

Adult Vaccination Update

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Overview of Presentation

- ❑ **Adult vaccination coverage**
 - Data source
 - Coverage by age group, race/ethnicity, vaccination indication
 - Associations of coverage with age, health insurance status, usual place for health care, physician contacts, and nativity
 - Limitations
 - Conclusions
- ❑ **Information Sources**

Data Source National Health Interview Survey, 2014

- ❑ **Annual in-home survey of U.S. non-institutionalized civilian population**
- ❑ **Detailed health survey of one adult per family in each household sampled**
- ❑ **Provides national coverage estimates**
- ❑ **Final sample of adult component:**
 - **Response rate:** 58.9%
 - **N = 36,324**
- ❑ **Sample for estimating influenza coverage, 2013-14 season:**
 - **Response rate:** 61.2% (2013); 58.9% (2014)
 - **N = 32,296**

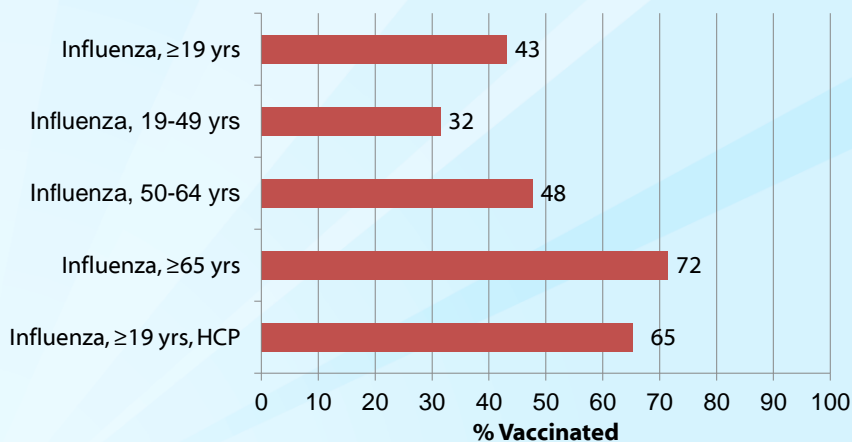
National Health Interview Survey, 2014 Vaccination Questions

- ❑ **Influenza**
- ❑ **PPSV or PCV13, Td/Tdap, HepA, HepB, Zoster, HPV**
 - Proportion of pneumococcal vaccination by type not measured
- ❑ **High-risk status**
 - Limited information collected for Hep A and Hep B
 - Hep A (travel status & chronic liver disease)
 - Hep B (travel status, chronic liver disease, & diabetes mellitus)
 - PPSV or PCV13
- ❑ **Health Care Personnel (HCP)**

Definition of High-Risk for Pneumococcal Disease

- ❑ **Adults were considered at high risk for pneumococcal disease if they had been told by a doctor or other health care professional that they:**
 - Ever had:
 - Diabetes Mellitus
 - Emphysema
 - Chronic obstructive pulmonary disease (beginning in 2012)
 - Coronary Heart Disease, Angina, Heart Attack, or other Heart Condition
 - Lymphoma, Leukemia, or Blood Cancer
 - Had during the preceding 12 months:
 - Cancer Diagnosis (excluding non-melanoma skin cancer)
 - Asthma Episode or Attack
 - Chronic Bronchitis
 - Weak or Failing Kidneys
- ❑ **Or were Current Smokers**

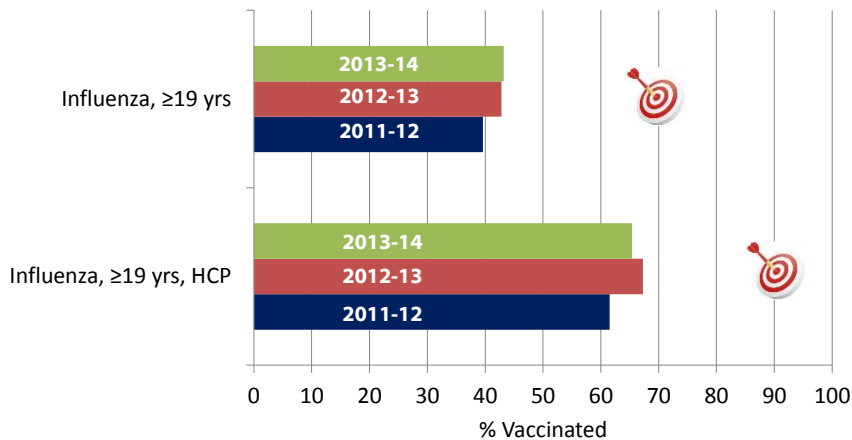
Adult Influenza Vaccination Coverage by Age, 2013-14 season, United States



Data Source: 2013-2014 NHIS

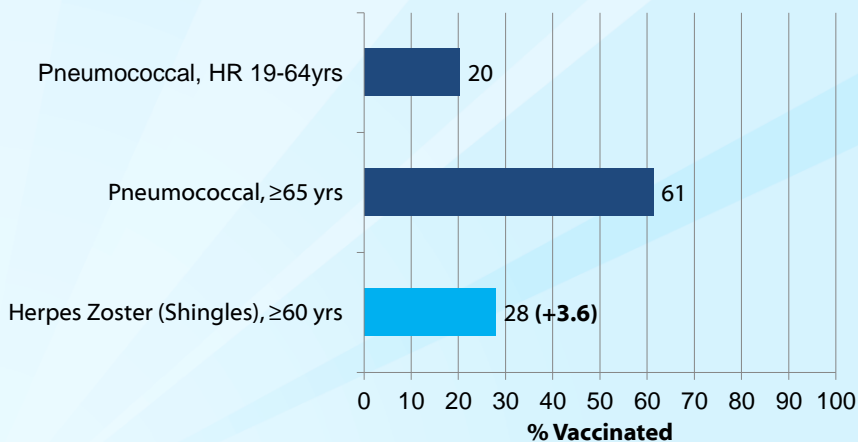
HP2020 Targets: 70% ≥19 years, 90% HCP ≥19 years

Adult Influenza Vaccination Coverage, by Age, United States



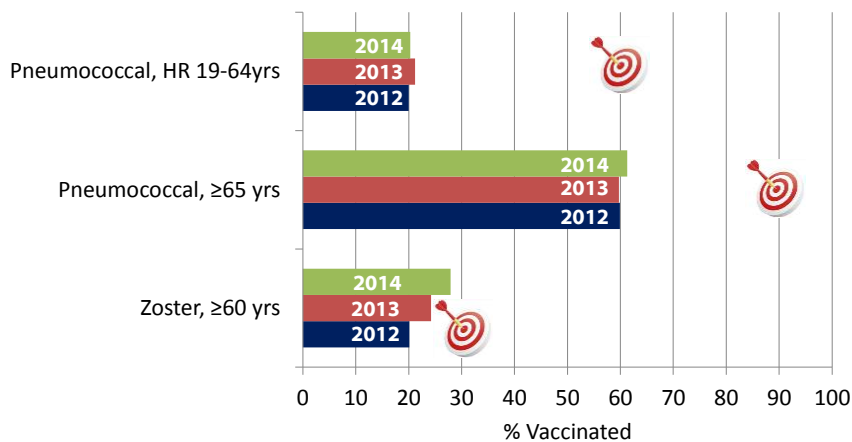
HP2020 Targets: 70% ≥19 years, 90% HCP ≥19 years
 Data Source: 2011, 2012, 2013 and 2014 NHIS

Adult Vaccination Coverage, Selected Vaccines by Age and High-risk Status, United States



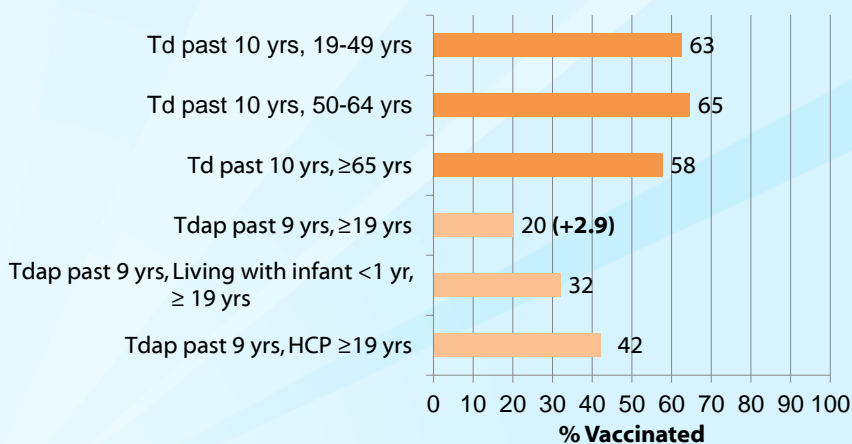
HP2020 Targets: 60% PPV HR 19-64 years, 90% PPV ≥65 years, 30% Shingles
 Data Source: 2014 NHIS

Adult Immunization Coverage, Selected Vaccines by Age and High-risk Status, United States



HP2020 Targets: 90% PPV ≥65 yrs, 60% PPV HR 19-64 yrs, 30% zoster ≥60 yrs
 Data Source: 2012, 2013 and 2014 NHIS

Adult Tetanus-containing Vaccination Coverage by Age and High-risk Status, United States



Data Source: 2014 NHIS

Potential for Bias in Tdap Estimates

❑ **37% of respondents were excluded**

Those:

- without a “yes” or “no” response for tetanus vaccination, past 10 years (5.4%)
- without a response to tetanus vaccination during 2005-2014 (3.0%)
- who reported tetanus vaccination but not told (23.7%) or did not know the vaccine type, refused to answer or data not obtained (4.9%)

❑ **Sensitivity analysis to assess magnitude of bias -- Tdap coverage could range from: 14.5% - 46.9% (adults 19-64 years); 9.5% - 41.6% (adults ≥65 years)**

Data Source: 2014 NHIS

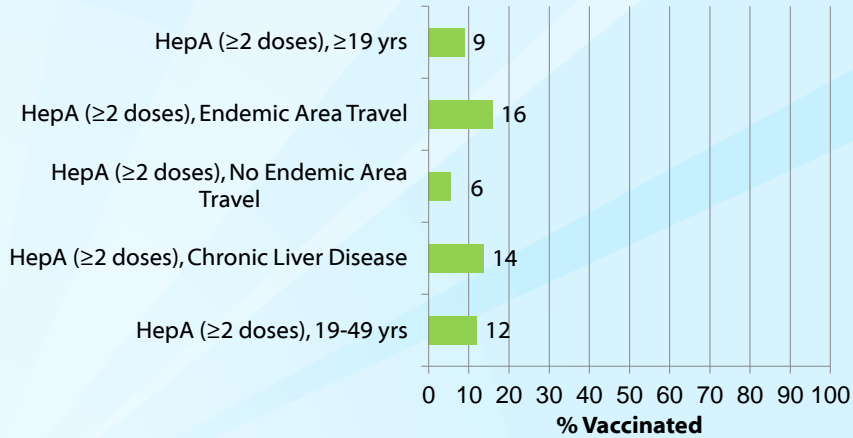
Proportion of adults ≥19 years of age who received Tdap vaccine

Group	Not Told (%)	Not Recall (%)	Tdap/Td+Tdap
Adults, ≥19 years, Overall	51	11	70
HCP, ≥19 years	35	7	81*
Non-HCP, ≥19 years	53	12	68

***p<0.05 by T test for comparisons between HCP and non-HCP ≥19 years.**

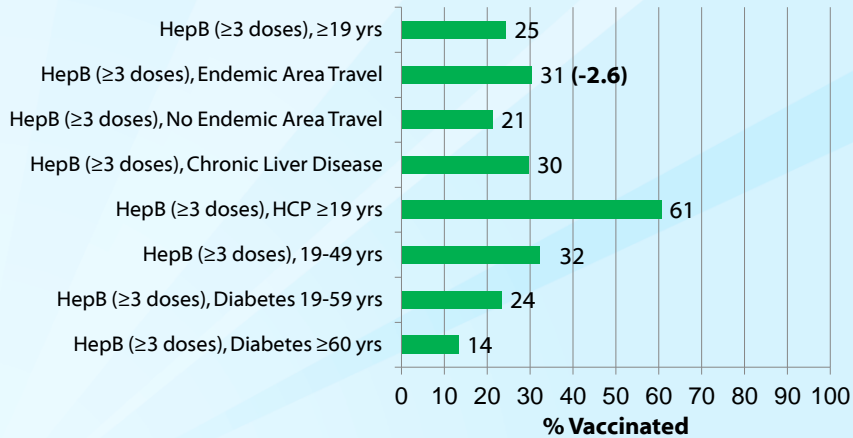
Data Source: 2014 NHIS

Hepatitis A Vaccination Coverage by Age and High-risk Status, United States



Data Source: 2014 NHIS

Hepatitis B Vaccination Coverage by Age and High-risk Status, United States



HP2020 Target: 90% HepB Healthcare Personnel (HCP)

Data Source: 2014 NHIS

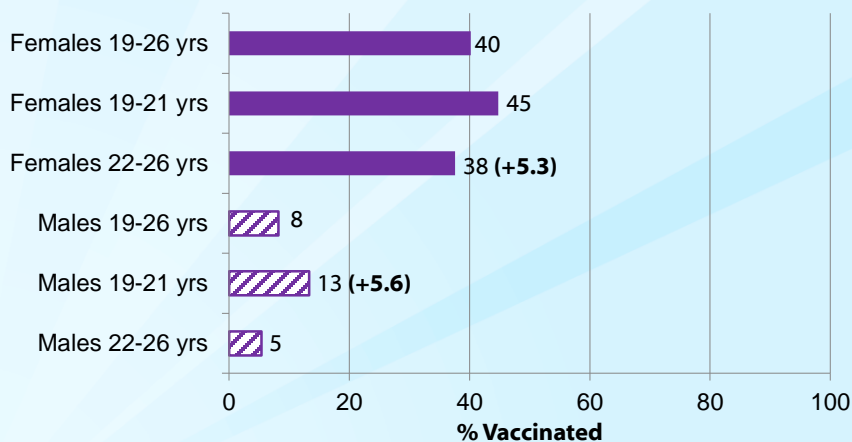
Proportion of HCP ≥ 19 years of age who received selected vaccines, by direct patient care

Group	%
Influenza (2013-14 season), ≥ 19 years, with direct patient care	65
Influenza (2013-14 season), ≥ 19 years, without direct patient care	66
Tdap, ≥ 19 years, with direct patient care	48
Tdap, ≥ 19 years, without direct patient care	32*
HepB (>3 doses), ≥ 19 years, with direct patient care	68
HepB (>3 doses), ≥ 19 years, without direct patient care	48*

* $p < 0.05$ by T test for comparisons between HCP with direct patient care responsibilities and HCP without direct patient care responsibilities.

Data Source: 2014 NHIS

HPV Vaccination Coverage (≥ 1 dose ever), Adults 19-26 years of age by Sex, United States



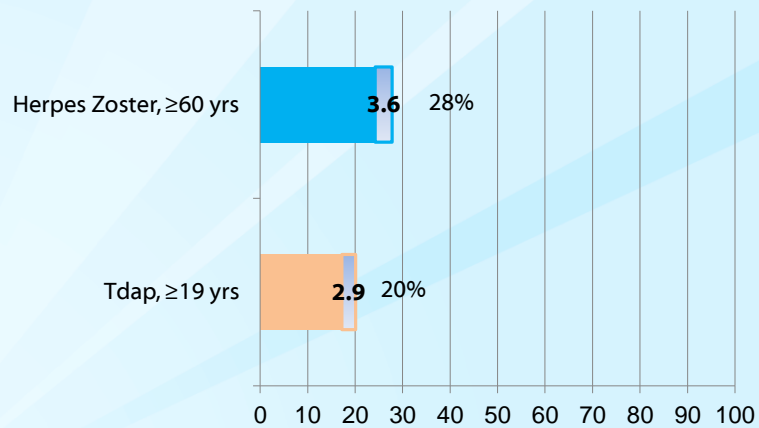
Data Source: 2014 NHIS

Age at First Dose of HPV Vaccination, Among Adults 19-26 years, United States

Age at First Dose	Women (%)	Men (%)
8-10	2	13
11-12	7	4
13-17	58	33
18	13	24
19-26	20	26

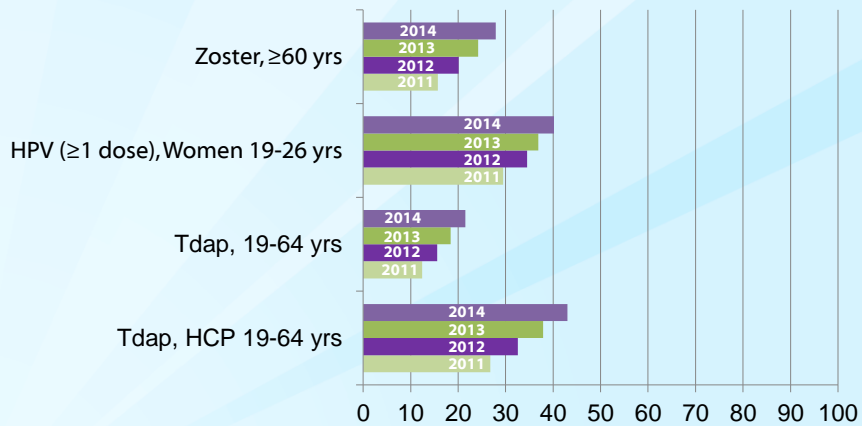
Data Source: 2014 NHIS

Adult Vaccination Coverage Rate Increases from 2013 to 2014



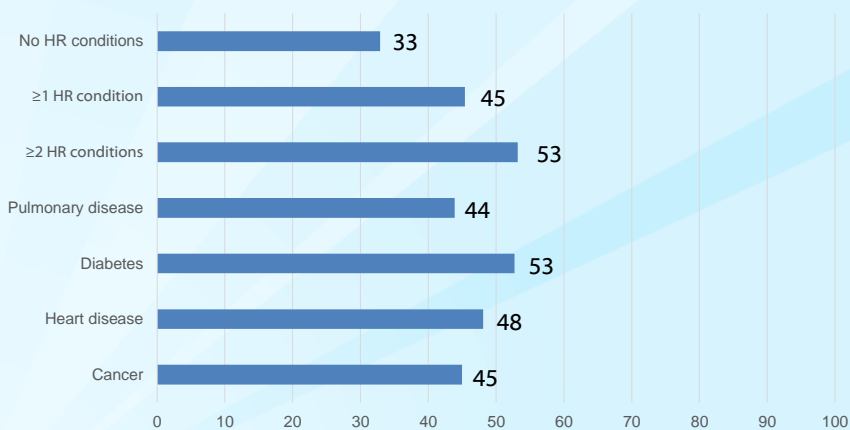
Data Source: NHIS 2013-2014

Adult Vaccination Coverage Selected Vaccines with Increases from 2011 to 2014



Data Source: NHIS 2011-2014

Adult Influenza Vaccination Coverage by High-Risk Condition, 2012-13 season, United States



Data Source: 2012-2013 BRFSS, and O'Halloran, et al. Am J Prev Med 2016;50:e15-e26.

Racial/Ethnic Vaccination Disparities

Vaccination Group	% Vaccinated Whites	Disparity, Blacks	Disparity, Hispanics	Disparity, Asians
Influenza, ≥19 yrs	47	-10	-14	-2
Influenza, 19-49 yrs	33	-3	-6	-3
Influenza, 50-64 yrs	50	-10	-9	-2
Influenza, ≥65 yrs	73	-12	-9	-1
Influenza, HCP ≥19 yrs	68	-17	-2	+10

Data Source: 2014 NHIS

Racial/Ethnic Vaccination Disparities

Vaccination Group	% Vaccinated Whites	Disparity, Blacks	Disparity, Hispanics	Disparity, Asians
Pneumo., HR 19-64 yrs	21	-1	-5	-7
Pneumo., ≥65 yrs	65	-15	-20	-17
Tetanus, 19-49 yrs	69	-16	-17	-17
Tetanus, 50-64 yrs	70	-20	-15	-20
Tetanus, ≥65 yrs	61	-18	-12	-14
Tdap, ≥19 yrs	24	-12	-11	-8
Tdap, 19-64 yrs	26	-13	-13	-11
Tdap, ≥65 yrs	16	-11	-9	-1
HepA, 19-49 yrs	13	-2	-3	+3
HepB, 19-49 yrs	36	-6	-16	-1
Herpes Zoster, ≥60 yrs	32	-20	-17	-16
HPV, Females 19-26 yrs	46	-9	-18	-24
Tdap, HCP ≥19 yrs	46	-22	-11	-5
HepB, HCP ≥19 yrs	63	-12	-12	+5

Racial/Ethnic Vaccination Disparities - Adjusted

Vaccination Group	Adjusted % Vaccinated Whites	Disparity, Blacks	Disparity, Hispanics	Disparity, Asians
Influenza, 19-64 yrs	31	-3	+2	+8
Influenza, 65 yrs	68	-13	-1	+4
Pneumo., HR 19-64 yrs	21	-4	-5	-6
Pneumo., ≥65 yrs	62	-16	-6	-9
Tetanus, 19-64 yrs	67	-11	-6	-11
Tetanus, ≥65 yrs	56	-8	-2	-5
Herpes Zoster, ≥60 yrs	21	-10	-7	0
HPV, Females 19-26 yrs	39	-11	-15	-18

Data Source: NHIS 2012

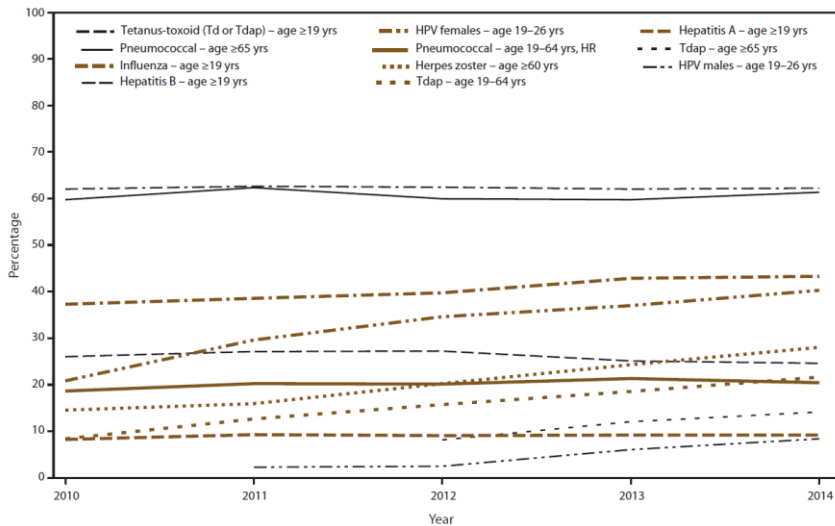
Lu PJ, O'Halloran A, Williams WW, Lindley MC, Farrall S, Bridges CB. Racial and ethnic disparities in vaccination coverage among adult populations in the U.S. Am J Prev Med 2015;49:S412-S424.

Racial/Ethnic Vaccination Disparities -- NHIS 2014 Compared with 2013, racial/ethnic differences persisted for all seven and widened for Tdap and herpes zoster:

- ❑ **Non-Hispanic blacks, Hispanics, and Non-Hispanic Asians had lower vaccination coverage than that of non-Hispanic whites for all of the vaccines routinely recommended for adults, except for:**
 - Influenza 19+ -- Asians had coverage similar to whites
 - PPSV/PCV13 19-64-HR -- Blacks had coverage similar to whites
 - HepA 19-49 – Blacks and Asians had coverage similar to whites
 - HepB 19-49 – Asians had coverage similar to whites
 - HPV 19-26 females – Blacks had coverage similar to whites
- ❑ **Health Care Personnel (HCP) – Non-Hispanic black HCP had lower coverage than white HCP for Influenza, Tdap, and HepB; Hispanic HCP had lower coverage than white HCP for Tdap and HepB.**

Trends in Adult Vaccination

FIGURE 1. Estimated proportion of adults aged ≥19 years who received selected vaccines,* by age group and high-risk status† — National Health Interview Survey, United States, 2010–2014



Footnotes for Figure 1

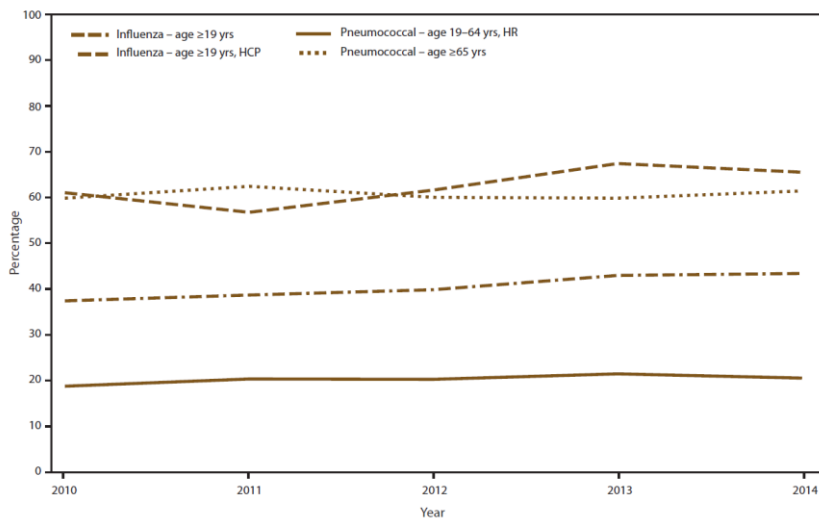
NOTE: Additional tables for this figure are available at <http://stacks.cdc.gov/view/cdc/37407>.

Abbreviations: HPV = human papillomavirus; HR = high risk; Td = tetanus-diphtheria toxoid; Tdap = tetanus, diphtheria, and acellular pertussis vaccine.

* Influenza vaccination coverage for 2010 is coverage from the 2009–10 season, 2011 is coverage from the 2010–11 season, 2012 is coverage from the 2011–12 season, 2013 is coverage from the 2012–13 season, and 2014 is coverage from the 2013–14 season. Interviews from August through June of each season were used to estimate coverage from July through May using Kaplan Meier survival analysis. Tdap vaccination coverage data among adults aged ≥ 65 years are available beginning in the NHIS 2012 survey. The 2010 HPV vaccination coverage estimate among males is suppressed due to relative standard error $>30\%$.

† Adults were considered at high risk for pneumococcal disease if they had ever been told by a doctor or other health professional that they had diabetes, emphysema, chronic obstructive pulmonary disease (beginning in 2012), coronary heart disease, angina, heart attack, or other heart condition; had a diagnosis of cancer during the previous 12 months (excluding nonmelanoma skin cancer); had ever been told by a doctor or other health professional that they had lymphoma, leukemia, or blood cancer; had been told by a doctor or other health professional that they had chronic bronchitis or weak or failing kidneys during the preceding 12 months; had an asthma episode or attack during the preceding 12 months; or they were current smokers.

FIGURE 2. Estimated proportion of adults* aged ≥ 19 years who received influenza[†] and pneumococcal vaccines, by age group and high-risk status[‡] — National Health Interview Survey, United States, 2010–2014



Footnotes for Figure 2

NOTE: Additional tables for this figure are available at <http://stacks.cdc.gov/view/cdc/37407>.

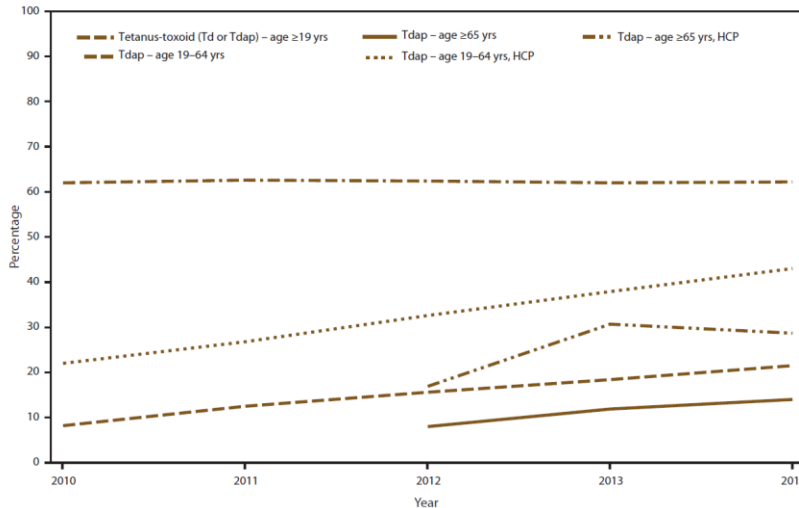
Abbreviations: HCP = health care personnel; HR = high risk.

* Adults were classified as health care personnel if they reported they currently volunteer or work in a hospital, medical clinic, doctor's office, dentist's office, nursing home or some other health-care facility including part-time and unpaid work in a health care facility as well as professional nursing care provided in the home.

† Influenza vaccination coverage for 2010 is coverage from the 2009–10 season, 2011 is coverage from the 2010–11 season, 2012 is coverage from the 2011–12 season, 2013 is coverage from the 2012–13 season, and 2014 is coverage from the 2013–14 season. Interviews from August through June of each season were used to estimate coverage from July through May using Kaplan Meier survival analysis.

§ Adults were considered at high risk for pneumococcal disease if they had ever been told by a doctor or other health professional that they had diabetes, emphysema, chronic obstructive pulmonary disease (beginning in 2012), coronary heart disease, angina, heart attack, or other heart condition; had a diagnosis of cancer during the previous 12 months (excluding nonmelanoma skin cancer); had ever been told by a doctor or other health professional that they had lymphoma, leukemia, or blood cancer; had been told by a doctor or other health professional that they had chronic bronchitis or weak or failing kidneys during the preceding 12 months; had an asthma episode or attack during the preceding 12 months; or were current smokers.

FIGURE 3. Estimated proportion of adults aged ≥19 years who received a tetanus toxoid-containing vaccine (Td or Tdap) and proportion of those who received Tdap vaccine, by age group* — National Health Interview Survey, United States, 2010–2014



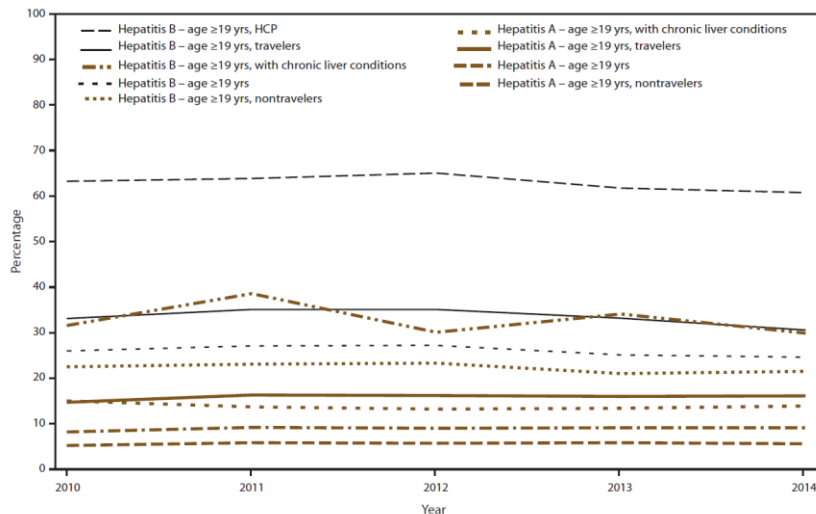
Footnotes for Figure 3

NOTE: Additional tables for this figure are available at <http://stacks.cdc.gov/view/cdc/37407>.

Abbreviations: HCP = health care personnel; Td = tetanus-diphtheria toxoid; Tdap = tetanus, diphtheria, and acellular pertussis vaccine.

* Tdap vaccination coverage data among adults aged ≥ 65 years are available beginning in the NHIS 2012 survey.

FIGURE 4. Estimated proportion of adults aged ≥ 19 years who received hepatitis A and hepatitis B vaccines, by age group and high-risk status — National Health Interview Survey, United States, 2010–2014

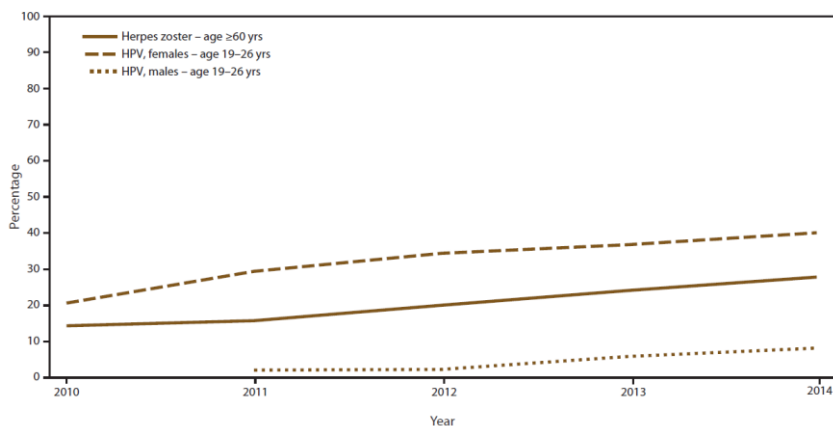


Footnotes for Figure 4

NOTE: Additional tables for this figure are available at <http://stacks.cdc.gov/view/cdc/37407>.

Abbreviations: HCP = health care personnel; travelers = persons who had traveled outside the United States to countries other than countries in Europe, Japan, Australia, New Zealand, or Canada since 1995; nontravelers = persons who had not traveled outside the United States to countries other than countries in Europe, Japan, Australia, New Zealand, or Canada since 1995.

FIGURE 5. Estimated proportion of adults aged ≥ 19 years who received herpes zoster and human papillomavirus* vaccines, by age group — National Health Interview Survey, United States, 2010–2014



Footnotes for Figure 5

NOTE: Additional tables for this figure are available at <http://stacks.cdc.gov/view/cdc/37407>.

Abbreviation: HPV = human papillomavirus.

* The 2010 HPV vaccination coverage estimate among males is suppressed due to relative standard error >30%.

Association of Age with Vaccination Coverage

- ❑ **Influenza and pneumococcal vaccination – adults aged ≥ 65 years had higher coverage than those aged 19-64 years**
- ❑ **Td and Tdap vaccination – adults aged 19-64 years had higher coverage than those aged ≥ 65 years**
- ❑ **HepB vaccination, persons with diabetes – adults aged 19-59 years had higher coverage than those aged ≥ 60 years**
- ❑ **Herpes zoster vaccination – adults age ≥ 65 years had higher coverage than those aged 60-64 years**

Association of Health Insurance Status with Vaccination Coverage

- ❑ **Most study respondents (87%) indicated having some type of health insurance**
- ❑ **Coverage was lower among adults without health insurance compared with those with health insurance, except for overall HepB vaccination among persons with chronic liver conditions or diabetes**
- ❑ **For influenza, Tdap, herpes zoster, and HPV vaccination – coverage was two to five times higher among those with health insurance compared with those without insurance**
- ❑ **Coverage differed by type of insurance for five of seven vaccines (all but influenza and HPV) – higher among those reporting private versus public insurance**

Association of Health Insurance Status and Having a Usual Place for Health Care with Vaccination Coverage

- ❑ **Except for HepA and HepB vaccination, adults with a usual place for health care were more likely to report having received recommended vaccinations than those who did not have a usual place for health care, among those who had health insurance**
- ❑ **Among adults without health insurance, coverage was higher for those who had a usual place for health care compared with those who did not for influenza vaccination, pneumococcal vaccination (19-64 years, HR), and overall tetanus vaccination (≥ 19 years)**

Adult Vaccination Coverage by Health Insurance Status and Physician Contacts

- ❑ **Except for overall HepA vaccination (≥ 19 years) and HPV vaccination (women 19-26 years), coverage was higher among those reporting having had one or more physician contacts in the past year compared with those who had not visited a physician, regardless of whether they had health insurance**
- ❑ **Vaccination coverage generally increased as the number of physician contacts increased**
- ❑ **Missed opportunities to vaccinate occurred among 24% - 89% of respondents, depending on the vaccine**

Adult Vaccination Coverage by Nativity

- ❑ **Vaccination coverage among U.S. - born respondents was higher than that of foreign-born respondents with few exceptions (influenza vaccination, 19-49 years; HepA vaccination, ≥ 19 ; HepB vaccination, persons with diabetes, ≥ 19 years and ≥ 60 years; HPV vaccination, males, 19-26 years)**

Adult Vaccination Coverage by Years Living in the United States and Citizenship

- ❑ **Coverage was higher for foreign-born persons living in the United States ≥ 10 years compared with those living in the United States < 10 years for influenza vaccination (≥ 19 years and ≥ 65 years)**
- ❑ **Coverage among foreign-born adults who were U.S. citizens was higher than that for foreign-born respondents who were not U.S. citizens, except for pneumococcal & Td vaccination (≥ 65 years), HepA & HepB persons with diabetes (≥ 19 years), and HPV (women 19-26 years)**

Limitations of Findings

- ❑ **NHIS excludes persons in the military and those residing in institutions – results apply to the civilian, non-institutionalized population**
- ❑ **Response rate 58.9% -- low response rate can result in sampling bias if the nonresponse is unequal among participants regarding vaccination**
- ❑ **Reported vaccination status and high-risk conditions not validated by medical records**
- ❑ **Self-report of vaccination subject to recall bias**
- ❑ **Tdap estimates: potential bias due to exclusions**

Conclusions

- ❑ **Overall coverage remains below HP2020 targets**
 - 70% for 19+ for influenza vaccine
 - 90% for 65+ years for pneumococcal vaccine
 - 60% for high risk 19-64 years for pneumococcal vaccine
 - 30% for 60+ years for Zoster vaccine
 - 90% for hepatitis B vaccine for healthcare personnel
- ❑ **Some improvement from 2013**
 - Tdap (≥19 year olds), and herpes zoster (≥60 year olds) vaccines
 - No improvements for other vaccines
- ❑ **Racial and ethnic disparities remain**
- ❑ **Much remains to be done to increase vaccine utilization among adults and to eliminate disparities**

Collaborators

- ❑ **Peng-Jun Lu, MD, PhD**
- ❑ **Alissa O'Halloran, MSPH**
- ❑ **Carolyn B. Bridges, MD**
- ❑ **David K. Kim, MD**
- ❑ **Lisa A. Grohskopf, MD**
- ❑ **Tamara Pilishvili, MPH**
- ❑ **Tami H. Skoff, MS**
- ❑ **Noele P. Nelson, MD, PhD**
- ❑ **Rafael Harpaz, MD**
- ❑ **Lauri E. Markowitz, MD**
- ❑ **Alfonso Rodriguez-Lainz, PhD, DVM**
- ❑ **Walter W. Williams, MD**

For Additional Information:

ACIP Recommendations for Specific Vaccines

- ❑ <http://www.cdc.gov/vaccines/hcp/acip-recs/index.html>

Surveillance of Adult Vaccination Coverage

- ❑ http://www.cdc.gov/mmwr/volumes/65/ss/ss6501a1.htm?s_cid=ss6501a1_w.htm

Surveillance of Adult Vaccination Coverage: additional tables for figures

- ❑ <http://stacks.cdc.gov/view/cdc/37407>

AdultVaxView

- ❑ <http://www.cdc.gov/vaccines/imz-managers/coverage/adultvaxview/index.html>

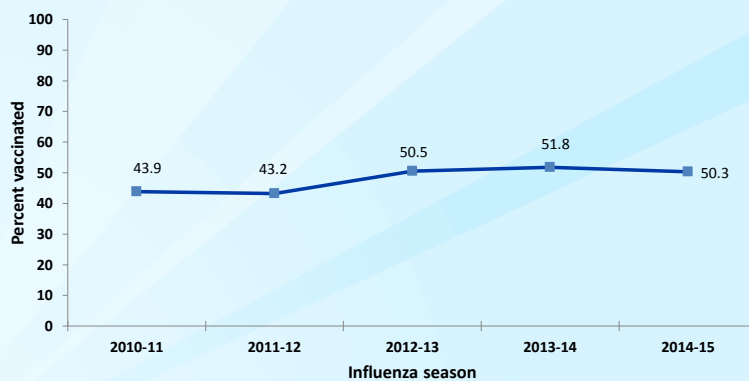


<http://www.cdc.gov/>

Extra Slides on Vaccination of Pregnant Women – Internet Panel Surveys

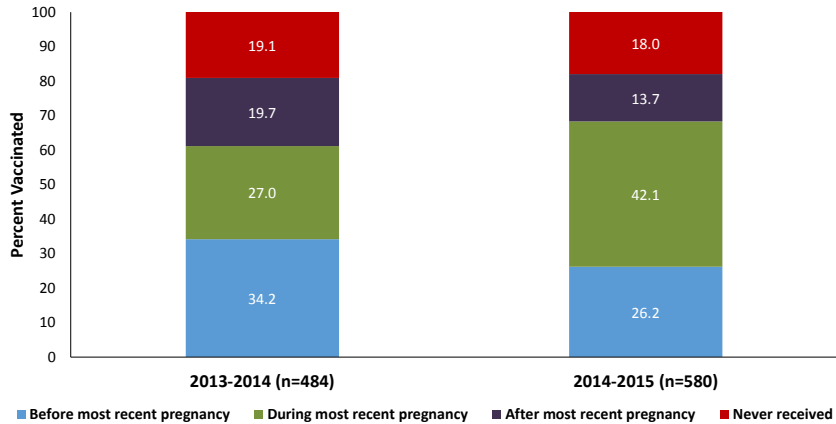
Influenza Vaccination Coverage among Pregnant Women, 2010-11 through 2014-15 seasons, Internet Panel Survey, United States

Influenza vaccination coverage* before and during pregnancy among women pregnant during October-January of each influenza season, Internet panel survey, United States



* Beginning in the 2012-13 season, women vaccinated since July 1 were counted as vaccinated. In prior seasons, only women vaccinated since August 1 were counted as vaccinated.

Tdap Coverage among Pregnant Women* by Timing of Vaccination, 2013-2014 through 2014-2015, Internet Panel Survey, United States



* Among women who had a live birth any time during August-March preceding each survey

Extra Slide on Seroprevalence of Human Papillomavirus Type Categories – Females and Males

Seroprevalence of HPV Types by Sex, NHANES -- 2005-2006, United States

Gender and Age Group	Any 9 HR	Any 7 HR	16/18	6/11
	%	%	%	%
Female, overall	40.5	30.0	18.3	22.7
14-19 yrs	16.2	10.7	5.3	8.7
20-29 yrs	44.6	33.6	20.0	25.0
30-39 yrs	52.4	40.5	27.8	30.1
40-49 yrs	45.5	35.1	21.1	23.6
50-59 yrs	32.9	21.5	11.5	20.0
Male, overall	19.4	11.9	6.6	10.5
14-19 yrs	5.9	4.1	1.6	2.3
20-29 yrs	15.6	6.8	2.9	9.5
30-39 yrs	23.6	14.9	7.5	11.9
40-49 yrs	27.4	19.4	13.4	13.7
50-59 yrs	18.4	10.1	4.7	11.8