KINDERGARTEN IMMUNIZATION COVERAGE SURVEY

School Year 2012-13

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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 *or* 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 *Haemophilus influenzae* 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 2012-2013 school year were collected and evaluated for immunization coverage. Vaccination coverage levels were calculated for children at the time of school entry 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 721 schools, 619 public and 102 private, included in the analysis, which consisted of a representative sample of 14,997 children from both public and private schools.

Coverage at Kindergarten Entry

The statewide coverage levels at school entry (i.e., on the first day of school for the 2012-2013 academic year) for all vaccinations required for school entry (DTaP5, Polio4, MMR2, Var2, HepB3) were at or above 86%, with HepB3 having the highest coverage at 96%. 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 5 required vaccinations (5-4-2-2-3) had a coverage level of 81% at school entry. Vaccination coverage levels for most immunizations increased within the first 30 days of school. Children enrolled in public schools had significantly higher coverage levels than children enrolled in private schools throughout Kansas for all required vaccines, except MMR2.

The 105 counties were grouped into 3 categories based on population density, and coverage levels were compared among these groups. "Urban" (≥150 persons per square mile) counties had the highest coverage level for MMR2 compared to counties that were "sparsely populated" (<20 persons per square mile). DTaP5, Polio4, Var2, and HepB3 showed no significant variation in coverage levels between population density groups. Six counties had ≥95% coverage for all 5 required vaccinations; all were sparsely populated (Appendix 2).

KINDERGARTEN IMMUNIZATION COVERAGE SURVEY
SCHOOL YEAR 2012-2013

INTRODUCTION

Objective
This study was conducted to estimate the immunization coverage levels of children at school entry.

Study Population
The study population included 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 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 6).[1] ***Immunization coverage levels were assessed for all kindergartners who were between the ages of five and seven years on the first day of the 2012-2013 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 different 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, every eighteenth, or every

[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 2011.

nineteenth 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). 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, 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.

Data Analysis

In the 2011-2012 survey, the analysis method changed from previous years. In the current study, the immunization coverage levels accounted for both exempt and non-exempt children's immunization status.[2] 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 the "grade" field not being consistently filled out in these records, only children who were between the ages of 5 and 6 were included from these schools.

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. Consistent with the Advisory Committee on Immunization Practices (ACIP) recommendations, children were considered up to date (UTD) for DTaP5 if the child had received a) five doses of DTaP or b) four doses of DTaP and the fourth dose was on or after their fourth birthday.[3] All children who indicated history of varicella were included in the denominator, but only those who reported history of vaccination were included in the numerator. This methodology was performed because the date of disease was frequently not recorded; thus it could not be determined if the child 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 2012-2013 academic year. Immunization coverage levels were also assessed at 30 days following school entry because many school districts maintain a policy of a "grace period" 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.

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.[4]

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

[2]

[3] Centers for Disease Control and Prevention. Epidemiology and Prevention of Vaccine-Preventable Diseases. Atkinson W, Wolfe S, Hamborsky J, eds. 12th ed. Washington DC: Public Health Foundation, 2011.

[4] Complex survey design effect was accounted for by using the SAS Procedure PROC SURVEYFREQ.

Sample weights were calculated using the number of kindergartners enrolled in a county and the number of records analyzed for that county.

All population and birth cohort data were calculated from the 2007 Annual Summary of Vital Statistics.[5] The 105 counties were categorized based on population densities, and for the purpose of this analysis, counties were grouped into "urban," "moderately populated," and "sparsely populated" (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 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. 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.[6]

Seventy-one percent of schools submitted KCIs, 24% submitted printouts from a commercially available computerized record keeping program, and 4% of the schools submitted a combination of the two types of records.[7] For the kindergarten analysis, 14,997 (99.98%) children were included in the analysis. Of the 729 schools submitting data, 285 schools reported having 481 exemptions in their kindergarten class, and reported sending a total of 453 exemption records; however, after examination of the immunization records received by KDHE, only 443 exemptions were identified from these schools.

The number of records included in the analysis by population density was: 3,997 (26.7% of all records used, representing 12.8% of the population after weighting) in sparsely populated counties, 7,035 (46.9% of all records used, representing 36.4% of the population after weighting) in moderately populated counties, and 3,965 (26.4% of all records used, representing 50.7% of the population after weighting) in urban counties. The 2007 birth cohort distribution across the state of Kansas was 10.7% in sparsely populated, 34.5% in moderately populated and 54.7% in urban counties.

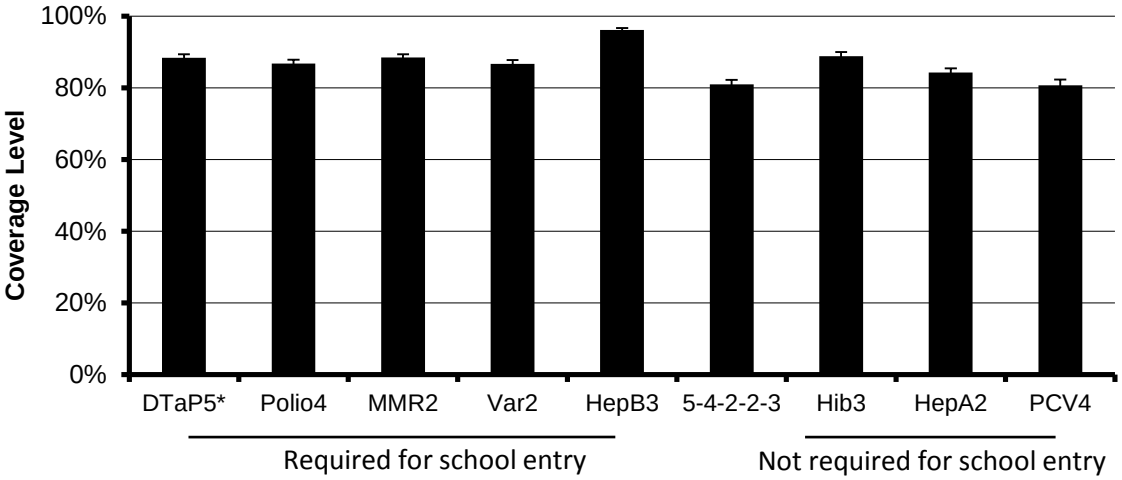
Statewide Immunization Coverage of Kindergartners at School Entry

The immunization coverage levels at school entry of all required vaccinations (DTaP5, Polio4, MMR2, Var2, and HepB3) were at or above 86%, 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 81% at school entry. Healthy People 2020 (HP2020) goals for kindergarten vaccination coverage levels

[5] 2007 Annual Summary of Kansas Vital Statistics (http://www.kdheks.gov/ches).
[6] Estimates from counties with small sample size (<50) may be unstable and changes over time should be interpreted with caution
[7] Numbers are rounded.

are ≥95% for all vaccines required by Kansas for school entry.[8] 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 80.7% of kindergartners documented as having been fully vaccinated.

Figure 1: Immunization coverage levels of kindergarten students at school entry, Kansas 2012-2013



*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 greater for most required vaccinations (DTaP5, Polio4, MMR2, Var2) when comparing coverage levels from school entry to 30 days following the first day of school (Table 1). The percentage of kindergartners up to date for all required vaccinations (5-4-2-2-3: DTaP5, Polio4, MMR2, Var2, HepB3) was significantly higher 30 days after school entry than they were at the first day of school. 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 during the first 30 days of school.

Table 1: Immunization coverage levels of kindergarten students at school entry and 30 days following school entry, Kansas 2012-2013.

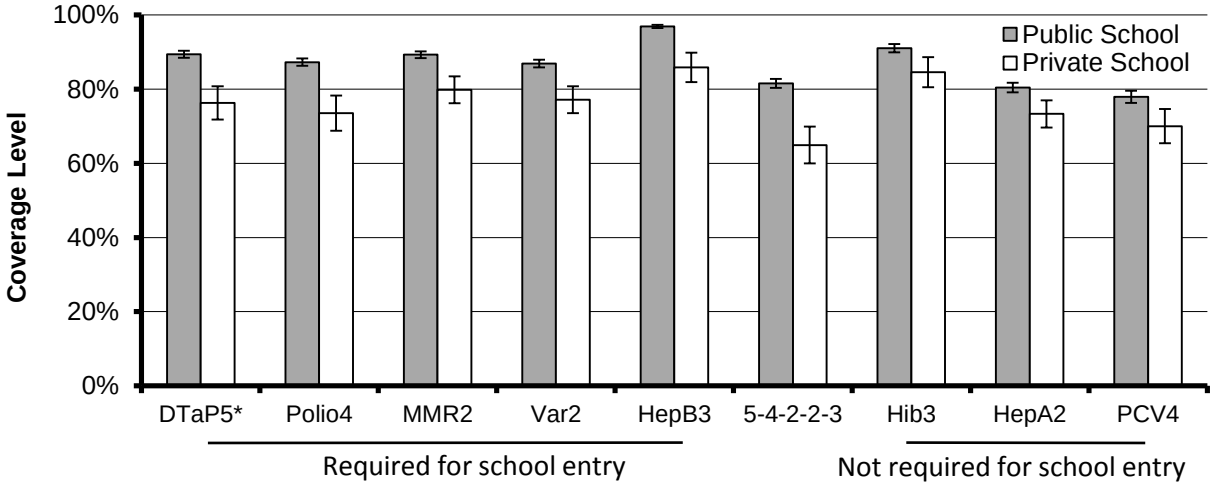
	At School Entry % (95% CI)	30 Days After School Entry % (95% CI)
DTaP5*	88.3 (87.3 - 89.4)	90.8 (89.8 - 91.8)
Polio4	86.8 (85.7 - 87.9)	89.3 (88.3 - 90.3)
MMR2	88.4 (87.5 - 89.4)	91.1 (90.3 - 91.9)
Var2	86.7 (85.6 - 87.7)	89.5 (88.6 - 90.4)
HepB3	96.1 (95.5 - 96.6)	96.2 (95.7 - 96.8)
5-4-2-2-3	81.0 (79.7 - 82.2)	83.9 (82.8 - 85.1)
Hib3	88.8 (87.6 – 90.0)	88.8 (87.6 – 90.0)
HepA2	84.2 (83.0 - 85.4)	85.0 (83.8 - 86.2)
PCV4	80.7 (79.2 - 82.2)	80.8 (79.2 - 82.3)

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

[8] Healthy People 2020 (http://www.healthypeople.gov)

There was significant 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 all required vaccinations, except MMR2, as well as the 5-4-2-2-3 combination than children enrolled in private school. However, 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 2012-2013



*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 displayed by county in Appendix 2.

Of the 101 counties submitting records, 78 reached the HP2020 goal of ≥95% for HepB3, which represents 82% of the birth cohort (Table 2). Three counties (Hodgeman, Lincoln, and Stanton) reached 100% coverage for all five required immunizations for kindergarten entry, and an additional 3 counties had ≥95% coverage level for all required vaccinations; all six counties are sparsely populated (Appendix 3).

Table 2: Number of Counties Reaching HP2020 Goal and Percentage of Birth Cohort, by Immunization, Kansas 2012-2013.

Vaccine	# of counties reaching HP2020 goal (n=101)	% of birth cohort
DTaP5*	17	8.2%
Polio4	14	2.8%
MMR2	19	6.2%
Var2	12	1.8%
HepB3	78	82%

*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 (Table 3). There were no differences among counties of varying population densities for DTaP5, Polio4, Var2, or HepB3. Sparsely populated counties had significantly lower coverage levels than urban counties for MMR2. There was no significant difference in coverage levels for the 5-4-2-2-3 series.

Table 3: Kansas immunization coverage levels by peer group for kindergartners, 2012-2013

Counties by Population Density – Condensed Groups n=14,997			
	Sparsely Populated (n=3997) % (95% CI)	**Moderately Populated (n=7035) % (95% CI)**	**Urban (n=3965) % (95% CI)**
DTaP5*	86.6 (84.4-88.8)	88.3 (86.7-89.8)	89.3 (87.4-91.1)
Polio4	85.3 (83.1-87.6)	86.8 (85.2-88.4)	87.5 (85.6-89.4)
MMR2	86.1 (84.1-88.2)	88.2 (86.7-89.6)	89.8 (88.3-91.4)
Var2	85.0 (82.9-87.2)	86.2 (84.6-87.9)	88.0 (86.2-89.7)
HepB3	96.3 (95.2-97.4)	96.3 (95.7-97.0)	95.8 (94.7-96.8)
5-4-2-2-3	80.3 (77.9-82.7)	81.1 (79.2-83.0)	81.2 (79.0-83.4)
Hib3	92.3 (90.8-93.9)	89.2 (87.1-91.2)	86.6 (84.4-88.7)
HepA2	85.7 (83.6-87.8)	82.2 (80.1-84.3)	85.3 (83.3-87.3)
PCV4	85.4 (83.4-87.3)	78.5 (75.8-81.2)	80.3 (77.7-82.9)

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

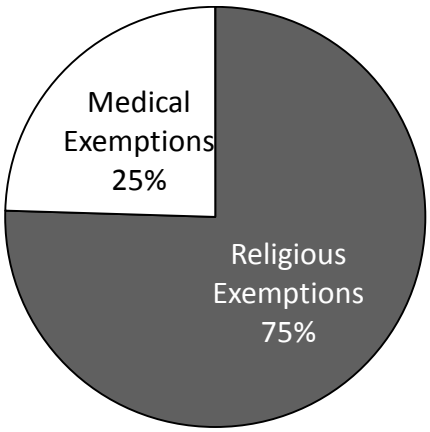
Kindergarten Exemptions

In the state of Kansas, two legal alternatives to vaccination at school entry exist: medical exemption and religious exemption.[9] To receive a medical exemption, a physician must sign a form stating the reason for exemption and from which vaccine(s) the child is exempt on an annual basis. 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 2012-2013 kindergarten study, 481 children were reported as having an exemption which correlates to 1.4% of the kindergarten population. Of the exemptions, 363 were categorized as religious, while the remaining 118 were medical (Figure 3). Exemptions occur throughout the state; however, counties with the greatest percentage of students with an exemption on file were found in the eastern half of the state (Appendix 5). Unified school districts (USDs) with the greatest percentage of students with an exemption are clustered in high population areas, including the areas surrounding Wichita, Kansas City,

[9] 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.

and Manhattan; additionally, there is a cluster of USDs with a high percentage of students with an exemption in the north-central region of the state. Of the 283 school districts that submitted data, 153 (54%) reported no exemptions, while three (1%) reported 10% or more students with an exemption.

Figure 3: Percentage of permissible exemptions reported by schools at kindergarten entry, Kansas 2012-2013 (% of exemptions).



DISCUSSION

All individual vaccinations required for school entry were at or above 86% coverage at school entry for kindergartners enrolled in Kansas schools. The only vaccination that met the HP2020 goal of at least 95% coverage was HepB3. DTaP5, Polio4, MMR2, and Var2 were nine percentage points or less 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, with both DTaP5 and MMR2 reaching 90%. 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 the counties of different population densities. There were no significant differences for any of the required vaccinations, except MMR2. MMR2 coverage levels were significantly lower for sparsely populated counties compared to urban counties. Conversely, the coverage levels for PCV4 were statistically greater in sparsely populated counties when compared to more 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 5-4-2-2-3 (Appendix 3). While the majority of these counties are sparsely populated, many other sparsely populated counties had low coverage levels which could account for the lack of statistical difference between counties of different population densities.

The counties and districts with the greatest percentage of exemptions are 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 accounted for 1.4% of the kindergarten students enrolled in participating schools, and the majority of exemptions were religious (75%). When children are exempt from vaccination (or not up to date) and they are a close contact of someone with a vaccine preventable disease, they are at risk for contracting the disease, and subsequently spreading the disease to unimmunized or under-immunized individuals (e.g., infants). Therefore, it is important that the percentage of exemptions in 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 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 historic 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 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 Hib3documented 222 cases of measles, of which 86% were unvaccinated or had unknown vaccination history.[10] 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, HepA2 and PCV4 are not required for school entry and may not consistently be reported on the immunization record, thus decreasing coverage levels for the individual vaccines. This is evident in Appendix 2 for several counties that have extremely low levels for Hib3, HepA2, and PCV3. 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 (e.g., first grade) being included in the analysis. Additionally, no descriptive data are collected about sex, race, or ethnicity. Finally, study coordinators 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 (e.g., history of varicella disease).

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 95% immunization coverage rate goal. To further assess the progress towards this goal, a similar survey is planned for next year.

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

Appendix 1: Kansas counties categorized based on population density, 2010.

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

Persons per Square Mile in Peer Groups
Sparsely Populated = ≤19.9
Moderately Populated = 20 – 149.9
Urban = ≥ 150.0

APPENDIX 2: Immunization Coverage Levels of Children at School Entry for Kansas Counties 2012-2013 (percentages).[§]

COUNTY	DTaP5*	Polio4	MMR2	Var2	HepB3	5-4-2-2-3	Hib3	HepA2	PCV3
STATEWIDE	***89***	***88***	***89***	***88***	***97***	***82***	***90***	***85***	***82***
ALLEN	95	93	95	94	99	89	96	80	90
ANDERSON	81	81	80	79	99	76	87	78	84
ATCHISON	82	80	83	76	88	69	89	73	79
BARBER	87	82	86	83	96	78	94	84	87
BARTON	96	97	95	94	99	92	96	88	89
BOURBON	89	89	98	96	98	86	97	69	83
BROWN	97	97	95	91	98	90	98	90	91
BUTLER	91	89	88	86	97	83	93	76	87
CHASE	92	92	92	75	92	67	100	100	100
CHAUTAUQUA	77	77	73	77	96	70	94	86	65
CHEROKEE	87	85	88	90	99	84	88	85	83
CHEYENNE	75	75	75	75	90	75	85	88	83
CLARK	82	82	84	84	98	80	93	82	91
CLAY	89	89	92	91	91	84	82	87	84
CLOUD	80	80	79	80	95	75	77	68	81
COFFEY	87	88	84	86	100	81	91	80	97
COMANCHE[‡]	.	.	.	.	.	.	.	.	.
COWLEY	85	84	86	85	95	78	94	87	69
CRAWFORD	77	78	82	76	94	70	82	80	73
DECATUR	93	93	93	93	89	89	89	83	86
DICKINSON	91	90	90	87	94	81	93	90	86
DONIPHAN	85	85	83	82	99	82	88	76	89
DOUGLAS	89	86	88	85	95	80	85	81	79
EDWARDS	99	99	99	96	100	96	94	91	85
ELK	66	68	68	68	95	66	95	69	79
ELLIS	90	88	89	87	98	83	84	90	79
ELLSWORTH	91	87	90	88	96	83	95	92	90
FINNEY	91	90	91	90	97	85	92	93	83
FORD	95	94	94	92	100	90	95	92	79
FRANKLIN	78	76	79	78	97	75	78	82	78
GEARY	92	87	92	89	98	79	89	84	76
GOVE	92	92	91	82	99	82	99	82	84
GRAHAM[‡]	.	.	.	.	.	.	.	.	.
GRANT	96	96	96	94	97	93	91	88	83
GRAY	91	91	86	86	98	81	94	90	81
GREELEY	91	86	91	91	95	86	100	86	91
GREENWOOD	91	80	80	80	98	79	97	80	97
HAMILTON	98	95	100	98	100	95	96	96	96
HARPER	81	83	83	84	96	72	96	88	81
HARVEY	91	92	90	89	97	86	96	72	67
HASKELL	91	93	95	93	98	91	93	89	87
HODGEMAN	100	100	100	100	100	100	81	94	94
JACKSON	91	90	88	87	98	85	91	84	83
JEFFERSON	93	91	90	89	98	87	95	92	91

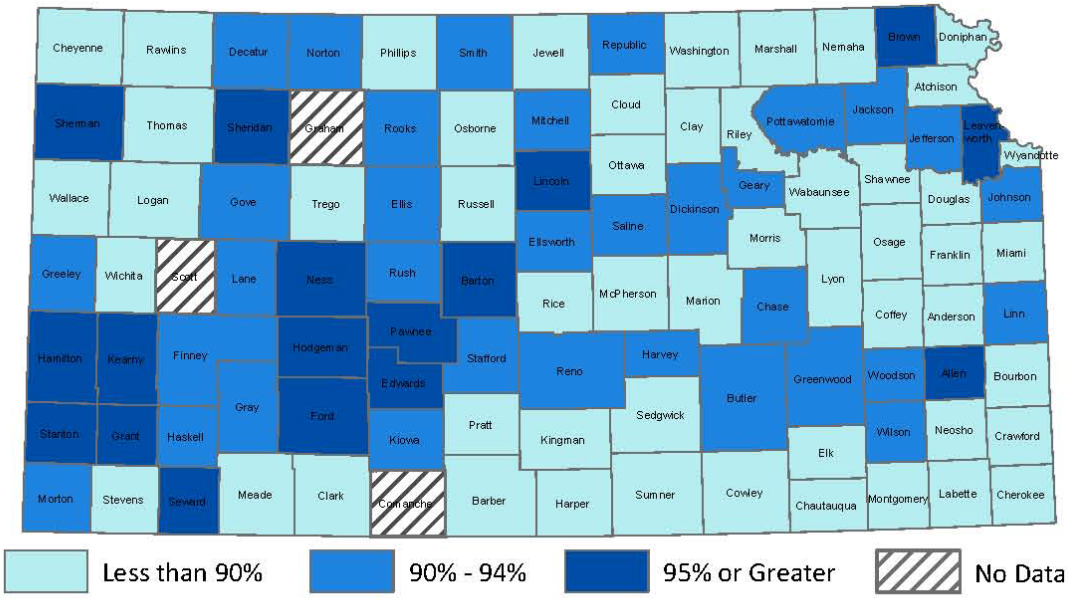
COUNTY	DTaP5*	Polio4	MMR2	Var2	HepB3	5-4-2-2-3	Hib3	HepA2	PCV3
STATEWIDE	***89***	***88***	***89***	***88***	***97***	***82***	***90***	***85***	***82***
JEWELL	81	81	86	86	90	76	67	33	62
JOHNSON	91	88	90	88	96	82	87	88	77
KEARNY	98	96	97	95	99	93	98	95	94
KINGMAN	84	81	77	78	91	68	94	81	74
KIOWA	91	93	93	93	100	91	100	91	94
LABETTE	86	82	87	85	95	77	93	80	84
LANE	94	94	100	94	100	88	100	94	94
LEAVENWORTH	95	93	95	92	95	87	91	80	87
LINCOLN	100	100	100	100	100	100	100	100	88
LINN	91	87	90	86	97	79	96	89	90
LOGAN	73	65	76	76	87	65	87	83	79
LYON	84	84	82	78	94	73	93	79	79
MARION	72	69	79	77	84	60	93	74	80
MARSHALL	84	86	84	86	96	82	94	88	88
MCPHERSON	83	81	82	81	93	77	45	70	38
MEADE	78	81	76	76	100	76	97	91	91
MIAMI	86	81	86	84	93	79	64	80	53
MITCHELL	94	91	93	94	96	87	75	93	69
MONTGOMERY	83	83	81	79	98	74	94	73	84
MORRIS	77	79	82	79	94	67	91	79	76
MORTON	92	92	92	89	97	88	89	84	85
NEMAHA	89	82	89	87	98	79	89	91	89
NEOSHO	85	87	88	87	90	79	90	59	58
NESS	100	100	90	100	100	90	100	100	84
NORTON	91	91	90	90	99	90	96	95	73
OSAGE	74	72	75	73	95	67	87	79	80
OSBORNE	83	76	79	76	94	72	91	79	81
OTTAWA	85	83	83	83	99	82	93	84	94
PAWNEE	96	96	95	95	100	94	100	100	100
PHILLIPS	89	86	89	89	96	86	96	91	79
POTTAWATOMIE	94	94	94	93	100	88	95	90	93
PRATT	65	66	71	69	94	62	93	75	84
RAWLINS	81	81	81	78	89	78	78	74	78
RENO	91	90	92	90	96	86	93	85	85
REPUBLIC	94	94	94	94	95	94	91	85	90
RICE	84	77	85	76	95	64	90	81	73
RILEY	85	81	85	82	93	74	84	68	77
ROOKS	91	91	90	87	99	87	97	96	95
RUSH	93	95	98	98	100	90	98	90	95
RUSSELL	66	65	68	66	95	63	94	87	92
SALINE	90	90	92	92	98	87	94	96	95
SCOTT‡	.	.	.	.	.	.	.	.	.
SEDGWICK	88	87	89	88	96	81	90	83	85
SEWARD	96	93	93	94	97	86	90	91	87
SHAWNEE	89	87	89	88	97	82	84	89	81
SHERIDAN	97	97	97	90	100	90	97	93	87

COUNTY	DTaP5*	Polio4	MMR2	Var2	HepB3	5-4-2-2-3	Hib3	HepA2	PCV3
STATEWIDE	***89***	***88***	***89***	***88***	***97***	***82***	***90***	***85***	***82***
SHERMAN	99	97	97	97	99	96	97	89	95
SMITH	90	87	87	84	100	81	100	97	93
STAFFORD	94	89	89	94	100	83	100	100	89
STANTON	100	100	100	100	100	100	93	82	86
STEVENS	80	78	79	78	96	74	95	92	80
SUMNER	87	84	87	83	98	78	94	80	63
THOMAS	75	67	69	68	79	66	77	66	75
TREGO	78	78	78	78	100	78	100	91	96
WABAUNSEE	89	89	89	85	91	78	93	76	74
WALLACE	89	93	89	89	100	86	96	86	85
WASHINGTON	88	87	85	88	97	83	90	87	90
WICHITA	83	83	86	86	91	83	91	86	86
WILSON	93	93	94	94	100	91	97	84	91
WOODSON	94	94	97	97	100	94	94	97	90
WYANDOTTE	85	87	91	89	94	74	79	82	72

§ Due to Hib3, HepA2, and PCV3 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 PCV3 coverage levels.
*5 doses of DTaP or 4 doses if the fourth is administered on or after the fourth birthday.
‡ No data available

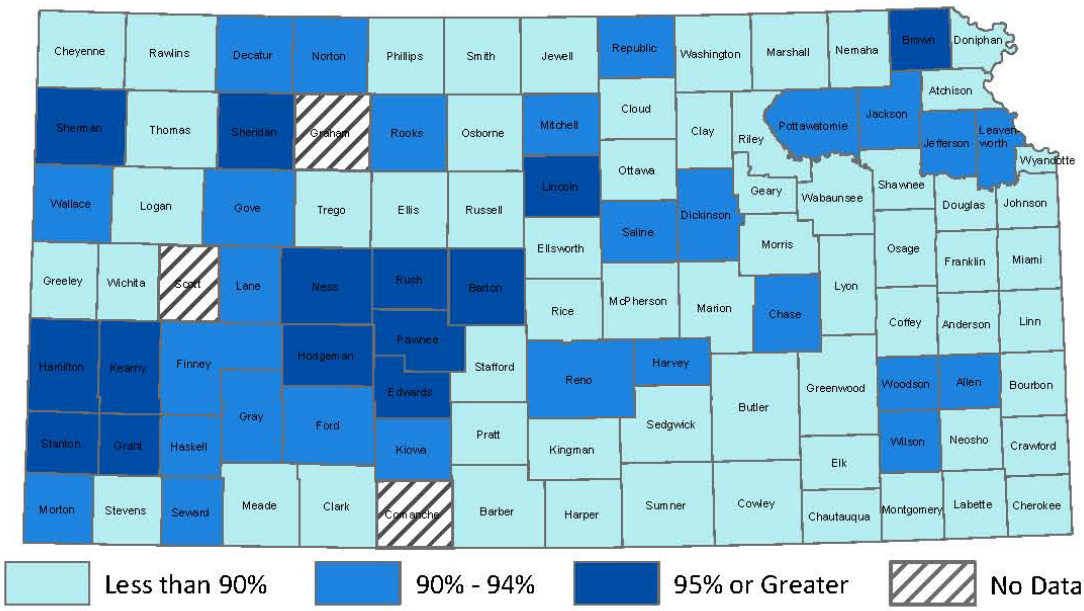
Appendix 3: Maps of immunization levels by county, 2011-12 Kindergarten Survey.

DTaP5 Coverage for Kindergarten Survey, 2012-13

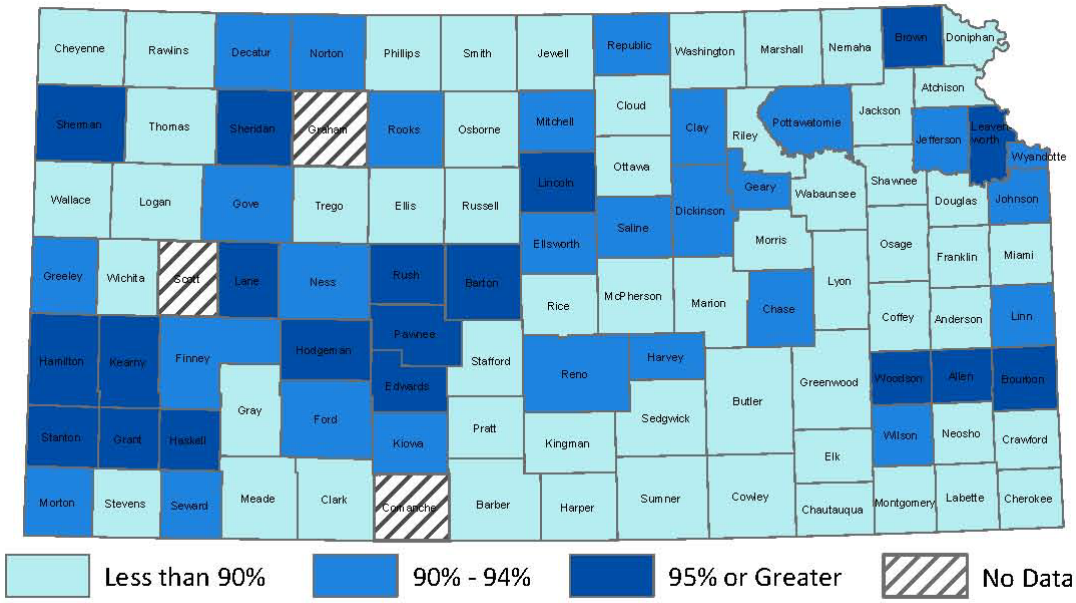


5 doses of DTaP or 4 doses if the fourth is administered on or after the fourth birthday

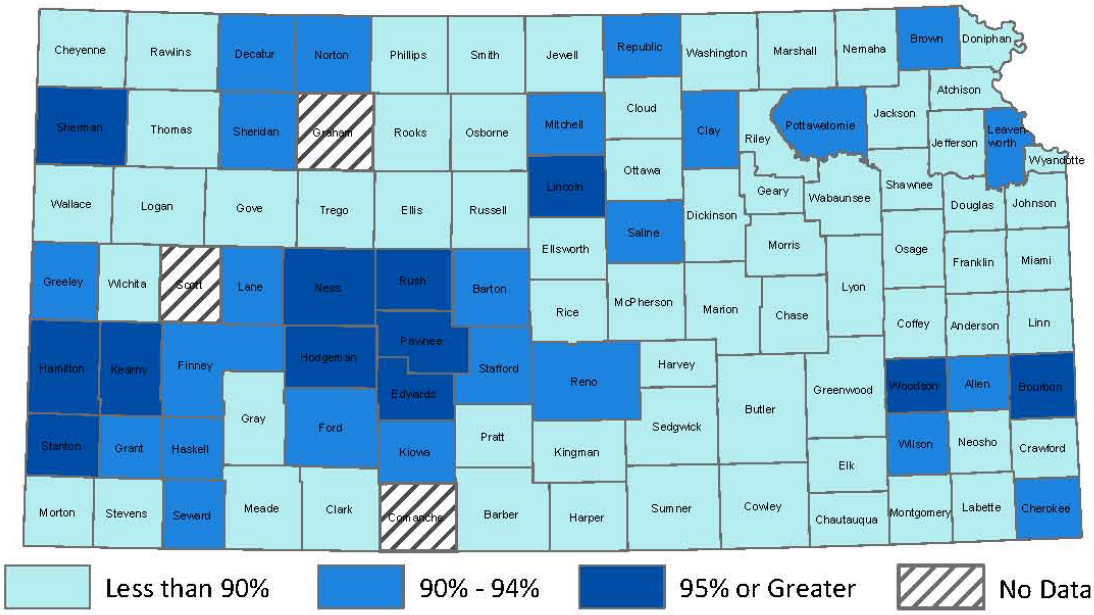
Polio4 Coverage for Kindergarten Survey, 2012-13



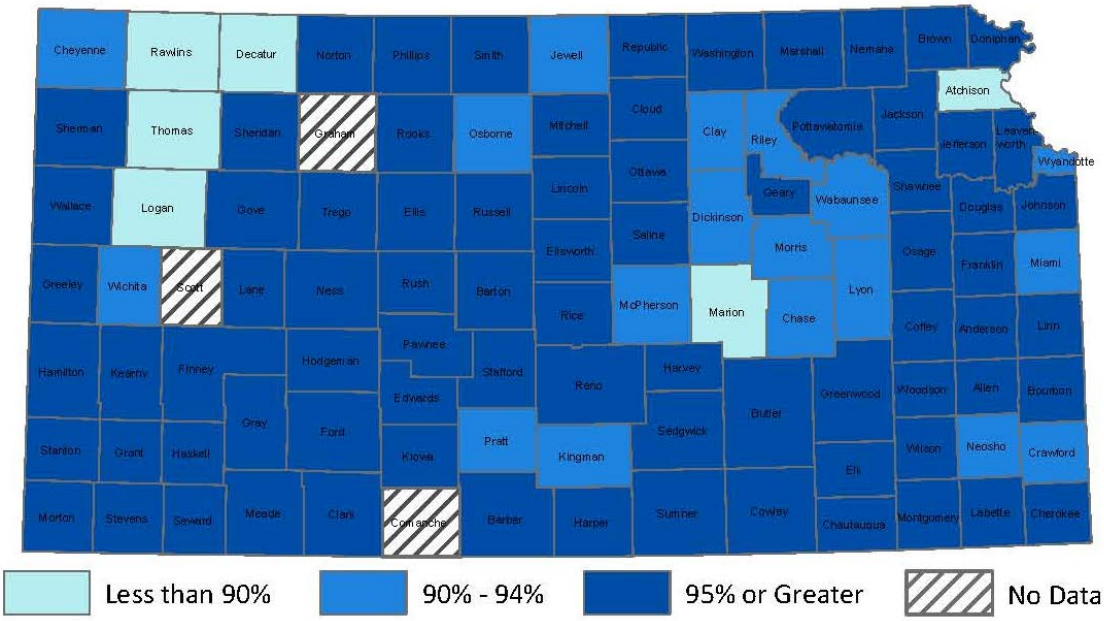
MMR2 Coverage for Kindergarten Survey, 2012-13



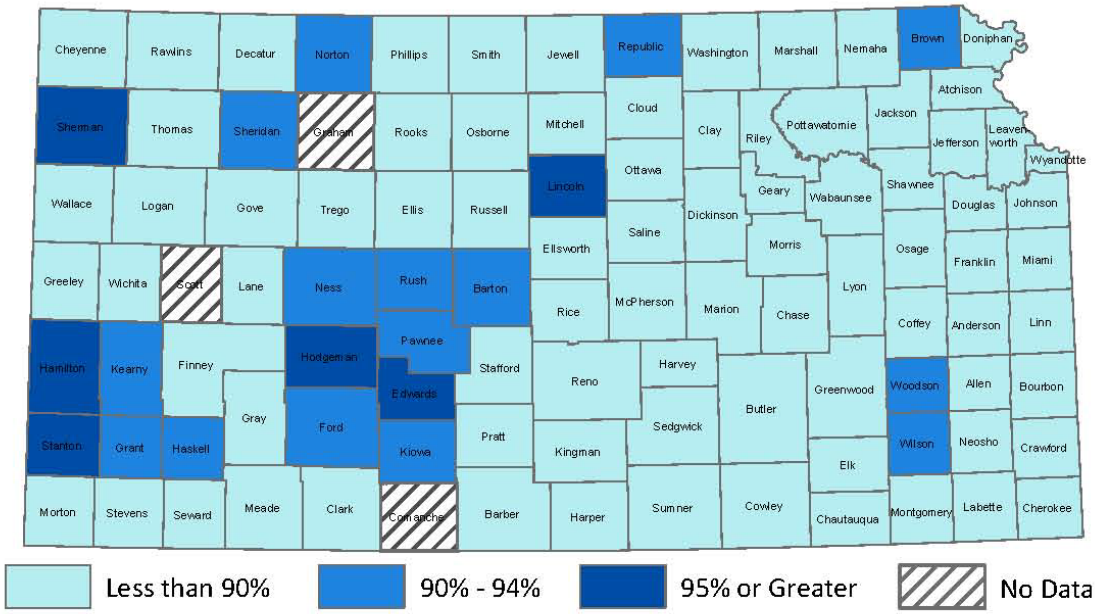
Var2 Coverage for Kindergarten Survey, 2012-13



HepB3 Coverage for Kindergarten Survey, 2012-13

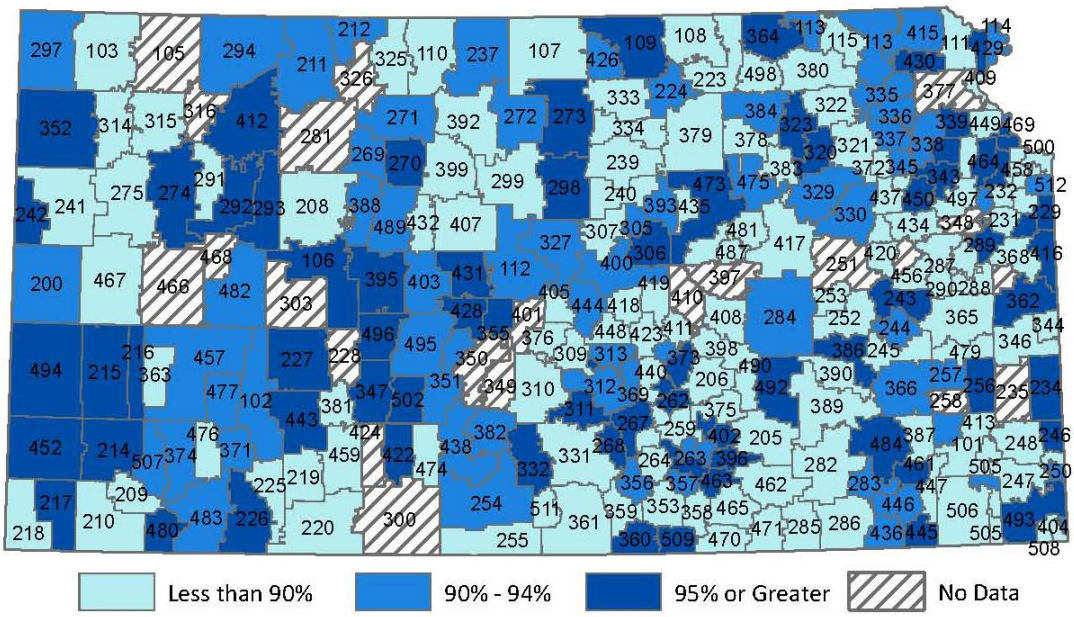


5-4-2-2-3 Coverage for Kindergarten Survey, 2012-13



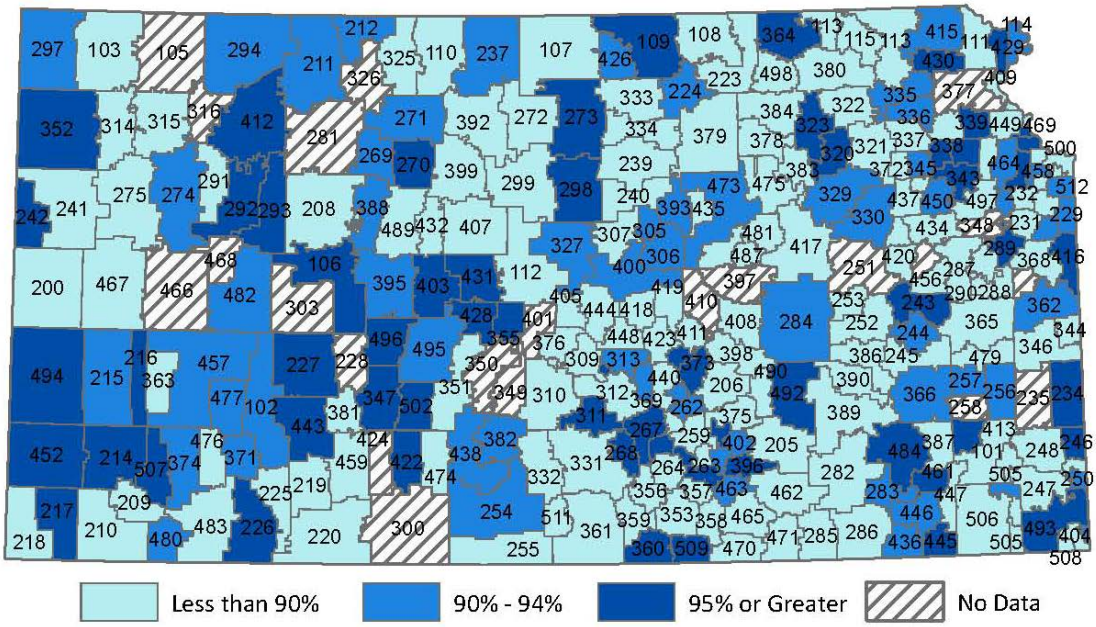
Appendix 4: Maps of immunization levels by district, 2012-13 Kindergarten Survey, public schools only.

DTaP5 Coverage for Kindergarten Survey,
by School District, 2012-13

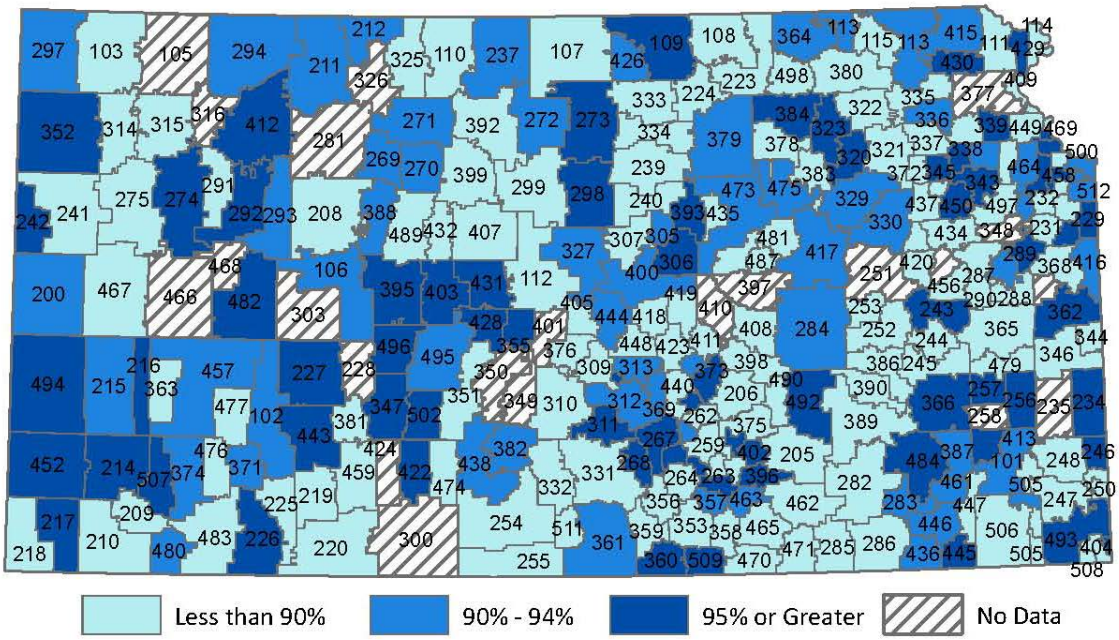


5 doses of DTaP or 4 doses if the fourth is administered on or after the fourth birthday

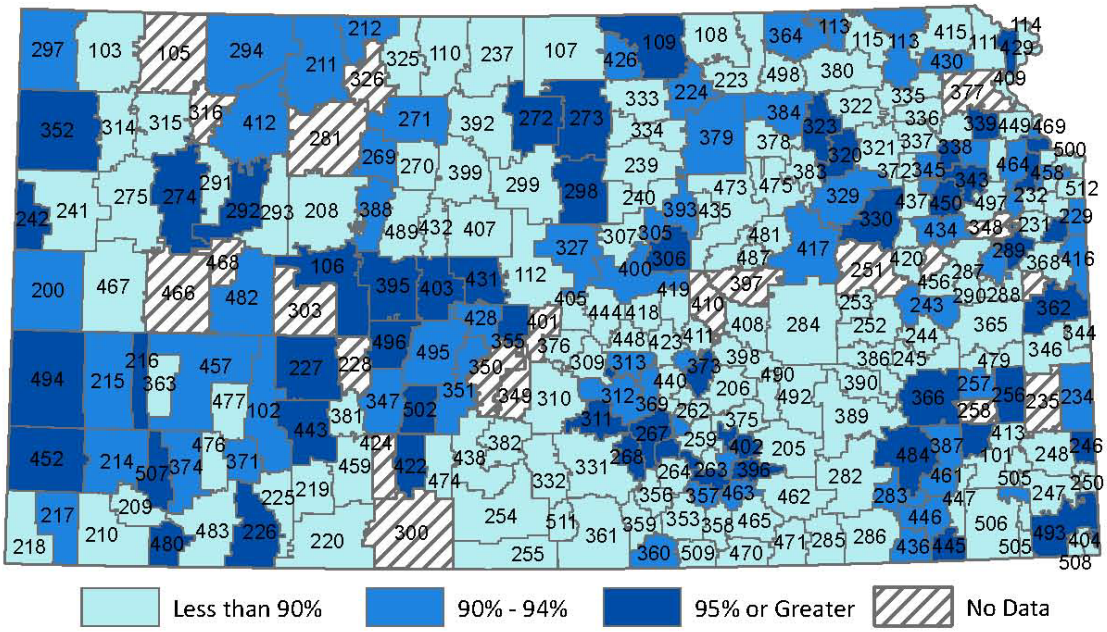
Polio4 Coverage for Kindergarten Survey,
by School District, 2012-13



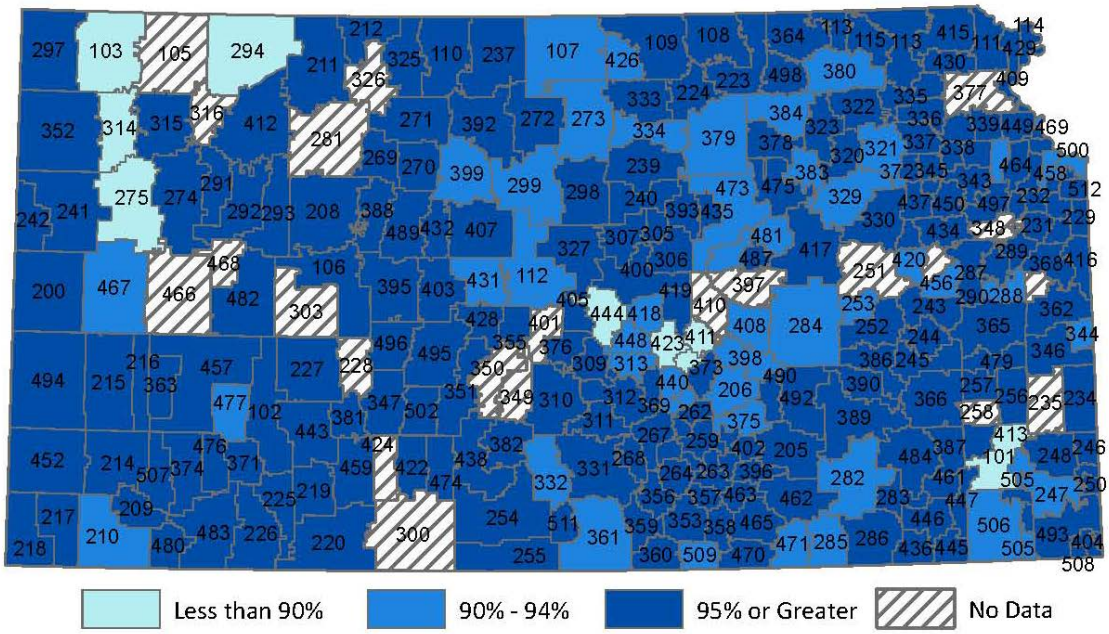
MMR2 Coverage for Kindergarten Survey,
by School District, 2012-13



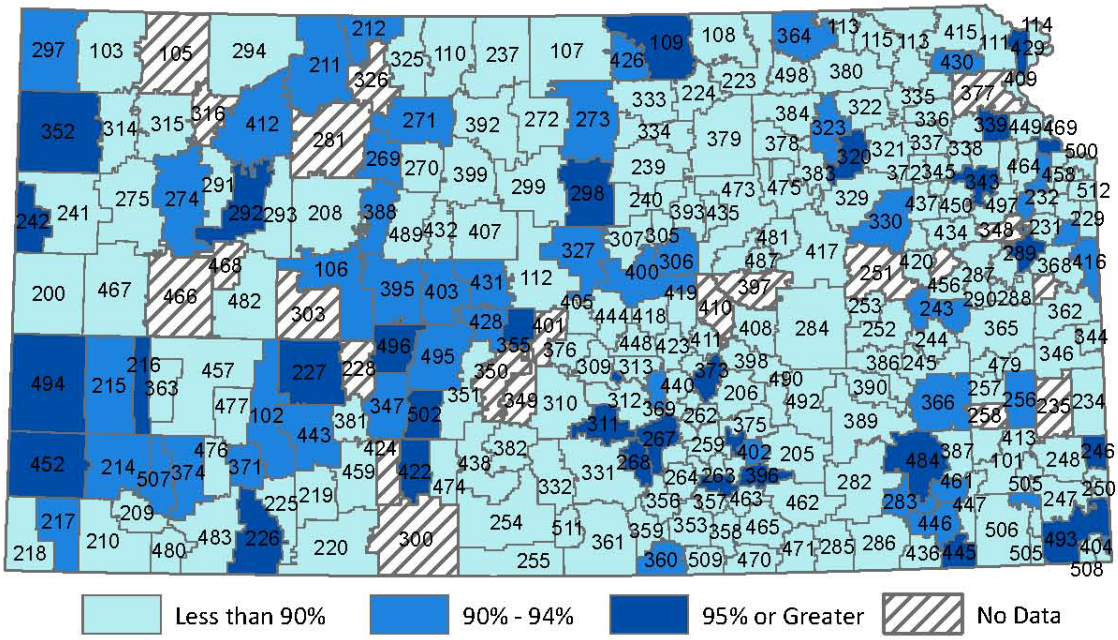
Var2 Coverage for Kindergarten Survey,
by School District, 2012-13



HepB3 Coverage for Kindergarten Survey,
by School District, 2012-13

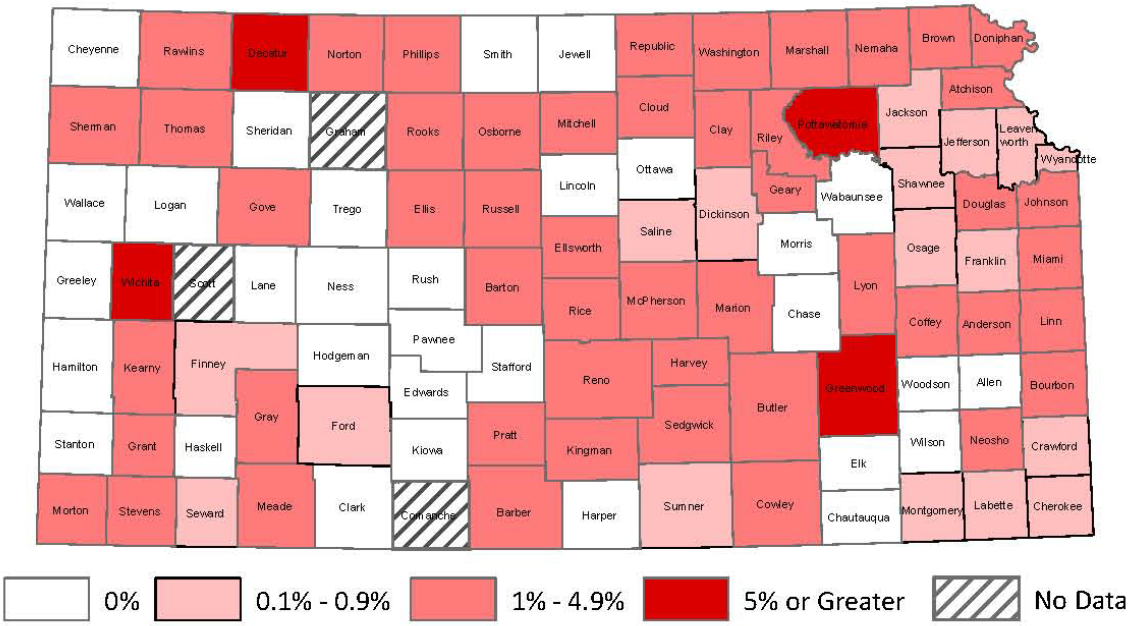


5-4-2-2-3 Coverage for Kindergarten Survey,
by School District, 2012-13



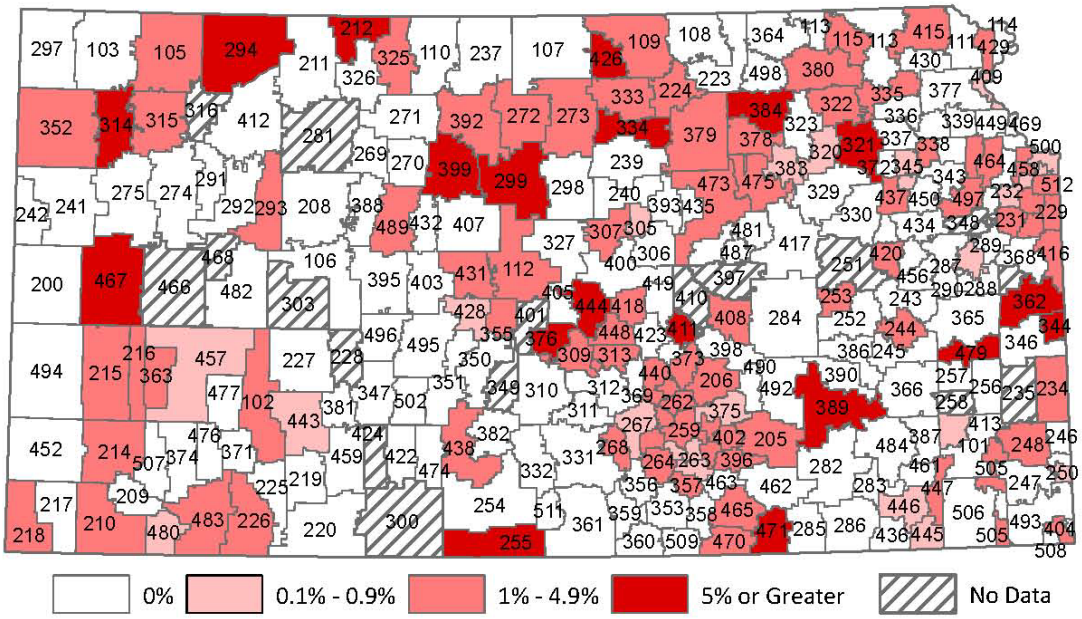
Appendix 5: Maps of exemptions by county and district, 2012-13 Kindergarten Survey.

Percent of Kindergartners Exempt at Submitting Schools,
by County, 2012-13



Includes children enrolled at both public and private schools

Percent of Kindergartners Exempt at Submitting Public Schools,
by District, 2012-13



Includes children enrolled at public schools only

Appendix 6: CDC's 2012 Advisory Committee on Immunization Practices (ACIP) Recommendations http://www.cdc.gov/mmwr/preview/mmwrhtml/mm6105a5.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[1]	HepB	HepB			HepB							
Rotavirus[2]			RV	RV	RV[2]							
Diphtheria, tetanus, pertussis[3]			DTaP	DTaP	DTaP		See footnote[3]	DTaP				DTaP
Haemophilus influenzae type b[4]			Hib	Hib	Hib[4]		Hib					
Pneumococcal[5]			PCV	PCV	PCV		PCV				PPSV	
Inactivated poliovirus[6]			IPV	IPV	IPV							IPV
Influenza[7]					Influenza (yearly)							
Measles, mumps, rubella[8]							MMR		See footnote[8]			MMR
Varicella[9]							VAR		See footnote[9]			VAR
Hepatitis A[10]							Dose 1[10]				HepA series	
Meningococcal[11]						MCV4 — See footnote[11]						

Range of recommended ages for all children

Range of recommended ages for certain high-risk groups

Range of recommended ages for all children and certain high-risk groups

This schedule includes 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/acip-list.htm. Clinically significant adverse events that follow vaccination should be reported to the Vaccine Adverse Event Reporting System (VAERS) online (http://www.vaers.hhs.gov) or by telephone (800-822-7967).

1. **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 ≥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 ≥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.
2. **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.
3. **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.
4. ***Haemophilus influenzae* type b (Hib) conjugate vaccine.** (Minimum age: 6 weeks)
   - If PRP-OMP (PedvaxHIB 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.
5. **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/rr5911.pdf.
6. **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.
7. **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/rr5908.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.
8. **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.
9. **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.
10. **Hepatitis A (HepA) vaccine.** (Minimum age: 12 months)
    - Administer the second (final) dose 6 to18 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/rr5507.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.
11. **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/06-11mening-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).