RETROSPECTIVE IMMUNIZATION COVERAGE SURVEY

2003- 2004 Results (School Year 2007-08)

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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)
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 *Haemophilus influenzae* 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
VAR2	2 doses of varicella vaccine

EXECUTIVE SUMMARY

Overview

The Kansas Certificates of Immunization (KCIs) for children enrolled in a kindergarten class in Kansas public and private schools during the 2007-2008 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, 2001, and September 1, 2002, and the coverage rates refer to children who were 24 months old between September 2, 2003, and September 1, 2004. 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 on September 1, 2007, were included. In total, there were 807 schools, 710 public and 97 private, included in the analysis. The 15,737 complete and useable KCIs are a representative sample of the population enrolled in kindergarten at both public and private schools. This was the second year that private schools were surveyed.

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 58%. 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 in Kansas since the 2004-2005 school year. By 24 months of age, the coverage rate was 88% for HepB3, 76% for varicella, and 47% 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.

Fourteen 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, eight counties had at least 90% coverage and 49 counties had at least 80% coverage. For IPV3, 68 counties had at least 90% coverage. For MMR1, 40 counties had 90% coverage or better. Five counties had at least 90% coverage for VAR1.

Coverage at School Entry

By school entry, the immunization rates reached at least 90% for DTaP4, Polio3, MMR1, and HepB3. For varicella, 89% 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 in recent years, but increased in 2003-04 (2007-08 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. Immunization is an important public health issue to increase herd immunity, reduce disease incidence and limit outbreaks.

RETROSPECTIVE IMMUNIZATION COVERAGE SURVEY 2003-2004 (SCHOOL YEAR 2007-2008)

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 2007-08 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 2007-08 school year. This is the second 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.[1] The schedule for 2002 is in Appendix 4. ***The results of the survey refer to children who were born between September 2, 2001, and September 1, 2002. The coverage rates refer to the point in time at which these children turned 24 months old, between September 2, 2003, and September 1, 2004. 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, 2007.***

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.[2] Due to the small size of the private school population in Kansas, all records from private schools were solicited.

[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 2002.

[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.

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 sixteenth, or every eighteenth 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

Starting in the 2006-07 Retrospective Survey and continuing with the 2007-08 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. For the 2007-08 study, the methods from 2006-07 were used. 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 data were weighted and all analyses were conducted to account for the complex sample design effect because of the stratification process and the 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. These weights were applied during analyses of statewide and county-level estimates.

Population densities were calculated based on population from the 2000 census to categorize counties.[4] 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.

[3] Complex survey design effect was accounted for by using the SAS Procedure PROC SURVEYFREQ.
[4] http://www.census.gov/

RESULTS

Data Collection

Letters of invitation to participate in the survey were sent to 845 Kansas public and private schools. There were 736 public schools and 109 private schools. One school reported not having a kindergarten class for the 2007-2008 school year and 37 did not respond. Data were received from and analyzed for 807 schools (710 public schools and 97 private schools) with kindergarten classes, corresponding to a school participation rate of 95.5%.

The number of children enrolled in kindergarten at the participating public and private schools was 35,780, which is 91% of the 39,338 children in that birth cohort.[5] The number of immunization records received was 16,026. This is equivalent to a sampling ratio of 2.2, meaning that one child was selected for every 2.2 children enrolled. The range of the sample size by county was from 13 to 1,226 records while the range of student enrollment was from 13 to 7,213.[6]

Of the 16,026 immunization records returned and examined, 15,737 (98%) were complete and had usable information regarding immunization history. The excluded records had missing or invalid birth dates making them unusable. Of the records received, 13,855 (86%) children were included in the 24 month old analysis because they were 24 months of age between September 2, 2001, and September 1, 2002. Of the records used in the analysis, 0.01% indicated that the child did not have vaccinations because of a medical exemption and 0.48% indicated that the child did not have vaccinations because of a religious exemption. For the analysis at kindergarten entry, 15,737 (98%) records were included for the children who were at least five and not older than seven years on August 31, 2007.

The number of records examined by population density includes: 3,655 (23% of all records used, representing 12% of the population after weighting) Sparsely-populated, 6,905 (44% of all records used, representing 34% of the population after weighting) Moderately-populated, and 3,295 (21% of all records used, representing 54% of the population after weighting) 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 increased or decreased compared to the coverage rates of the previous year except for Polio3 and Hib3. MMR1 was the only one that significantly decreased. DTaP4, HepB3, the 4-3-1-3-3 series, VAR1, and PCV3 coverage rates increased significantly from last year. The coverage rate for the 4-3-1-3-3 series was 57.8%. 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, then decreased significantly in 2001-02 and 2002-03 and then increased significantly in 2003-04 for DTaP4, Hib3 and 4-3-1-3-3 as displayed in Figure 1. The coverage rate for PCV3, which was measured for the second time, was 47.3% (Table 1). Hepatitis A was measured for the first time in the 2007-08 school year. The rate of coverage for one dose was 31.0% (95% CI 29.8%-32.2%) and 1.1% (95% CI 0.8%-1.4%) for two doses.

[5] 2002 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

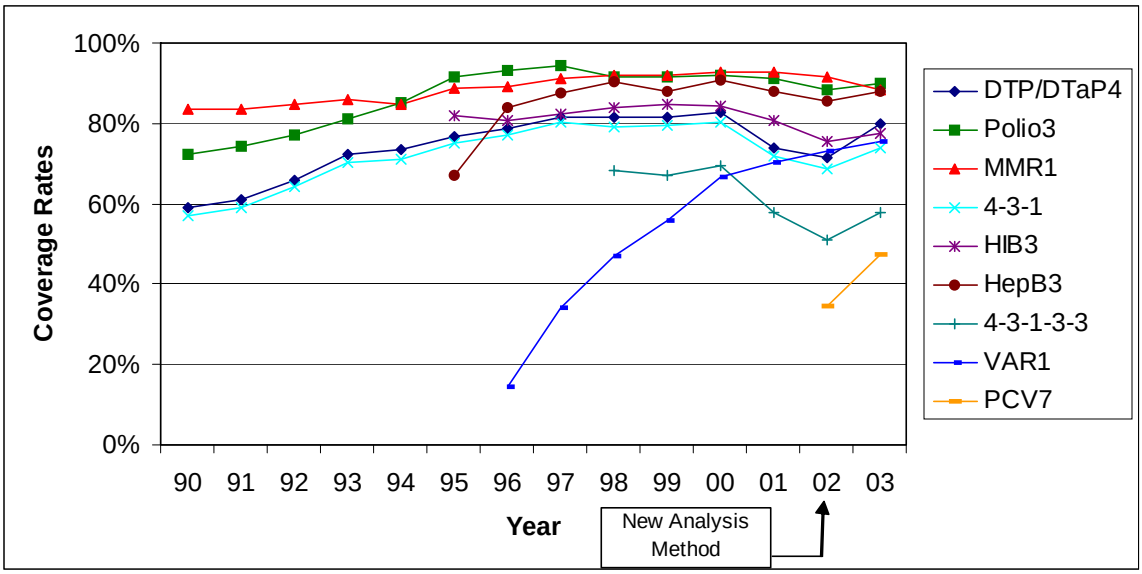
TABLE 1 Kansas immunization coverage rates at 24 months of age by vaccine for 2003-2004.

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

	Percent (%)	95% CI
DTaP4	80.1	79.1 – 81.1
Polio3	90.0	89.2 – 90.8
MMR1	88.4	87.6 – 89.2
Hib3	77.7	76.7 – 78.8
HepB3	88.0	87.1 – 88.9
4-3-1-3-3 Series	57.8	56.6 – 59.2
VAR1	75.6	74.5 – 76.7
PCV3	47.3	46.0 – 48.6
HepA1	31.0	29.8 – 32.2
HepA2	1.1	0.8 – 1.4

* Based on retrospective survey from school year starting in 2007.

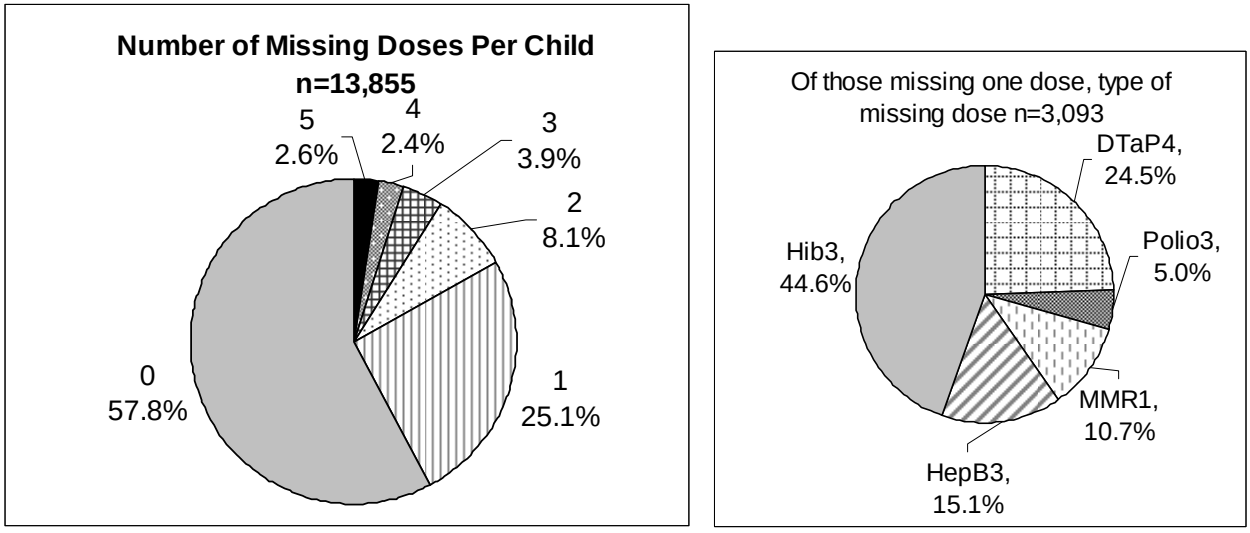
FIGURE 1 Kansas immunization coverage rates at 24 months of age by vaccine from 1990-91 through 2003-2004. *



* Based on retrospective surveys from school years starting in 1994 through 2007.

Of children not up-to-date at 24 months of age, 57% (25% 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 57.9% to 82.9%. Among children who needed one additional immunization, 24.5% needed DTaP4 (Figure 2). Among children not up-to-date at 24 months of age, 7.9% (2.6% 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 for the 4-3-1-3-3 at 24 months of age, Kansas 2003 - 2004. *



*Based on the retrospective survey for the school year starting 2007.

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. Appendix 3 shows maps of the state with county level coverage ranges.

Fourteen 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, eight counties had at least 90% coverage and 49 counties had at least 80% coverage. For Polio3, 68 counties had at least 90% coverage. For MMR1, 40 counties had 90% coverage or better. Five counties had at least 90% coverage for VAR1. Geographic regions where immunization rates were low were identified for DTaP4 and Polio3 in the southeast and southwest corners of the state. 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 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 2003-2004

Counties by Population Density – Condensed Groups n=13,855			
	Sparsely Populated n=3,655 (95% CI)	**Moderately Populated n=6,905 (95% CI)**	**Urban n=3,295 (95% CI)**
DTaP4	81.1 (79.9-82.4)	78.2 (77.2-79.3)	81.0 (79.3-82.8)
Polio3	91.3 (90.4-92.3)	89.8 (89.0-90.6)	89.9 (88.5-91.2)
MMR1	86.3 (85.2-87.4)	87.8 (86.9-88.6)	89.2 (87.8-90.6)
Hib3	87.5 (86.4-88.6)	77.7 (76.6-78.9)	75.7 (73.8-77.7)
HepB3	89.4 (88.4-90.4)	88.1 (87.3-89.0)	87.6 (86.1-89.1)
4-3-1-3-3 Series	67.0 (65.4-68.5)	58.3 (57.0-59.6)	55.8 (53.6-58.1)
VAR1	71.3 (69.9-72.8)	70.9 (69.7-72.1)	79.4 (77.5-81.2)
PCV3	47.7 (46.1-49.4)	45.1 (43.8-46.4)	48.6 (46.4-50.9)

* Based on retrospective surveys from school years starting in 2007.

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 16,026 immunization records returned and examined, 15,737 (98%) 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, 2007.

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 88.9%, significantly down from last year's 91.5%. The vaccine coverage rate for VAR2 was calculated for the first time and was 66.7% for school entry. The rates for MMR1 and VAR1 were both significantly lower than last year. Only 0.55% of the children had indicated history of varicella disease. Compared to last year's study, the rates for DTaP4 and Polio3 were significantly higher. Hepatitis A vaccine coverage rates were also calculated for the first time. Coverage of one dose of hepatitis A vaccine was 17.6% by school entry and 12.3% for two doses.

Table 3 Immunization rates of Kansas kindergartners at school entry, 2007-08.

Percentage up-to-date and 95% confidence interval

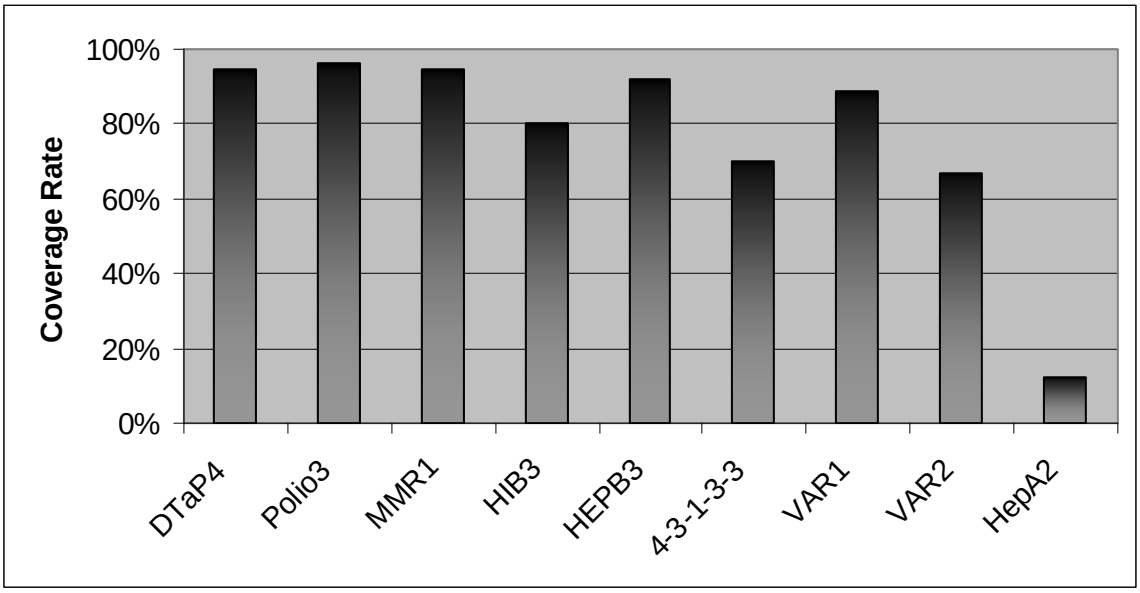
	2006-07	2007-08
	% (95% CI)	% (95% CI)
DTaP4	93.6 (92.9-94.2)	94.8 (94.3-95.3**)
Polio3	95.0 (94.4-95.6)	96.3 (95.9-96.8**)
MMR1	98.5 (98.1-98.8)	94.5 (94.0-95.1***)
HIB3	78.0 (76.7-79.2)	80.1 (79.0-81.0)
HEPB3	90.8 (90.0-91.6)	91.9 (91.2-92.6)
4-3-1-3-3	68.5 (67.1-69.9)	69.8 (68.7-70.9)
VAR1	91.5 (90.8-92.2)	88.9 (88.1-89.6***)
VAR2	-	66.7 (65.5-67.8)
HepA2	-	12.3 (11.4-13.2)

* Based on retrospective surveys from school years starting in 2007.

** Significantly higher than 2006-07

*** Significantly lower than 2006-07

FIGURE 3 Immunization rates of Kansas kindergartners at school entry, 2007-08. *



*Based on the retrospective survey for the school year starting 2007

DISCUSSION

Statewide immunization coverage rates by age 24 months statistically increased from last year for DTaP4, HepB3, the 4-3-1-3-3 series, VAR1, and PCV3 in the current 2007-2008 Retrospective Survey. The rate for MMR1 was the only one that significantly decreased. Despite only 76% coverage for VAR1, rates have significantly increased each year since analysis began in 2000. The number of children protected from varicella did not statistically increase when history of varicella disease was included. 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 Polio3 reached the Healthy People 2010 (HP2010) goal of at least 90% coverage. The coverage rates for DTaP4, MMR1, and HepB3 were 10 percentage points or less from meeting this goal.[7] Immunization against *H. influenzae* type B (Hib3), 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.

The deferral period of the 4th dose of DTaP was from March 2001 - July 2002. Included in this study were children born September 2001- September 2002, 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 reinstitution of the vaccine does not always happen quickly after the cause of the deferral has abated. Due to this deferral, coverage rates might be lower than expected.

Fourteen 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, eight counties had at least 90%

[7]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.

coverage and 49 counties had at least 80% coverage. For Polio3, 68 counties had at least 90% coverage. For MMR1, 40 counties had 90% coverage or better. Five counties had at least 90% coverage for VAR1. Geographic regions where immunization rates were low were identified for DTaP4 and Polio3 in the southeast and southwest corners of the state. Coverage rates for MMR1 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 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 DTaP4, Polio3, Hib3, HepB3 and the 4-3-1-3-3 series. "Sparsely populated" had the lowest rate for MMR1. The "moderately populated" category, which covers 32% of the population surveyed, had the lowest coverage estimates for DTaP4, Polio3, VAR1 and PCV3. 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, and the 4-3-1-3-3 series. The Urban category had the highest rate for MMR1, Var1, and PCV3. 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 2004 National Immunization Survey (NIS), which refers to the same time period in this retrospective survey.[8] 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 (57.9 [95% CI 56.6 – 59.2]) when compared to the NIS result (77.5 [95%CI 70.5 – 84.3]) 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, 88.9% 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.

[8] *Morbidity and Mortality Weekly Report;* July 29, 2005 / 54(29);717-721.

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 occurred 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.

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.

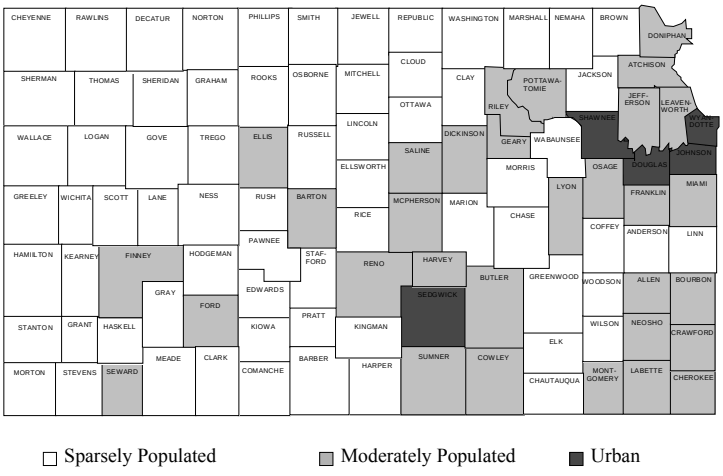
Strengths

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.

Sparsely Populated		Moderately Populated	Urban
Anderson	Marion	Allen	Douglas
Barber	Marshall	Atchison	Johnson
Brown	Morris	Barton	Sedgwick
Chase	Morton	Bourbon	Shawnee
Chautauqua	Nemaha	Butler	Wyandotte
Cheyenne	Ness	Cherokee	
Clark	Norton	Cowley	
Clay	Osborne	Crawford	
Cloud	Ottawa	Dickinson	
Coffey	Pawnee	Doniphan	
Comanche	Phillips	Ellis	
Decatur	Pratt	Finney	
Edwards	Rawlins	Ford	
Elk	Republic	Franklin	
Ellsworth	Rice	Geary	
Gove	Rooks	Harvey	
Graham	Rush	Jefferson	
Grant	Russell	Labette	
Gray	Scott	Leavenworth	
Greeley	Sheridan	Lyon	
Greenwood	Sherman	McPherson	
Hamilton	Sherman	Miami	
Harper	Smith	Montgomery	
Haskell	Stafford	Neosho	
Hodgeman	Stanton	Osage	
Jackson	Stevens	Pottawatomie	
Jewell	Thomas	Reno	
Kearny	Trego	Riley	
Kingman	Wabaunsee	Saline	
Kiowa	Wallace	Seward	
Lane	Washington		
Lincoln	Wichita		
Linn	Wilson		
Logan	Woodson		

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 2007-2008.*

COUNTY	DTP4	Polio3	MMR1	HIB3	HEPB3	4-3-1-3-3	VAR1	PCV3
STATEWIDE	80	90	88	78	88	58	76	47
ALLEN	77	90	87	88	86	65	56	36
ANDERSON	76	92	88	91	88	68	71	51
ATCHISON	80	90	88	88	91	69	53	17
BARBER	88	94	97	91	94	88	79	56
BARTON	84	92	92	79	90	67	86	51
BOURBON	68	81	82	82	77	56	56	38
BROWN	68	90	80	76	88	47	35	22
BUTLER	79	91	86	89	86	66	70	52
CHASE	75	82	93	82	82	71	57	0
CHAUTAUQUA	89	94	83	94	94	81	72	67
CHEROKEE	78	87	83	78	85	61	77	67
CHEYENNE	81	95	86	90	81	71	71	48
CLARK	64	88	76	88	76	44	80	76
CLAY	88	94	94	86	91	73	86	58
CLOUD	89	91	91	86	90	79	81	78
COFFEY	84	94	90	94	89	77	70	33
COMANCHE	89	94	94	89	94	83	94	44
COWLEY	78	90	90	50	91	40	59	23
CRAWFORD	72	89	86	91	87	61	55	30
DECATUR	95	95	95	95	95	74	63	42
DICKINSON	79	88	82	87	87	62	81	70
DONIPHAN	69	91	88	81	84	56	69	32
DOUGLAS	81	91	90	41	88	31	81	19
EDWARDS	79	93	93	97	86	69	86	62
ELK	89	93	93	96	93	78	74	56
ELLIS	84	92	93	87	94	71	72	52
ELLSWORTH	86	98	91	91	95	75	50	41
FINNEY	80	92	86	89	95	72	79	63
FORD	80	91	88	90	92	68	75	75
FRANKLIN	71	85	90	80	84	56	85	57
GEARY	75	86	85	81	86	52	82	41
GOVE	100	100	100	95	85	80	70	50
GRAHAM	90	100	95	95	100	86	95	67
GRANT	77	85	89	90	89	66	63	50
GRAY	88	98	70	84	93	50	86	38
GREELEY	85	85	92	92	85	69	69	77
GREENWOOD	76	88	88	87	88	65	60	45
HAMILTON	84	94	94	100	100	84	81	78
HARPER	85	94	93	93	94	74	72	44
HARVEY	83	92	89	72	87	56	68	49
HASKELL	79	89	81	85	85	57	94	49
HODGEMAN	88	94	88	88	88	81	69	69
JACKSON	75	86	76	77	85	56	49	36
JEFFERSON	75	85	84	87	88	62	71	60

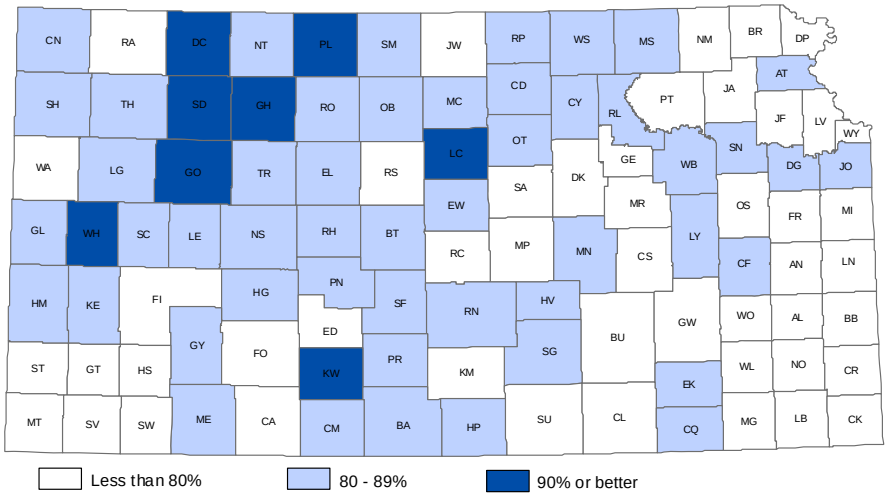
COUNTY	DTP4	Polio3	MMR1	HIB3	HEPB3	4-3-1-3-3	VAR1	PCV3
JEWELL	71	93	79	86	93	64	36	43
JOHNSON	85	90	91	72	87	53	86	52
KEARNY	84	94	91	94	88	81	75	72
KINGMAN	72	86	79	81	83	51	75	38
KIOWA	95	100	86	100	90	76	86	24
LABETTE	78	89	87	60	91	46	79	26
LANE	85	100	90	95	90	75	80	75
LEAVENWORTH	79	92	85	63	84	46	81	42
LINCOLN	96	100	93	100	96	86	89	4
LINN	75	88	84	88	85	57	70	31
LOGAN	81	97	81	97	100	65	42	52
LYON	81	91	88	87	93	70	43	28
MARION	83	92	88	66	87	51	63	12
MARSHALL	87	94	94	82	89	67	66	70
MCPHERSON	80	90	91	8	89	4	75	4
MEADE	85	98	90	93	93	76	80	51
MIAMI	78	87	93	83	86	64	75	13
MITCHELL	88	90	90	87	86	76	82	68
MONTGOMERY	77	88	91	83	85	61	79	14
MORRIS	70	85	89	80	91	63	57	35
MORTON	69	86	69	90	84	41	80	37
NEMAHA	80	92	85	91	90	72	55	34
NEOSHO	74	85	82	29	71	19	55	4
NESS	80	92	92	88	88	72	80	72
NORTON	84	91	82	84	88	63	77	51
OSAGE	79	87	84	76	85	48	63	50
OSBORNE	87	91	100	91	87	70	74	52
OTTAWA	80	91	91	80	91	71	63	60
PAWNEE	85	94	90	87	94	77	90	76
PHILLIPS	93	100	95	98	100	90	76	66
POTTAWATOMIE	78	95	92	92	89	70	78	67
PRATT	83	92	94	92	89	71	89	29
RAWLINS	69	85	62	77	85	38	62	54
RENO	83	94	86	91	88	68	80	73
REPUBLIC	89	91	96	96	91	87	80	84
RICE	72	88	66	82	90	49	69	47
RILEY	81	94	87	69	87	59	79	43
ROOKS	89	97	94	95	97	83	88	68
RUSH	81	95	89	92	95	73	73	32
RUSSELL	75	81	80	85	80	64	61	59
SALINE	78	91	90	86	92	66	84	78
SCOTT	87	95	89	92	92	82	84	76
SEDGWICK	80	89	89	86	88	62	75	46
SEWARD	73	87	87	82	84	59	70	52
SHAWNEE	84	93	89	89	91	72	73	67
SHERIDAN	100	86	86	77	86	50	73	27
SHERMAN	84	88	88	88	86	67	67	57

COUNTY	DTP4	Polio3	MMR1	HIB3	HEPB3	4-3-1-3-3	VAR1	PCV3
SMITH	85	97	82	100	91	70	85	76
STAFFORD	81	88	79	90	88	69	85	44
STANTON	77	97	94	97	90	71	81	65
STEVENS	67	88	88	78	86	50	78	10
SUMNER	77	90	86	88	88	61	40	21
THOMAS	83	91	74	87	90	59	69	46
TREGO	88	91	88	84	94	69	84	66
WABAUNSEE	84	92	81	92	92	66	77	66
WALLACE	58	83	75	83	83	58	67	25
WASHINGTON	87	100	94	95	100	79	86	73
WICHITA	93	96	93	96	96	89	93	70
WILSON	77	92	83	87	84	66	61	5
WOODSON	56	72	94	94	91	50	53	28
WYANDOTTE	70	88	84	65	88	46	79	42

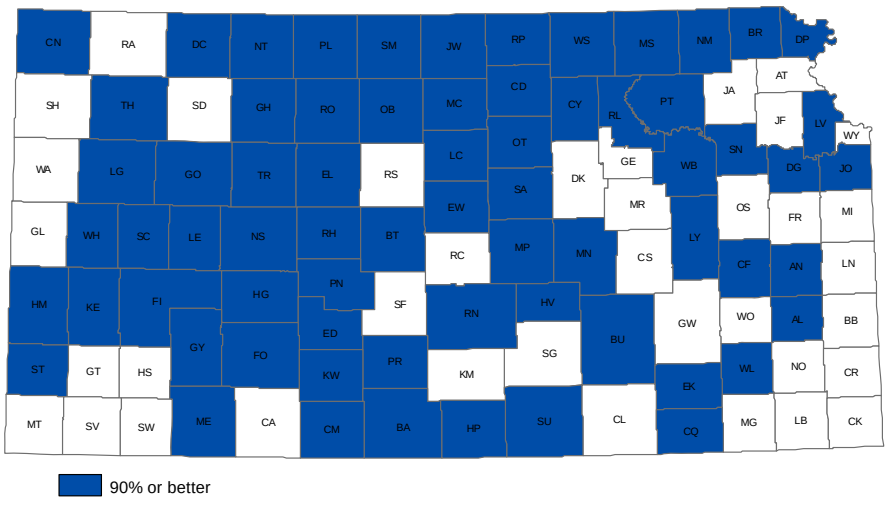
* Based on the retrospective survey for the school year starting 2007.

Appendix 3: Maps of immunization rates by county, 2007-08 Retrospective Survey.

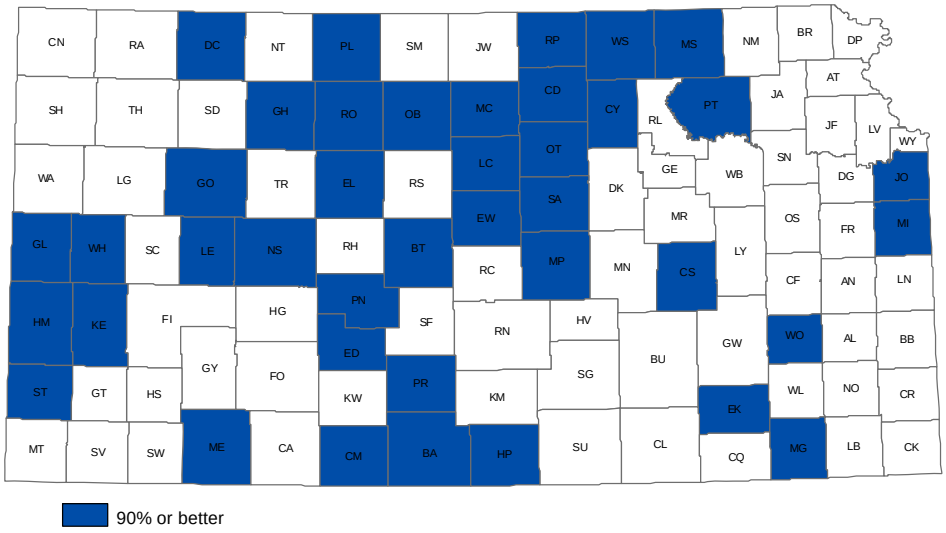
DTP4 Series for Retrospective Survey 2007-08



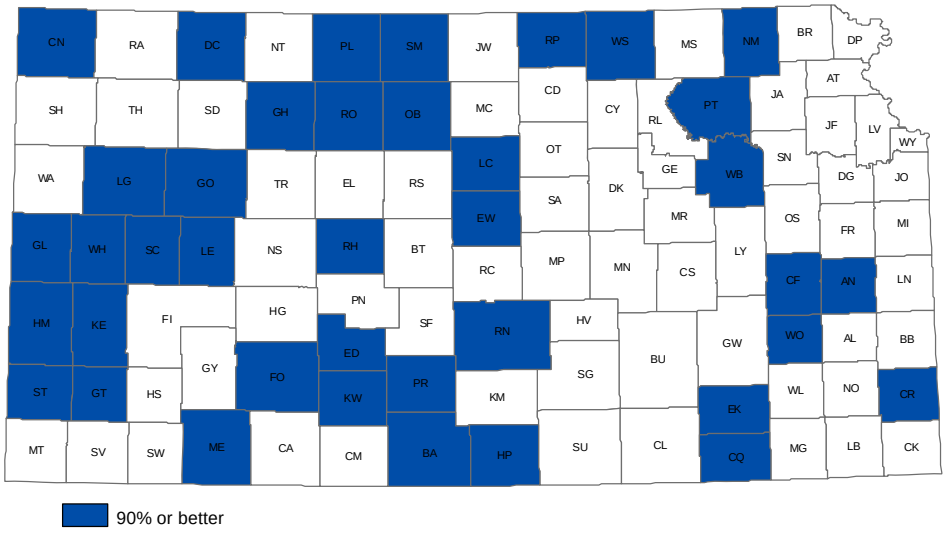
Polio3 Series for Retrospective Survey 2007-08



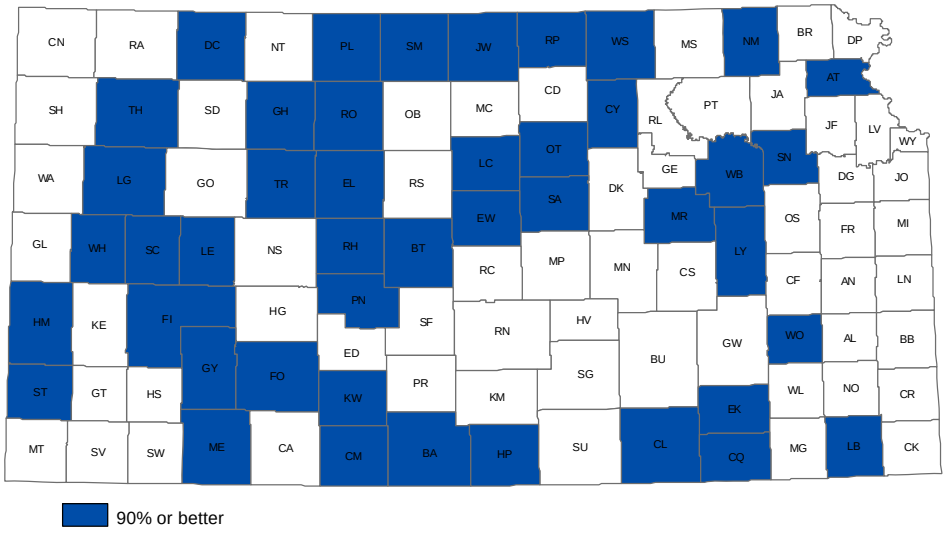
MMR1 Series for Retrospective Survey 2007-08



Hib3 Series for Retrospective Survey 2007-08

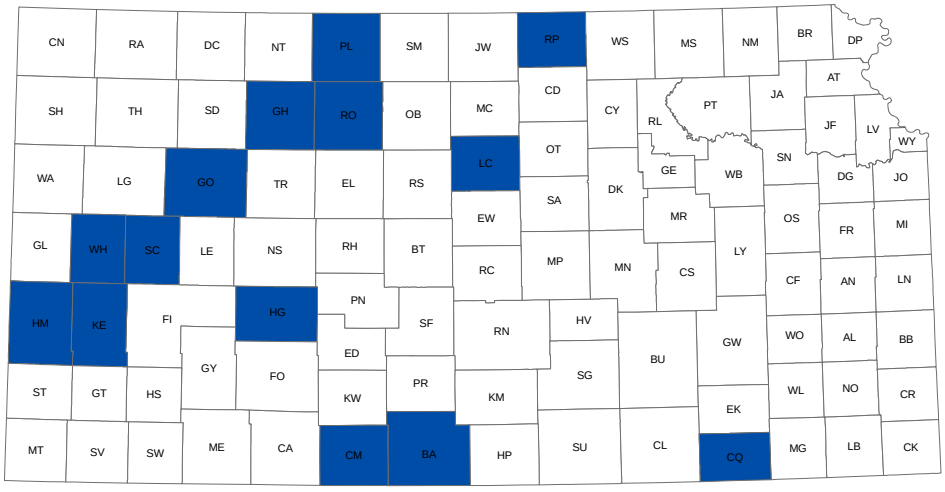


HepB3 Series for Retrospective Survey 2007-08



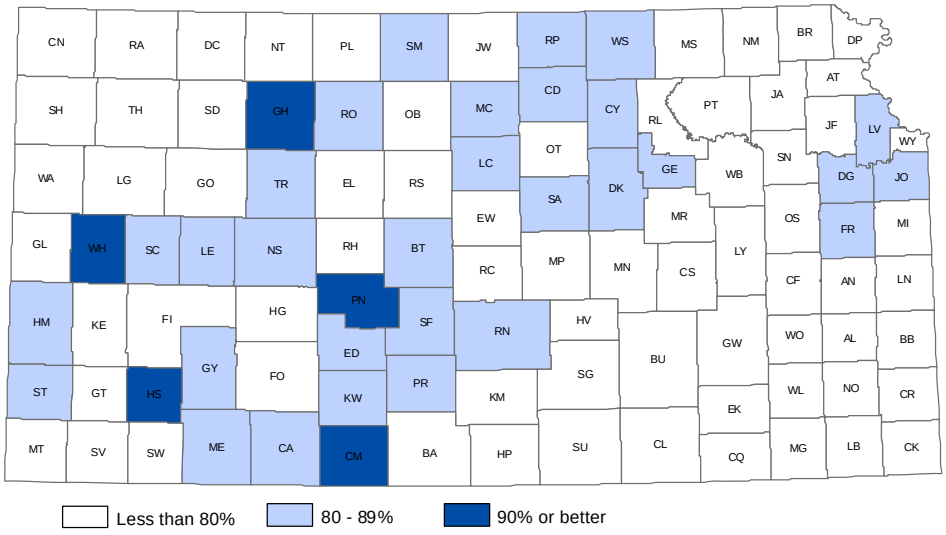
90% or better

4-3-1-3-3 Series for Retrospective Survey 2007-08

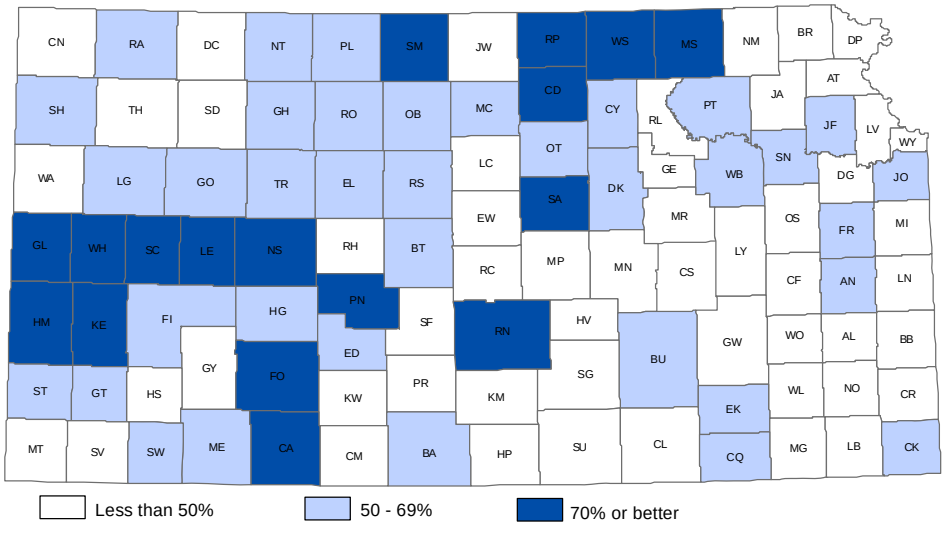


80% or better

Var1 Series for Retrospective Survey 2007-08



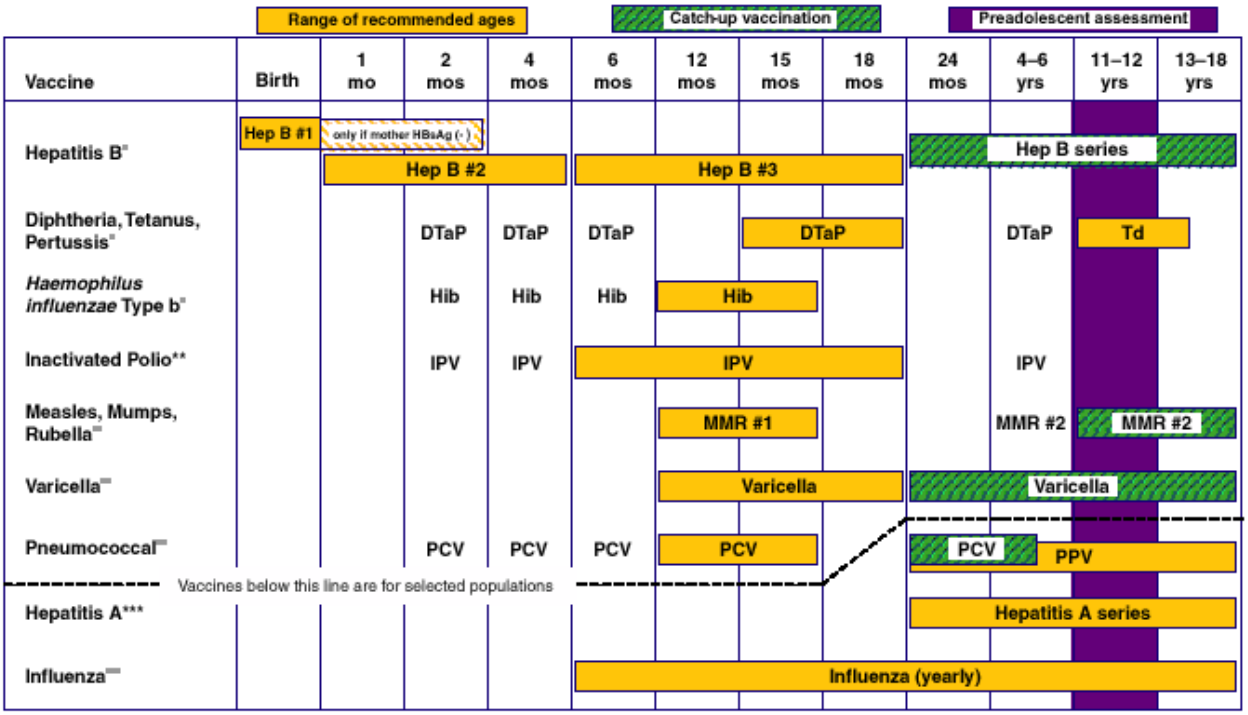
PCV3 Series for Retrospective Survey 2007-08



*Note: The intervals used are different from the other maps.

Appendix 4: CDC's 2002 Advisory Committee on Immunization Practices (ACIP) Recommendations http://www.cdc.gov/MMWR/PREVIEW/MMWRHTML/mm5102a4.htm

FIGURE 1. Recommended childhood immunization schedule* — United States, 2002



* Indicates the recommended ages for routine administration of currently licensed childhood vaccines, as of December 1, 2001, 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. 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.

† **Hepatitis B vaccine (Hep B).** All infants should receive the first dose of hepatitis B 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 hepatitis B vaccine can be used for the birth dose. Monovalent or combination vaccine containing Hep B may be used to complete the series; 4 doses of vaccine may be administered if combination vaccine is used. The second dose should be given at least 4 weeks after the first dose except for Hib-containing vaccine, 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 hepatitis B 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 and the vaccination series should be completed (third or fourth dose) at age 6 months. Infants born to mothers whose HBsAg status is unknown should receive the first dose of the hepatitis B vaccine series within 12 hours of birth. Maternal blood should be drawn at the time of 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).

§ **Diphtheria and tetanus toxoids and acellular pertussis vaccine (DTaP).** The fourth dose of DTaP may be administered as early as 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 tetanus and diphtheria toxoid-containing vaccine. Subsequent routine Td boosters are recommended every 10 years.

¶ ***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 immunization in infants at age 2, 4 or 6 months but can be used as boosters following any Hib vaccine.

** **Inactivated poliovirus vaccine (IPV).** An all-IPV schedule is recommended for routine childhood poliovirus vaccination in the United States. All children should receive 4 doses of IPV at age 2, 4, and 6–18 months, and 4–6 years.

†† **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 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 previously received the second dose should complete the schedule by the visit at age 11–12 years.

§§ **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.

¶¶ **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.

*** **Hepatitis A vaccine.** Hepatitis A vaccine is recommended for use 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.

††† **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; see *MMWR* 2001;50[No. RR-4]:1–44), and can be administered to all others wishing to obtain immunity. 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, vaccine supply, and contraindications for immunization is available at http://www.cdc.gov/nip or at the National Immunization hotline, 800-232-2522 (English), or 800-232-0233 (Spanish). Copies of the schedule can be obtained at http://www.cdc.gov/nip/recs/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).