Adolescent Vaccination Coverage in Kansas, an Analysis of BRFSS Surveys

2011 - 2016

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Background

The Behavioral Risk Factor Surveillance System (BRFSS) is the largest telephone survey in the world which collects data on United States residents risk behaviors, chronic health illnesses and use of preventative medical services. The first BRFSS survey was conducted in Kansas in 1990 and has been conducted annually since 1992[1]. Traditionally a survey using landline telephones, BRFSS survey sampling methodology underwent a major change in 2011 to account for the increase in prevalence of cellular telephones. A dual frame sampling methodology was implemented that included a landline telephone and cellular telephone component; both components included non-institutionalized adults, 18 years and older[1]. The BRFSS survey conducted by all states consists of a core section and optional modules/state-added questions section. The Core section of the survey is consistent across all states as this section includes questions prescribed by the CDC. The optional modules are selected by the states from a bank of CDC-supported modules, or each state designs its own modules (state-added modules). Kansas BRFSS uses a split questionnaire design. It consists of the core section, which is asked of all respondents and then survey splits into two "branches" of optional modules/state-added modules. Once respondents have been asked the core questions, they will either be asked questions in questionnaire A (also called Part A) or questionnaire B (also called Part B) of the survey. Respondents will be randomly assigned to one of these two arms of the survey[1].

Random Child Selection involves asking a randomly-selected BRFSS respondent about the presence of children in his/her household. If there are one or more children under age 17 years in the household, one child is randomly selected. From 2011 to 2016 questions were added to assess for completion of required and recommended adolescent vaccinations. For a list of questions and years these questions were asked refer to appendix.

The Advisory Committee for Immunization Practices (ACIP) recommends adolescent children between the ages of 10 and 17 receive one dose of tetanus, diphtheria and pertussis (Tdap) vaccine. Tdap was first licensed in 2005, in 2007 ACIP recommended administration of Tdap instead of the tetanus and diphtheria (Td) toxoids vaccine for booster immunization[2]. School year 2009-2010 Kansas implemented requirements that all students aged 12 years have one dose of Tdap, with proof of immunization provided to school prior to first day of attendance[3]. Additionally, in 2005 ACIP recommended that children aged 11 to 12 years receive one dose of meningococcal conjugate vaccine (MenACWY) with a booster at age 16 years. The first HPV vaccine was first licensed in 2005 and provides protection against the most common strains of HPV that are associated with cervical cancer[4]. This vaccine was initially only licensed for use in females, however, in 2010 became licensed for males. The HPV vaccine is given as a three dose series of the human papillomavirus (HPV) vaccine given at age 11 to 12 years; second dose 1-2 months later; and 3rd dose 6 months after first dose[6]. While recommended, Kansas does not require students to receive the MenACWY or the HPV vaccines prior to school attendance[5], Table 1.

Table 1: ACIP adolescent immunization recommendations

	Age recommended	Number of doses	Required for school attendance in Kansas
Tdap	11-12 years	1	Yes
MenAWCY	11-12 years	1 (and Booster at 16)	No
HPV	11-12 years	3	No

Methods

The study population was analyzed for BRFSS data collected from 2011-2016; Tdap vaccine coverage (appendix 1) was assessed in 2011 and 2014, MenACWY coverage (appendix 2) in 2012 and 2015, and HPV (appendix 3) in 2013 and 2016. Factors examined included parental race, insurance status, income, education level, socioeconomic status, number of children in household, and child's ethnicity.

Data was weighted using a raking method which enables increased representation in groups that would otherwise be underrepresented by reducing non-response bias and error within estimates. Chi-squared analysis was performed to determine if any variables were significantly associated with immunization coverage. Finally, logistic regression and confounding analysis were performed to determine which factors had a measurable effect on coverage rates. Respondents were excluded from coverage and further analysis if parental respondent did not know the child's immunization status. BRFSS data was analyzed using SAS®.

Results:

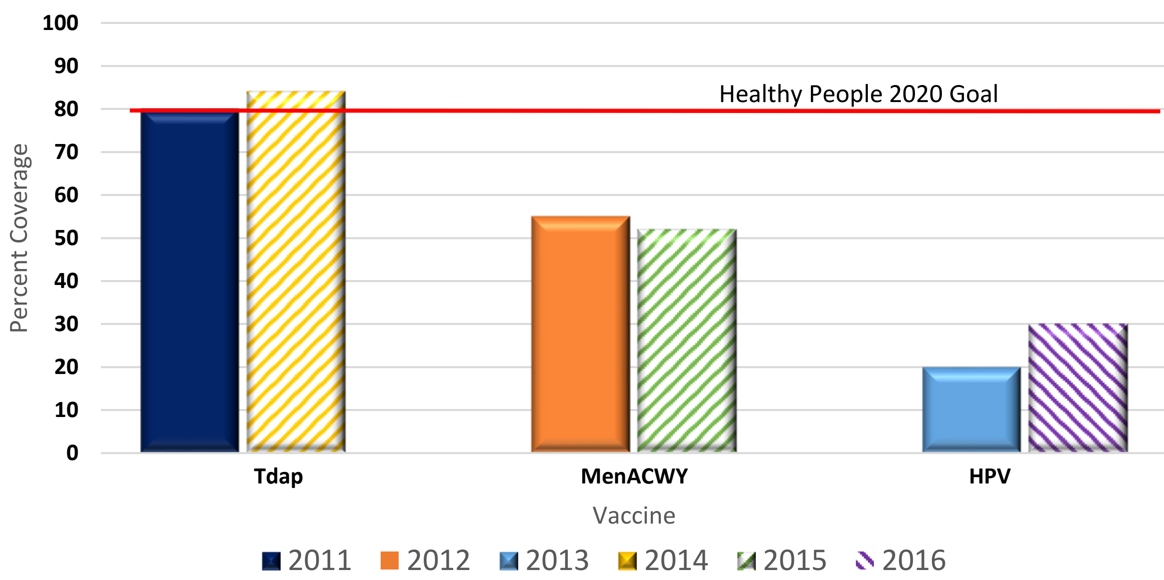
A fraction of the total respondents was included in the analysis, which varied by year (Table 2). Every year, a majority of the sample population was White, non-Hispanic, college educated, earned $50,000 or more per year, had medical insurance and lived in an urban county (≥150 persons per square mile).

Table 2: Study population demographics by year, Kansas

BRFSS Year	Total Respondents	Included in Analysis	White	Non-Hispanic	College Educated	Annual Income ≥$50k	Insured	Urban County Resident
2011	20,712	971	85.5%	87.3%	66.1%	54.6%	83.7%	52.1%
2012	11,801	568	82.3%	85.3%	61.9%	52.1%	89.9%	53.3%
2013	13,282	1,280	82.3%	81.3%	63.4%	49.1%	80.2%	55.7%
2014	13,743	641	81.6%	82.3%	67.9%	51.9%	84.4%	54.8%
2015	23,236	1,073	87.8%	83.7%	63.5%	54.6%	84.6%	54.2%
2016	12,188	670	81.3%	84.5%	64.8%	52.9%	82.2%	57.5%

The only adolescent immunization to meet Healthy People 2020 (HP2020) goals of 80% coverage was Tdap (Figure 1). MenACWY and HPV coverage were well below national metrics for all years analyzed. There was an increase in Tdap coverage in 2014 compared to 2011, though not statistically significant. A significant increase was observed in HPV coverage between 2013 and 2015 (19.6% vs. 29.5%, respectively). MenACWY coverage experienced a decrease in 2015 compared to 2012; however, this change was also not significant.

Figure 1: Adolescent immunization coverage by year, Kansas



Tetanus, Diphtheria, acellular Pertussis (Tdap) Vaccine

2011: Of the 971 respondents included in analysis, 80.1% (784) stated his/her adolescent aged child received Td or Tdap within the past 10 years and 73.3% (574) stated the vaccination was received since

2005. Overall 80.2% (256) of Kansas respondents stated their adolescent child received Tdap vaccine, meeting HP2020 goals (Table 3, Figure 2).

Further analysis revealed that children of persons who had some college education and medical coverage had over two times the odds of receiving the Tdap vaccine compared to children without insurance and whose parents did not attend college (Table 4). No other factors were statistically associated with Tdap vaccination coverage.

2014: Of the 641 surveyed parents included in the analysis, 83.5% (529) reported their adolescent child received Td or Tdap within the past 10 years and 74.7% (407) stated immunization had been received since 2005. Overall, 81.0% (209) of Kansas respondents stated their adolescent child received Tdap vaccine, exceeding national metrics for Tdap coverage among adolescents (Figure 2). Though not significant, an increase in coverage of tetanus, including tetanus shots with pertussis, was observed between 2011 and 2014 (Table 3).

Further analysis revealed that children of parents with some college education and an annual income ≥$50k had over two times the odds of receiving the Tdap vaccine compared to children of parents with <$50k annual income and did not attend college (Table 4). No other factors were statistically associated with Tdap immunization coverage.

Table 3: Tetanus immunization coverage for adolescent children by year, Kansas

BRFSS Year	Question	n	%	% Change from Previous Year	95% Confidence Interval
2011	**Received tetanus shot within past 10 years** (n=971)	784	80.10		77.23 – 82.98
	Received tetanus shot since 2005 (n=784)	574	73.27		69.78 – 76.75
	Tetanus shot contained pertussis vaccine (n=323)	256	80.20		75.27 – 85.13
2014	**Received tetanus shot within past 10 years** (n=641)	529	83.52	+4.27	79.87 – 87.17
	Received tetanus shot since 2005 (n=529)	407	74.71	+1.97	69.72 – 79.71
	Tetanus shot contained pertussis vaccine (n=259)	209	80.98	+0.97	74.89 – 87.07

Figure 2: Tetanus vaccination coverage by year, Kansas

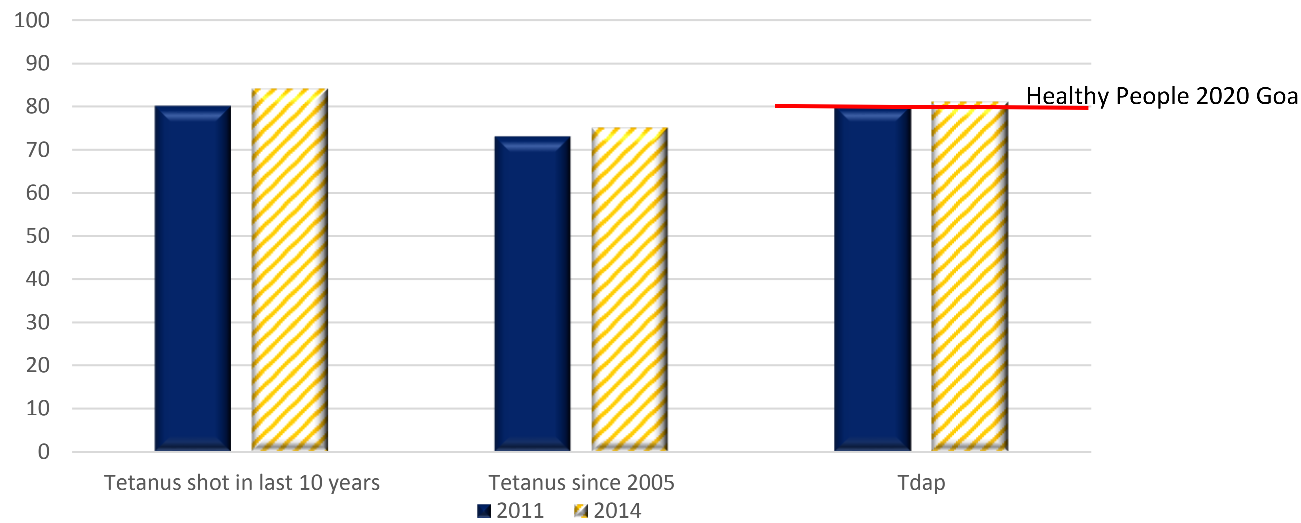


Table 4: Factors statistically associated with Tdap coverage by year, Kansas

BRFSS Year	Factor	Odds Ratio	95% Confidence Interval
2011	**Insurance** (Yes vs. No)	2.68	2.49 – 2.89
	Parental Education Level (Some College vs. No College)	2.24	2.11 – 2.38
2014	**Parent Education Level** (Some College vs. No College)	2.50	2.27 – 2.76
	Annual Income (≥$50k vs. <$50k)	2.50	2.35 – 2.66

Meningococcal Conjugate (MenACWY) Vaccine

2012: Of the 398 respondents with an adolescent aged child that knew his/her child's MenACWY vaccination status, 54.6% (210) reported their child had received at least one dose of vaccine; among children 16 years and older, 32.2% (68) had received both doses (Table 5). Kansas' vaccination coverage level for MenACWY is below the national average of 74.0%, as reported in the National Immunization Survey-Teen (NIS-Teen) (Figure 3). No assessed factors were statistically associated with MenACWY vaccination coverage.

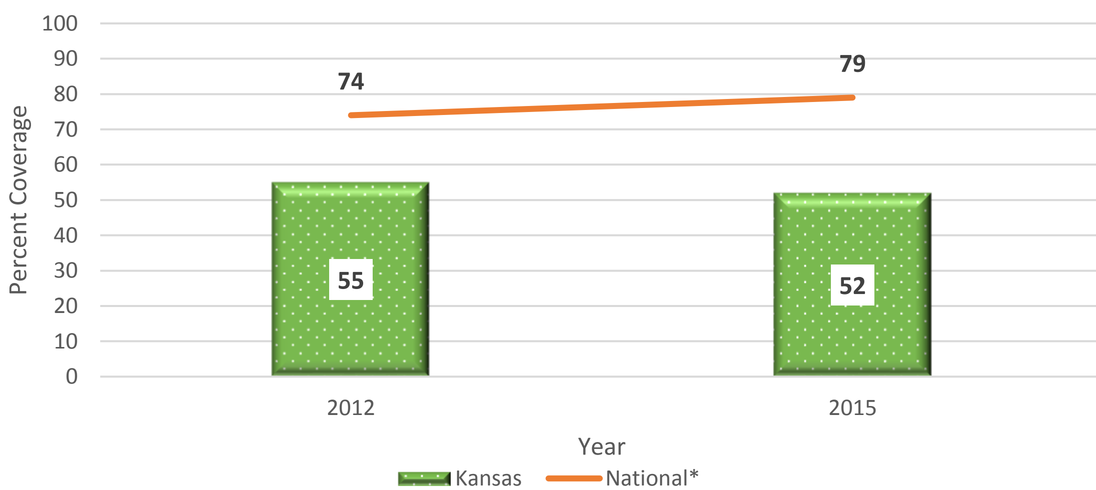
2015: Of the 721 respondents with an adolescent aged child that knew his/her child's MenACWY vaccination status, 52.2% (371) stated their child had received MenACWY vaccine (Table 5). This observation was a nonsignificant 4.4% decrease in coverage. Kansas' coverage level for MenACWY was below HP2020 goal of 80% and below the NIS-Teen national rate (Figure 3).

Further analysis was performed to determine if any factors were associated with receipt of MenACWY vaccine by adolescent children in Kansas. When adjusted for insurance status, children that resided in urban counties had nearly two times the odds of receiving MenACWY compared to those adolescents that lived in rural counties (Table 6). Additionally, it was observed that children with medical insurance also had nearly two times the odds of receiving this adolescent vaccination compared to children without insurance. No other factors were statistically associated with MenACWY vaccination coverage.

Table 5: MenACWY immunization coverage for adolescent children by year, Kansas

BRFSS Year	Question	n	%	% Change from Previous Year	95% Confidence Interval
2012	**Received MenACWY** (n=398)	210	54.61		48.78 – 60.44
	Received 2 doses of MenACWY (n=210)	68	32.15		24.72 – 39.58
2015	**Received MenACWY** (n=721)	371	52.23	-4.36	47.83 – 56.62

Figure 3: MenACWY vaccination coverage by year, Kansas



*National rates from National Immunization Survey- Teen

Table 6: Factors statistically associated with MenACWY coverage by year, Kansas

BRFSS Year	Factor	Odds Ratio	95% Confidence Interval
2015	**Insurance** (Yes vs. No)	1.86	1.14 – 3.04
	County of residence* (Urban vs. Rural)	1.77	1.16 – 2.71

**Adjusted for insurance status*

Human Papillomavirus (HPV) Vaccine

2013: Of the 1,093 respondents with an adolescent aged child that knew his/her child's HPV immunization status, 19.6% (212) indicated their child received at least one dose of the HPV series; well below the Healthy People 2020 goal of 80% (Figure 1). More female children received at least one dose of the vaccine than male children, 25.0% versus 14.3%, respectively (Table 7). Of the 212 children that received their first dose, 108 (51.4%) went on to complete the series; equating to 10.1% of adolescent Kansas children being fully vaccinated against HPV (Figure 4).

Further analysis revealed that female children had two times the odds of receiving at least one dose of the HPV vaccine compared to their male counterparts (Table 8). Older children (aged 15 to 17 years) had over two times the odds of receiving at least the first dose of this vaccine compared to younger children (12 to 14 years). Finally, it was observed that adolescent children who lived in urban counties had 1.5 times the odds of getting HPV vaccination compared to children living in rural counties. No other factors were statistically associated with HPV vaccination coverage.

2016: Of the 555 respondents with an adolescent aged child that knew his/her child's HPV immunization status, 29.5% (168) indicated their child received at least one dose of the vaccine series; while still below HP2020 goals, this is a significant increase over 2013 coverage rates (Figure 1). More female children received at least one dose of the vaccine than male children, 33.7% versus 25.8%, respectively. The gender gap is much less and reveals a significant increase in male vaccination rates than previously observed (Table 7). Of the children that received their first dose, 69 (50.6%) went on to complete the series; equating to an overall rate 14.9% for Kansas children being fully vaccinated against HPV (Figure 4).

HPV vaccination hesitancy was analyzed for the first time in 2016 for responses which indicated the child did not receive the vaccine. It was observed that most respondents felt their "child [did] not need it", the "child is too young", or did not vaccinate because the "doctor did not recommend it" (18.8%, 14.9% and 13.0%, respectively) (Table 7). Further analysis revealed that older children (15 to 17 years) had greater odds of receiving at least one dose of the HPV vaccine compared to younger children (12 to 14 years) (Table 8). No other factors were statistically associated with HPV vaccination coverage.

Table 7: HPV immunization coverage for adolescent children by year, Kansas

BRFSS Year	Factor	n	%	% Change from Previous Year	95% Confidence Interval
2013	**Ever received HPV** (n=1,093)	212	19.62		16.74 – 22.49
	Female (n=507)	132	24.99		20.55 – 29.44
	Male (n=586)	80	14.26		10.65 – 17.88
	Completed series (n=212)	108	51.40		43.17 – 59.64
2016	**Ever received HPV** (n=555)	168	29.48	+50.25*	24.94 – 34.02
	Female (n=262)	94	33.66	+34.45	27.03 – 40.29
	Male (n=293)	74	25.82	+81.07*	19.55 – 32.09
	Completed series (n=139)†	69	50.56	-1.63	40.49 – 60.63
	Vaccination hesitancy (n=385)				
	Child doesn't need it	74	18.76		14.19 – 23.33
	Child is too young	51	14.85		10.51 – 19.19
	Doctor did not recommend it	45	13.01		8.79 – 17.23

**Significant change*

† where number of doses was known

Figure 4: HPV vaccination coverage by gender and overall completion by year, Kansas

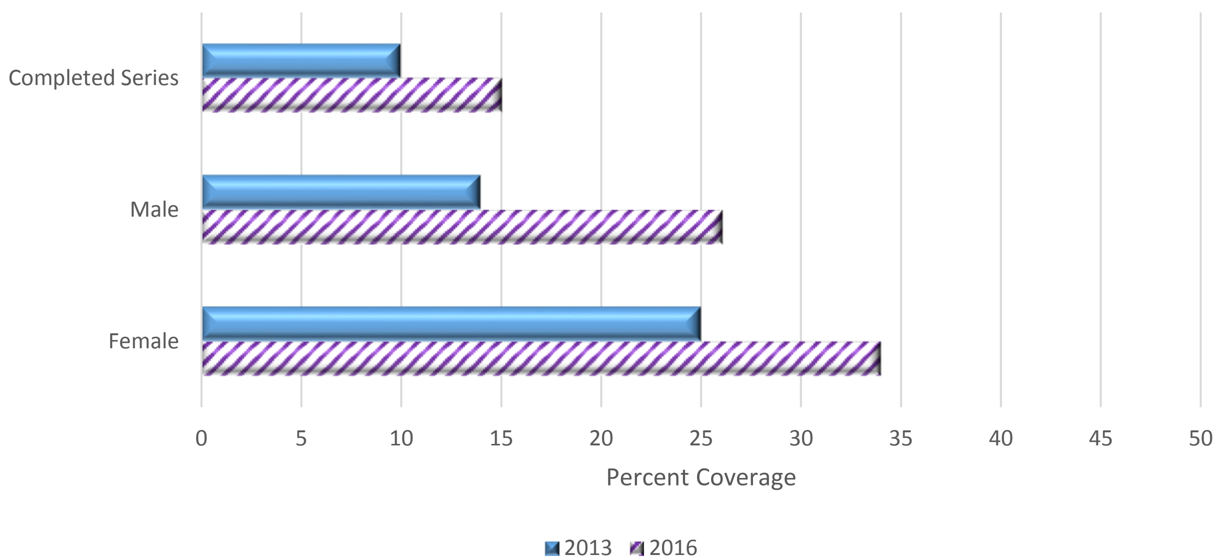


Table 8: Factors statistically associated with receiving HPV vaccine by year, Kansas

BRFSS Year	Factor	Odds Ratio	95% Confidence Interval
2013	**Gender of child** (Female vs. Male)	2.00	1.97 – 2.04
	Age of child (15 to 17 vs. 12 to 14 years)	2.31	2.26 – 2.36
	County of residence (Urban vs. Rural)	1.48	1.43 – 1.52
2016	**Age of child** (15 to 17 vs. 12 to 14 years)	1.22	1.19 – 1.26

Discussion:

Data from BRFSS analysis revealed areas of success and identified areas of improvement for adolescent vaccination coverage in Kansas. Factors significantly associated with receipt of each vaccine provide a guide to develop intervention programs and to identify barriers to vaccination. Factors that significantly affected the odds of a child receiving Tdap were lack of medical insurance, lower parental education level, and lower annual household income. For MenACWY, lack of insurance was found to be associated with lower coverage rates. These observations demonstrate that cost of care was a barrier to vaccination. Kansas does participate in the Vaccines for Children Program (VFC) to provide vaccines for those children that are underinsured or uninsured; however, this is an opt-in program among providers. Access to care was another barrier identified for receipt of adolescent vaccinations. Children living in urban counties had significantly higher odds of receiving MenACWY and HPV vaccinations compared to children living in less densely populated counties. When compared to urban counties, rural counties do not have as many pediatricians which may prevent parents from easily getting their child vaccinated[7].

HPV was the only adolescent vaccine that gender affected the odds of receipt among children of respondents. Females had significantly higher odds of receiving at least one dose of the HPV vaccine series compared to male counterparts. This observation was likely a consequence from the vaccine being licensed and only recommended for females initially. In 2011, ACIP included recommendations for males to also receive HPV vaccination. In 2016 there was an 80% increase in the number of males who received at least one dose compared to 2013 and gender was no longer significantly associated with receipt of the HPV vaccine. HPV was also the only adolescent vaccine that was associated with age of the child; older children (15 to 17 years) were significantly more likely to receive at least one dose of HPV when compared to children aged 12 to 14 years. While other adolescent vaccinations are also recommended around 12 years of age, HPV appears to have slower uptake. This may be an artifact of slower acceptance of this vaccine or lack of awareness of this vaccine recommendation. These observations demonstrate the need to increase awareness of available public services, improve access to preventative care in rural areas, and provide information on the importance of timing for vaccine administration to adolescents.

Limitations:

One limitation to this analysis was that responses of unknown vaccination status for the child were removed from analysis causing a possible underrepresentation of true coverage levels. This percentage of respondents ranged from 53% for Tdap, 30% for MenACWY, to 13% for HPV. However, coverage reported using this method still closely mirrors those found in other studies, including NIS-Teen. Additionally, BRFSS data is self-reported and is subject to recall bias. Lastly, this study does not include persons without telephones. Phone ownership is highly correlated to income, so lower income persons may be underrepresented in this study.

Strengths:

Despite limitations, the standardized methodology and consistency BRFSS provides allowed for reliable results which can be generalized to all Kansas children. Unlike other studies, BRFSS respondents provide socioeconomic information which allowed for analysis into the effects of these factors on vaccination. Respondents were randomly selected, eliminating selection bias. Lastly, the large sample size enabled for a more in-depth analysis to be performed while maintaining results that are representative of Kansas.

References

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Appendix

Tdap Questions from the 2011 and 2014 BRFSS Surveys

CATI note: If respondent is aged 10 to 17, continue. Otherwise, go to next module.

I would like to ask you some questions about the tetanus diphtheria vaccine for your child.

1. **Has he/she received a tetanus shot in the past 10 years?**

Yes	
No	**[Go to next module]**
Don't know / Not sure	**[Go to next module]**
Refused	**[Go to next module]**

2. **Was his/her most recent tetanus given in 2005 or later?**

Yes	
No	**[Go to next module]**
Don't know / Not sure	**[Go to next module]**
Refused	**[Go to next module]**

3. **There are currently two types of tetanus shots available today for older children and teenagers. One is the Td which contains the tetanus diphtheria vaccine. The other type is Tdap, which contains tetanus diphtheria and pertussis or whooping cough vaccine. Thinking back to his/her most recent tetanus shot, did the doctor tell you the vaccine included the pertussis or whooping cough vaccine?**

Yes
No
Doctor did not say
Don't know / Not sure
Refused

Meningococcal Conjugate Vaccination Questions from the 2012 and 2015 BRFSS Survey

If selected child is between ages 11 and 17 years; continue. Otherwise, go to next module.

1. A vaccine to prevent some types of meningitis caused by bacteria is available. Has this child ever had the Meningococcal vaccination?

Yes	
No	**[Go to next module]**
Doctor refused when asked	**[Go to next module]**
Don't know / Not sure	**[Go to next module]**
Refused	**[Go to next module]**

2. How many meningococcal shots did [Fill: she/he] receive?

Number of shots
All shots
Don't know / Not sure

Questions from 2015

If selected child is between ages 11 and 17 years; continue. Otherwise, go to next module.

1. A vaccine to prevent some types of meningitis caused by bacteria is available. Has this child ever had the Meningococcal vaccination?

Yes	
No	**[Go to next module]**
Doctor refused when asked	**[Go to next module]**
Don't know / Not sure	**[Go to next module]**
Refused	**[Go to next module]**

HPV Vaccination Questions from the 2013 and 2016 BFSS Survey

If selected child is between ages 9 and 17 years; continue. Otherwise, go to next module.

NOTE: Human Papilloma Virus (Human Pap·uh·loh·muh Virus);

Gardasil (Gar·duh· l)); Cervarix (Sir·var· icks)

I have two additional questions about a vaccination the selected child may have had.

1. A vaccine to prevent the human papilloma virus or HPV infection is available and is called the cervical cancer or genital warts vaccine, HPV shot, [Fill: if female "GARDASIL or CERVARIX"; if male " or GARDASIL"]. Has this child EVER had an HPV vaccination?

Yes	
No	**[Go to next module]**
Doctor refused when asked	**[Go to next module]**
Don't know / Not sure	**[Go to next module]**
Refused	**[Go to next module]**

2. How many HPV shots did [Fill: she/he] receive?

Number of shots
All shots
Don't know / Not sure
Refused

Questions from 2016

If selected child is between ages 11 and 17 years; continue. Otherwise, go to next module.

1. A vaccine to prevent the human papilloma virus or HPV infection is available and is called the cervical cancer or genital warts vaccine, HPV shot, [Fill: if female "GARDASIL or CERVARIX"; if male "or GARDASIL"]. Has this child EVER had an HPV vaccination?

Yes	
No	**[Go to question 3]**
Doctor refused when asked	**[Go to next module]**
Don't know / Not sure	**[Go to next module]**
Refused	**[Go to next module]**

2. How many HPV shots did [Fill: she/he] receive?

Number of shots	**[Go to next module]**
All shots	**[Go to next module]**
Don't know / Not sure	**[Go to next module]**
Refused	**[Go to next module]**

3. What is the MAIN reason [Fill: he/she] has not received a HPV vaccination?

Do not read answer choices below. Select category that best matches response.

Child does not need it
Doctor did not recommend it
Child not sexually active
Did not know that child should be vaccinated
HPV is not that serious
Side effects
Does not work
Plan to get child vaccinated later
HPV vaccination costs too much
Inconvenient to get vaccinated
Saving vaccine for people who need it more
Tried to find vaccine, but could not get it
Not eligible to receive vaccine
Other (specify) ________________
Have not got around to it/ didn’t get it
Parent does not believe/ approve or is against HPV shots
Age is too young
Do not trust vaccine
Needs more information about vaccine
Don’t know / Not sure (Probe: “What is the main reason?”)
Refused