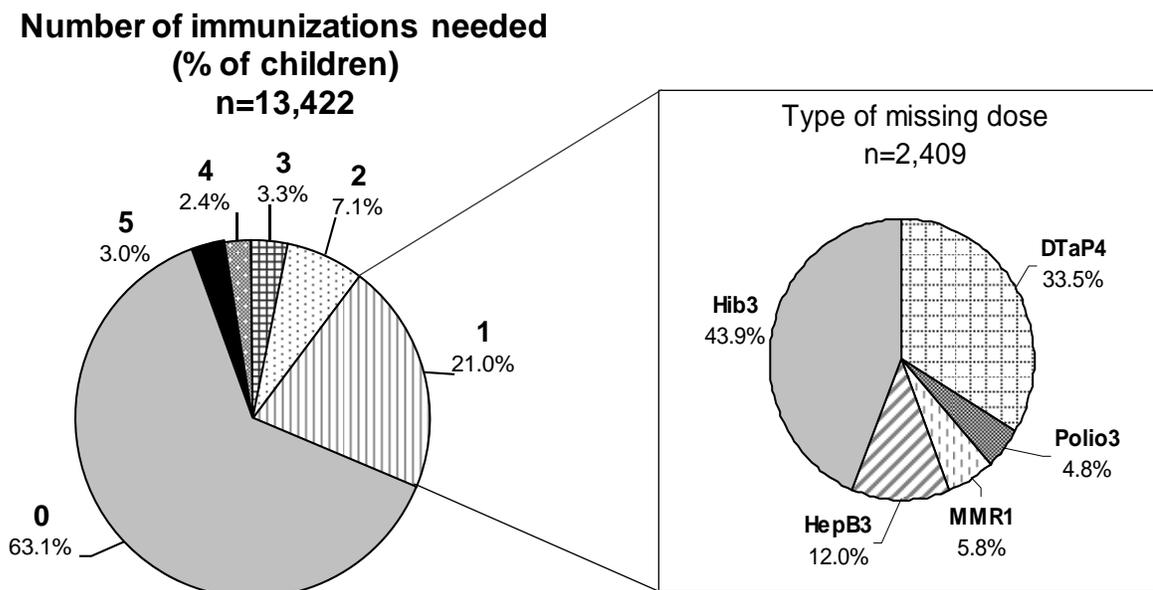
FIGURE 2 Kansas immunization coverage rates at 24 months of age by vaccine from 1996-97 through 2004-05.*



* Based on retrospective surveys from school years starting in 2000 through 2008.

Of children not up-to-date for the 4-3-1-3-3 at 24 months of age, 57% (21% of total population studied) needed one additional immunization (Figure 3). If these children had received the missing vaccination, the coverage rates for the 4-3-1-3-3 series would have increased from 63.1% to 84.1%. Among children who needed one immunization, 43.9% needed Hib3 and 33.5% needed DTaP4 (Figure 3). Of children not up-to-date at 24 months of age, 8.2% (3.0% of total population) were missing DTaP4, Polio3, MMR1, HepB3 and Hib3. When children with either a medical or religious exemption were excluded from the analysis, 7.5% (2.7% of total population) were not up-to-date for any of the 5 vaccination series (DTaP4, Polio3, MMR1, HepB3, and Hib3).

FIGURE 3: Number and type of immunizations kindergartners needed to be up-to-date for the 4-3-1-3-3 at 24 months of age, Kansas 2004 - 2005.*



*Based on the retrospective survey for the school year starting 2008.

County-level Immunization Coverage of 24 Month Olds

Immunization coverage was also analyzed at the county level. All vaccine coverage rates are displayed by county in Appendix 2.

Of the 105 counties, 28 reached the Healthy People goal of at least 80% coverage for the 4-3-1-3-3 series; 27 of these 28 counties were sparsely populated (Appendix 3). Eighteen counties had 90% coverage or better for DTaP4 and 74 counties had a minimum of 90% coverage for both Polio3 and MMR1. 10 counties had coverage of 90% or better for Var1. Geographic regions with low immunization rates for DTaP4 and MMR1 were in the southeast and northwest corners of the state. Those counties with less than 80% coverage for 4-3-1-3-3 were primarily in the eastern half of the state.

Counties were classified based on their population densities, and coverage rates were compared among the three categories (Table 2). Counties that were sparsely populated had significantly 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 2004-2005.*

Counties by Population Density – Condensed Groups n=13,422			
	Sparsely Populated n=3,569 (95% CI)	Moderately Populated n=6,213 (95% CI)	Urban n=3,640 (95% CI)
DTaP4	82.2 (80.9-83.5)	77.8 (76.7-78.9)	79.0 (77.0-80.9)
Polio3	91.3 (90.4-92.3)	90.2 (89.4-91.0)	90.6 (89.3-92.0)
MMR1	91.3 (90.4-92.3)	90.4 (89.7-91.2)	90.2 (89.5-92.3)
Hib3	88.8 (87.8-89.8)	83.5 (82.5-84.5)	76.1 (74.0-78.2)
HepB3	91.7 (90.8-92.6)	89.7 (88.9-90.5)	89.6 (88.2-91.1)
4-3-1-3-3 Series	74.6 (73.2-76.1)	65.4 (64.1-66.7)	54.2 (51.8-56.6)
Var1	78.4 (77.0-79.7)	77.5 (76.4-78.6)	82.7 (80.9-84.5)
PCV3	59.8 (58.2-61.4)	59.6 (58.3-60.9)	54.2 (51.8-56.6)

* Based on retrospective surveys from school years starting in 2008

Statewide Immunization Coverage of Children at School Entry for Kindergarten

Immunization rates were calculated for children entering kindergarten (Table 3 and Figure 4). The required vaccines for school entry were DTaP5, Polio4, MMR2, Var1, and HepB3. By the time the children started kindergarten, at least 90% were up-to-date for MMR2, HepB3, and Var1, while at least 80% were up-to-date for DTaP5 and Polio4 (Table 3). Vaccines that were recommended for all children, but not required for school entry were Hib3, HepA2, and PCV3. These vaccines had significantly lower coverage rates than the required vaccines.

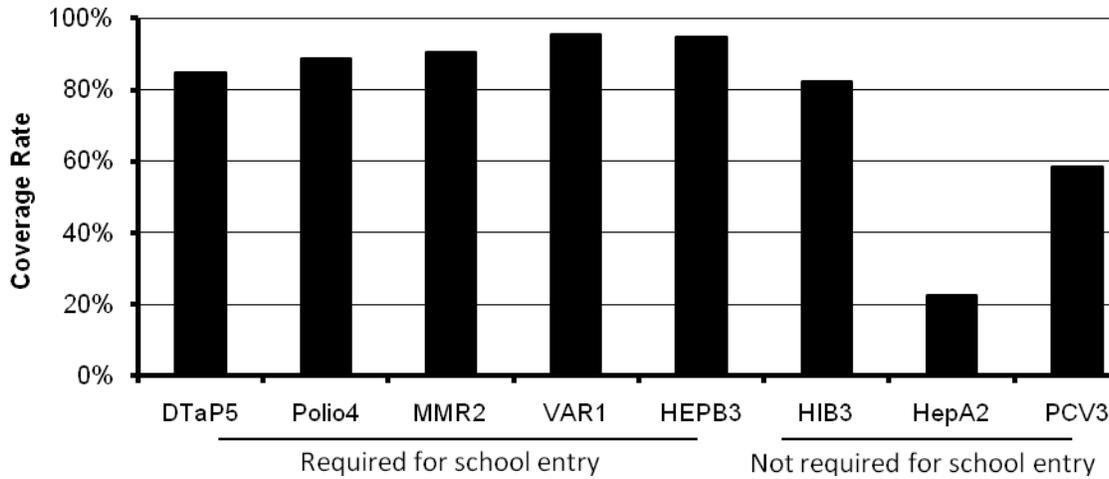
Table 3 Immunization rates of Kansas kindergartners at school entry, 2008-09

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

	2008-09
	% (95% CI)
DTaP5	84.8 (83.8-85.7)
Polio4	88.9 (88.1-89.7)
MMR2	90.4 (89.6-91.2)
Var1	95.5 (95.0-96.1)
HepB3	94.8 (94.2-95.4)
Hib3	82.4 (81.3-83.5)
HepA2	22.4 (21.2-23.6)
PCV3	58.6 (57.3-59.9)

* Based on retrospective surveys from school years starting in 2008.

FIGURE 3 Immunization rates of Kansas kindergartners at school entry, 2008-09.*



*Based on the retrospective survey for the school year starting 2008.

DISCUSSION

Statewide immunization coverage rates by 24 months of age statistically increased from last year for most single antigen vaccines (HepB3, Var1, MMR1, PCV3, and HepA1) in the current 2008-2009 Retrospective Survey. Polio3 and MMR1 were the only vaccinations that met the Healthy People 2010 goal of at least 90% coverage. The coverage rates for DTaP4, Hib3, HepB3, and Var1 were less than 11 percentage points from meeting this goal.⁸ The 4-3-1-3-3 series remains more than 16 percentage points from meeting the goal of 80% coverage. However, if the children missing only one vaccination in the 4-3-1-3-3 series received the needed immunization, the goal would be exceeded (84.1%). Since 2002-2003, Var1 and PCV3 have significantly increased each year. Immunization against *H. influenzae* type B, hepatitis A and the second dose of varicella were not required for school entry for the 2007-2008 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.

Twenty-eight counties reached the Healthy People goal of at least 80% coverage for the 4-3-1-3-3 series. Twenty-seven of these counties were sparsely populated (Appendix 3). For DTaP4, eighteen counties had at least 90% coverage, and 74 counties had a minimum of 90% coverage for both Polio3 and MMR1. Only ten counties had 90% or greater coverage for Var1. Geographic regions where immunization rates were low for DTaP4, MMR1, and PCV3 were in the southeast corner of the state. Coverage rates for 4-3-1-3-3 and Hib3 were lower in the eastern part of the state. The southeast and northwest parts of the state had low coverage for Var1.

County designations were used to create categories by population. The coverage rate estimates were 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 sparsely populated counties was statistically higher compared to moderately populated and urban counties, but the moderately populated and urban rates were not statistically different from each other. The coverage rate estimate for the sparsely populated category,

⁸Healthy 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.

which only accounts for 11% of the population surveyed, compared to the coverage rate estimates of the other two categories (moderately populated, urban) was highest for DTaP4, Polio3, Hib3, HepB3, PCV3, and the 4-3-1-3-3 series. The moderately populated category, which is comprised of 32% of the population surveyed, had the lowest coverage estimates for DTaP4, Polio3, MMR1, and Var1. The moderately populated counties did not have the highest rate for any vaccine. Urban, which includes the most densely populated counties and represents 57% of the population surveyed, had the lowest coverage rate estimates for Hib3, HepB3, the 4-3-1-3-3 series, and PCV3. The urban category had the highest rate for only two of the vaccines, MMR1 and Var1. Due to the large percentage of the population living in the 5 urban counties (57%), targeting this population to improve vaccination coverage would increase the statewide immunization rates.

The results from this survey were compared with the results from the 2005 National Immunization Survey (NIS), which refers to the same time period as this retrospective survey.⁹ The results were compared to confirm the coverage rates in the retrospective survey and to compare immunization 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 (63.1 [95% CI 61.8 – 64.5]) when compared to the NIS result (83.8 [95% CI 78.8 – 88.8]) 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 as well as differences in sampling methodologies. The NIS also assesses 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 disparity in rates.

Immunization coverage rates were also examined for children that were between the ages of five and seven when they entered kindergarten. Of the required vaccines, at least 90% of the children had received MMR2, HepB3, and Var1, and at least 80% received Polio4 and DTaP5. However, the Healthy People 2010 goals of at least 95% coverage rates for DTaP, MMR, and Polio were not met. Required vaccines had significantly greater immunization rates than those vaccines that were recommended for children by time of entry into kindergarten. Two of these recommended vaccines, HepA2 and PCV3 were well below 80% coverage, at 22.4% and 58.6% respectively. However, because they were not required for school entry, there may be a lack of reporting on the KCI.

Vaccine coverage is of great public health importance. By having greater vaccine coverage rates, there is an increase in herd immunity, which leads to lower incidence rates and an ability to limit the size of disease outbreaks. In 2006, a widespread outbreak of mumps occurred in Kansas and across the United States. Prior to the outbreak, the incidence rate of mumps was at a historical low, and even with the outbreak, the rates were still lower than pre-vaccination era. Due to high vaccine coverage rates, tens or hundreds of thousands of cases were possibly prevented.

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.

⁹ *Morbidity and Mortality Weekly Report*; September 15, 2006 / 55(36);988-993.

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.

Sparsely Populated

- Anderson
- Barber
- Brown
- Chase
- Chautauqua
- Cheyenne
- Clark
- Clay
- Cloud
- Coffey
- Comanche
- Decatur
- 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

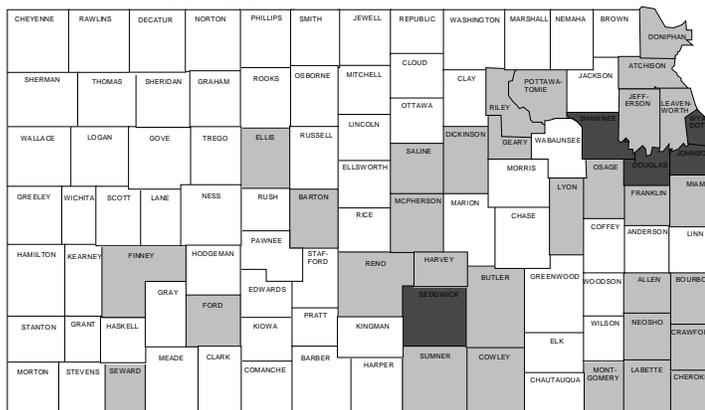
Moderately Populated

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

Urban

- 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



□ Sparsely Populated ■ Moderately Populated ■ Urban

APPENDIX 2: Immunization Coverage Rates of Children 24 Months of Age for Kansas Counties
2008-2009 (percentages).*

COUNTY	DTaP4	Polio3	MMR1	Hib3	HepB3	4-3-1-3-3	Var1	PCV3	HepA1
STATEWIDE	79	91	91	80	90	63	81	57	42
ALLEN	77	93	90	92	92	71	72	61	19
ANDERSON	74	91	90	87	94	70	74	69	34
ATCHISON	74	87	85	87	88	65	54	26	34
BARBER	59	85	87	85	87	59	62	46	21
BARTON	86	92	98	80	89	71	86	68	71
BOURBON	68	82	83	83	81	58	62	63	5
BROWN	76	91	91	75	92	51	57	24	39
BUTLER	81	93	89	90	89	71	79	63	35
CHASE	88	96	92	88	96	72	56	8	4
CHAUTAUQUA	91	97	97	97	100	91	84	75	28
CHEROKEE	79	94	94	96	91	70	80	85	35
CHEYENNE	76	86	86	93	86	59	69	76	41
CLARK	91	94	97	97	94	85	82	82	50
CLAY	81	94	90	88	89	72	86	65	62
CLOUD	77	90	91	85	89	71	85	75	25
COFFEY	91	95	96	95	92	88	85	56	4
COMANCHE	94	100	94	88	94	81	81	44	19
COWLEY	75	89	88	66	92	54	66	45	23
CRAWFORD	76	89	87	86	90	68	57	35	33
DECATUR	83	91	96	87	91	78	61	61	0
DICKINSON	81	90	91	87	93	71	83	78	34
DONIPHAN	72	93	92	87	93	69	75	55	42
DOUGLAS	80	92	90	73	91	56	85	59	14
EDWARDS	83	81	92	86	92	72	83	61	22
ELK	96	100	100	100	100	96	100	91	22
ELLIS	89	94	94	89	94	77	89	60	17
ELLSWORTH	86	90	98	94	94	84	84	78	56
FINNEY	83	94	93	92	94	79	87	74	81
FORD	82	93	94	91	93	77	83	81	74
FRANKLIN	73	87	87	87	89	65	85	74	74
GEARY	69	85	87	77	86	60	83	63	29
GOVE	100	100	100	100	100	100	93	73	7
GRAHAM	76	88	82	94	94	71	76	53	6
GRANT	78	93	91	91	97	74	81	67	47
GRAY	89	95	95	95	92	87	77	68	75
GREELEY	86	100	100	100	100	86	86	71	71
GREENWOOD	91	94	94	96	99	87	76	51	40
HAMILTON	89	92	89	89	100	84	86	73	97
HARPER	76	85	90	94	85	68	68	42	11
HARVEY	80	79	86	86	91	57	72	54	32
HASKELL	86	93	93	91	88	77	86	77	70
HODGEMAN	80	100	100	100	100	80	87	93	100
JACKSON	89	95	96	75	91	66	71	48	28
JEFFERSON	76	93	92	91	95	69	84	74	27

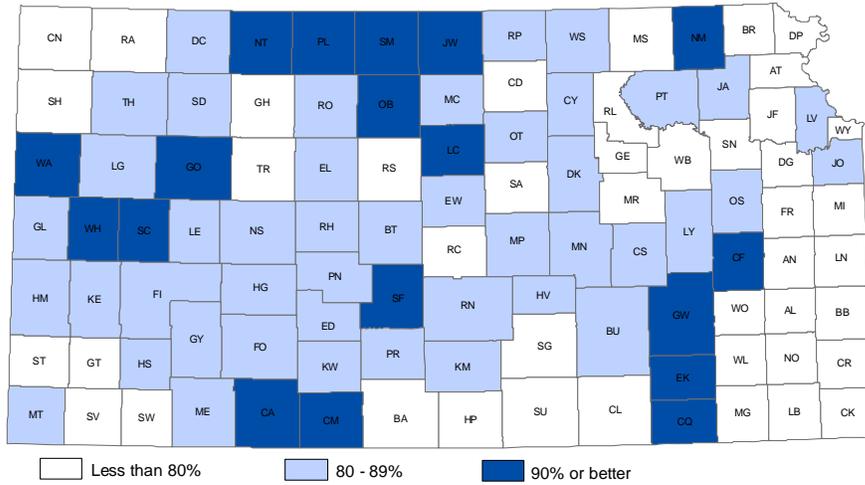
COUNTY	DTaP4	Polio3	MMR1	Hib3	HepB3	4-3-1-3-3	Var1	PCV3	HepA1
STATEWIDE	79	91	91	80	90	63	81	57	42
JEWELL	93	100	93	100	100	93	93	67	7
JOHNSON	84	90	93	68	87	56	87	47	49
KEARNY	80	86	88	84	92	71	84	65	88
KINGMAN	81	88	86	86	88	70	75	23	25
KIOWA	86	100	86	71	100	57	86	86	14
LABETTE	77	91	91	85	90	68	85	55	39
LANE	84	92	100	92	92	84	84	88	100
LEAVENWORTH	81	92	92	66	91	50	83	51	43
LINCOLN	97	97	100	94	91	79	88	0	3
LINN	71	83	89	80	82	60	74	39	16
LOGAN	85	96	92	88	96	73	46	62	15
LYON	82	94	90	90	93	73	57	32	21
MARION	85	94	88	93	90	77	76	64	36
MARSHALL	79	91	90	90	93	75	79	75	49
MCPHERSON	86	92	91	14	90	11	79	10	13
MEADE	80	96	89	67	98	60	87	76	44
MIAMI	75	85	87	85	82	61	78	43	33
MITCHELL	82	92	97	89	94	79	87	75	10
MONTGOMERY	74	86	94	83	87	64	83	49	39
MORRIS	80	90	86	90	94	75	74	42	35
MORTON	81	86	92	78	86	64	89	42	22
NEMAHA	93	97	94	94	94	84	67	75	69
NEOSHO	32	91	90	88	34	25	65	15	60
NESS	80	93	93	100	93	73	87	60	13
NORTON	96	100	100	94	94	88	90	63	69
OSAGE	82	91	91	72	92	60	73	55	14
OSBORNE	92	96	96	96	96	92	92	50	8
OTTAWA	85	95	94	92	97	81	82	68	31
PAWNEE	88	96	94	94	96	88	92	82	70
PHILLIPS	95	98	95	98	98	90	80	65	54
POTTAWATOMIE	84	95	93	91	93	80	83	77	32
PRATT	82	91	88	96	97	74	86	55	67
RAWLINS	60	80	73	80	80	53	67	60	20
RENO	82	95	90	89	92	70	83	79	26
REPUBLIC	84	92	97	97	97	84	81	78	41
RICE	66	82	79	78	85	58	65	50	10
RILEY	79	89	90	85	92	66	84	71	13
ROOKS	87	90	92	96	94	85	87	77	62
RUSH	85	88	88	92	85	77	81	77	19
RUSSELL	77	82	86	79	79	67	71	68	25
SALINE	79	91	92	85	94	70	85	78	78
SCOTT	90	100	97	93	97	90	100	87	90
SEDGWICK	76	92	90	86	92	66	79	59	43
SEWARD	72	91	95	81	90	65	77	65	67
SHAWNEE	79	89	91	86	89	69	81	75	44
SHERIDAN	84	94	91	88	78	63	69	56	13

COUNTY	DTaP4	Polio3	MMR1	Hib3	HepB3	4-3-1-3-3	Var1	PCV3	HepA1
STATEWIDE	79	91	91	80	90	63	81	57	42
SHERMAN	76	85	83	85	89	76	70	41	7
SMITH	93	100	93	100	100	93	79	86	14
STAFFORD	92	94	94	90	92	83	94	65	56
STANTON	79	100	100	96	100	79	88	67	67
STEVENS	74	89	94	83	94	70	74	15	81
SUMNER	76	88	88	88	93	69	52	31	15
THOMAS	82	91	91	92	92	78	75	69	42
TREGO	67	92	83	83	75	50	83	83	17
WABAUNSEE	75	89	86	89	88	66	77	73	28
WALLACE	92	96	100	96	100	88	96	64	24
WASHINGTON	87	95	98	89	91	75	89	73	40
WICHITA	97	97	97	97	100	92	92	85	26
WILSON	71	83	85	83	83	60	67	17	30
WOODSON	56	74	70	78	81	56	67	56	7
WYANDOTTE	70	88	90	70	90	50	81	44	49

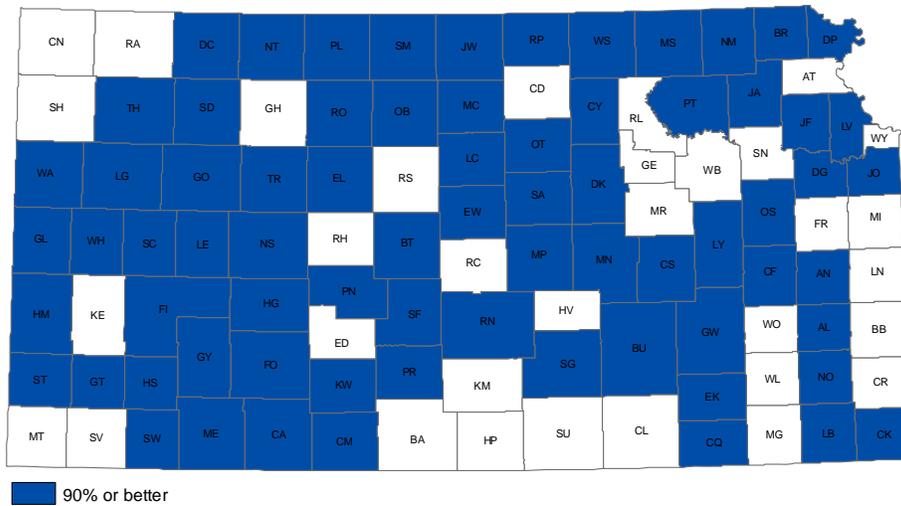
* Based on the retrospective survey for the school year starting 2008.

Appendix 3: Maps of immunization rates by county, 2008-09 Retrospective Survey.

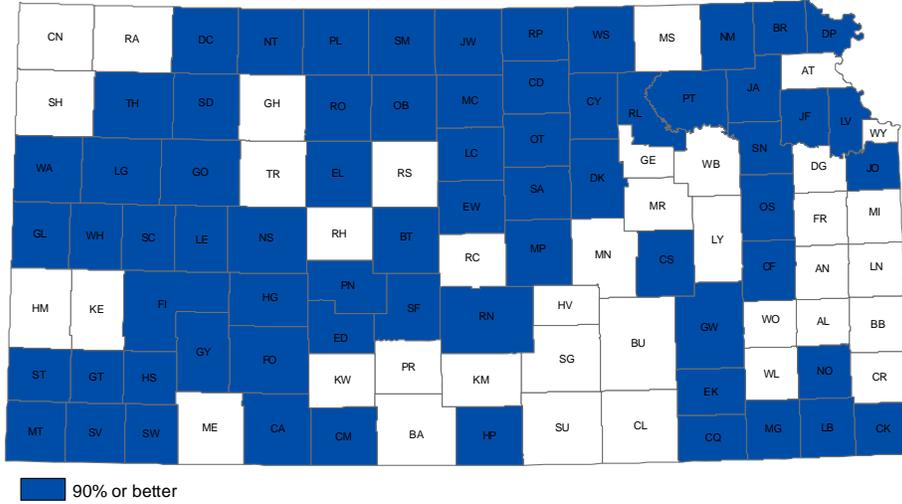
DTaP4 Series for Retrospective Survey 2008-09



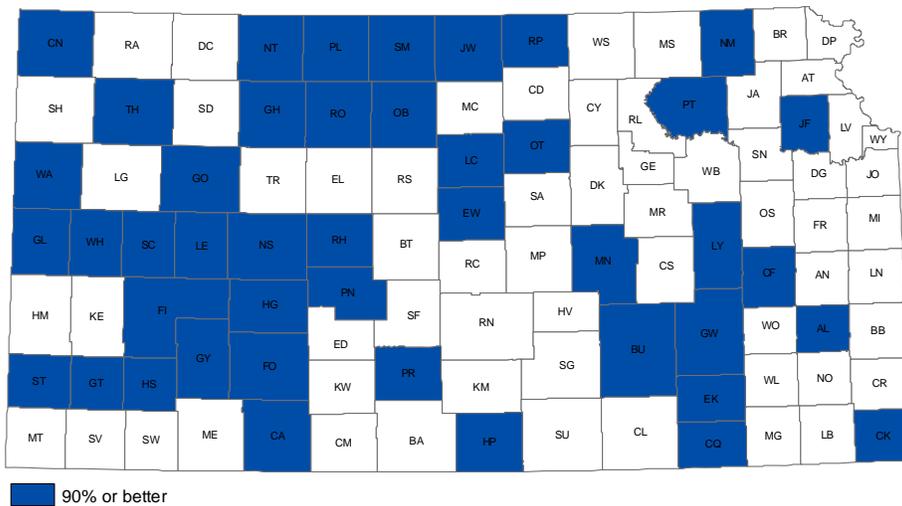
Polio3 Series for Retrospective Survey 2008-09



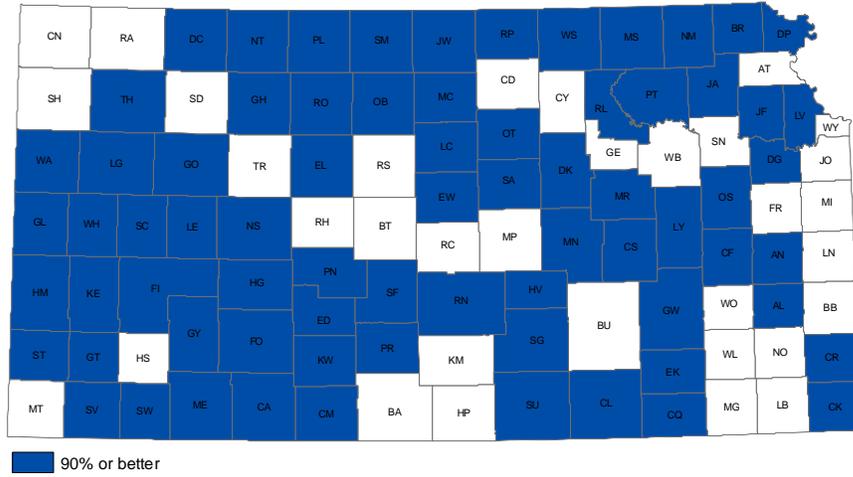
MMR1 Series for Retrospective Survey 2008-09



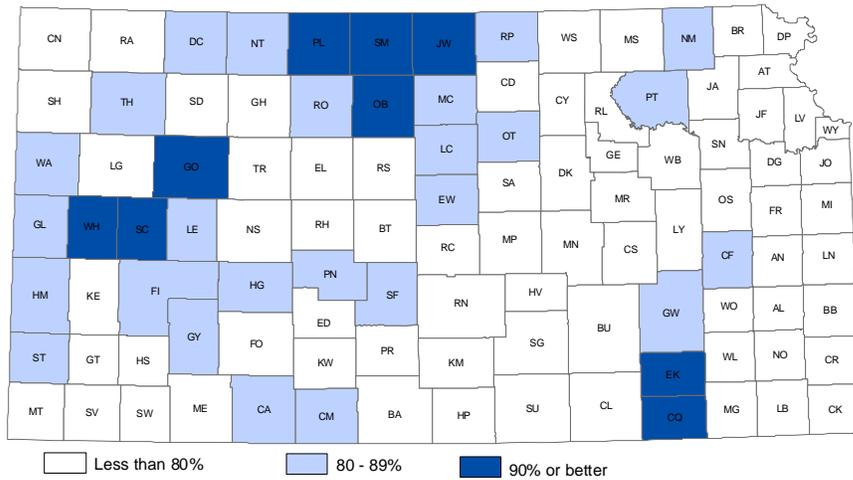
Hib3 Series for Retrospective Survey 2008-09



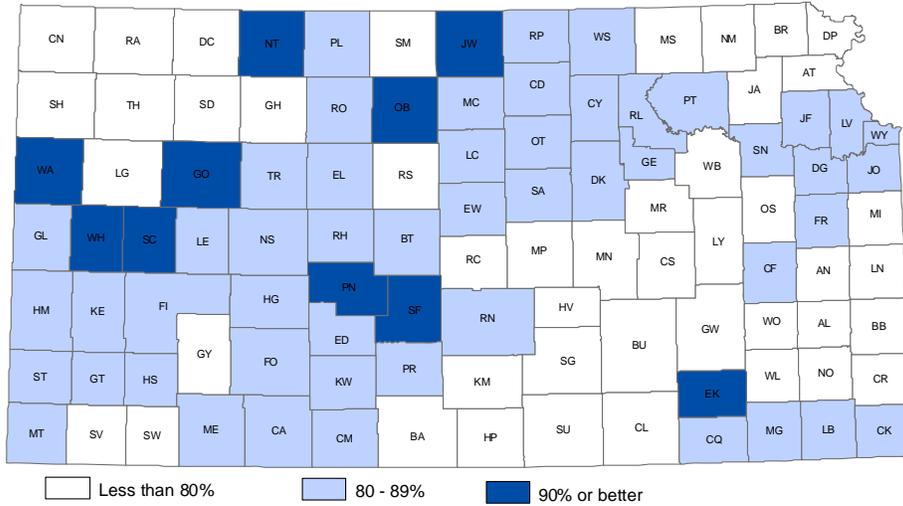
HepB3 Series for Retrospective Survey 2008-09



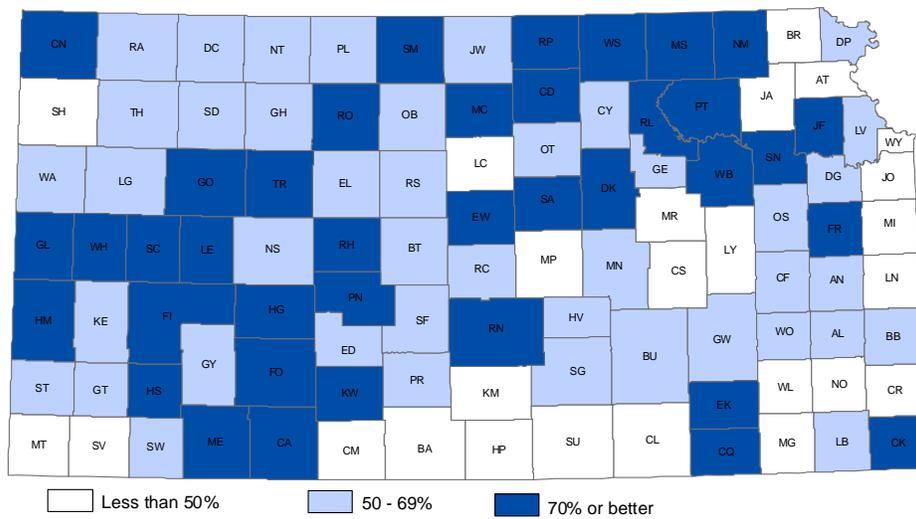
4-3-1-3 Series for Retrospective Survey 2008-09



Var1 Series for Retrospective Survey 2008-09



PCV3 Series for Retrospective Survey 2008-09



Note: Intervals used are different from the other maps

Appendix 4: CDC's 2003 Advisory Committee on Immunization Practices (ACIP) Recommendations <http://www.cdc.gov/mmwr/preview/mmwrhtml/mm5204-Immunizational1.htm>

FIGURE. Recommended childhood and adolescent immunization schedule¹ — United States, 2003

Vaccine	Range of recommended ages				Catch-up vaccination				Preadolescent assessment			
	Birth	1 mo	2 mos	4 mos	6 mos	12 mos	15 mos	18 mos	24 mos	4–6 yrs	11–12 yrs	13–18 yrs
Hepatitis B²	HepB #1	only if mother HBsAg (-)		HepB #2		HepB #3		HepB series				
Diphtheria, Tetanus, Pertussis³		DTaP	DTaP	DTaP		DTaP			DTaP		Td	
Haemophilus influenzae Type b⁴		Hib	Hib	Hib		Hib						
Inactivated Polio		IPV	IPV	IPV					IPV			
Measles, Mumps, Rubella⁵						MMR #1			MMR #2		MMR #2	
Varicella⁶						Varicella			Varicella			
Pneumococcal⁷			PCV	PCV	PCV	PCV			PCV		PPV	
----- Vaccines below this line are for selected populations												
Hepatitis A⁸											HepA series	
Influenza⁹											Influenza (yearly)	

1. Indicates the recommended ages for routine administration of currently licensed childhood vaccines, as of December 1, 2002, for children through age 18 years. Any dose not given at the recommended age should be given at any subsequent visit when indicated and feasible. [Hatched box] Indicates age groups that warrant special effort to administer those vaccines not given previously. 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 manufacturers' package inserts for detailed recommendations.

2. **Hepatitis B vaccine (HepB).** All infants should receive the first dose of HepB vaccine soon after birth and before hospital discharge; the first dose also may be given by age 2 months if the infant's mother is HBsAg-negative. Only monovalent HepB vaccine can be used for the birth dose. Monovalent or combination vaccine containing HepB may be used to complete the series; 4 doses of vaccine may be administered when a birth dose is given. The second dose should be given at least 4 weeks after the first dose except for combination vaccines, which cannot be administered before age 6 weeks. The third dose should be given at least 16 weeks after the first dose and at least 8 weeks after the second dose. The last dose in the vaccination series (third or fourth dose) should not be administered before age 6 months. Infants born to HBsAg-positive mothers should receive HepB vaccine 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. The last dose in the vaccination series should not be administered before age 6 months. These infants should be tested for HBsAg and anti-HBs at 9–15 months of age. Infants born to mothers whose HBsAg status is unknown should receive the first dose of the HepB vaccine series within 12 hours of birth. Maternal blood should be drawn as soon as possible 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). The second dose is recommended at age 1–2 months. The last dose in the vaccination series should not be administered before age 6 months.

3. **Diphtheria and tetanus toxoids and acellular pertussis vaccine (DTaP).** The fourth dose of DTaP may be administered at age 12 months provided that 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 Td-containing vaccine. Subsequent routine Td boosters are recommended every 10 years.

4. **Haemophilus influenzae type b (Hib) conjugate vaccine.** Three Hib conjugate vaccines are licensed for infant use. If PRP-OMP (PedvaxHIB[®] or ComVax[®] [Merck]) is administered at age 2 and 4 months, a dose at age 6 months is not required. DTaP/Hib combination products should not be used for primary vaccination in infants at age 2, 4, or 6 months but can be used as boosters following any Hib vaccine.

5. **Measles, mumps, and rubella vaccine (MMR).** The second dose of MMR is recommended routinely at age 4–6 years but may be administered during any visit provided that at least 4 weeks have elapsed since the first dose and that both doses are administered beginning at or after age 12 months. Those who have not received the second dose previously should complete the schedule by the visit at age 11–12 years.

6. **Varicella vaccine.** Varicella vaccine is recommended at any visit at or after age 12 months for susceptible children (i.e., those who lack a reliable history of chickenpox). Susceptible persons aged ≥13 years should receive 2 doses given at least 4 weeks apart.

7. **Pneumococcal vaccine.** The heptavalent pneumococcal conjugate vaccine (PCV) is recommended for all children aged 2–23 months and for certain children aged 24–59 months. **Pneumococcal polysaccharide vaccine (PPV)** is recommended in addition to PCV for certain high-risk groups. See *MMWR* 2000;49(No. RR-9):1–37.

8. **Hepatitis A vaccine.** Hepatitis A vaccine is recommended for children and adolescents in selected states and regions, and for certain high-risk groups. Consult local public health authority and *MMWR* 1999;48(No. RR-12):1–37. Children and adolescents in these states, regions, and high-risk groups who have not been immunized against hepatitis A can begin the hepatitis A vaccination series during any visit. The two doses in the series should be administered at least 6 months apart.

9. **Influenza vaccine.** Influenza vaccine is recommended annually for children aged ≥6 months with certain risk factors (including but not limited to asthma, cardiac disease, sickle cell disease, HIV, and diabetes, and household members of persons in groups at high risk (see *MMWR* 2002;51[No. RR-3]:1–31), and can be administered to all others wishing to obtain immunity. In addition, healthy children age 6–23 months are encouraged to receive influenza vaccine if feasible because children in this age group are at substantially increased risk for influenza-related hospitalizations. Children aged ≤12 years should receive vaccine in a dosage appropriate for their age (0.25 mL if 6–35 months or 0.5 mL if ≥3 years). Children aged ≥8 years who are receiving influenza vaccine for the first time should receive 2 doses separated by at least 4 weeks.

Additional information about vaccines, including precautions and contraindications for vaccination and vaccine shortages, is available at <http://www.cdc.gov/nip> or at the National Immunization information hotline, telephone 800-232-2522 (English) or 800-232-0233 (Spanish). Copies of the schedule can be obtained at <http://www.cdc.gov/nip/occs/child-schedule.htm>. Approved by the **Advisory Committee on Immunization Practices** (<http://www.cdc.gov/nip/acip>), the **American Academy of Pediatrics** (<http://www.aap.org>), and the **American Academy of Family Physicians** (<http://www.aafp.org>).