

RETROSPECTIVE IMMUNIZATION COVERAGE SURVEY
2008-2009 Results (School Year 2012-13)



Elizabeth M. Lawlor, MS
Bureau of Epidemiology and Public Health Informatics
Division of Health
Kansas Department of Health and Environment
1000 SW Jackson, Suite 210
Topeka, Kansas 66612-1290
Telephone (785) 296-1059
Fax (785) 291-3775

VACCINE ACRONYMS

DTaP4	4 doses of diphtheria and tetanus toxoids and acellular pertussis vaccines including diphtheria and tetanus toxoids (DTaP/DT) vaccine
HepB3	3 doses of hepatitis B vaccine
Hib3	3 doses of <i>Haemophilus influenzae</i> type b vaccine
MMR1	1 doses of measles, mumps, and rubella vaccine
PCV3	4 doses of pneumococcal conjugate vaccine
Polio3	3 doses of polio vaccine
Var1	1 dose of varicella vaccine
4-3-1-3-3	DTaP4-Polio3-MMR1-Hib3-HepB3
4-3-1-3-3-1-4	DTaP4-Polio3-MMR1-Hib3-HepB3-Var1-PCV4

INTRODUCTION

Objective

This study was conducted to estimate the immunization coverage levels of children at 24 months and 35 months of age.

Study Population

The study population included a representative sample of all kindergarten students enrolled in both public and private schools in the 2012-2013 school year.

Study Design

A stratified, cross-sectional design was utilized for this study, with each county representing a stratum. The characteristics of interest, or outcome variables, were the percentages of children who were immunized against diphtheria, tetanus, pertussis, polio, measles, mumps, rubella, *Haemophilus influenzae* type b, hepatitis B virus, varicella, and pneumococcal disease. Vaccination coverage was retrospectively assessed for these children at 24 months and at 35 months of age.

Immunization coverage levels were measured for single vaccination series and combinations of vaccinations according to the recommended immunization schedule for children by 24 months of age.¹ *The results of the survey refer to children who were born between September 2, 2006, and September 1, 2007. The coverage levels refer to the point in time at which these children turned 24 months old, between September 2, 2008, and September 1, 2009.*

METHODS

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

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 2006.

systematic sampling technique. Due to the small size of the private school population in Kansas, all records from private schools were solicited.

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 (KDHE) and the Kansas State Department of Education (KSDE), requesting their participation in the survey.

Point estimates of coverage levels and 95% confidence intervals (95% CI) for DTaP4, Polio3, MMR1, Hib3, HepB3, Var1, PCV4 vaccinations, 4-3-1-3-3 series, and 4-3-1-3-3-1-4 series were calculated. A child was considered up-to-date (UTD) for single vaccination series 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, or four doses of pneumococcal conjugate (PCV4). A child was considered up-to-date for the 4-3-1-3-3 series if he or she was up-to-date for DTaP4, Polio3, MMR1, Hib3, and HepB3 vaccinations, and up-to-date for the 4-3-1-3-3-1-4 series if he or she was up-to-date for DTaP4, Polio3, MMR1, Hib3, HepB3, Var1, and PCV4 vaccinations. Approximately 0.8% of children in the study had a history of varicella infection recorded on their immunization record and these children were included in the denominator, but only those who reported history of varicella vaccination were included in the numerator. This methodology was performed because the date of disease was frequently not recorded; thus it could not be determined at what age the child had varicella.

The results from this survey were compared with the results from the 2009 National Immunization Survey (NIS).^{2,3} 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, healthcare providers of children included in the survey are contacted by mail.

The complete methodology for this study has been described previously, http://www.kdheks.gov/immunize/download/retrospective_2011-12.pdf.

RESULTS

Data Collection

Letters of invitation to participate in the survey were sent to 843 Kansas schools; of these, 724 were public schools and 119 were private. Nineteen schools reported not having a kindergarten class for the 2012-2013 school year and 95 did not respond. Immunization data were received from 729 schools (629 public schools and 100 private schools) with kindergarten classes, corresponding to a school participation of 86.5%; all responding schools were included in the analysis. One hundred and two counties were included in the analysis; schools in three counties did not submit records.

The number of children enrolled in kindergarten at the participating public and private schools was 35,203, which is 84% of the 41,951 children in that birth cohort. The children in the birth cohort that did not participate in the study include children who are home schooled or attend other special schools as well as those enrolled in schools that did not take part in the study. The number of immunization records received was 15,357, which is equivalent to one child selected for every 2.3 children enrolled.

² <http://www.cdc.gov/vaccines/stats-surv/nis/default.htm#nis>

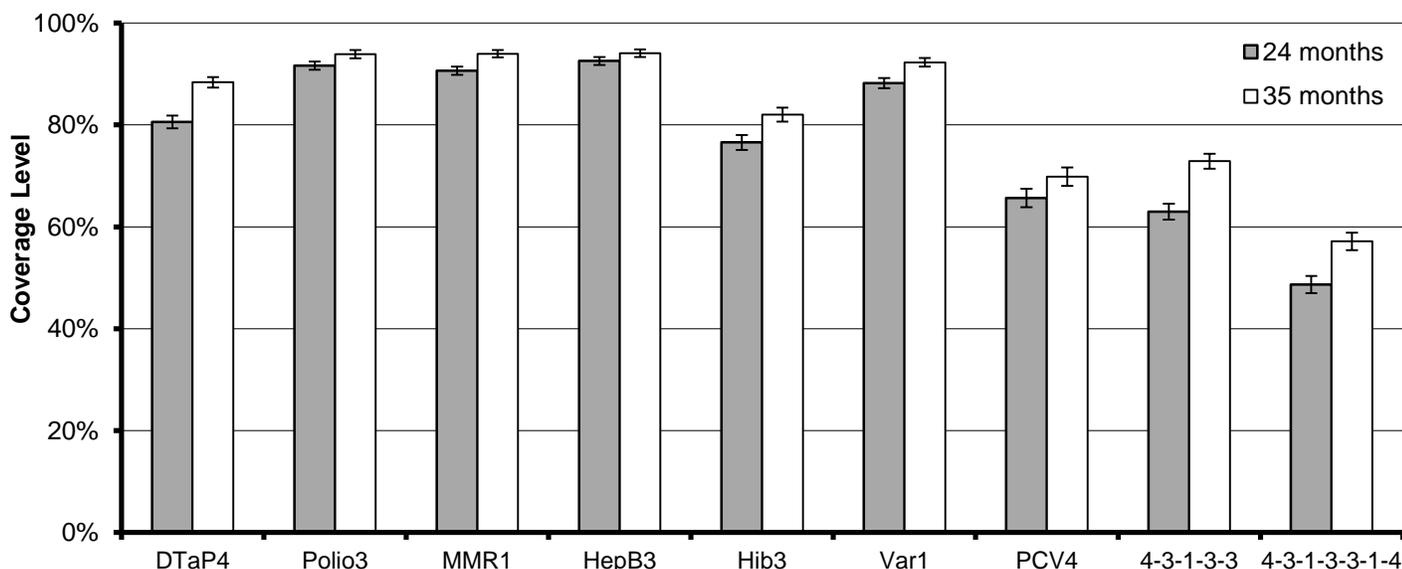
³ Children in the 2009 NIS were born between January 2006 and June 2008

The range of the sample size by county was from 13 to 1,436 records while the range of student enrollment was from 13 to 7,125.⁴ For the 24 month old analysis, 14,997 (98%) children were included in the analysis because they were 24 months of age between September 2, 2007 and September 1, 2008.

Statewide Immunization Coverage by Age 24 and 35 Months

By 24 months of age, the immunization coverage levels for Polio3, MMR1, HepB3, and Var1 were all greater than 80%, but only HepB3, MMR1, and Polio3 met the HP2010 goal of 90%. PCV4 had the lowest immunization coverage level at 63.9% (Figure 1). The immunization coverage level for 4-3-1-3-3 and 4-3-1-3-3-1-4 was 61.4% and 47.0%, respectively. By the time these children were 35 months of age, Var1 exceeded the HP2010 goal of 90% (91.4%), the 4-3-1-3-3 series increased to 71.4%, and the 4-3-1-3-3-1-4 series had reached 55.4% coverage. All vaccinations, except HepB3, and both vaccination series increased significantly from 24 months of age to 35 months of age.

FIGURE 1: Immunization coverage levels at 24 and 35 months of age by vaccine, Kansas 2008-2009



National Immunization Survey (NIS) Coverage at 19-35 Months of Age

Comparison of Kansas NIS results for immunization coverage at 19-35 months of age with results from the current retrospective study, for 35 month olds, showed significant coverage differences in Hib3, PCV4, and the 4-3-1-3-3-1-4 series (Table 1).⁵ The other immunization estimates (DTaP4, Polio3, MMR1, HepB3, Var1, and the 4-3-1-3-3 series) did not vary significantly between the two surveys. The US National immunization coverage measured by NIS was significantly higher than the vaccination coverage levels measured by the retrospective study for Hib3, PCV4, the 4-3-1-3-3, and the 4-3-1-3-3-1-4 series. The estimates from the Kansas NIS were not statistically different from the US National NIS estimates for any of the vaccination series.

⁴Estimates from counties with small sample size (<50) may be unstable and changes over time should be interpreted with caution

⁵ http://www.cdc.gov/vaccines/stats-surv/nis/data/tables_2009.htm

TABLE 1: Kansas and US National immunization coverage levels

	Retrospective Study, 35 month olds % (95% CI)	Kansas NIS[§] % (95% CI)	US National NIS[§] % (95% CI)
DTaP4	87.3 (86.2 - 88.4)	87.2 (81.3 – 93.1)	83.9 (82.9 – 84.9)
Polio3	93.1 (92.3 - 93.9)	93.8 (89.4 - 98.2)	92.8 (92.1 - 93.5)
MMR1	93.2 (92.5 – 94.0)	92.5 (87.9 – 97.1)	90.0 (89.2 - 90.8)
Hib3	80.7 (79.3 – 82.0)	86.7 (80.4 – 93.0)	92.1 (92.9 - 91.3)
HepB3	93.3 (92.5 - 94.1)	91.6 (87.0 – 96.2)	92.4 (91.7 - 93.1)
Var1	91.4 (90.6 - 92.3)	92.0 (87.4 – 96.6)	89.6 (88.8 - 90.4)
PCV4	68.0 (66.2 - 69.8)	78.6 (71.2 – 86.0)	80.4 (79.3 - 81.5)
4-3-1-3-3 series	71.4 (69.9 - 72.9)	77.5 (70.1 - 84.9)	71.9 (70.7 – 73.1)
4-3-1-3-3-1-4 series	55.4 (53.7 - 57.1)	65.8 (57.2 – 74.3)	63.6 (62.3 – 64.9)

[§]Based on 2009 NIS, children aged 19-35 months of age

DISCUSSION

Polio3, MMR1, and HepB3 were the only vaccinations that met the Healthy People 2010 goal of at least 90% coverage at 24 months of age; by 35 months of age, Var1 also reached the HP2010 goal. The immunization estimate for PCV4 had the lowest with coverage of 68.0% by 35 months. Compared to the 2011-12 Retrospective Study, at 24 months of age Hib3, the 4-3-1-3-3 series and the 4-3-1-3-3-1-4 series were all significantly lower in the current study by approximately 10 percentage points. This drop in coverage levels for Hib3 may be due to a lack of immunization or it may be due to a change in record keeping by submitting schools. Hib3 is not required for school entry and thus not always recorded on the school immunization record. However, there was a significant increase in the coverage estimate with Hib3 in children from 24 to 35 months of age and no significant difference at 35 months of age between the Retrospective Study and the Kansas NIS for Hib3, therefore it is likely this decrease in coverage may be due to a lack of immunization with Hib3.

The coverage level for the 4-3-1-3-3-1-4 series was lower in the 2012-13 Retrospective Survey when compared to the Kansas NIS for 19-35 month olds; however, the 4-3-1-3-3 series was not significantly different. PCV4 was significantly lower in the retrospective study compared to the KS NIS coverage. However, since PCV4 is not required for school entry, this may reflect a lack of recording this immunization series on the kindergarten immunization record.

Vaccine coverage is of great public health importance. By having greater vaccination coverage, there is an increase in herd immunity, which leads to lower disease incidence 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 of mumps was at a historical low, and even with the outbreak, mumps disease rates were lower than in the pre-vaccination era. Due to high vaccination coverage, tens or hundreds of thousands of cases were possibly prevented.

However, due to unvaccinated and undervaccinated individuals, the United States has seen a rise in diseases that were previously present at low levels. In 2008, the United States had 140 measles cases reported, more than any year since 1996, and in 2011 the United States has documented 222 cases of

measles, of which 86% were unvaccinated or had unknown vaccination history.⁶ Additionally, in 2012 there was a rise in the number of pertussis cases throughout the United States, including Kansas which was in a statewide outbreak in 2012 with 887 cases, compared to 145 cases in 2011.

Limitations

A limitation of this study is Hib3 and PCV4 are not required for school entry and may not consistently be reported on the immunization record, thus appearing to show lower coverage levels for the individual vaccines as well as the 4-3-1-3-3 and 4-3-1-3-3-1-4 series. Additionally, no descriptive data are collected about sex, race, or ethnicity.

Strengths

Despite the limitations, the retrospective immunization survey provides a good estimate of early childhood immunization coverage levels for Kansas. It allows state and local officials to identify counties and regions with low vaccine coverage levels. Focus on these areas with the implementation of enhanced vaccination delivery methods and educational campaigns can aid in Kansas achieving a 90% coverage goal. To aid in this goal, a similar survey is planned for next year.

⁶ Centers for Disease Control and Prevention. Measles – United States, 2011. MMWR 2012; 61: 253-7.

**APPENDIX 1: Immunization Coverage Levels of Children 35 Months of Age for Kansas Counties
2008-2009.*§**

COUNTY	DTaP4	Polio3	MMR1	Hib3	HepB3	Var1	PCV4	4-3-1-3-3	4-3-1-3-3-1-4
STATEWIDE	87%	93%	93%	81%	93%	91%	68%	71%	55%
ALLEN	87%	95%	98%	90%	96%	95%	80%	81%	74%
ANDERSON	80%	86%	84%	81%	97%	81%	77%	75%	71%
ATCHISON	84%	88%	87%	79%	85%	86%	72%	68%	58%
BARBER	90%	94%	95%	86%	94%	90%	68%	82%	64%
BARTON	81%	99%	86%	73%	98%	84%	74%	55%	48%
BOURBON	84%	96%	94%	94%	97%	91%	79%	79%	65%
BROWN	88%	98%	96%	92%	98%	90%	62%	84%	54%
BUTLER	88%	96%	95%	88%	96%	93%	80%	78%	67%
CHASE	83%	92%	92%	75%	92%	83%	83%	58%	50%
CHAUTAUQUA	80%	94%	86%	87%	96%	93%	53%	67%	47%
CHEROKEE	90%	96%	96%	79%	97%	94%	72%	72%	56%
CHEYENNE	78%	90%	88%	83%	90%	90%	83%	70%	68%
CLARK	89%	95%	93%	91%	98%	91%	86%	84%	80%
CLAY	79%	93%	93%	70%	88%	92%	70%	59%	49%
CLOUD	86%	91%	87%	57%	95%	92%	80%	57%	55%
COFFEY	92%	100%	93%	87%	100%	96%	94%	77%	74%
COMANCHE [†]
COWLEY	86%	93%	92%	88%	93%	92%	64%	76%	57%
CRAWFORD	82%	89%	92%	73%	92%	83%	63%	65%	43%
DECATUR	79%	89%	89%	83%	86%	86%	79%	69%	69%
DICKINSON	86%	94%	94%	86%	91%	94%	65%	76%	55%
DONIPHAN	94%	97%	89%	72%	97%	83%	74%	67%	48%
DOUGLAS	85%	92%	92%	71%	93%	90%	75%	62%	50%
EDWARDS	97%	100%	100%	94%	94%	96%	81%	85%	78%
ELK	83%	98%	100%	90%	92%	98%	70%	79%	65%
ELLIS	90%	95%	95%	84%	96%	92%	67%	75%	61%
ELLSWORTH	90%	93%	94%	81%	94%	91%	57%	77%	47%
FINNEY	82%	94%	93%	87%	93%	91%	70%	74%	60%
FORD	89%	99%	96%	90%	99%	94%	74%	83%	66%
FRANKLIN	74%	84%	93%	67%	84%	92%	46%	60%	32%
GEARY	85%	90%	91%	83%	92%	91%	63%	70%	51%
GOVE	93%	95%	96%	95%	95%	89%	79%	92%	75%
GRAHAM [†]
GRANT	78%	91%	93%	83%	95%	91%	34%	73%	31%
GRAY	90%	94%	93%	90%	91%	89%	59%	77%	53%
GREELEY	95%	95%	91%	100%	95%	95%	86%	91%	86%
GREENWOOD	95%	96%	97%	96%	97%	97%	92%	93%	90%
HAMILTON	95%	95%	96%	95%	96%	96%	40%	91%	38%
HARPER	89%	95%	94%	80%	93%	97%	73%	64%	52%
HARVEY	79%	96%	97%	95%	96%	96%	49%	74%	44%
HASKELL	93%	97%	97%	93%	95%	97%	49%	89%	45%
HODGEMAN	94%	100%	100%	81%	100%	100%	38%	75%	19%
JACKSON	90%	96%	96%	77%	96%	93%	57%	72%	49%
JEFFERSON	88%	96%	97%	81%	96%	95%	83%	71%	63%

COUNTY	DTaP4	Polio3	MMR1	Hib3	HepB3	Var1	PCV4	4-3-1-3-3	4-3-1-3-3-1-4
STATEWIDE	87%	93%	93%	81%	93%	91%	68%	71%	55%
JEWELL	76%	86%	86%	52%	86%	86%	48%	52%	38%
JOHNSON	90%	92%	93%	80%	93%	91%	67%	71%	54%
KEARNY	92%	95%	93%	95%	96%	93%	91%	90%	89%
KINGMAN	84%	92%	91%	87%	90%	76%	57%	72%	48%
KIOWA	92%	98%	98%	91%	98%	98%	63%	85%	63%
LABETTE	86%	95%	94%	89%	94%	93%	73%	76%	63%
LANE	94%	94%	94%	94%	94%	94%	88%	94%	88%
LEAVENWORTH	89%	94%	94%	75%	91%	92%	79%	66%	58%
LINCOLN	100%	100%	100%	75%	100%	100%	25%	75%	25%
LINN	88%	94%	95%	88%	94%	87%	80%	81%	69%
LOGAN	76%	82%	92%	86%	87%	90%	72%	68%	54%
LYON	86%	91%	87%	90%	93%	82%	75%	79%	63%
MARION	86%	84%	94%	88%	77%	89%	75%	67%	51%
MARSHALL	90%	95%	94%	85%	94%	94%	57%	82%	48%
MCPHERSON	86%	94%	91%	36%	90%	89%	34%	31%	22%
MEADE	95%	97%	100%	95%	100%	97%	58%	89%	50%
MIAMI	86%	94%	90%	59%	92%	89%	49%	48%	41%
MITCHELL	93%	94%	94%	62%	96%	91%	63%	61%	49%
MONTGOMERY	84%	93%	95%	90%	97%	95%	67%	75%	55%
MORRIS	76%	85%	88%	81%	90%	88%	58%	66%	45%
MORTON	89%	96%	96%	80%	97%	93%	56%	77%	45%
NEMAHA	96%	94%	96%	89%	98%	95%	72%	86%	66%
NEOSHO	65%	93%	93%	86%	90%	93%	50%	58%	44%
NESS	90%	100%	100%	100%	100%	100%	84%	90%	74%
NORTON	97%	99%	98%	95%	98%	98%	22%	94%	21%
OSAGE	81%	90%	92%	73%	93%	90%	67%	64%	53%
OSBORNE	82%	86%	91%	87%	94%	84%	76%	79%	65%
OTTAWA	95%	97%	96%	86%	98%	96%	92%	84%	81%
PAWNEE	100%	100%	100%	100%	100%	100%	89%	100%	85%
PHILLIPS	84%	86%	91%	89%	89%	91%	42%	82%	40%
POTTAWATOMIE	93%	99%	98%	87%	95%	96%	83%	75%	64%
PRATT	83%	91%	91%	87%	91%	91%	78%	80%	73%
RAWLINS	82%	78%	85%	78%	89%	82%	67%	78%	67%
RENO	87%	95%	95%	84%	94%	92%	76%	76%	66%
REPUBLIC	94%	95%	95%	87%	95%	95%	84%	85%	77%
RICE	79%	86%	92%	75%	85%	86%	67%	61%	48%
RILEY	84%	89%	92%	75%	86%	88%	68%	64%	50%
ROOKS	93%	99%	98%	92%	99%	93%	60%	86%	53%
RUSH	91%	98%	95%	98%	100%	95%	83%	86%	76%
RUSSELL	92%	94%	94%	69%	94%	92%	48%	65%	21%
SALINE	93%	96%	98%	79%	98%	98%	80%	74%	65%
SCOTT [†]
SEDGWICK	89%	93%	93%	83%	93%	92%	71%	74%	60%
SEWARD	89%	93%	94%	81%	96%	94%	52%	73%	43%
SHAWNEE	89%	94%	94%	65%	92%	94%	67%	59%	47%
SHERIDAN	100%	100%	100%	97%	97%	93%	83%	93%	73%

COUNTY	DTaP4	Polio3	MMR1	Hib3	HepB3	Var1	PCV4	4-3-1-3-3	4-3-1-3-3-1-4
<i>STATEWIDE</i>	87%	93%	93%	81%	93%	91%	68%	71%	55%
SHERMAN	95%	97%	95%	75%	97%	95%	91%	72%	71%
SMITH	93%	98%	98%	98%	100%	92%	75%	88%	64%
STAFFORD	94%	89%	100%	94%	100%	100%	78%	89%	78%
STANTON	89%	93%	96%	79%	96%	96%	79%	75%	68%
STEVENS	94%	96%	98%	94%	95%	95%	56%	91%	53%
SUMNER	89%	95%	96%	87%	96%	93%	50%	80%	44%
THOMAS	75%	78%	78%	67%	78%	77%	31%	59%	22%
TREGO	96%	100%	96%	100%	100%	96%	96%	96%	96%
WABAUNSEE	85%	96%	96%	71%	86%	94%	68%	64%	50%
WALLACE	93%	96%	93%	85%	96%	93%	85%	81%	73%
WASHINGTON	92%	96%	96%	68%	96%	96%	84%	68%	60%
WICHITA	83%	89%	89%	89%	89%	89%	83%	83%	83%
WILSON	88%	98%	92%	95%	99%	94%	73%	82%	64%
WOODSON	87%	90%	87%	84%	94%	87%	58%	81%	55%
WYANDOTTE	81%	89%	89%	74%	89%	88%	59%	62%	48%

* Based on the retrospective survey for the school year starting 2011.

§ Due to Hib3 and PCV4 not being required for school entry, these vaccines may not consistently be reported on the immunization record, thus decreasing coverage levels for the individual vaccines, as well as the 4-3-1-3-3 and 4-3-1-3-3-1-4 series. This is evident for several counties that have low coverage levels for the 4-3-1-3-3 and 4-3-1-3-3-1-4 series as well as low Hib3 and PCV4 coverage levels.

‡ No data available