

RETROSPECTIVE IMMUNIZATION COVERAGE SURVEY

1996-1997 Results (School Year 2000-2001)



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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 1997-1998 (School Year 2001-2002)

Executive Summary

The Kansas Immunization Certificates (KICs) for children five-years of age enrolled in a kindergarten class in a Kansas public school during the 2001-2002 school year were collected and evaluated for immunization coverage rates. The children included in this survey were born between September 2, 1995, and September 1, 1996, and the coverage rates refer to when they were two years old, which was between September 2, 1997, and September 1, 1998. Immunization coverage rates were also calculated for the children who were 5 years of age. The results for this survey were measured against similar previous studies.

All 789 Kansas public schools were invited to participate. Fifty-nine (7%) schools were not included in the data analysis (20 had no kindergarten class and 39 failed to respond). One hundred and four of the 105 counties in Kansas were represented in this survey. A representative sample of 11,082 complete KICs from 730 schools were analyzed.

Coverage rates for the entire state of Kansas and individual counties were calculated for 4 doses of diphtheria, tetanus, and pertussis (DTP4), 3 doses of polio (Polio3), 1 dose of measles, mumps, and rubella (MMR1), 3 doses of *H. influenzae* (HIB3), 3 doses of hepatitis B (HEPB3), 1 dose of varicella (VAR1) and the combination of DTP4, Polio3, and MMR1 (4-3-1 combination). The statewide coverage rate for the 4-3-1 combination (that is, DTP4, Polio3, MMR1) was 80%, a statistically significant increase from the value of 77% observed the previous year. Statistically significant increases in coverage rate were also present for all single vaccines.

As in previous years, coverage rates were also calculated at 4, 6, 8, 17, and 20 months of age in order to determine at which age coverage rates begin to decrease. At 4 months of age, 93% of the children were up-to-date for immunizations. However, as the number of immunizations required increased at each age point, the coverage rates decreased. Immunization coverage rates declined by 20 percentage points between 4 and 8 months of age. After 8 months of age, immunization coverage rates began to increase until they reached 80% at 2 years of age.

Overall, Kansas immunization coverage rates for the 4-3-1 combination have steadily increased from 57% in 1990-1991 to 80% in 2001-2002 for the 4-3-1 combination. 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 1997-1998 (School year 2001-2002)

Objectives

To estimate the immunization coverage rates at the age of two years for children enrolled in the Kansas public school system during the 2001-02 school year.

Study Population

The study population included all children enrolled in kindergarten in the Kansas public school system during the 2001-2002 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 percentage of children who were fully immunized at two years of age against the diphtheria, tetanus, pertussis, polio, measles, mumps, rubella, *H. influenzae*, hepatitis B virus, and varicella. Also, this was the first year to examine immunization coverage rates at five years of age.

Immunization coverage rates were measured for single vaccines and combinations of vaccines according to the recommended immunization schedule for children two years of age.¹ 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. *The results of the survey refer to children who were born between September 2, 1995, and September 1, 1996. The coverage rates refer to the time these children were two-years-old, which is between September 2, 1997, and September 1, 1998 as well as coverage rates at five years of age when first entering school.*

Similar studies have been performed every year since the 1990-91 school year, except the 1991-92 school year. Confidence intervals (CI) have been calculated since the 1994-95 school year.

Sampling Techniques

The survey relied 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 while maximizing the efficiency of the sampling process, a different sampling ratio was established for each county,

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 1995.

and a probability sample was selected using a systematic sample technique.²

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 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. 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 of the selected children and the current total number of kindergarten enrollees in each school were forwarded to KDHE.

Data Analysis

The immunization information from each record was entered into a computer file and then reentered for validity. The data were analyzed using SAS 8.2.

Point estimates of coverage rates and 95% confidence intervals (95% CI) for DTP4, Polio3, MMR1, 4-3-1 combination, HIB3, HEPB3, and VAR1 vaccines were calculated using SAS. A child was 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. influenzae* type b (HIB3), three doses of Hepatis B (HEPB3), and one dose of the varicella (VAR1) vaccine respectively. A child was considered “up-to-date” for the 4-3-1 combination antigen if he or she was up-to-date for all: DTP4, Polio3, and MMR1 vaccines. The statewide estimates took into consideration the complex survey design effect due to the stratification process and to the differences in sampling ratios among counties.³

Coverage rates were calculated for each of the 104 counties in Kansas.⁴ These rates served as the means of comparing the 2000-01 and 2001-02 school year surveys and identifying those counties which improved or declined in immunization coverage. Differences between estimates were considered significant if the 95% CI of the current year did not overlap with the 95% CI of the previous year.

Coverage rates were also calculated at 4, 6, 8, 17, and 20 months goal points. Each goal point

² 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.

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

⁴Records from Wichita county were not included in the analysis since the number of records available for this county was too small to produce valid results .

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 The 4 month and 24 months goal points were 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 were calculated for this group of children at the time of their enrollment in kindergarten, that is, at the age of 5 years.

Results

Letters of invitation to participate in the survey were sent to 789 Kansas public schools. Twenty schools did not have a kindergarten class for the 2001-2002 school year and 39 schools with kindergarten classes did not respond. Data were received from and analyzed for 730 (95%) schools out of 769 schools that had kindergarten schools.

The number of children enrolled in kindergarten at the participating schools was 31,264, which represents 86% of that birth cohort.⁵ The number of immunization records received was 13,237. This represented an overall sampling ratio of 2.4, meaning that one child was selected for every 2.4 children enrolled. The sample size by county ranged from 14 to 330 records while enrollment ranged from 16 to 5,682.⁶

Of the 13,237 immunization records returned and examined, 11,082 (84%) were complete and had usable information of immunization history. This included children who were at least five years of age but less than six years of age on September 1, 2001. Of the 2155 children excluded, 1622 (75%) were not 5 years of age. The remaining records excluded had incomplete or unuseable KCIs. SAS 8.2 was used to analyze and select these records.

The immunization coverage rates for the all single vaccines and 4-3-1 combination had a statistically significant increase compared to the coverage rates of the previous year. As seen in Table 1 the greatest increase in coverage rates was seen in the VAR1 which rose 20 percentage points from 14.5% to 34.0% in just one year even though it is not required for school entry. Also not required for school entry but recommended are HIB3 and HEPB3. Immunization coverage rates have risen each year from 1990-91 through 1996-97 as displayed in Figure 1.

⁵1996 Annual Summary of Kansas Vital Statistics.

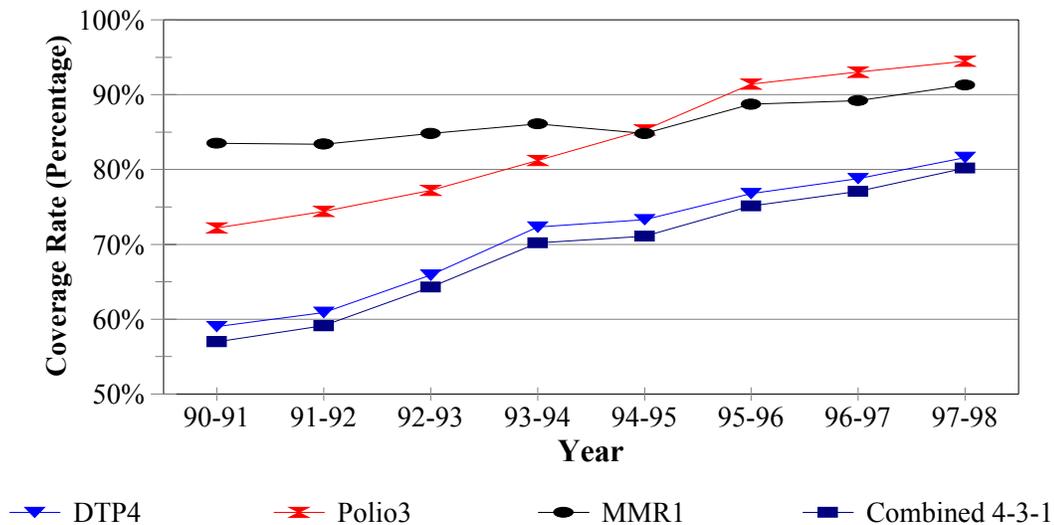
⁶Estimates from counties with small sample size (<50) may be unstable and changes in time should be interpreted with caution.

TABLE 1 Kansas immunization coverage rates at the age of 2 years by vaccine from 1994-95 through 1997-98. * Percentage up-to-date and 95% confidence interval.

	1994-95	1995-96	1996-97	1997-98
DTP4	73.3% (71.0, 74.6)	76.8% (75.5, 78.1)	78.8% (78.3, 79.2)	81.6% (80.4, 82.8)
Polio3	85.3% (84.2, 86.4)	91.4% (90.6, 92.3)	93.0% (92.7, 93.3)	94.5% (93.8, 95.2)
MMR1	84.8% (83.7, 85.9)	88.7% (87.7, 89.7)	89.2% (88.9, 89.5)	91.3% (90.4, 92.1)
Combined 4-3-1	71.1% (69.8, 72.5)	75.1% (73.8, 76.5)	77.1% (76.6, 77.6)	80.2% (78.9, 81.4)
HIB3	N/A	81.9% (80.5, 83.3)	80.6% (80.2, 81.1)	82.3% (81.2, 83.5)
HEPB3	N/A	67.1% (65.6, 68.6)	84.1% (83.7, 84.5)	87.5% (86.5, 88.6)
VAR1	N/A	N/A	14.5% (14.2, 14.9)	34.0% (32.4, 35.5)

* Based on the 1998-1999 to 2001-2002 school years' retrospective surveys.

FIGURE 1 Kansas immunization coverage rates at the age of 2 years by vaccine from 1990-91 through 1996-97.*

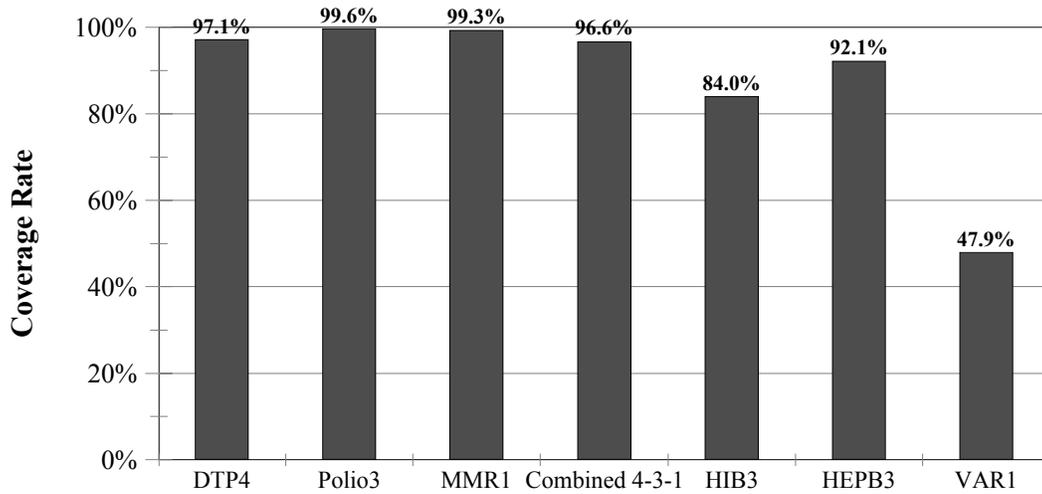


* Based on the 1994-1995 to 2001-2002 school years' retrospective surveys.

Immunization rates of kindergartners when they were five years old were also calculated (Figure 2). By age 5 over 95% of children are up-to-date for DTP4, Polio3, MMR1 and the 4-3-1 combination, and almost half (47.9%) of the children are up-to-date for VAR1. This means that by school entry, the total immunization rates are greater than those at the age of 2 years. School entry vaccination requirements are the most likely reason for this increase, although coverage rates for non-required vaccines increased as well (by smaller amounts).

FIGURE 2 Immunization rates of Kansas kindergartners at age five years, Kansas, 2001-02.*

* Based on the 2001-2002 school years' retrospective surveys



Appendix 1 shows the coverage rates for each individual county for the single vaccines and 4-3-1 combination. For single vaccines and 4-3-1 combination, the lowest coverage rate among individual counties decreased. However, a great amount of variability in the coverage rates at the county level still occurred. The greatest range in coverage rates was found for VAR1 with difference of more than 64 percentage points. (Table 2). Polio3, which has the narrowest range, raised its lowest coverage rate by almost 2 percentage points from the previous year, with every county had more than 87% of its children fully vaccinated against polio by the age of two.

TABLE 2 Range of immunization coverage rates among Kansas counties, by vaccine,

from 1994-94 through 1997-98. *

	1994-95	1995-96	1996-97	1997-98
DTP4	51.9-93.1	57.1-100	65.0-100	68.4-100
Polio3	73.4-100	81.6-100	85.5-100	87.1-100
MMR1	73.3-100	76.7-100	81.6-100	79.2-100
Combined 4-3-1	49.1-95.5	56.0-100	63.5-100	67.9-97.0
HIB3	N/A	24.6-100	38.7-100	45.8-100
HEPB3	N/A	17.6-89.3	63.9-100	68.0-100
VAR1	N/A	N/A	0-41.3	7.7-72.2

* Based on the 1998-1999 to 2001-2002 school years' retrospective surveys.

For all of the single vaccines and the 4-3-1 combination more than half of the counties had significant increase in coverage rates including VAR1 in which all 105 counties had a significant increase coverage rate. Only 36 (34.6%) of the counties experienced a significant decrease in HEPB3 coverage rates.

Table 3 shows median values, or value that half of the counties meet or exceed, of coverage rates for the single and combination antigens. The highest median of 95% is for Polio3, which means that half of the counties have 95% or better coverage. At least half of the counties met the Healthy Kansas 2010 goal of 90% or better coverage rates for MMR1, Polio3 and HEPB3. However, some counties with larger populations had lower rates, which in turn lowered the overall immunization coverage rate for the state.

TABLE 3 Kansas counties median immunization coverage rates by vaccine from 1994-95 through 1997-98*

	1994-95	1995-96	1996-97	1997-98
DTP4	78%	82%	83%	84%
Polio3	89%	95%	95%	95%
MMR1	90%	91%	92%	93%
Combined 4-3-1	74%	80%	82%	83%
HIB3	N/A	87%	87%	87%
HEPB3	N/A	66%	88%	90%
VAR1	N/A	N/A	9%	28%

* Based on the 1998-1999 to 2001-2002 school years' retrospective surveys.

Up-to-date coverage rates for goal points at 4, 6, 8, 17, and 20 months were assessed for DTP,

Polio, and MMR (Table 4). For reference, the coverage rates at 24 months have also been included in the table. Compared to previous years, coverage rates have increased for each goal point. At 4 months of age, 93.2% children were up-to-date. Coverage rates drop almost 10 percentage points at 6 months of age and then at 8 months of age drop another 11 percentage points. After the goal point of 8 months, immunization coverage rates increase at 17 months, 20 months, and 24 months of age but never reach the same coverage rates as at 4 months.

TABLE 4 Coverage rates at 4, 6, 8, 17, 20, and 24 months goal points for Kansas in 1994-95 through 1997-98.*

Goal point (age)	Antigen	1994-95	1995-96	1996-97	1997-98
4 months	DTP1, Polio1	86.5%	89.6%	92.2%	93.2%
6 months	DTP2, Polio2	74.0%	79.0%	82.1%	84.3%
8 months	DTP3, Polio2	60.4%	67.2%	70.8%	73.1%
17 months	DTP3, Polio2, MMR1	61.3%	69.5%	73.5%	76.8%
20 months	DTP4, Polio3, MMR1	61.2%	67.1%	71.0%	74.7%
24 months	DTP4, Polio3, MMR1	71.1%	75.1%	77.1%	81.6%

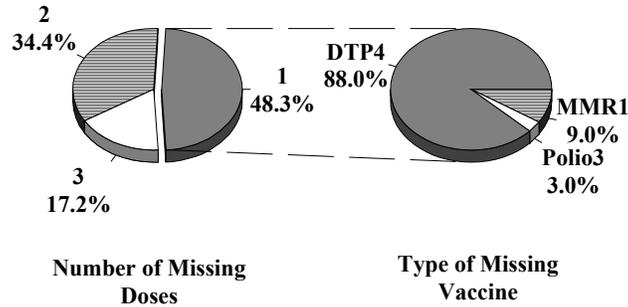
* Based on the 1998-1999 to 2001-2002 school years' retrospective surveys.

Of the 10,333 children who were up-to-date at 4 months, 8756 (85%) were still up-to-date at 24 months of age. Of the 749 children who were late at 4 months only 230 (30%) caught up and were up-to-date at 24 months. This means that 70% of children who are not up-to-date at 4 months do not catch up before 24 months, and children who start the series on time are 2.8 times more likely to complete the immunization series by 24 months of age than those who begin the series late.

Of the children not up-to-date at 24 months of age, 48.3% (9.1% of total population studied) only needed one additional immunization in order to be up-to-date (Figure 3). If these children had received one additional immunization the coverage rates for the 4-3-1 combination would have increased from 81.6% to 91.8%. For those children needing one additional immunization, 88.1% needed DTP4, 3.0% needed Polio3, and 9.0% needed MMR1.

FIGURE 3 Number and type of immunizations kindergartners needed to be up-to-date

at the age of 24 months, Kansas 1997-98.*



* Based on the 2001-2002 school years' retrospective surveys.

Comments

Statewide immunization coverage rates continue to steadily increase. Based on the 2001-2002 retrospective survey, considerable increases in coverage rates were present for DTP4, Polio3, MMR1, 4-3-1 combination, HIB3, HEPB3, and VAR1. Immunization coverage rates in Kansas have already achieved the Healthy People 2010 (HP 2010) immunization goals for Polio3 and MMR1.⁷ The antigens DTP4, HIB3 and HEP3 are less than 10 percentage points away from meeting the 90% goal. Unfortunately, VAR1 is 66 percentage points below the goal despite doubling the coverage rate from last year. Immunizations against hepatitis B (HEPB3), *H. influenzae* (HIB3), and varicella (VAR1) are not required for school entry and thus not always recorded onto the KCI. For this reason the immunization coverage rates might actually be higher than presented.

At least half of the counties have coverage rates above 80% for the 4-3-1 combination and each of the single vaccines except VAR1. Despite this, a considerable variability existed at the individual county level. Only fifteen counties have coverage rates lower than 75% for the 4-3-1 combination and most of these counties are clustered in the southeast corner of Kansas.

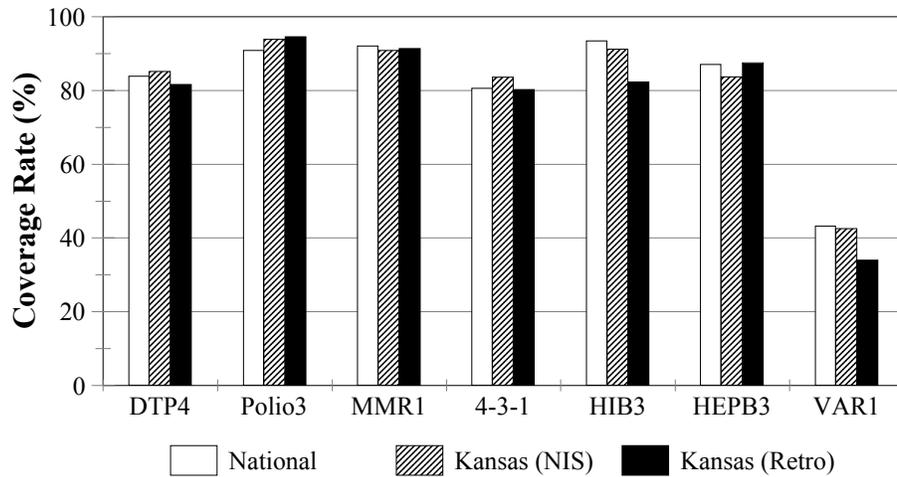
The results from this survey concurred with the results from the 1998 National Immunization Survey (NIS) which refers to the same time period in this retrospective survey.⁸ Data for NIS was collected by the Centers for Disease Control and Prevention (CDC) through a telephone survey of randomly selected households. For accuracy, the healthcare providers (family physicians, pediatricians, etc.) of the children included in the survey were contacted by mail.

⁷ Healthy People 2010 set goals of 90% coverage for DTP4, Polio3, MMR1, HIB3, HEPB3 and VAR1 among children aged 19 to 35 months.

⁸MMWR, 1999; 48(37);829-830. Children in NIS were born between 02/95 and 05/97.

Despite the slight differences between the results from the retrospective immunization survey and the NIS for Kansas, these two different surveys support each other (Figures 4,5). The coverage rates for HIB3 and VAR1 were significantly lower when compared to the NIS for Kansas results. One possible reason for the difference in rates is that since neither HIB3 or VAR1 are not required for school entry, they may not be routinely recorded on the KCIs.

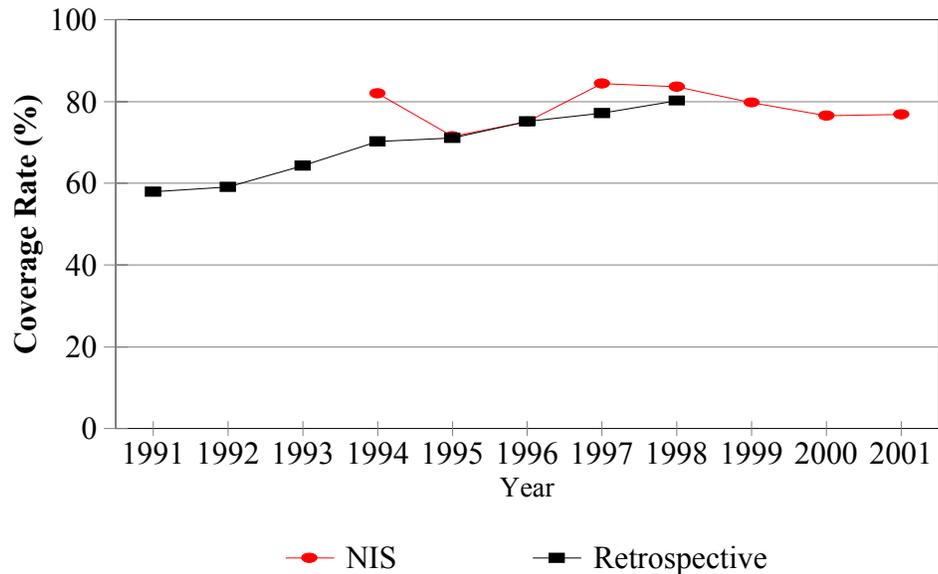
FIGURE 4: Immunization Coverage Rates for United States and Kansas, 1997-98.*



*National and Kansas (NIS) rates were estimated by the National Immunization Survey 1998) and the Kansas (Retro) rates were estimated by the Retrospective Immunization Coverage Survey (1997-98).

FIGURE 5: Comparison of Immunization Coverage Rates for the 4-3-1 from the Kansas

NIS and Retrospective Survey, 1991-2001.



Only 81.6% of all children were up-to-date for the 4-3-1 combination at 24 months of age. Of the children not up-to-date at 24 months of age, 48.3% (9.1% of study population) only needed one additional immunization in order to be up-to-date. For those children not up-to-date at 24 months of age, it is likely that an opportunity to administer all immunizations was missed. If this additional immunization was administered, the statewide coverage rates for the 4-3-1 combination would have increased from 81.6% to 91.8%. This missed opportunity can occur when a child visits both public and private care providers.. Emphasizing simultaneous administration of several vaccines as recommended by the ACIP, provided that the child is eligible, can greatly increase coverage rates.

This survey had a few limitations. Most importantly this survey reports data that refers to immunization coverage rates which occurred three years before the survey. The retrospective immunization survey only included children who were enrolled in kindergarten in a Kansas public school. Children who attended a private school or are home-schooled were excluded from the survey. However, the records analyzed are representative of about 86% of this birth cohort, which is likely to ensure their validity. Also, no descriptive data were collected about race, ethnic status, or religious and medical exemptions.

Despite the limitations, the retrospective immunization survey provides a good estimation of the 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.