

# **KINDERGARTEN IMMUNIZATION COVERAGE SURVEY**

**School Year 2013-2014**



**Charles L. Cohlma, MPH  
Bureau of Epidemiology and Public Health Informatics  
Division of Health  
Kansas Department of Health and Environment  
1000 SW Jackson, Suite 075  
Topeka, Kansas 66612-1290  
Telephone (877) 427-7317  
Fax (877) 427-7318**

## **ACRONYMS**

CI	Confidence interval
HP2020	Healthy People 2020
KCI	Kansas Certificate of Immunizations
KDHE	Kansas Department of Health and Environment
KSDE	Kansas State Department of Education
USD	Unified School District
UTD	Up to date

## **VACCINE ACRONYMS**

DTaP5	5 doses of diphtheria, tetanus toxoids and acellular pertussis vaccines including diphtheria and tetanus toxoids (DTaP/DT) vaccine <i>or</i> 4 doses of DTaP if the fourth dose is given on or after the fourth birthday
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
MMR2	2 doses of measles, mumps, and rubella vaccine
PCV4	4 doses of pneumococcal conjugate vaccine
Polio4	4 doses of polio vaccine
Var2	Varicella vaccine
5-4-2-2-3	DTaP5 – Polio4 – MMR2 – Var2 – HepB3

## **EXECUTIVE SUMMARY**

### Overview

The Kansas Certificates of Immunizations (KCIs) and other immunization records for children enrolled in a kindergarten class in Kansas public and private schools during the 2013-2014 school year were collected and evaluated for immunization coverage. Vaccination coverage levels were calculated for children at the time of school entry (i.e., on the first day of school for the 2013-2014 academic year) and 30 days following school entry. Children who were between the ages of five and seven years on the first day of the school year were included in the study. In total, there were 616 schools, 535 public and 81 private, included in the analysis, which consisted of a representative sample of 11,526 children from both public and private schools.

### Coverage at Kindergarten Entry

The statewide coverage levels at school entry for all vaccinations required for school entry (DTaP5, Polio4, MMR2, Var2, and HepB3) were above 85%, with HepB3 having the highest coverage at 95.8%. HepB3 was the only vaccination to meet the Healthy People 2020 goal of at least 95% coverage for kindergarten immunizations. The complete series for all five required vaccinations (5-4-2-2-3) had a coverage level of 80.2% at school entry. Vaccination coverage levels for most immunizations increased after the first 30 days of school. Children enrolled in public schools had higher coverage levels than children enrolled in private schools throughout Kansas for all required vaccines; the difference was statistically significant in HepB3 vaccination and the 5-4-2-2-3 series.

The 105 Kansas counties were grouped into three categories based on population density, and coverage levels were compared among these groups. “Urban” ( $\geq 150$  persons per square mile) counties had the highest coverage level for DTaP5, Polio4, MMR2, and Var2. Polio4, Var2, MMR2, and HepB3 showed no significant variation in coverage levels between population density groups, while urban counties had significantly higher coverage levels for DTaP5 compared to counties that were “sparsely populated” ( $\leq 19.9$  persons per square mile). Seven counties had  $\geq 95\%$  coverage for all five required vaccinations and all of them were sparsely populated counties (Appendix 2).

# KINDERGARTEN IMMUNIZATION COVERAGE SURVEY SCHOOL YEAR 2013-2014

## INTRODUCTION

### **Objective**

This study was conducted to estimate the immunization coverage levels of children at school entry and 30 days following school entry into kindergarten.

### **Study Population**

The study population included all Kansas kindergarten students who were between the ages of five and seven years on the first day of the 2013-2014 academic year enrolled in either a public or private school.

### **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 fully immunized against diphtheria, tetanus, pertussis, polio, measles, mumps, rubella, *Haemophilus influenzae* type b, hepatitis A virus, hepatitis B virus, varicella, and pneumococcal disease. Vaccination coverage was assessed for these children at school entry into kindergarten and 30 days following school entry.

Vaccination coverage was measured for single vaccines and combinations of vaccines according to the recommended immunization schedule for children by five years of age (Appendix 5).<sup>1</sup> Immunization coverage levels were assessed for all kindergartners of the 2013-2014 academic year.

## 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 sampling ratio was established for each county, and a probability sample was selected using a systematic sampling technique. 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 (KDHE) and the Kansas State Department of Education (KSDE), requesting their participation in the survey. The letters sent to public schools specified the number of records required to generate estimates of county-specific coverage levels and outlined the process of systematically selecting a probability sample of records. The study coordinator at each school (typically the school nurse) was instructed to select all kindergarten exemptions for submission to KDHE, then, depending on the calculated sampling ratio for their county, proceed to select all, every other, every third, every sixth, every seventh, or every nineteenth

---

<sup>1</sup> The Recommended Immunization Schedule used as reference for ages and immunizations in this study 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 2012.

immunization record regardless of the size of the kindergarten class at that school. The private schools were instructed to select all immunization records (including exemptions) for children enrolled in kindergarten. Children who were exempt from immunizations were excluded from the sampling. The schools were informed they could submit KCIs or any other form of immunization record, including printouts from computerized record keeping programs. For schools who reported that all kindergarten students' immunization records were entered into the Kansas immunization registry, KSWebIZ, KDHE utilized the electronic records, and the schools were not required to submit paper records. The study coordinators were also advised to remove all personal identifiers from paper records, except date of birth, to ensure confidentiality. Copies of the immunization records, exemption records, the current total number of kindergarten enrollees, the total number of exemptions, and the number of records sent for both medical and religious exemption in each school were forwarded to KDHE. Additionally, the study coordinators were asked to complete a two-question survey assessing policies and procedures at their school regarding grace periods with respect to vaccination requirements and exclusions. Children who are home schooled or attended other special schools were not included in this analysis.

### Data Analysis

In the current study, the immunization coverage levels accounted for both exempt and non-exempt children's immunization status.<sup>2</sup> Consistent with previous studies, children who had a date of birth recorded on the Kansas Certificate of Immunizations (KCI) or other data source and were the appropriate age for the analysis were included in the denominator. All immunization records in the school module of KSWebIZ were extracted and matched by school name to those who reported that all kindergarten records were entered into KSWebIZ. Due to inconsistent use in the "grade" field of these records, only children who were between the ages of 5 and 7 were included from these schools. Schools that did not provide at least 75% of the non-exempt immunization records requested were excluded from analysis.

Point estimates of coverage levels and 95% confidence intervals (95% CI) for DTaP5, Polio4, MMR2, Hib3, HepB3, Var2, HepA2, and PCV4 vaccines were calculated at time of school entry. Children were considered up to date for DTaP5 if the child had received either a) five doses of DTaP or b) four doses of DTaP and the fourth dose was on or after their fourth birthday.<sup>3</sup> All children who indicated history of varicella disease 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 not consistently recorded; it could not be determined if some children had the disease before school entry. The date of school entry was reported by the study coordinators as the first day of school for the 2013-2014 academic year. Immunization coverage levels were also assessed at 30 days following school entry because many school districts maintain a "grace period" policy during which a child may be vaccinated with the appropriate vaccines without being excluded from school. Records submitted from schools reporting exemptions were examined and classified as medical, religious, or non-exempt.

$$\frac{\left( \text{Weighted percentage of non-exempt children UTD} \times \text{Number of non-exempt children} \right) + \text{Number of exempt children UTD}}{\text{Total number of children enrolled}}$$

<sup>2</sup> Total number of children enrolled

<sup>3</sup> Centers for Disease Control and Prevention. Pertussis: Epidemiology and Prevention of Vaccine-Preventable Diseases. Atkinson W, Wolfe S, Hamborsky J, eds. 12th ed., second printing. Washington DC: Public Health Foundation, 2012.

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 between counties.<sup>4</sup> Sample weights were calculated using the number of non-exempt kindergartners enrolled in a county and the number of records analyzed for that county.

All population and birth cohort data were calculated from the 2008 Annual Summary of Vital Statistics.<sup>5</sup> The 105 counties were categorized based on population densities, and for the purpose of this analysis, counties were grouped into “urban” ( $\geq 150$  persons per square mile), “moderately populated” (20-149.9 persons per square mile), and “sparsely populated” ( $\leq 19.9$  persons per square mile) (Appendix 1). Immunization coverage level estimates were compared among these groups.

## **RESULTS**

### **Data Collection**

Letters of invitation to participate in the survey were sent to 833 Kansas schools; of these, 720 were public schools and 113 were private. Five schools reported not having a kindergarten class for the 2013-2014 school year and 73 did not respond. Of the 755 responding schools, 139 did not provide at least 75% of the requested records and were excluded. The remaining 616 schools (535 public and 81 private) from 94 Kansas counties provided requested immunization data and were included in the analysis. This corresponds to a school participation rate of 74%. Seventy-eight percent of participating schools submitted KCIs, 7% submitted immunization records through the KSWebIZ system, and 15% of the schools submitted a combination of the two types of records.<sup>6</sup>

The number of children enrolled in kindergarten at public and private schools included in the analysis was 30,339, which is 74% of the 41,107 children enrolled in a Kansas kindergarten in the 2013-2014 school year. The number of immunization records received was 12,084 and the number of records included in the analysis was 11,526 (95.4%) which is equivalent to one child selected for every 3.6 children enrolled.

Responding schools reported a total of 487 students with exemptions (406 religious and 81 medical), and 438 exemption records were submitted. Of the exemption records received, 364 were religious exemptions and 74 were medical exemptions.

The 2013-2014 school year enrollment distribution across the state of Kansas was 11.3% in sparsely populated counties, 32.8% in moderately populated counties, and 55.9% in urban counties. The number of records included in the analysis by population density was: 2,645 (22.9% of all records used, representing 9.8% of the population after weighting) in sparsely populated counties, 5,715 (49.6% of all records used, representing 33.4% of the population after weighting) in moderately populated counties, and 3,166 (27.5% of all records used, representing 56.9% of the population after weighting) in urban counties.

### **Statewide Immunization Coverage of Kindergartners at School Entry**

The immunization coverage levels at school entry of all required vaccinations (DTaP5, Polio4, MMR2, Var2, and HepB3) were above 85%, with HepB3 having the highest coverage of any vaccination (Figure 1). The complete series for all five required vaccinations (5-4-2-2-3) had a coverage level of 80.2% at

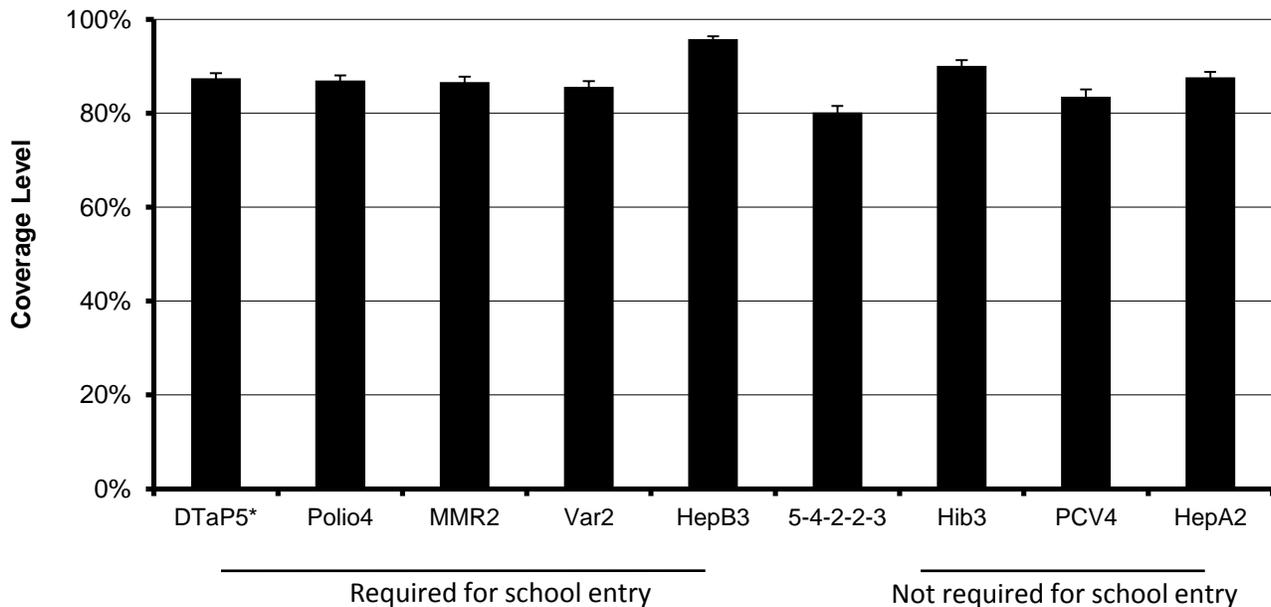
<sup>4</sup> Complex survey design effect was accounted for by using the SAS Procedure PROC SURVEYFREQ.

<sup>5</sup> 2008 Annual Summary of Kansas Vital Statistics (<http://www.kdheks.gov/hci/annsumm.html>).

<sup>6</sup> Percentages are rounded.

school entry. Healthy People 2020 (HP2020) goals for kindergarten vaccination coverage levels are  $\geq 95\%$  for all vaccines required by Kansas for school entry.<sup>7</sup> Hepatitis B vaccination was the only immunization that reached this goal. Of the vaccinations not required for school entry, PCV4 had the lowest coverage with 83.5% of kindergartners fully vaccinated at school entry.

**Figure 1: Immunization coverage levels of kindergarten students at school entry, Kansas 2013-2014**



*\*5 doses of DTaP or 4 doses if the fourth is administered on or after the fourth birthday*

The immunization coverage level of kindergartners was significantly higher for most required vaccinations (DTaP5, Polio4, MMR2, Var2) as well as the 5-4-2-2-3 vaccine series when comparing coverage levels from school entry to 30 days following the first day of school (Table 1). The only required vaccination that did not have a significantly increased coverage level was HepB3. Additionally, the coverage level for the three non-required vaccinations (Hib3, HepA2, PCV4) did not significantly increase after the first 30 days of school.

<sup>7</sup> Healthy People 2020 (<http://www.healthypeople.gov>)

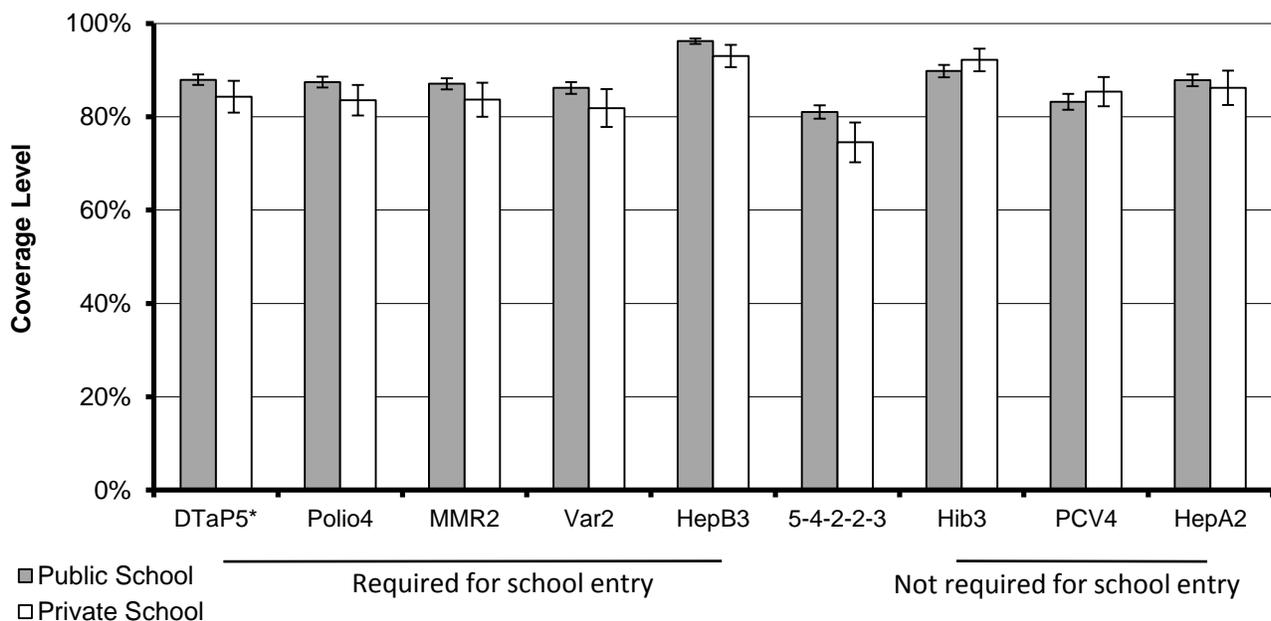
**Table 1: Immunization coverage levels of kindergarten students at school entry and 30 days following school entry, Kansas 2013-2014**

	At School Entry % (95% CI)	30 Days After School Entry % (95% CI)
<b>DTaP5*</b>	87.4 (86.4-88.5)	90.1 (89.0-91.1)
<b>Polio4</b>	86.9 (85.8-88.0)	89.2 (88.1-90.2)
<b>MMR2</b>	86.6 (85.5-87.8)	89.6 (88.6-90.7)
<b>Var2</b>	85.6 (84.4-86.8)	88.3 (87.1-89.5)
<b>HepB3</b>	95.8 (95.2-96.4)	95.9 (95.3-96.5)
<b>5-4-2-2-3</b>	80.2 (78.8-81.6)	83.0 (81.7-84.4)
<b>Hib3</b>	90.1 (88.9-91.3)	90.1 (88.9-91.3)
<b>PCV4</b>	83.5 (82.0-85.0)	83.5 (82.0-85.0)
<b>HepA2</b>	87.6 (86.4-88.8)	88.1 (86.9-89.2)

\*5 doses of DTaP or 4 doses if the fourth is administered on or after the fourth birthday.

There was variation in the immunization coverage levels for kindergartners enrolled in public and private schools (Figure 2). Children enrolled in public schools had significantly higher immunization coverage for HepB3 and the 5-4-2-2-3 vaccine series than children enrolled in private schools. There was no significant difference in immunization coverage levels for the non-required vaccinations between public school and private school enrollees.

**Figure 2: Immunization coverage levels of public and private school kindergartners at school entry, Kansas 2013-2014**



\*5 doses of DTaP or 4 doses if the fourth is administered on or after the fourth birthday

### County-level Immunization Coverage of Kindergartners at School Entry

Immunization coverage was also analyzed at the county level. All vaccination coverage levels are listed by county in Appendix two. Maps of coverage by county are in Appendix three.

Assessments were completed to determine the number of counties which met vaccine-specific HP2020 goals for kindergarten immunization coverage. For four of the five vaccines required for school entry, counties with a smaller enrollment population were more likely to meet or exceed HP2020 goals (Table 2). Of the 94 counties included in the analysis, 72 reached the HP2020 goal of  $\geq 95\%$  for HepB3. Two counties (Haskell and Thomas) reached 100% coverage for all five required immunizations for kindergarten entry and an additional five counties had  $\geq 95\%$  coverage level for all required vaccinations; all of these counties are sparsely populated.

**Table 2: Number of counties reaching Healthy People 2020 goal and percentage of total enrolled population, by immunization, Kansas 2013-2014**

Vaccine	# of counties reaching HP2020 goal (n=102)	% of 2013-2014 Enrollment
<b>DTaP5*</b>	11	3.7%
<b>Polio4</b>	13	4.4%
<b>MMR2</b>	10	3.9%
<b>Var2</b>	8	2.5%
<b>HepB3</b>	72	79.4%

*\*5 doses of DTaP or 4 doses if the fourth is administered on or after the fourth birthday*

Counties were classified based on their population densities, and coverage levels were compared among the three categories, sparsely populated, moderately populated, and urban (Table 3). Urban counties had significantly higher coverage levels for DTaP5 compared to counties that were sparsely populated. There was no significant difference in coverage levels among county population density categories for any other vaccine or the 5-4-2-2-3 series.

**Table 3: Kansas immunization coverage levels for kindergartners by county population density group and immunization, Kansas 2013-2014**

	County Population Density Category		
	Sparsely Populated (n=2712)	Moderately Populated (n=5884)	Urban (n=3238)
	% (95% CI)	% (95% CI)	% (95% CI)
<b>DTaP5*</b>	84.8 (82.5-87.1)	85.7 (83.9-87.5)	89.8 (88.2-91.4)
<b>Polio4</b>	85.8 (83.6-88.1)	86.0 (84.3-87.7)	88.0 (86.3-89.8)
<b>MMR2</b>	84.3 (81.9-86.7)	85.6 (83.8-87.4)	88.3 (86.5-90.1)
<b>Var2</b>	82.8 (80.0-85.7)	85.0 (83.2-86.9)	87.2 (85.2-89.1)
<b>HepB3</b>	96.7 (95.4-97.9)	95.8 (94.9-96.7)	95.5 (94.5-96.5)
<b>5-4-2-2-3</b>	79.4 (76.6-82.3)	79.8 (77.7-81.8)	80.7 (78.4-83.0)
<b>Hib3</b>	92.5 (90.8-94.3)	89.2 (87.1-91.3)	89.8 (87.9-91.7)
<b>PCV4</b>	87.9 (85.4-90.3)	80.9 (78.3-83.6)	83.7 (81.3-86.1)
<b>HepA2</b>	88.0 (85.4-90.6)	86.2 (84.3-88.2)	88.5 (86.6-90.3)

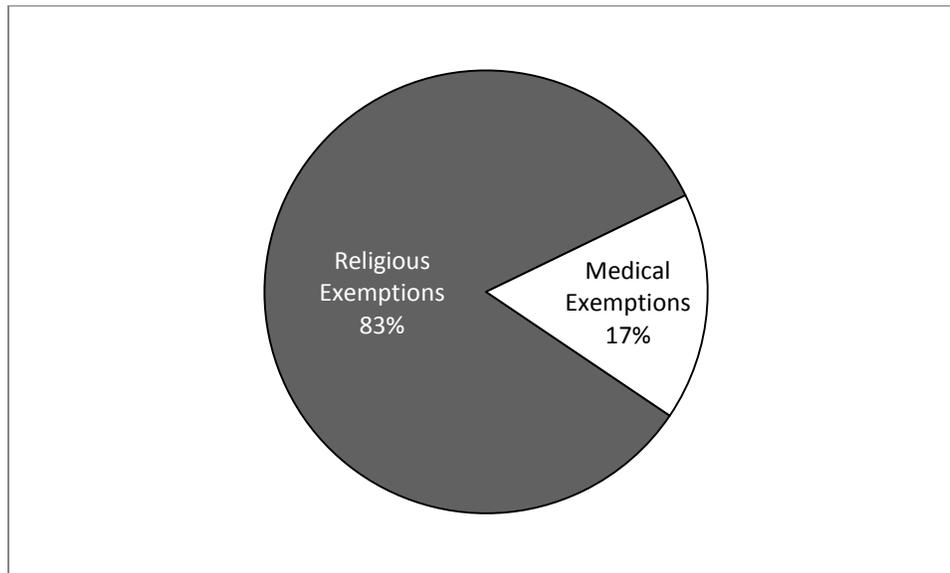
\*5 doses of DTaP or 4 doses if the fourth is administered on or after the fourth birthday

### Kindergarten Exemptions

In the state of Kansas, two legal alternatives to vaccination at school entry exist: medical exemption and religious exemption.<sup>8</sup> To receive a medical exemption, a physician must annually sign a form stating the reason for exemption and from which vaccine(s) the child is exempt. To receive a religious exemption, a parent or guardian must write a statement explaining that the child is an adherent of a religious denomination whose religious teachings are opposed to such tests or inoculations. During the 2013-2014 school year, 487 kindergartners from 616 schools were reported as having an exemption, which correlates to 1.6% of the kindergarten population. Of the 487 exemptions reported, 406 were categorized as religious and 81 were medical (Figure 3). Exemptions occur throughout the state; however, counties with the greatest percentage of kindergartners with an exemption on file were in the eastern half of the state (Appendix 4). Schools with the greatest percentage of kindergartners with an exemption were clustered in high population areas, including the areas surrounding Wichita, Kansas City, and Manhattan. Additionally, there is a cluster of schools with a high percentage of kindergartners with an exemption in the north-central region of the state.

<sup>8</sup> Statute 72-5209: Same; certification of completion required, alternatives; duties of school boards. (a) In each school year, every pupil enrolling or enrolled in any school for the first time in this state, and each child enrolling or enrolled for the first time in a preschool or day care program operated by a school, and such other pupils as may be designated by the secretary, prior to admission to and attendance at school, shall present to the appropriate school board certification from a physician or local health department that the pupil has received such tests and inoculations as are deemed necessary by the secretary by such means as are approved by the secretary. Pupils who have not completed the required inoculations may enroll or remain enrolled while completing the required inoculations if a physician or local health department certifies that the pupil has received the most recent appropriate inoculations in all required series. Failure to timely complete all required series shall be deemed non-compliance. (b) As an alternative to the certification required under subsection (a), a pupil shall present: (1) An annual written statement signed by a licensed physician stating the physical condition of the child to be such that the tests or inoculations would seriously endanger the life or health of the child, or (2) a written statement signed by one parent or guardian that the child is an adherent of a religious denomination whose religious teachings are opposed to such tests or inoculations. (c) On or before May 15 of each school year, the school board of every school affected by this act shall notify the parents or guardians of all known pupils who are enrolled or who will be enrolling in the school of the provisions this act and any policy regarding the implementation of the provisions of this act adopted by the school board. (d) If a pupil transfers from one school to another, the school from which the pupil transfers shall forward with the pupil's transcript the certification or statement showing evidence of compliance with the requirements of this act to the school to which the pupil transfers.

**Figure 3: Percentage of permissible exemptions reported by schools at kindergarten entry, Kansas 2013-2014**



The percentage of kindergarten students with an exemption has steadily increased over the last four years. Since the 2010-2011 school year, the percentage of kindergartners with an exemption has increased by 0.58%. The percentage of medical exemptions has remained steady and the percentage of children with a religious exemption increased significantly by 0.59% (Table 4).

**Table 4: Religious and medical exemption status among Kansas kindergartners by year, 2010-2014**

School Year	Religious Exemptions Reported % (95% CI)	Medical Exemptions Reported % (95% CI)	All Exemptions Reported % (95% CI)	Total Enrollment
2010-2011	0.75 (0.66-0.83)	0.29 (0.23-0.34)	1.03 (0.93-1.14)	38,496
2011-2012	0.95 (0.85-1.05)	0.34 (0.28-0.40)	1.29 (1.17-1.40)	38,410
2012-2013	1.03 (0.92-1.14)	0.34 (0.27-0.40)	1.37 (1.24-1.49)	35,203
2013-2014	1.34 (1.21-1.47)	0.27 (0.21-0.33)	1.61 (1.46-1.75)	30,339

Vaccine exemptions were compared among the three county population density categories and the percent of total enrollment for each year. Compared to the 2010-2011 school year, the percentage of enrolled kindergarten students with religious exemptions in the 2013-2014 school year significantly increased among moderately populated and urban counties by 0.66% and 0.55% respectively. Sparsely populated counties also experienced an increase in the percentage of children reported with a 0.69% increase. The highest percentage of kindergartners with religious exemptions was in sparsely populated Kansas counties (Table 5). Maps of exemptions by county are in Appendix 4.

**Table 5: Religious and medical exemption status among Kansas kindergartners by year and county population density group, 2010-2014**

School Year	County Population Density Category					
	Sparsely Populated		Moderately Populated		Urban	
	Religious % (95% CI)	Medical % (95% CI)	Religious % (95% CI)	Medical % (95% CI)	Religious % (95% CI)	Medical % (95% CI)
<b>2010-2011</b>	0.92 (0.67-1.24)	0.30 (0.16-0.50)	0.71 (0.57-0.87)	0.34 (0.25-0.46)	0.73 (0.61-0.84)	0.25 (0.19-0.33)
<b>2011-2012</b>	0.84 (0.59-1.16)	0.58 (0.38-0.86)	0.86 (0.70-1.02)	0.37 (0.27-0.49)	1.02 (0.89-1.16)	0.27 (0.20-0.35)
<b>2012-2013</b>	1.19 (0.88-1.56)	0.51 (0.32-0.78)	0.90 (0.73-1.07)	0.27 (0.19-0.38)	1.08 (0.92-1.23)	0.34 (0.26-0.43)
<b>2013-2014</b>	1.61 (1.17-2.16)	0.40 (0.20-0.72)	1.37 (1.13-1.61)	0.18 (0.10-0.29)	1.28 (1.11-1.45)	0.29 (0.22-0.38)

**DISCUSSION**

All individual vaccinations required for school entry were above 85% coverage at school entry for Kansas kindergartners included in the study. The only vaccination that met the HP2020 goal of at least 95% coverage was HepB3. DTaP5, Polio4, MMR2, and Var2 were eight percentage points from meeting the goal. For required vaccinations that did not meet the HP2020 goal, immunization levels 30 days following the start of the school year were significantly higher when compared to immunization coverage levels for the first day of school. No increase in vaccination coverage was seen for Hib3, PCV4, or HepA2; this is likely because these vaccinations are not required for school entry and not universally recommended for children over five years of age. Additionally, as Hib3, PCV4, and HepA2 are not required for school entry, they were not always recorded on school immunization records, and therefore immunization coverage levels might actually be higher than those represented in this report.

The coverage estimates were compared to determine if differences exist among counties of different population densities. There were no significant differences for any of the required vaccinations, except DTaP5. DTaP5 coverage levels were significantly higher in urban counties than in sparsely populated counties.

The western half of the state had the largest number of counties with high immunization levels (95% or greater) for DTaP5, Polio4, MMR2, Var2, and the 5-4-2-2-3 vaccine series. All seven counties with immunization coverage levels for the five required vaccines at 95% or greater were sparsely populated; however, many other sparsely populated counties had low coverage levels. This variation could account for the lack statistical differences among counties of different population densities.

The counties with the greatest percentage of exemptions were concentrated more heavily in the eastern half of Kansas; the counties in the eastern half of the state also tend to have lower immunization coverage levels than the western half of the state. Exemptions were reported for 1.6% of the kindergarten students enrolled in participating schools and the majority of the exemptions were classified as religious (82%). The percentage of children with a religious exemption has significantly

increased over the last four years. This increase occurred in all three county peer groups with significant increases in urban and moderately populated areas of Kansas. Religious exemptions in rural Kansas counties increased, but it was not statistically significant.

When children are exempt from vaccination (or not up to date) they are at risk for contracting vaccine preventable diseases (VPDs) and subsequently spreading the disease to other unimmunized or under-immunized individuals (e.g., infants) or other high-risk persons. Therefore, it is important that the numbers of exempt and under-immunized school-aged children remain low.

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 VPD outbreaks. However, due to unvaccinated and under-vaccinated individuals, the United States has experienced increased incidence in diseases that were previously present at low levels. In 2008, the United States had 140 measles cases, more than any year since 1996, and in 2011 the United States documented 222 cases of measles, of which 86% were unvaccinated or had unknown vaccination history.<sup>9</sup> Additionally, in 2012 there was an increase in the number of pertussis cases throughout the United States, including Kansas which experienced a statewide outbreak in 2012 with 887 cases, compared to 145 cases in 2011.

### **Limitations**

A limitation of this study is Hib3, HepA2, and PCV4 are not required for school entry and may not be consistently reported on the immunization record, thus decreasing coverage estimates for these vaccines. Some schools who submitted records through KSWebIZ did not associate their students with a grade, and therefore records were included based on age at school entry; this may result in children from other grades being included in the analysis. Additionally, school personnel reported the number of exemptions in their school and the number of exemptions they actually sent to KDHE for the purpose of this study. KDHE was unable to verify all of these exemptions due to immunization records not being clearly marked as an exempt record or records being incorrectly classified as medically exempt. Finally, no descriptive data are collected about sex, race, or ethnicity.

Of the 755 schools that sent immunization records, 139 were excluded for sending in fewer records than were requested and therefore, could not be used in this analysis.

### **Strengths**

Despite the limitations, the kindergarten immunization survey provides a good estimation of the immunization coverage levels for kindergarten children enrolled in private and public schools in Kansas. It allows state and local officials to identify counties and regions with low vaccine coverage levels in order to focus on these areas and implement enhanced vaccination delivery methods and educational campaigns that can aid in Kansas achieving the HP2020 goal of 95% immunization coverage. To further assess the progress, a similar survey is planned for next year.

---

<sup>9</sup> Centers for Disease Control and Prevention. Measles – United States, 2011. MMWR 2012; 61: 253-7.



**Appendix 2: Average school immunization coverage levels for children at school entry for Kansas counties, 2013-2014 (percentages) §**

COUNTY	DTaP5*	Polio4	MMR2	Var2	HepB3	5-4-2-2-3	Hib3	PCV4	HepA2
<b>STATEWIDE</b>	<b>87%</b>	<b>87%</b>	<b>87%</b>	<b>86%</b>	<b>96%</b>	<b>80%</b>	<b>90%</b>	<b>84%</b>	<b>88%</b>
ALLEN	87%	86%	88%	88%	97%	85%	95%	93%	90%
ANDERSON	78%	78%	80%	80%	98%	75%	98%	93%	92%
ATCHISON	81%	79%	76%	76%	98%	76%	92%	82%	85%
BARBER	90%	90%	89%	86%	100%	86%	99%	90%	90%
BARTON	88%	89%	89%	85%	97%	84%	95%	87%	90%
BOURBON	97%	95%	94%	90%	96%	85%	94%	91%	83%
BROWN	89%	89%	90%	89%	99%	86%	96%	94%	90%
BUTLER	84%	84%	87%	84%	96%	78%	91%	84%	87%
CHASE	86%	75%	82%	82%	89%	64%	89%	43%	82%
CHAUTAUQUA	85%	85%	85%	85%	98%	85%	85%	78%	94%
CHEROKEE	82%	83%	86%	83%	100%	79%	85%	85%	86%
CHEYENNE	88%	86%	88%	88%	100%	86%	100%	86%	84%
CLARK	86%	86%	86%	86%	100%	86%	100%	100%	95%
CLAY	80%	80%	89%	85%	90%	74%	78%	76%	93%
CLOUD	53%	53%	53%	49%	88%	49%	88%	70%	44%
COFFEY	80%	88%	80%	81%	96%	75%	94%	88%	93%
COMANCHE	90%	85%	90%	90%	100%	85%	95%	85%	85%
COWLEY	89%	91%	87%	87%	99%	84%	96%	87%	94%
CRAWFORD	84%	86%	83%	84%	93%	74%	88%	78%	81%
DECATUR	87%	87%	84%	84%	94%	84%	87%	87%	90%
DICKINSON	83%	84%	81%	80%	94%	73%	90%	86%	86%
DONIPHAN	92%	88%	90%	90%	96%	86%	96%	90%	92%
DOUGLAS	87%	84%	87%	84%	96%	78%	89%	73%	85%
EDWARDS	87%	87%	93%	85%	98%	80%	92%	87%	98%
ELK	90%	91%	91%	91%	96%	88%	91%	86%	79%
ELLIS	94%	96%	95%	95%	100%	92%	100%	98%	95%
ELLSWORTH	86%	86%	86%	83%	100%	81%	83%	92%	93%
FINNEY	85%	85%	85%	85%	98%	82%	93%	86%	91%
FORD	88%	88%	90%	89%	97%	84%	93%	79%	91%
FRANKLIN	90%	100%	90%	90%	100%	90%	90%	100%	100%
GEARY	92%	92%	91%	92%	98%	90%	93%	87%	91%
GOVE	91%	85%	82%	88%	100%	79%	92%	92%	92%
GRAHAM <sup>‡</sup>									
GRANT <sup>‡</sup>									
GRAY	85%	85%	86%	86%	100%	84%	92%	93%	98%
GREELEY	87%	93%	87%	87%	100%	87%	100%	100%	100%
GREENWOOD	93%	94%	93%	93%	96%	91%	98%	97%	96%
HAMILTON	95%	95%	95%	95%	100%	90%	95%	93%	90%
HARPER	86%	85%	87%	85%	98%	81%	83%	85%	78%
HARVEY	90%	91%	89%	89%	95%	83%	90%	72%	83%
HASKELL	100%	100%	100%	100%	100%	100%	89%	95%	100%
HODGEMAN <sup>‡</sup>									
JACKSON	93%	90%	90%	90%	100%	86%	100%	97%	86%

COUNTY	DTaP5*	Polio4	MMR2	Var2	HepB3	5-4-2-2-3	Hib3	PCV4	HepA2
<b>STATEWIDE</b>	<b>87%</b>	<b>87%</b>	<b>87%</b>	<b>86%</b>	<b>96%</b>	<b>80%</b>	<b>90%</b>	<b>84%</b>	<b>88%</b>
JEFFERSON	84%	85%	84%	84%	93%	79%	92%	87%	90%
JEWELL	68%	68%	72%	72%	100%	64%	96%	100%	52%
JOHNSON	91%	88%	89%	87%	96%	82%	91%	85%	89%
KEARNY	95%	100%	95%	100%	100%	91%	91%	95%	100%
KINGMAN	81%	81%	72%	72%	91%	72%	91%	75%	74%
KIOWA	78%	76%	78%	78%	100%	76%	86%	78%	86%
LABETTE	77%	75%	76%	75%	92%	70%	80%	74%	73%
LANE	83%	100%	83%	83%	100%	83%	98%	100%	100%
LEAVENWORTH	91%	90%	91%	88%	93%	79%	91%	88%	87%
LINCOLN	88%	88%	83%	88%	96%	83%	96%	96%	92%
LINN	83%	86%	83%	81%	89%	72%	90%	76%	84%
LOGAN	81%	81%	56%	25%	100%	25%	75%	75%	75%
LYON	67%	73%	71%	71%	93%	64%	89%	77%	87%
MARION	78%	80%	79%	76%	91%	71%	93%	85%	80%
MARSHALL	97%	98%	97%	96%	99%	96%	98%	97%	96%
MCPHERSON	78%	76%	77%	77%	93%	70%	51%	39%	76%
MEADE	76%	73%	76%	72%	100%	68%	86%	88%	86%
MIAMI	90%	80%	90%	90%	93%	74%	71%	61%	83%
MITCHELL	97%	95%	96%	97%	100%	94%	98%	97%	99%
MONTGOMERY	80%	76%	77%	71%	96%	67%	90%	77%	82%
MORRIS <sup>‡</sup>									
MORTON	86%	87%	82%	82%	95%	77%	87%	84%	80%
NEMAHA	75%	75%	69%	69%	100%	69%	100%	81%	94%
NEOSHO	90%	90%	93%	90%	99%	86%	97%	49%	53%
NESS	74%	82%	76%	76%	100%	71%	97%	100%	89%
NORTON <sup>‡</sup>									
OSAGE	82%	85%	81%	84%	97%	79%	89%	83%	84%
OSBORNE	92%	88%	92%	92%	100%	88%	100%	92%	92%
OTTAWA	78%	81%	80%	80%	98%	72%	96%	93%	85%
PAWNEE	88%	87%	88%	88%	98%	85%	98%	96%	96%
PHILLIPS	83%	83%	83%	83%	100%	83%	100%	83%	100%
POTTAWATOMIE	82%	83%	81%	80%	90%	78%	85%	77%	84%
PRATT	97%	96%	97%	97%	99%	95%	99%	97%	97%
RAWLINS	90%	90%	90%	90%	97%	90%	87%	87%	87%
RENO	90%	93%	88%	90%	97%	84%	94%	89%	90%
REPUBLIC	97%	96%	93%	93%	98%	91%	93%	93%	77%
RICE	85%	85%	85%	78%	90%	78%	88%	76%	91%
RILEY	87%	88%	88%	87%	95%	82%	90%	83%	78%
ROOKS <sup>‡</sup>									
RUSH	87%	91%	95%	89%	94%	82%	88%	77%	77%
RUSSELL	74%	79%	79%	74%	100%	74%	95%	84%	74%
SALINE	91%	87%	90%	90%	98%	86%	94%	92%	95%
SCOTT <sup>‡</sup>									
SEDGWICK	90%	88%	89%	88%	96%	82%	89%	83%	88%
SEWARD	95%	94%	96%	94%	98%	88%	88%	90%	92%
SHAWNEE	83%	86%	82%	81%	96%	77%	91%	89%	91%

COUNTY	DTaP5*	Polio4	MMR2	Var2	HepB3	5-4-2-2-3	Hib3	PCV4	HepA2
STATEWIDE	87%	87%	87%	86%	96%	80%	90%	84%	88%
SHERIDAN	97%	94%	94%	94%	97%	94%	94%	94%	94%
SHERMAN <sup>‡</sup>									
SMITH <sup>‡</sup>									
STAFFORD	72%	80%	74%	72%	100%	70%	98%	90%	88%
STANTON	81%	79%	81%	79%	94%	68%	91%	89%	89%
STEVENS	82%	83%	81%	77%	99%	74%	93%	90%	94%
SUMNER	89%	85%	86%	88%	90%	78%	88%	68%	82%
THOMAS	100%	100%	100%	100%	100%	100%	100%	100%	100%
TREGO	85%	85%	85%	85%	100%	85%	100%	96%	96%
WABAUNSEE	72%	73%	72%	72%	100%	72%	97%	97%	98%
WALLACE	50%	50%	50%	50%	50%	50%	50%	50%	25%
WASHINGTON	92%	92%	91%	91%	98%	86%	98%	90%	93%
WICHITA <sup>‡</sup>									
WILSON	93%	96%	93%	93%	100%	92%	95%	92%	94%
WOODSON <sup>‡</sup>									
WYANDOTTE	91%	89%	89%	90%	92%	78%	87%	80%	89%

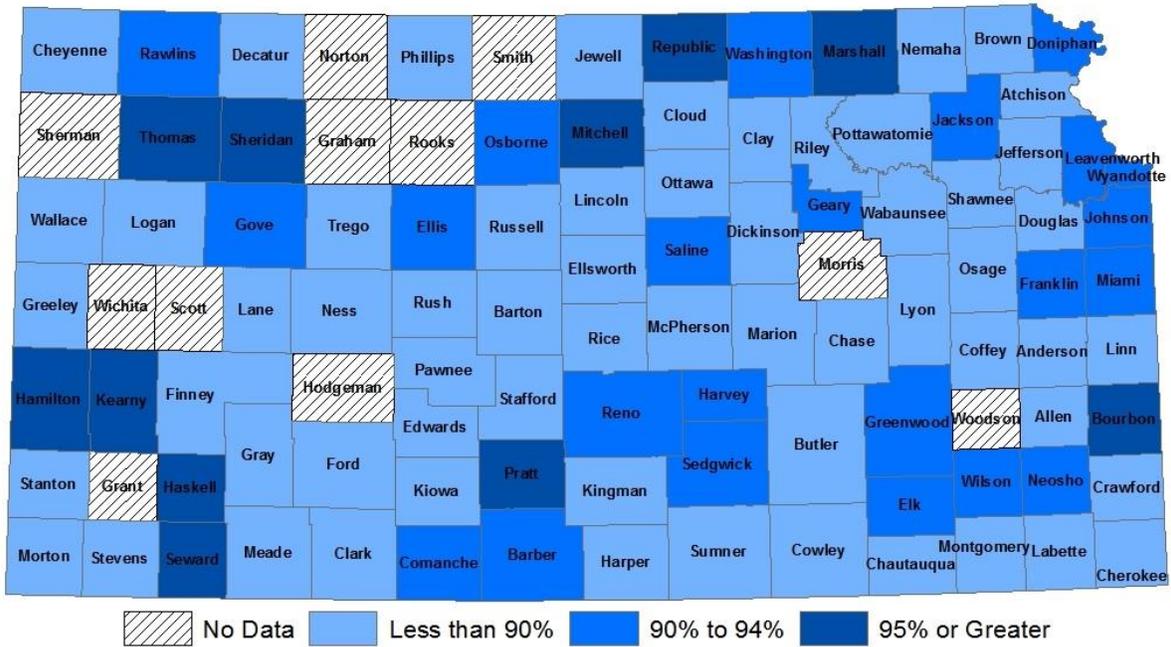
§ Due to Hib3, HepA2, and PCV4 not being required for school entry, these vaccines may not consistently be reported on the immunization record, thus decreasing coverage levels for the individual vaccines. This is evident for several counties that have extremely low levels for the Hib3, HepA2 and PCV4 coverage levels.

\*5 doses of DTaP or 4 doses if the fourth is administered on or after the fourth birthday.

‡ No data available

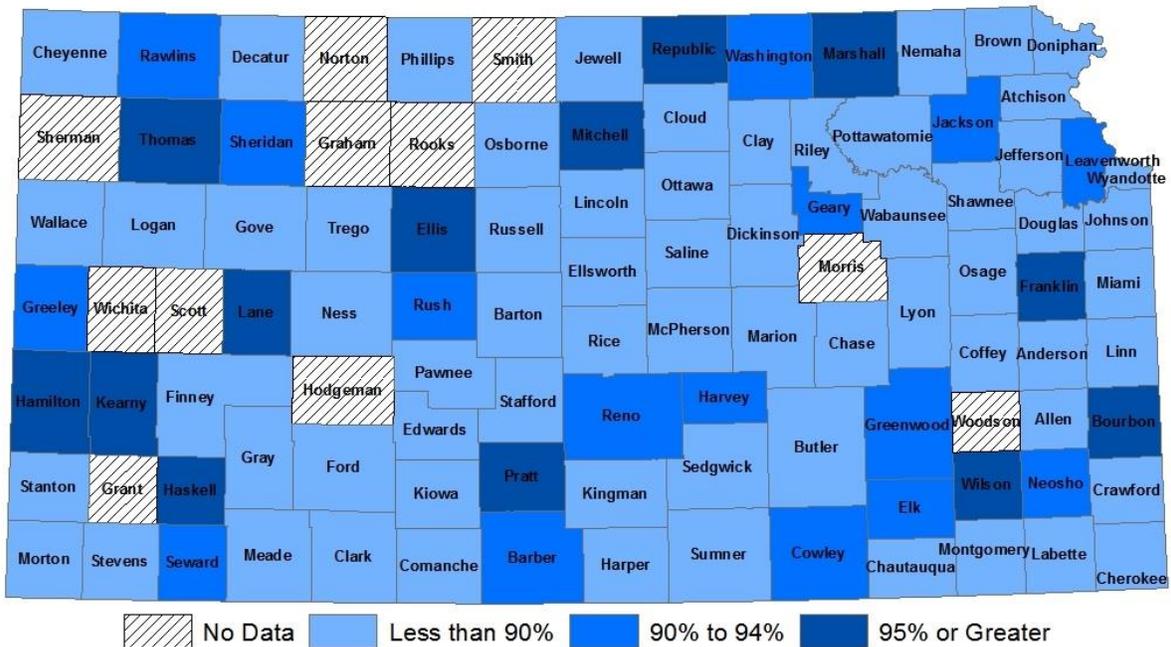
### Appendix 3: Maps of immunization levels by county, 2013-2014 Kindergarten Survey

#### DTaP5 Coverage for Kindergarten Survey, 2013-2014

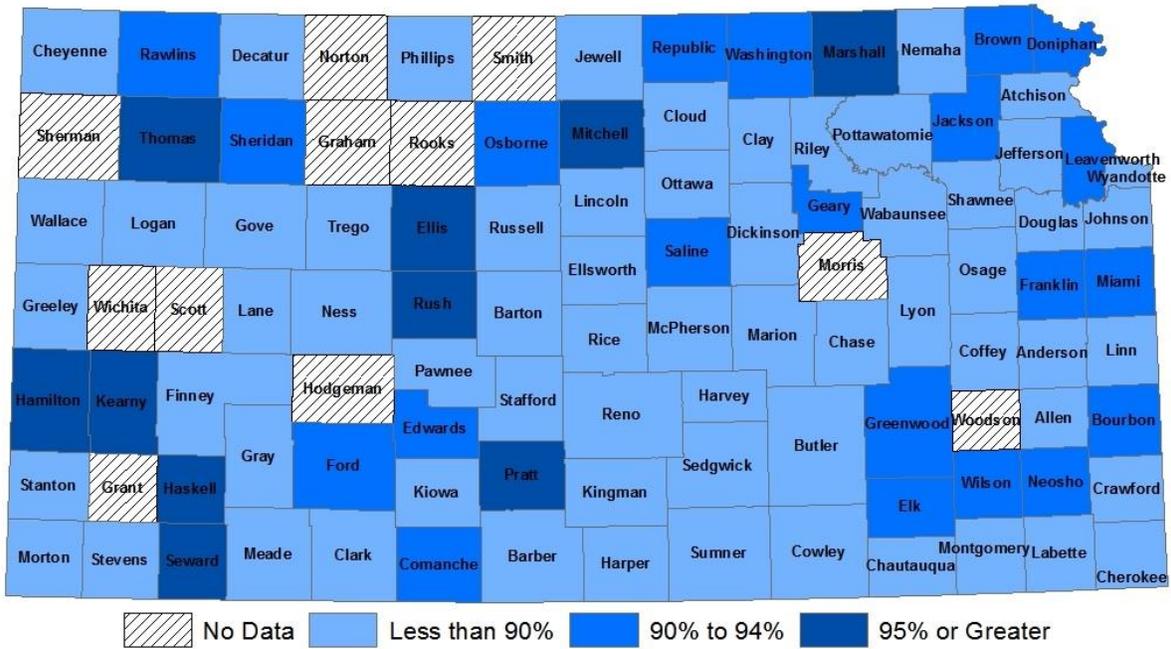


*5 doses of DTaP or 4 doses if the fourth is administered on or after the fourth birthday*

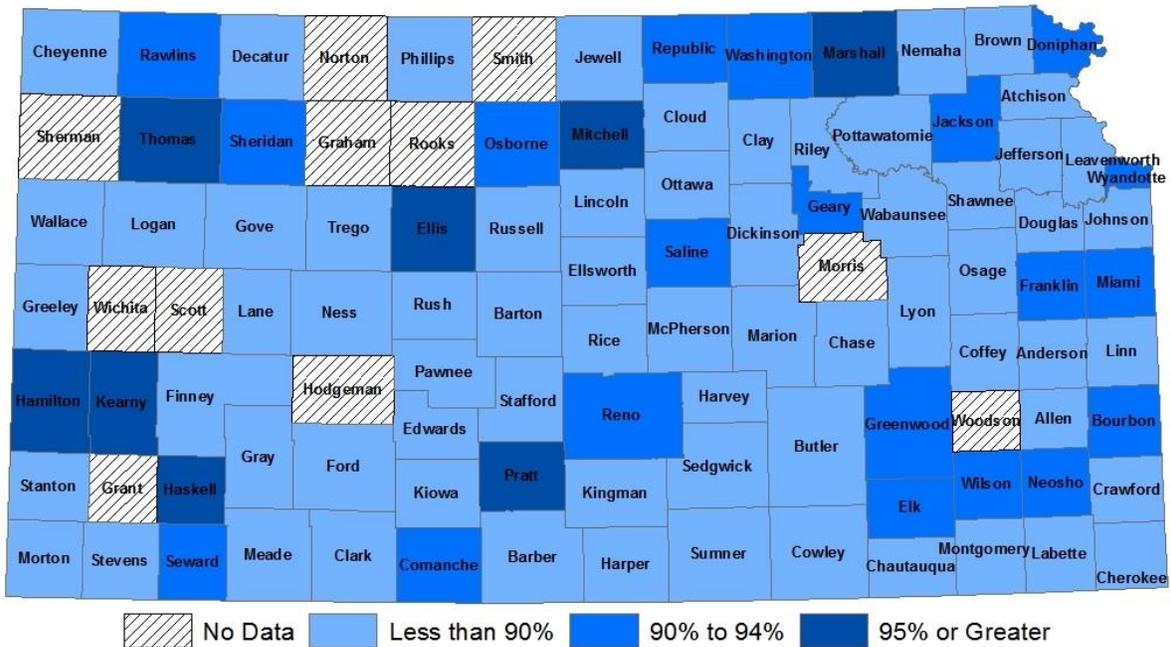
#### Polio4 Coverage for Kindergarten Survey, 2013-2014



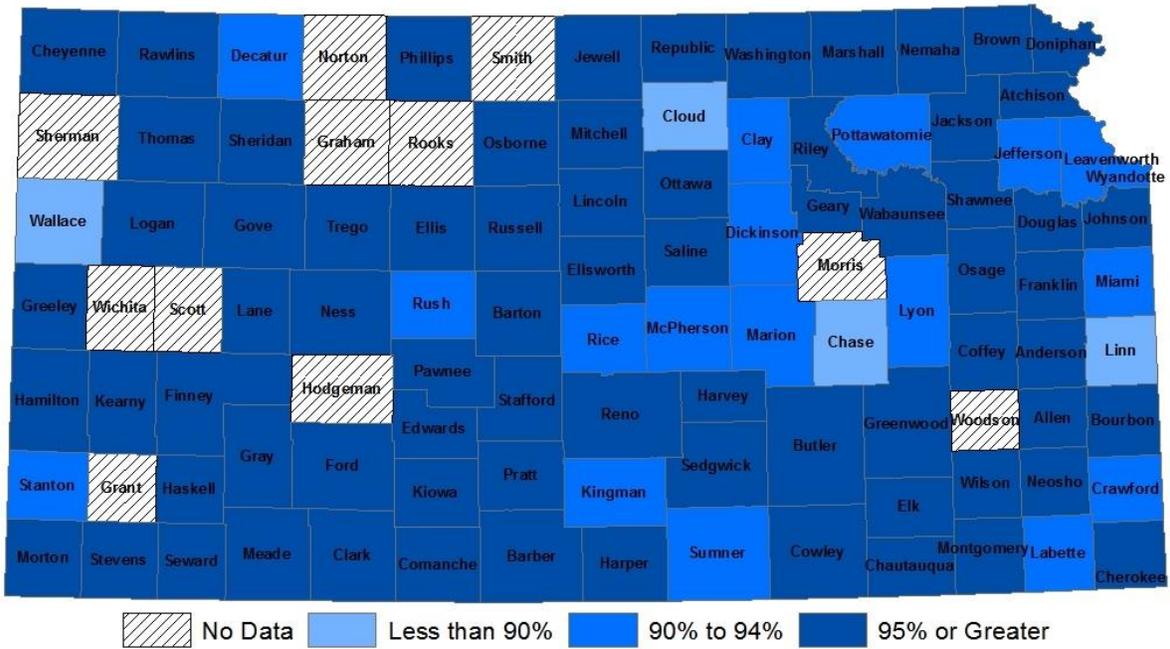
### MMR2 Coverage for Kindergarten Survey, 2013-2014



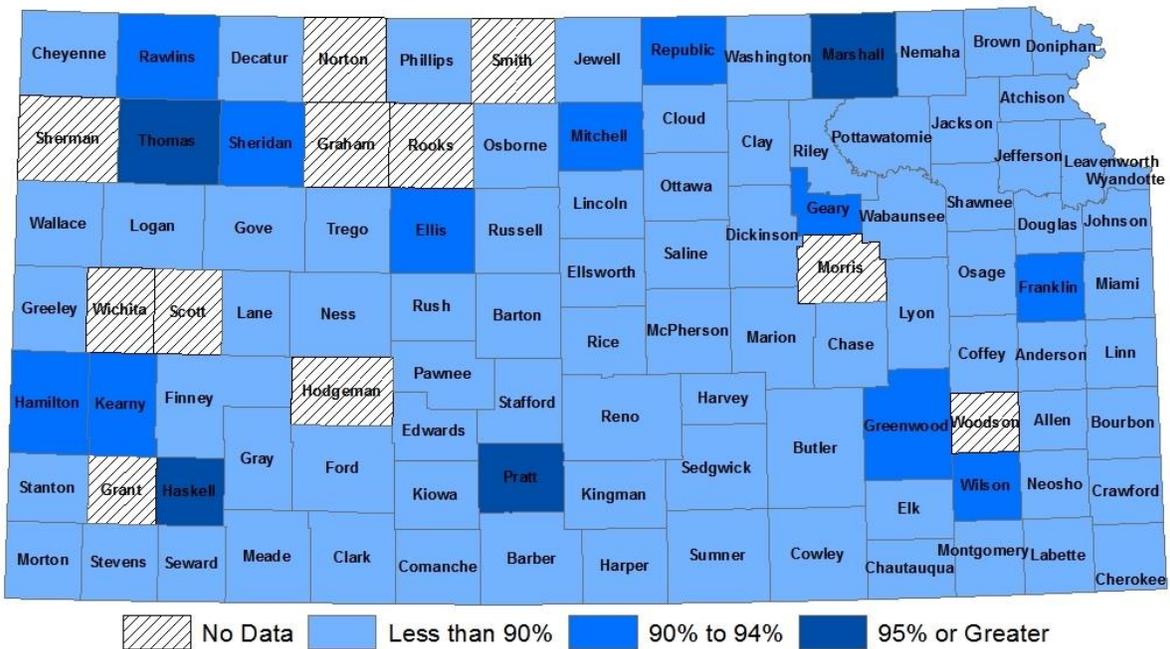
### Var2 Coverage for Kindergarten Survey, 2013-2014



### HepB3 Coverage for Kindergarten Survey, 2013-2014

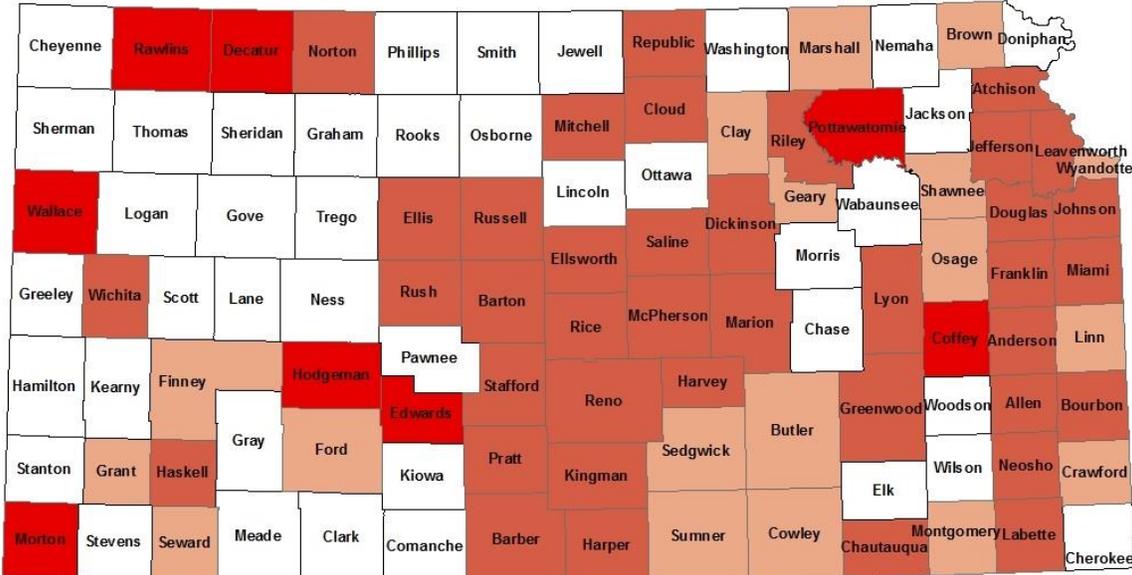


### 5-4-2-2-3 Coverage for Kindergarten Survey, 2013-2014





Percent of Kindergartners with a Religious Exemption at Submitting Schools,  
by County, 2013-2014



0%    0.1% to 0.9%    1.0% to 4.9%    5.0% or Greater

*Includes children enrolled at both public and private schools*

# Appendix 5: CDC's 2012 Advisory Committee on Immunization Practices (ACIP) Recommendations <http://www.cdc.gov/mmwr/preview/mmwrhtml/su6201a2.htm>

FIGURE 1. Recommended immunization schedule for persons aged 0 through 6 years — United States, 2012 (for those who fall behind or start late, see the catch-up schedule [Figure 3])

Vaccine ▼	Age ►	Birth	1 month	2 months	4 months	6 months	9 months	12 months	15 months	18 months	19–23 months	2–3 years	4–6 years
Hepatitis B <sup>1</sup>		HepB	HepB			HepB							
Rotavirus <sup>2</sup>				RV	RV	RV <sup>2</sup>							
Diphtheria, tetanus, pertussis <sup>3</sup>				DTaP	DTaP	DTaP	See footnote <sup>3</sup>		DTaP				DTaP
<i>Haemophilus influenzae</i> type b <sup>4</sup>				Hib	Hib	Hib <sup>4</sup>		Hib					
Pneumococcal <sup>5</sup>				PCV	PCV	PCV		PCV				PPSV	
Inactivated poliovirus <sup>6</sup>				IPV	IPV		IPV						IPV
Influenza <sup>7</sup>							Influenza (yearly)						
Measles, mumps, rubella <sup>8</sup>							MMR			See footnote <sup>8</sup>			MMR
Varicella <sup>9</sup>							VAR			See footnote <sup>9</sup>			VAR
Hepatitis A <sup>10</sup>								Dose 1 <sup>10</sup>				HepA series	
Meningococcal <sup>11</sup>							MCV4 — See footnote <sup>11</sup>						

This schedule includes recommended recommendations in effect as of December 23, 2011. Any dose not administered at the recommended age should be administered at a subsequent visit, when indicated and feasible. The use of a combination vaccine generally is preferred over separate injections of its equivalent component vaccines. Vaccination providers should consult the relevant Advisory Committee on Immunization Practices (ACIP) statement for detailed recommendations, available online at <http://www.cdc.gov/vaccines/pubs/adp-list.htm>. Clinically significant adverse events that follow vaccination should be reported to the Vaccine Adverse Reporting System (VAERS) online (<http://www.vaers.hhs.gov>) or by telephone (800-822-7967).

- Hepatitis B (HepB) vaccine.** (Minimum age: birth)
  - At birth:
    - Administer monovalent HepB vaccine to all newborns before hospital discharge.
    - For infants born to hepatitis B surface antigen (HBsAg)-positive mothers, administer HepB vaccine and 0.5 mL of hepatitis B immune globulin (HBIG) within 12 hours of birth. These infants should be tested for HBsAg and antibody to HBsAg (anti-HBs) 1 to 2 months after receiving the last dose of the series.
    - If mother's HBsAg status is unknown, within 12 hours of birth administer HepB vaccine for infants weighing  $\geq 2,000$  grams, and HepB vaccine plus HBIG for infants weighing  $< 2,000$  grams. Determine mother's HBsAg status as soon as possible and, if she is HBsAg positive, administer HBIG for infants weighing  $\geq 2,000$  grams (no later than age 1 week).
  - Doses after the birth dose:
    - The second dose should be administered at age 1 to 2 months. Monovalent HepB vaccine should be used for doses administered before age 6 weeks.
    - Administration of a total of 4 doses of HepB vaccine is permissible when a combination vaccine containing HepB is administered after the birth dose.
    - Infants who did not receive a birth dose should receive 3 doses of a HepB-containing vaccine starting as soon as feasible (Figure 3).
    - The minimum interval between dose 1 and dose 2 is 4 weeks, and between dose 2 and 3 is 8 weeks. The final (third or fourth) dose in the HepB vaccine series should be administered no earlier than age 24 weeks and at least 16 weeks after the first dose.
- Rotavirus (RV) vaccines.** (Minimum age: 6 weeks for both RV-1 [Rotarix] and RV-5 [Rota Teq])
  - The maximum age for the first dose in the series is 14 weeks, 6 days; and 8 months, 0 days for the final dose in the series. Vaccination should not be initiated for infants aged 15 weeks, 0 days or older.
  - If RV-1 (Rotarix) is administered at ages 2 and 4 months, a dose at 6 months is not indicated.
- Diphtheria and tetanus toxoids and acellular pertussis (DTaP) vaccine.** (Minimum age: 6 weeks)
  - The fourth dose may be administered as early as age 12 months, provided at least 6 months have elapsed since the third dose.
- Haemophilus influenzae* type b (Hib) conjugate vaccine.** (Minimum age: 6 weeks)
  - If PRP-OMP (Pedvax-HIB or Comvax [HepB-Hib]) is administered at ages 2 and 4 months, a dose at age 6 months is not indicated.
  - Hiberix should only be used for the booster (final) dose in children aged 12 months through 4 years.
- Pneumococcal vaccines.** (Minimum age: 6 weeks for pneumococcal conjugate vaccine [PCV]; 2 years for pneumococcal polysaccharide vaccine [PPSV])
  - Administer 1 dose of PCV to all healthy children aged 24 through 59 months who are not completely vaccinated for their age.
  - For children who have received an age-appropriate series of 7-valent PCV (PCV7), a single supplemental dose of 13-valent PCV (PCV13) is recommended for:
    - All children aged 14 through 59 months
    - Children aged 60 through 71 months with underlying medical conditions.
  - Administer PPSV at least 8 weeks after last dose of PCV to children aged 2 years or older with certain underlying medical conditions, including a cochlear implant. See *MMWR* 2010;59(No. RR-11), available at <http://www.cdc.gov/mmwr/pdf/rr/r115911.pdf>.
- Inactivated poliovirus vaccine (IPV).** (Minimum age: 6 weeks)
  - If 4 or more doses are administered before age 4 years, an additional dose should be administered at age 4 through 6 years.
  - The final dose in the series should be administered on or after the fourth birthday and at least 6 months after the previous dose.
- Influenza vaccines.** (Minimum age: 6 months for trivalent inactivated influenza vaccine [TIV]; 2 years for live, attenuated influenza vaccine [LAIV])
  - For most healthy children aged 2 years and older, either LAIV or TIV may be used. However, LAIV should not be administered to some children, including 1) children with asthma, 2) children 2 through 4 years who had wheezing in the past 12 months, or 3) children who have any other underlying medical conditions that predispose them to influenza complications. For all other contraindications to use of LAIV, see *MMWR* 2010;59(No. RR-8), available at <http://www.cdc.gov/mmwr/pdf/rr/r115908.pdf>.
  - For children aged 6 months through 8 years:
    - For the 2011–12 season, administer 2 doses (separated by at least 4 weeks) to those who did not receive at least 1 dose of the 2010–11 vaccine. Those who received at least 1 dose of the 2010–11 vaccine require 1 dose for the 2011–12 season.
    - For the 2012–13 season, follow dosing guidelines in the 2012 ACIP influenza vaccine recommendations.
- Measles, mumps, and rubella (MMR) vaccine.** (Minimum age: 12 months)
  - The second dose may be administered before age 4 years, provided at least 4 weeks have elapsed since the first dose.
  - Administer MMR vaccine to infants aged 6 through 11 months who are traveling internationally. These children should be revaccinated with 2 doses of MMR vaccine, the first at ages 12 through 15 months and at least 4 weeks after the previous dose, and the second at ages 4 through 6 years.
- Varicella (VAR) vaccine.** (Minimum age: 12 months)
  - The second dose may be administered before age 4 years, provided at least 3 months have elapsed since the first dose.
  - For children aged 12 months through 12 years, the recommended minimum interval between doses is 3 months. However, if the second dose was administered at least 4 weeks after the first dose, it can be accepted as valid.
- Hepatitis A (HepA) vaccine.** (Minimum age: 12 months)
  - Administer the second (final) dose 6 to 18 months after the first.
  - Unvaccinated children 24 months and older at high risk should be vaccinated. See *MMWR* 2006;55(No. RR-7), available at <http://www.cdc.gov/mmwr/pdf/rr/r115507.pdf>.
  - A 2-dose HepA vaccine series is recommended for anyone aged 24 months and older, previously unvaccinated, for whom immunity against hepatitis A virus infection is desired.
- Meningococcal conjugate vaccines, quadrivalent (MCV4).** (Minimum age: 9 months for Menactra [MCV4-D], 2 years for Menveo [MCV4-CRM])
  - For children aged 9 through 23 months 1) with persistent complement component deficiency; 2) who are residents of or travelers to countries with hyperendemic or epidemic disease; or 3) who are present during outbreaks caused by a vaccine serogroup, administer 2 primary doses of MCV4-D, ideally at ages 9 months and 12 months or at least 8 weeks apart.
  - For children aged 24 months and older with 1) persistent complement component deficiency who have not been previously vaccinated; or 2) anatomic/functional asplenia, administer 2 primary doses of either MCV4 at least 8 weeks apart.
  - For children with anatomic/functional asplenia, if MCV4-D (Menactra) is used, administer at a minimum age of 2 years and at least 4 weeks after completion of all PCV doses.
  - See *MMWR* 2011;60:72–6, available at <http://www.cdc.gov/mmwr/pdf/wk/mm6003.pdf>, and *Vaccines for Children Program resolution No. 6/11-1*, available at <http://www.cdc.gov/vaccines/programs/vfc/downloads/resolutions/06-11/11mening-mcv.pdf>, and *MMWR* 2011;60:1391–2, available at <http://www.cdc.gov/mmwr/pdf/wk/mm6040.pdf>, for further guidance, including revaccination guidelines.

This schedule is approved by the Advisory Committee on Immunization Practices (<http://www.cdc.gov/vaccines/recs/acip>), the American Academy of Pediatrics (<http://www.aap.org>), and the American Academy of Family Physicians (<http://www.aafp.org>).