KINDERGARTEN IMMUNIZATION COVERAGE SURVEY

School Year 2010-11

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ACRONYMS

CI	Confidence interval
HP2010	Healthy People 2010
KCI	Kansas Certificate of Immunizations
KDHE	Kansas Department of Health and Environment
KSDE	Kansas State Department of Education

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
PCV3	3 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 2010-2011 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. Two types of exemptions from school immunization requirements – medical and religious – are permitted in Kansas, and only those who were not exempt were included in the analysis. In total, there were 792 schools, 690 public and 102 private, included in the analysis, which consisted of a representative sample of 14,449 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 2010-2011 academic year) for all vaccinations required for school entry (DTaP5, Polio4, MMR2, Var2, HepB3) were above 87%, with HepB3 having the highest coverage at 97%. HepB3 was the only vaccine to meet the Healthy People 2010 goal of at least 95% coverage for kindergarten immunizations. Vaccination coverage levels of 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 required vaccines; MMR2 and Var2 are the exceptions, with no significant difference in coverage levels for kindergartners in public and private schools.

The 105 counties were grouped into 3 categories based on population density, and coverage levels were compared among these groups. Counties that were "sparsely populated" (<20 persons per square mile) had the lowest coverage levels for Var2 compared to "moderately populated" (20 – 149.9 persons per square mile) and "urban" (≥150 persons per square mile) counties. DTaP5, Polio4, and MMR2 showed no significant variation in coverage levels between population density groups. Two counties had 100% coverage for all 5 required vaccinations; both were sparsely populated (Appendix 2).

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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 2010-11 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, *H. 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 5 years of age (Appendix 4).[1] ***Immunization coverage levels were assessed for all non-exempt kindergartners who were between the ages of five and seven years on the first day of the 2010-11 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, then, depending on the calculated sampling ratio for their county, proceed to select all, every other, every third, every sixth, every eighteenth, or every nineteenth immunization record

[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 2010.

regardless of the size of the kindergarten class at that school. The private schools were instructed to select all immunization records (including exemptions). In order to assess kindergarten exemptions, children who were exempt from immunizations were excluded from the sampling.[2] The schools were informed they could submit KCIs or any other form of immunization record, including printouts from computerized record keeping programs. The study coordinators were also advised to remove all personal identifiers, except date of birth, to ensure confidentiality. Copies of the immunization records, the current total number of kindergarten enrollees, the total number of exemptions and the number of exemptions sent for both medical and religious exemption in each school were forwarded to KDHE.

Data Analysis

In the 2010-11 survey, the analysis method changed from previous years. In the current study, only non-exempt children were included in the analysis of coverage levels. Exemption status was determined through examination of records sent by schools. Due to the sampling method, children who were exempt from immunization were not included in the analysis. 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. Point estimates of coverage levels and 95% confidence intervals (95% CI) for DTaP5, Polio4, MMR2, Hib3, HepB3, Var2, HepA2 and PCV3 vaccines were calculated at time of school entry. Consistent with the Advisory Committee on Immunization Practices (ACIP) recommendations, children are considered up-to-date for DTaP5 if the child has received a) 5 doses of DTaP or b) the fourth dose of DTaP on or after the 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 2010-11 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.

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] 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 was calculated from the 2005 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.

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[2] To simplify the selection of immunization records, each study coordinator was asked to select all exemptions and then sample the remaining kindergarten immunization records according to the county's sampling scheme. This allowed for a simpler method of record keeping and shipment of immunization records to KDHE.

[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.

[5] 2005 Annual Summary of Kansas Vital Statistics (http://www.kdheks.gov/ches).

RESULTS

Data Collection

Letters of invitation to participate in the survey were sent to 856 Kansas schools; of these, 738 were public schools and 118 were private. Twenty-six schools reported not having a kindergarten class for the 2010-2011 school year and 30 did not respond. Immunization data were received from 800 schools (698 public schools and 102 private schools) with kindergarten classes, corresponding to a school participation of 96.4%. In total 792 schools were included in the analysis (690 public schools and 102 private schools). KCIs from eight schools were not included in the analysis because the dates of birth had been removed.

The number of children enrolled in kindergarten at the participating public and private schools was 38,496, which is 97% of the 39,701 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 participate in the study. The number of immunization records received was 15,744, which is equivalent to one child selected for every 2.5 children enrolled. The range of the sample size by county was from 6 to 1,124 records while the range of student enrollment was from 6 to 7,684.[6]

Of the 15,744 immunization records returned and examined, 14,932 (95%) had readable information regarding birth dates and immunization history. Seventy-seven percent of schools submitted KCIs, while 17% submitted printouts from a computerized record keeping program, and 6% of the schools submitted a combination of the two types of records. For the kindergarten analysis, 14,499 (97.1%) children were included in the analysis because they were between the ages of 5 and 7 at school entry and were not exempt from immunizations. Of the 800 schools submitting data, 249 schools reported having 398 exemptions and sending a total of 376 exemption records; however, examination of the immunization records sent by these schools resulted in the identification of 360 exemptions.

The number of records included in the analysis by population density includes: 4,382 (30.2% of all records used, representing 13.8% of the population after weighting) in sparsely populated, 6,487 (44.7% of all records used, representing 33.4% of the population after weighting) in moderately populated, and 3,630 (25.0% of all records used, representing 52.8% of the population after weighting) in urban counties. The birth cohort across the state of Kansas is 10.5% in sparsely populated, 34.4% in moderately populated and 55.1% in urban counties.[7]

Statewide Immunization Coverage of Kindergartners at School Entry

The immunization coverage levels at school entry of all the vaccinations required for school entry (DTaP5, Polio4, MMR2, Var2, and HepB3) were above 87%, with HepB3 having the highest coverage of any vaccine (Figure 1). The complete series for all 5 required vaccinations (5-4-2-2-3) had a coverage level of 82% at school entry. Healthy People 2010 (HP2010) goals for kindergarten vaccination coverage levels are ≥95% for all vaccines required by Kansas for school entry.[8] Hepatitis B vaccine was the only immunization that reached this goal. Of the vaccinations not required for school

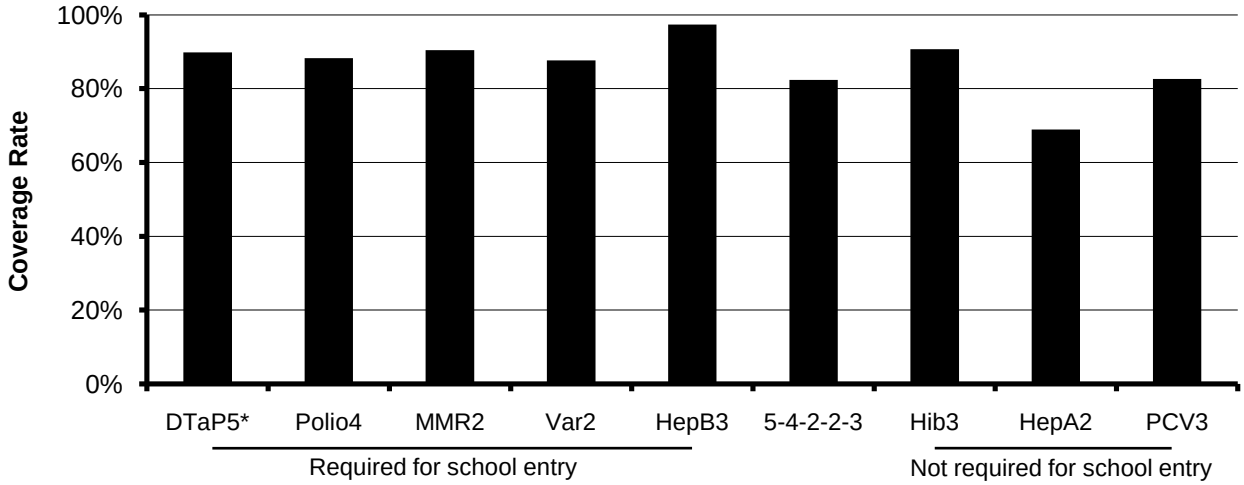
[6] Estimates from counties with small sample size (<50) may be unstable and changes over time should be interpreted with caution

[7] Numbers are rounded

[8] Healthy People 2010 (http://www.healthypeople.gov)

entry, HepA2 had the lowest coverage, with 69% of kindergartners documented as having been fully vaccinated.

Figure 1: Immunization coverage levels of kindergarten students at school entry, Kansas 2010-2011[§]



[§] Based on kindergarten survey from school year starting in 2010; analysis only consists of non-exempt children
*5 doses of DTaP or 4 doses if the fourth is administered on or after the fourth birthday.

The immunization coverage level of kindergartners are 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 [DTaP5, Polio4, MMR2, Var2, HepB3 (5-4-2-2-3)] 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, none of the three non-required vaccinations assessed significantly increased during the first 30 days of school.

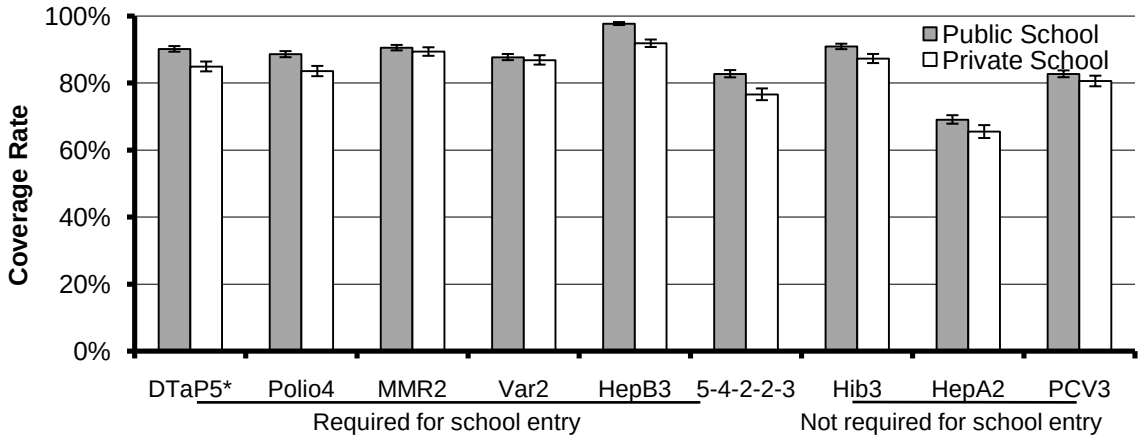
Table 1: Immunization coverage levels of kindergarten students at school entry and 30 days following school entry, Kansas 2010-2011. [§]

	At School Entry % (95% CI)	30 Days After School Entry % (95% CI)
DTaP5*	89.9 (89.1 - 90.7)	92.5 (91.8 - 93.2)
Polio4	88.3 (87.5 - 89.2)	91.0 (90.2 - 91.7)
MMR2	90.5 (89.7 - 91.2)	93.0 (92.3 - 93.6)
Var2	87.7 (86.8 - 88.5)	90.4 (89.6 - 91.2)
HepB3	97.4 (97.0 - 97.8)	97.5 (97.1 - 97.9)
5-4-2-2-3	82.4 (81.4 - 83.4)	85.5 (84.6 - 86.5)
Hib3	90.7 (89.9 - 91.5)	90.7 (89.9 - 91.5)
HepA2	68.9 (67.7 - 70.1)	69.9 (68.7 - 71.1)
PCV3	82.6 (81.6 - 83.6)	82.6 (81.6 - 83.6)

[§] Based on kindergarten survey from school year starting in 2010; analysis only consists of non-exempt children
*5 doses of DTaP or 4 doses if the fourth is administered on or after the fourth birthday.

There was significant variation in the immunization coverage levels for kindergartners enrolled in public and private schools for several required vaccines (Figure 2). For DTaP5, Polio4, HepB3, and 5-4-2-2-3, children enrolled in public school had greater immunization coverage than those enrolled in private schools. Additionally, children in public schools had significantly greater immunization coverage for two of the three non-required vaccinations (Hib3 and HepA2) than children in private schools.

FIGURE 2: Immunization coverage levels of public and private school kindergartners at school entry, Kansas 2010-2011 [§]



[§]Based on kindergarten survey from school year starting in 2010; analysis only consists of non-exempt children
*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 vaccine coverage levels are displayed by county in Appendix 2.

Of the 105 counties, 96 reached the HP2010 goal of ≥95% for HepB3. However, less than 30 counties reached the HP2010 goal for the remaining required vaccines (DTaP5, Polio4, MMR2, and Var2). Two counties, Hamilton and Hodgeman, reached 100% coverage for all 5 required immunizations for kindergarten entry. Both of these counties are sparsely populated.

Counties were classified based on their population densities, and coverage levels were compared among the three categories (Table 2). There were no differences among counties of varying population densities for DTaP5, Polio4, MMR2, or PCV3. Urban counties had the highest coverage levels for HepA2, but had significantly lower coverage levels for HepB3 and Hib3 than the counties with lower population densities (sparsely populated and moderately populated). Urban counties also had significantly lower coverage for the 5-4-2-2-3 series than moderately populated counties. Conversely, counties that were sparsely populated had significantly lower coverage levels for Var2 than counties with greater population densities (moderately populated and urban).

TABLE 2: Kansas immunization coverage levels by peer group for kindergartners, 2010-11 [§]

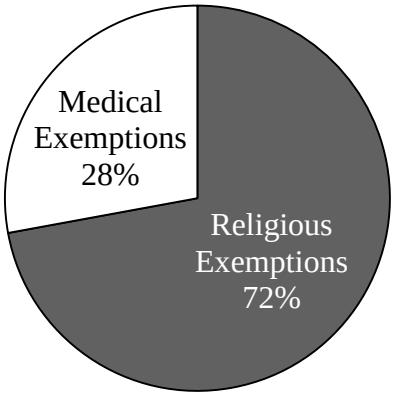
Counties by Population Density – Condensed Groups n=14,499			
	Sparsely Populated (n=4382) % (95%CI)	**Moderately Populated (n=6487) % (95%CI)**	**Urban (n=3630) % (95%CI)**
DTaP5*	88.9 (87.8 - 90.1)	90.1 (89.3 - 90.9)	89.9 (88.5 - 91.3)
Polio4	87.6 (86.4 - 88.9)	88.7 (87.9 - 89.6)	87.7 (86.1 - 89.2)
MMR2	88.6 (87.4 - 89.8)	90.1 (89.3 - 90.9)	91.0 (89.6 - 92.3)
Var2	84.8 (83.4 - 86.2)	87.4 (86.5 - 88.2)	88.4 (86.9 - 89.9)
HepB3	97.6 (96.8 - 98.4)	97.8 (97.4 - 98.2)	94.4 (93.4 - 95.3)
5-4-2-2-3	81.5 (80.0 - 83.0)	83.0 (82.0 - 84.0)	79.6 (77.8 - 81.5)
Hib3	93.7 (92.6 - 94.8)	91.8 (91.1 - 92.6)	89.1 (87.7 - 90.5)
HepA2	64.5 (62.8 - 66.3)	65.0 (63.8 - 66.3)	72.4 (70.3 - 74.5)
PCV3	83.1 (81.7 - 84.5)	82.7 (81.8 - 83.7)	82.3 (80.5 - 84.0)

[§]Based on kindergarten survey from school year starting in 2010; analysis only consists of non-exempt children
*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 exist: medical exemption and religious exemption. 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. 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 2010-11 kindergarten study, 398 children were reported as having an exemption which correlates to 1% of the kindergarten population. Of the exemptions, 287 were categorized as religious, while the remaining 111 were medical (Figure 3).

Figure 3: Percentage of permissible exemptions reported by schools at kindergarten entry, Kansas 2010-2011.



DISCUSSION

All individual vaccinations required for school entry were above 87% coverage at school entry for kindergartners enrolled in Kansas schools. The only vaccine that met the HP2010 goal of at least 95% coverage was HepB3. DTaP5, Polio4, MMR2, and Var2 were less than 8 percentage points away from meeting the goal. For required vaccinations that did not meet the HP2010 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 or PCV3 because these vaccinations are not recommended for this age group. Additionally, as HIB3, PCV3 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 the data.

Twenty-eight counties (representing 9% of the birth cohort) reached the Healthy People 2010 goal of at least 95% coverage for the MMR2 vaccine series (Appendix 3). For DTaP5, 25 counties (representing 9.3% of the birth cohort) had at least 95% coverage, while 18 counties (representing 3.5% of the birth cohort) had 95% coverage or better for Polio4. Ninety-nine counties (representing 96.4% of the birth cohort) had a minimum of 95% coverage for HepB3. Twelve counties (representing 2.8% of the birth cohort) had 95% or greater coverage for Var2.

The coverage rate estimates were compared to determine if differences exist among the counties of different population densities. For HepB3, the coverage levels of moderately populated counties were statistically higher compared to urban counties. Var2 coverage levels were significantly lower for sparsely populated counties compared to moderately populated and urban counties. Conversely, the coverage levels for HepA2 were statistically greater in urban counties when compared to less populated counties. Hepatitis A vaccination is not required for school entry, but is required for school-run childcare centers and preschools; because there are more of these programs in urban counties, this may account for the greater vaccination coverage levels for HepA2.

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 accounts for the lack of statistical difference between counties of different population densities.

Vaccine coverage is of great public health importance. By having greater vaccine coverage, there is an increase in herd immunity, which leads to lower disease incidence and an ability to limit the size of disease outbreaks. In 2006, a widespread outbreak of mumps occurred in Kansas and across the United States. Prior to the outbreak, the incidence of mumps was at a historical low, and even with the outbreak, the mumps disease rates were still lower than pre-vaccination era. Due to high vaccination coverage, tens or hundreds of thousands of cases were possibly prevented.

However, due to unvaccinated and undervaccinated individuals, the United States has seen a rise in diseases that were previously present at low levels. In 2008, the United States had 140 measles cases, more than any year since 1996, and as of May 20, 2011 the United States has documented 118 cases of

measles, of which 89% were unvaccinated.[9] Additionally, there has been a rise in the number of pertussis cases throughout the United States, and Kansas has had several outbreaks in unvaccinated or undervaccinated populations.

Limitations

One limitation of this study is Hib3, HepA2 and PCV3 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. Second, the sampling method employed excluded subjects with either a medical or religious exemption, which could have artificially increased coverage rates reported. However, the potential magnitude for the bias was small, as we estimated only approximately one percent of all students in kindergarten had an exemption on file, based on the records received. Additionally, no descriptive data are collected about sex, race, or ethnicity.

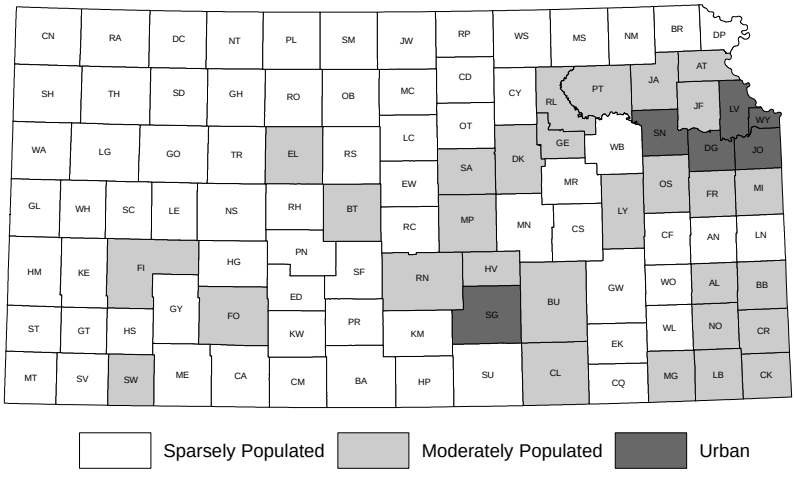
Strengths

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.

[9] Centers for Disease Control and Prevention. Measles – United States, January – May 20, 2011. MMWR 2011; 60: 666-668.

Appendix 1: Kansas counties categorized based on population density, 2009.

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	Ellis	
Comanche	Pawnee	Finney	
Decatur	Phillips	Ford	
Doniphan	Pratt	Franklin	
Edwards	Rawlins	Geary	
Elk	Republic	Harvey	
Ellsworth	Rice	Jackson	
Gove	Rooks	Jefferson	
Graham	Rush	Labette	
Grant	Russell	Lyon	
Gray	Scott	McPherson	
Greeley	Sheridan	Miami	
Greenwood	Sherman	Montgomery	
Hamilton	Smith	Neosho	
Harper	Stafford	Osage	
Haskell	Stanton	Pottawatomie	
Hodgeman	Stevens	Reno	
Jewell	Sumner	Riley	
Kearny	Thomas	Saline	
Kingman	Trego	Seward	
Kiowa	Wabaunsee		
Lane	Wallace		
Lincoln	Washington		
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 2010-2011 (percentages).[†§]

COUNTY	DTaP5*	Polio4	MMR2	Var2	HepB3	5-4-2-2-3	Hib3	HepA2	PCV3
STATEWIDE	*90*	*88*	*90*	*88*	*97*	*82*	*91*	*69*	*83*
ALLEN	94	91	95	91	99	86	94	55	78
ANDERSON	90	90	91	88	99	87	98	65	94
ATCHISON	90	88	89	85	100	81	97	63	90
BARBER	93	93	93	93	100	93	100	54	85
BARTON	95	95	97	93	98	89	93	68	89
BOURBON	91	86	91	82	95	74	88	46	88
BROWN	91	90	90	77	97	72	91	66	82
BUTLER	86	84	87	84	97	80	93	61	86
CHASE	78	74	78	65	91	65	91	39	39
CHAUTAUQUA	91	91	91	85	97	82	100	41	88
CHEROKEE	94	89	93	90	99	86	90	71	92
CHEYENNE	89	89	89	85	100	81	100	67	93
CLARK	88	88	88	85	100	85	98	63	93
CLAY	88	86	85	85	99	83	97	72	92
CLOUD	89	89	88	87	97	83	89	56	90
COFFEY	90	87	91	86	98	79	96	50	85
COMANCHE	100	100	100	95	100	95	100	57	71
COWLEY	92	92	92	90	100	86	96	71	72
CRAWFORD	88	86	89	84	98	79	93	51	78
DECATUR	69	69	69	63	94	63	88	50	75
DICKINSON	90	88	90	85	99	82	96	65	92
DONIPHAN	84	78	82	79	97	70	88	51	80
DOUGLAS	91	89	92	87	98	83	85	69	74
EDWARDS	97	97	97	97	100	97	90	94	84
ELK	72	72	69	72	100	64	94	39	83
ELLIS	95	94	95	95	99	91	83	77	76
ELLSWORTH	78	80	77	74	99	67	97	70	94
FINNEY	89	87	91	90	99	86	96	83	92
FORD	93	92	92	90	99	88	94	80	77
FRANKLIN	91	90	91	87	98	83	88	65	90
GEARY	87	85	85	85	97	79	91	65	83
GOVE	97	97	97	90	97	90	97	43	77
GRAHAM	100	97	100	97	100	94	100	61	77
GRANT	97	97	98	98	100	96	94	82	88
GRAY	80	79	79	78	96	74	94	71	92
GREELEY	100	92	100	100	100	92	100	92	92
GREENWOOD	88	88	95	89	97	82	90	68	85
HAMILTON	100	100	100	100	100	100	97	91	91
HARPER	82	85	82	82	99	79	97	43	70
HARVEY	96	94	95	93	97	88	94	63	88
HASKELL	94	90	100	94	100	90	94	85	88
HODGEMAN	100	100	100	100	100	100	95	91	95
JACKSON	89	87	88	85	96	79	83	62	79
JEFFERSON	91	89	88	88	100	84	99	79	95

COUNTY	DTaP5*	Polio4	MMR2	Var2	HepB3	5-4-2-2-3	Hib3	HepA2	PCV3
STATEWIDE	*90*	*88*	*90*	*88*	*97*	*82*	*91*	*69*	*83*
JEWELL	69	69	77	77	100	69	85	38	62
JOHNSON	91	89	93	90	95	83	85	77	79
KEARNY	94	93	94	91	97	90	93	70	93
KINGMAN	83	81	84	81	93	79	91	46	68
KIOWA	96	91	96	91	100	87	96	43	70
LABETTE	94	92	96	93	99	88	77	48	74
LANE	94	91	91	89	100	83	91	78	85
LEAVENWORTH	93	92	94	90	98	86	95	72	88
LINCOLN	79	79	83	83	97	72	86	79	100
LINN	87	90	90	80	99	75	96	67	91
LOGAN	79	77	82	77	100	72	97	64	97
LYON	77	76	76	73	97	69	96	65	45
MARION	77	76	79	76	92	69	90	41	81
MARSHALL	93	93	92	92	99	88	96	73	93
MCPHERSON	85	83	86	83	98	76	65	44	60
MEADE	79	78	75	75	100	75	96	79	90
MIAMI	90	90	92	89	97	85	90	65	90
MITCHELL	99	99	99	92	100	92	97	78	95
MONTGOMERY	92	93	92	89	99	84	93	61	88
MORRIS	87	85	88	87	99	82	91	63	61
MORTON	92	88	90	88	100	81	85	60	79
NEMAHA	89	87	87	83	98	79	96	68	86
NEOSHO	89	94	96	93	100	84	93	11	20
NESS	87	87	87	78	96	74	96	57	83
NORTON	89	89	88	85	99	82	97	82	59
OSAGE	90	89	90	88	98	85	97	63	94
OSBORNE	86	86	86	82	96	82	94	51	80
OTTAWA	93	90	93	88	98	85	100	95	98
PAWNEE	86	85	85	85	99	83	92	58	83
PHILLIPS	88	88	90	90	100	88	98	80	88
POTTAWATOMIE	97	98	97	95	98	93	94	45	91
PRATT	87	85	87	85	98	82	89	55	78
RAWLINS	89	83	89	89	100	83	94	17	100
RENO	95	94	94	91	99	89	98	67	96
REPUBLIC	98	98	98	95	100	95	100	71	91
RICE	79	79	76	68	98	65	91	49	76
RILEY	87	82	85	81	94	76	84	57	83
ROOKS	97	97	96	91	100	90	99	74	96
RUSH	83	83	83	83	100	83	93	50	90
RUSSELL	88	90	85	85	98	83	95	43	93
SALINE	86	85	86	84	99	82	95	80	96
SCOTT	95	95	97	97	100	94	98	77	97
SEDGWICK	89	87	90	88	98	81	95	67	88
SEWARD	95	94	98	90	99	88	97	78	89
SHAWNEE	92	90	92	90	97	84	93	75	89
SHERIDAN	48	41	44	44	96	41	96	15	93

COUNTY	DTaP5*	Polio4	MMR2	Var2	HepB3	5-4-2-2-3	Hib3	HepA2	PCV3
STATEWIDE	*90*	*88*	*90*	*88*	*97*	*82*	*91*	*69*	*83*
SHERMAN	96	95	97	92	99	89	97	70	95
SMITH	89	89	89	89	100	89	100	72	94
STAFFORD	93	93	93	93	100	93	95	63	78
STANTON	97	100	97	92	100	89	97	63	84
STEVENS	95	94	90	90	100	88	90	80	76
SUMNER	89	87	88	84	99	82	94	55	48
THOMAS	94	94	91	86	97	83	96	58	85
TREGO	100	97	97	94	100	88	88	81	91
WABAUNSEE	91	87	87	85	98	85	95	60	96
WALLACE	40	40	40	40	100	40	100	80	100
WASHINGTON	94	93	92	89	99	86	99	58	97
WICHITA	96	96	96	92	100	92	96	92	96
WILSON	97	97	96	95	100	93	96	67	91
WOODSON	89	86	89	78	92	76	86	76	78
WYANDOTTE	86	85	88	85	97	78	80	75	69

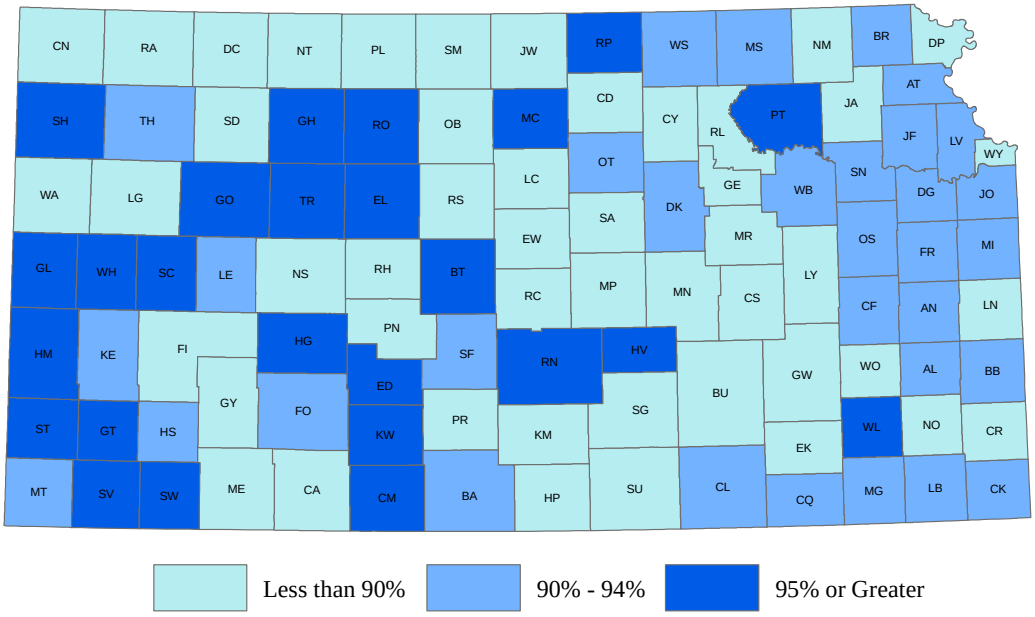
† Based on the Kindergarten survey for the school year starting 2010; immunization levels for non-exempt children only.

§ 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.

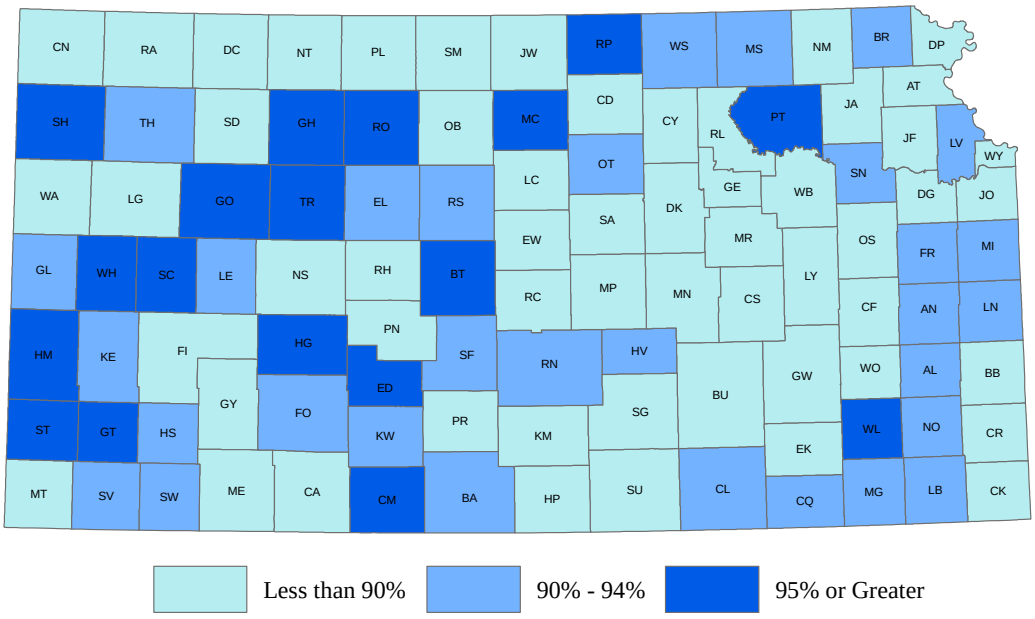
*5 doses of DTaP or 4 doses if the fourth is administered on or after the fourth birthday.

Appendix 3: Maps of immunization levels by county, 2010-11 Kindergarten Survey.

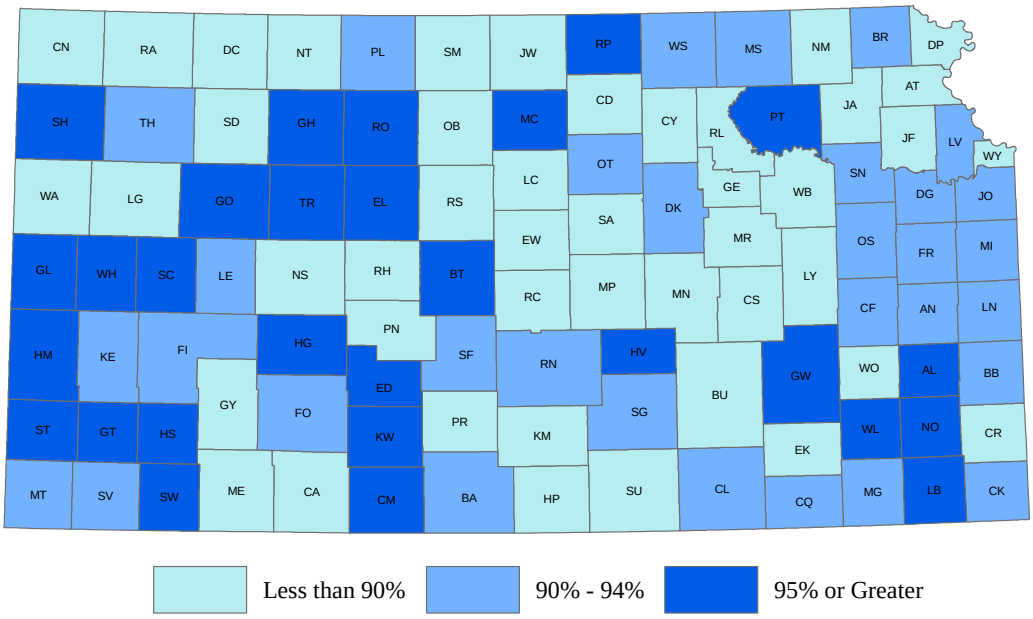
DTaP5 Series for Kindergarten Survey 2010-2011



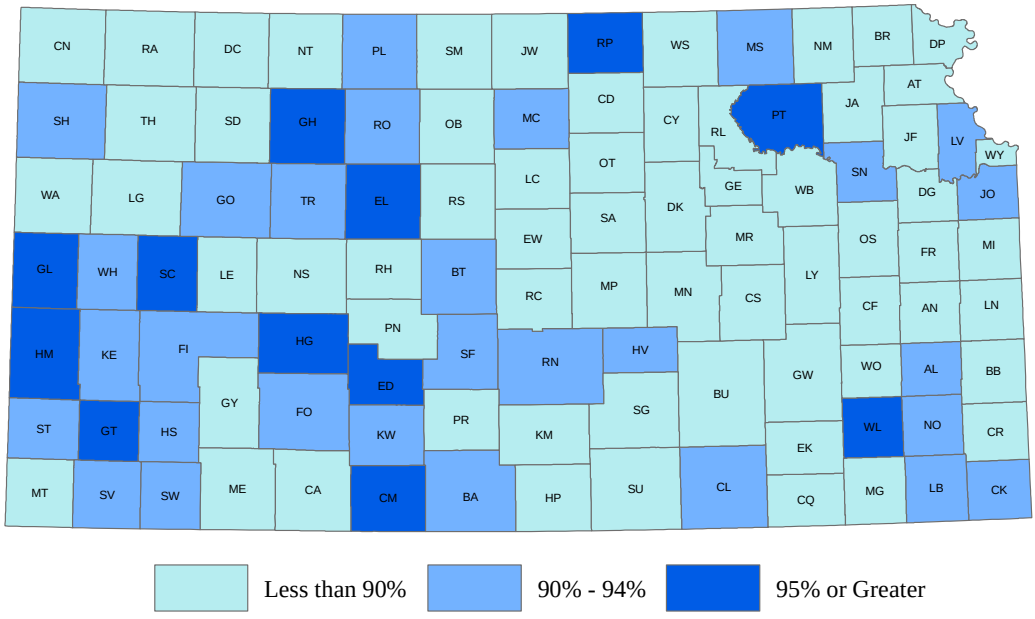
Polio4 Series for Kindergarten Survey 2010-2011



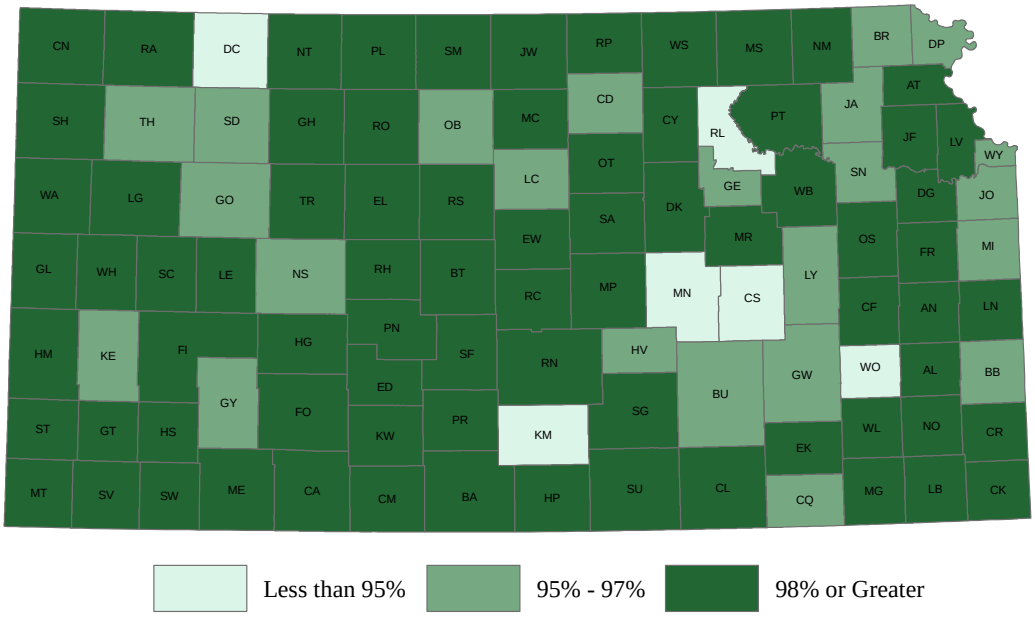
MMR2 Series for Kindergarten Survey 2010-2011



Var2 Series for Kindergarten Survey 2010-2011

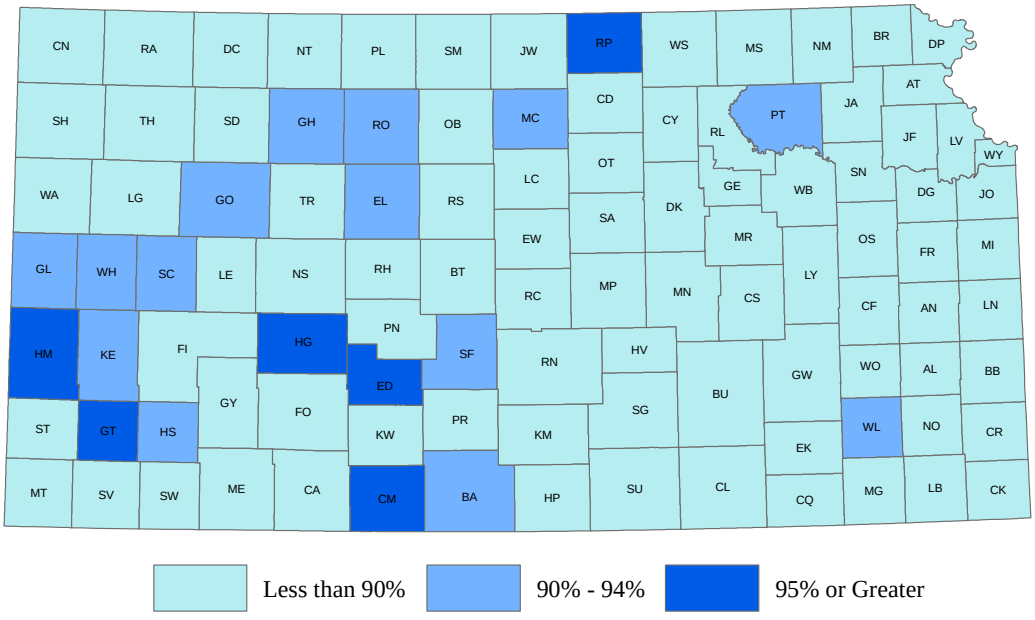


HepB3 Series for Kindergarten Survey 2010-2011



Note: Intervals used are different from the other maps

5-4-2-2-3 Series for Kindergarten Survey 2010-2011



Appendix 4: CDC's 2010 Advisory Committee on Immunization Practices (ACIP) Recommendations http://www.cdc.gov/mmwr/preview/mmwrhtml/mm5851a6.htm?s_cid=mm5851a6_e

FIGURE 1. Recommended immunization schedule for persons aged 0 through 6 years — United States, 2010 (for those who fall behind or start late, see the catch-up schedule [Table])

Vaccine ▼ Age ►	Birth	1 month	2 months	4 months	6 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]						Varicella	see footnote[9]				Varicella
Hepatitis A[10]						HepA (2 doses)				HepA Series	
Meningococcal[11]										MCV	

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

Range of recommended ages for certain high-risk groups

This schedule includes recommendations in effect as of December 15, 2009. 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. Considerations should include provider assessment, patient preference, and the potential for adverse events. Providers should consult the relevant Advisory Committee on Immunization Practices statement for detailed recommendations: http://www.cdc.gov/vaccines/pubs/acip-list.htm. Clinically significant adverse events that follow immunization should be reported to the Vaccine Adverse Event Reporting System (VAERS) at http://www.vaers.hhs.gov or by telephone, 800-822-7967.

1. **Hepatitis B vaccine (HepB).** (Minimum age: birth)
   At birth:
   - Administer monovalent HepB to all newborns before hospital discharge.
   - If mother is hepatitis B surface antigen (HBsAg)-positive, administer HepB and 0.5 mL of hepatitis B immune globulin (HBIG) within 12 hours of birth.
   - If mother's HBsAg status is unknown, administer HepB within 12 hours of birth. Determine mother's HBsAg status as soon as possible and, if HBsAg-positive, administer HBIG (no later than age 1 week).

   After the birth dose:
   - The HepB series should be completed with either monovalent HepB or a combination vaccine containing HepB. The second dose should be administered at age 1 or 2 months. Monovalent HepB vaccine should be used for doses administered before age 6 weeks. The final dose should be administered no earlier than age 24 weeks.
   - Infants born to HBsAg-positive mothers should be tested for HBsAg and antibody to HBsAg 1 to 2 months after completion of at least 3 doses of the HepB series, at age 9 through 18 months (generally at the next well-child visit).
   - Administration of 4 doses of HepB to infants is permissible when a combination vaccine containing HepB is administered after the birth dose. The fourth dose should be administered no earlier than age 24 weeks.
2. **Rotavirus vaccine (RV).** (Minimum age: 6 weeks)
   - Administer the first dose at age 6 through 14 weeks (maximum age: 14 weeks 6 days). Vaccination should not be initiated for infants aged 15 weeks 0 days or older.
   - The maximum age for the final dose in the series is 8 months 0 days
   - If 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 vaccine (DTaP).** (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.
   - Administer the final dose in the series at age 4 through 6 years.
4. ***Haemophilus influenzae* type b conjugate vaccine (Hib).** (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.
   - TriHiBit (DTaP/Hib) and Hiberix (PRP-T) should not be used for doses at ages 2, 4, or 6 months for the primary series but can be used as the final dose in children aged 12 months through 4 years.
5. **Pneumococcal vaccine.** (Minimum age: 6 weeks for pneumococcal conjugate vaccine [PCV]; 2 years for pneumococcal polysaccharide vaccine [PPSV])
   - PCV is recommended for all children aged younger than 5 years. Administer 1 dose of PCV to all healthy children aged 24 through 59 months who are not completely vaccinated for their age.
   - Administer PPSV 2 or more months after last dose of PCV to children aged 2 years or older with certain underlying medical conditions, including a cochlear implant. See *MMWR* 1997;46(No. RR-8).
6. **Inactivated poliovirus vaccine (IPV)** (Minimum age: 6 weeks)
   - The final dose in the series should be administered on or after the fourth birthday and at least 6 months following the previous dose.
   - If 4 doses are administered prior to age 4 years a fifth dose should be administered at age 4 through 6 years. See *MMWR* 2009;58(30):829–30.
7. **Influenza vaccine (seasonal).** (Minimum age: 6 months for trivalent inactivated influenza vaccine [TIV]; 2 years for live, attenuated influenza vaccine [LAIV])
   - Administer annually to children aged 6 months through 18 years.
   - For healthy children aged 2 through 6 years (i.e., those who do not have underlying medical conditions that predispose them to influenza complications), either LAIV or TIV may be used, except LAIV should not be given to children aged 2 through 4 years who have had wheezing in the past 12 months.
   - Children receiving TIV should receive 0.25 mL if aged 6 through 35 months or 0.5 mL if aged 3 years or older.
   - Administer 2 doses (separated by at least 4 weeks) to children aged younger than 9 years who are receiving influenza vaccine for the first time or who were vaccinated for the first time during the previous influenza season but only received 1 dose.
   - For recommendations for use of influenza A (H1N1) 2009 monovalent vaccine see *MMWR* 2009;58(No. RR-10).
8. **Measles, mumps, and rubella vaccine (MMR).** (Minimum age: 12 months)
   - Administer the second dose routinely at age 4 through 6 years. However, the second dose may be administered before age 4, provided at least 28 days have elapsed since the first dose.
9. **Varicella vaccine.** (Minimum age: 12 months)
   - Administer the second dose routinely at age 4 through 6 years. However, the second dose may be administered before age 4, provided at least 3 months have elapsed since the first dose.
   - For children aged 12 months through 12 years the minimum interval between doses is 3 months. However, if the second dose was administered at least 28 days after the first dose, it can be accepted as valid.
10. **Hepatitis A vaccine (HepA).** (Minimum age: 12 months)
    - Administer to all children aged 1 year (i.e., aged 12 through 23 months). Administer 2 doses at least 6 months apart.
    - Children not fully vaccinated by age 2 years can be vaccinated at subsequent visits
    - HepA also is recommended for older children who live in areas where vaccination programs target older children, who are at increased risk for infection, or for whom immunity against hepatitis A is desired.
11. **Meningococcal vaccine.** (Minimum age: 2 years for meningococcal conjugate vaccine [MCV4] and for meningococcal polysaccharide vaccine [MPSV4])
    - Administer MCV4 to children aged 2 through 10 years with persistent complement component deficiency, anatomic or functional asplenia, and certain other conditions placing them at high risk.
    - Administer MCV4 to children previously vaccinated with MCV4 or MPSV4 after 3 years if first dose administered at age 2 through 6 years. See *MMWR* 2009; 58:1042–3.

The Recommended Immunization Schedules for Persons Aged 0 through 18 Years are 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).
Department of Health and Human Services • Centers for Disease Control and Prevention