Our Best Shot: Expanding Prevention through Vaccination in Older Adults

A White Paper
July 29, 2015

Alliance
FOR AGING RESEARCH

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Acknowledgements

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Executive Summary

Vaccines are widely recognized as safe, clinically-effective, and cost-effective, and thus they are an integral part of public health policy in the United States. However, vaccination rates are below targeted levels, particularly for vaccines recommended for older adults. The Alliance for Aging Research is interested in understanding the drivers of "underutilization" of adult vaccines and in developing policy recommendations that might lead to increased appropriate utilization. Toward that aim, they have commissioned this analysis.

To further understanding of drivers and obstacles of adult vaccine use, this paper first provides context by reviewing vaccination levels, trends, and targets, incidence rates, relevant health insurance coverage policies, and the cost effectiveness literature and other reports that have evaluated vaccine utilization in this population. We then identify factors that are shown to be related to vaccine utilization in a nationally representative survey of health status and behaviors that has been conducted since 2000.

Our analysis identifies obstacles that reduce the likelihood that older adults will use different vaccines and measures the extent to which financial, information, health barriers and demographic factors contribute to underutilization of vaccines. Based the results of this analysis and other findings in the literature we conclude with policy recommendations to reduce barriers or mitigate their effect on vaccination rates among older adults in the US.

Recommendations to Increase Vaccinations Rates in Older Adults

Information strategies.

- Expand efforts to provide specific education to adult patients about adult vaccines
- Create more general awareness of the importance of adult vaccination
- Encourage retail pharmacy clinics to administer and promote the shingles vaccine
- Evaluate the potential benefit of recommending that seniors with multiple chronic conditions vaccinate with their medical homes, as opposed to in pharmacy settings

Health care and administrative strategies.

- Encourage states that do not allow pharmacists to administer the tetanus vaccines to do so
- Encourage physicians to participate in TransactRx
- Encourage the use of electronic medical records and systems that incorporate adult vaccines into clinical workflow models

- Evaluate the potential gains from the government sponsoring CDC vaccine distribution and tracking program similar to the Vaccines for Children (VFC) program
- Require providers to ascertain beneficiaries' vaccination history and discuss recommended vaccines during the Initial Preventive Physical Examination (IPPE)
- Advance the incorporation of vaccine utilization into quality measures into Medicare Star Rating programs and in private quality metrics such as HEDIS

Financial strategies.

- Evaluate the impact of a government-sponsored vaccine buy-back program
- Evaluate the potential for CMS to "pre-pay" providers for vaccines
- Consider a proposal that CMS consistently communicate to Part D plans the option of including a $0-vaccine only tier in benefit design

Introduction and scope of charge

Vaccines are widely recognized as safe, clinically-effective, and cost-effective, and thus they are an integral part of public health policy in the United States. However, vaccination rates are below targeted levels, particularly for vaccines recommended for older adults. The Alliance for Aging Research is interested in understanding the drivers of "underutilization" of adult vaccines and in developing policy recommendations that might lead to increased appropriate utilization. Toward that aim, they have commissioned this analysis.

To further understanding of drivers and obstacles of adult vaccine use, this paper first provides context by reviewing vaccination levels, trends, and targets, incidence rates, relevant health insurance coverage policies, and the cost effectiveness literature and other reports that have evaluated vaccine utilization in this population. We then identify factors that are shown to be related to vaccine utilization in a nationally representative survey of health status and behaviors that has been conducted since 2000. This analysis identifies obstacles that reduce the likelihood that older adults will use different vaccines and measures the extent to which financial, information, health barriers and demographic factors contribute to underutilization of vaccines. Based the results of this analysis and other findings in the literature we conclude with policy recommendations thought to reduce barriers or mitigate their effect on vaccination rates among older adults in the US.

Background

ACIP vaccine recommendations

The Centers for Disease Control's Advisory Committee for Immunization Practices (ACIP) maintains vaccine recommendations, including who should receive particular vaccines and when they should receive them.[1] These recommendations cover a wide range of vaccines for all members of the population, including pediatric patients as well as adults. In fact, vaccines are probably more commonly thought of in terms of preventing illnesses in infants. Despite the importance of vaccination in that population, our focus here is on the vaccination of elderly adults. Hence, we will not discuss in any detail, utilization of vaccines such as DTaP, MMR, Polio or other important vaccines. Our focus will be on the four vaccines most generally used in adult elderly populations: the Influenza, Pneumococcal, Tetanus and Shingles vaccines.

As shown below in Figure 1, ACIP recommends the influenza, pneumococcal, tetanus, and shingles vaccines for virtually all older adults and the Hepatitis B vaccine for certain subsets of the population. Figure 1 also indicates the coverage status of each relevant vaccine under the Medicare program as will be discussed in section 0. These vaccines protect against the following diseases:

- Influenza: Influenza (also known as the "flu") is a respiratory infection caused by several strains of viruses. Typical symptoms include chills, fever, muscle aches, sore throat, cough, runny nose and headaches. Some people may also have nausea and vomiting. Influenza is very contagious and can be spread up to seven days after symptoms have subsided. Recovery typically takes one week, although many people develop complications. Influenza can cause death among children and older adults. Individuals age 65 and older account for 50% of hospitalizations for influenza.[2] The first vaccine for influenza mass produced for civilian use was made available in 1945.[3] The vaccine can potentially change every year in anticipation of the type of influenza strain forecasted for the coming flu season.
- Pneumococcal disease: The *streptococcus pneumoniae* bacterium causes pneumococcal pneumonia, pneumococcal bacteremia, pneumococcal meningitis, and other diseases. Symptoms of pneumococcal disease commonly include an abrupt onset of fever and chills or rigors, chest pain, shortness of breath, rapid breathing, rusty sputum, cough, weakness, and malaise.[4] The

[1] Centers for Disease Control Advisory Committee for Immunization Practices, "Vaccine Recommendations of the ACIP," accessed August 28, 2014, http://www.cdc.gov/vaccines/hcp/acip-recs/vacc-specific/index.html.

[2] CDC 2013, CDC Influenza Update for Geriatricians and Other Clinicians Caring for People 65 and Older.

[3] Claude Hannon, "The Evolving History of Influenza Viruses and Influenza Vaccines," *Expert Review of Vaccines* 12, no. 9 (2013): 1087.

[4] Centers for disease Control, *The Pink Book: Course Textbook* 12th ed. (Atlanta: Centers for disease Control, 2012): 233-

bacterium can commonly inhabit humans asymptomatically, only causing sickness after the immune system is weakened. Each year, more than 900,000 cases of community-acquired pneumonia are estimated to occur in seniors in the U.S.[5] An estimated 64% of the total economic burden of influenza comes from those over 65 years old.[6] Although the bacterium was first isolated by Pasteur in 1881, the first vaccine was developed only in 1977, and the first conjugate vaccine was developed in 2000.[7]

- Tetanus: Tetanus, commonly known as "lockjaw," is a bacterial infection that affects the nervous system and can cause jaw cramping, muscle spasms, and seizures.[8] Infection is caused by the introduction of the *Clostridium Tetani* bacterium through breaks in the skin. Symptoms from tetanus generally occur within seven to eight days after exposure.[9] Tetanus infection is considered a medical emergency and requires intensive treatment that includes hospitalization, aggressive wound care, and in some cases, a ventilator to assist in breathing. According to the Centers for Disease Control, up to one in five tetanus cases result in death. A tetanus vaccination can confer an immunity of up to 10 years and booster shots after ten years are recommended. Most people who seek professional care for a wound will receive a tetanus booster if they had not received one in the previous five years.[10]
- Shingles: Shingles (also known as herpes zoster) is a viral infection resulting from the reactivation of the virus that causes chickenpox.[11] About half of those that live to be 85 will get shingles during their lives.[12] Symptoms include painful rashes, and effective treatment is limited.[13] In studies, 42% of patients described their worst pain from shingles as "horrible" or "excruciating," exceeding the pain from childbirth, musculoskeletal pain, osteoarthritis, and chronic cancer.[14] Approximately 10% of shingles patients develop postherpetic neuralgia (PHN),

248, *available at* http://www.cdc.gov/vaccines/pubs/pinkbook/downloads/pneumo.pdf.

5 Jackson et al. 2004, The Burden of Community Acquired Pneumonia in Seniors.

6 Molinari et al. 2007, The Annual Impact of Seasonal Influenza in the U.S.

7 Centers for disease Control, *The Pink Book: Course Textbook* 12th ed. (Atlanta: Centers for disease Control, 2012): 233-248, *available at* http://www.cdc.gov/vaccines/pubs/pinkbook/downloads/pneumo.pdf.

8 Centers for Disease Control, "About Tetanus," http://www.cdc.gov/tetanus/about/index.html, accessed September 18, 2014.

9 Mayo Clinic, "Tetanus: Expert Answers," http://www.mayoclinic.org/diseases-conditions/tetanus/expert-answers/tetanus-shots/faq-20058209, accessed September 18, 2014.

10 Mayo Clinic, "Tetanus: Definition," http://www.mayoclinic.org/diseases-conditions/tetanus/basics/definition/con-20021956, accessed September 18, 2014.

11 Over 98% of Americans have had chicken pox and are at risk for developing shingles. Government Accountability Office, "Many Factors, Including Administrative Challenges, Affect Access to Part D Vaccinations," page 50, *available at* http://www.gao.gov/assets/590/587009.pdf.

12 Schmander 2001, Herpes Zoster in Older Adults

13 Government Accountability Office, "Many Factors, Including Administrative Challenges, Affect Access to Part D Vaccinations," page 50, *available at* http://www.gao.gov/assets/590/587009.pdf.

14 Michael Oxman, MD, Study Chairman of the Department of Veterans Affairs' (VA) Shingles Prevention Study and Professor of Medicine and Pathology, University of California, San Diego and Staff Physician (Infectious Diseases) at the VA San Diego Healthcare System, stated that, "Shingles can really blight the lives of older people...I have seen active people end up in a nursing home due to PHN."

a condition in which patients continue to experience the pain from shingles for months or years, even after the rashes have resolved. Approximately one to four percentof shingles episodes result in hospitalization and the average length of stay is 4.8 days.[15] Shingles can cause blindness for the 10% of patients who develop facial rashes. A vaccine for shingles was introduced in 2006 by Merck.

- Hepatitis B: Hepatitis B is a viral infection that primarily affects the liver and is spread through contact with blood and other body fluids from an infected person.[16] In its acute form, which can last up to six months, symptoms can include abdominal pain, dark urine, fever, and jaundice. Among adults, acute hepatitis B infection can transition into a chronic infection six to 10 percent of the time. For these individuals, the acute symptoms disappear, but the virus continues to cause damage to the liver for decades after the initial exposure. Up to a quarter of those chronically infected end up with a serious liver disease, such as cirrhosis or cancer. The CDC began recommending routine vaccination of all infants in 1991.[17]

[15] CDC 2008, Prevention of Herpes Zoster.

[16] Centers for Disease Control, "Hepatitis B Information for the Public," http://www.cdc.gov/hepatitis/B/index.htm, accessed September 24, 2014.

[17] Centers for Disease Control and Prevention (CDC), "Hepatitis B Virus: A Comprehensive Strategy for Eliminating Transmission in the United States through Universal Childhood Vaccination: Recommendations of the Immunization Practices Advisory Committee," Morbidity and Mortality Weekly Report, November 22, 1991, http://www.cdc.gov/mmwr/preview/mmwrhtml/00033405.htm, accessed September 24, 2014.

Figure 1: ACIP vaccine recommendations and Medicare coverage

Vaccine	ACIP recommendation	Part B coverage	Part D coverage
Hepatitis B	All infants at birth and adults in certain risk groups[18]	✔ (in certain risk groups[19])	✔
Influenza	Annually for all people over the age of 6 months	✔	
Pneumococcal	Persons age 65 and over, immunocompromised adults aged 19-64, children in certain risk groups, and children younger than five	✔	
Tdap/Td (Tetanus)[20]	All children are vaccinated with DTaP (or DT, if contraindications are present). Adolescents receive a course of Td and Tdap. Adults receive a regular booster of Td or Tdap every ten years and/or after exposure	✔ (after exposure)	✔
Zoster (Shingles)	Once for adults over the age of 60		✔
Hepatitis A, Hib, Measles, Mumps, Rubella, polio, rotavirus, varicella	All children	N/A	N/A
HPV, Meningococcal disease	All adolescents	N/A	N/A
Japanese encephalitis, typhoid, yellow fever	Certain travelers	N/A	N/A
Rabies, Anthrax, Smallpox	Postexposure and laboratory workers	N/A	N/A

Source: Advisory Committee for Immunization Practices, "ACIP Vaccine Recommendations," http://www.cdc.gov/vaccines/hcp/acip-recs/index.html, accessed September 24, 2014.

Vaccination rates, trends, and targets

Despite the potentially debilitating health outcomes associated with influenza, pneumonia, shingles, and tetanus, not all older adults receive these recommended vaccines. Figure 2 below reports vaccination rates for the four routinely-recommended vaccines during the 2000-2012 period.[21] It

[18] Includes those with more than one sex partner during the previous 6 months, HIV positive individuals, healthcare workers who must handle blood, and certain international travelers.

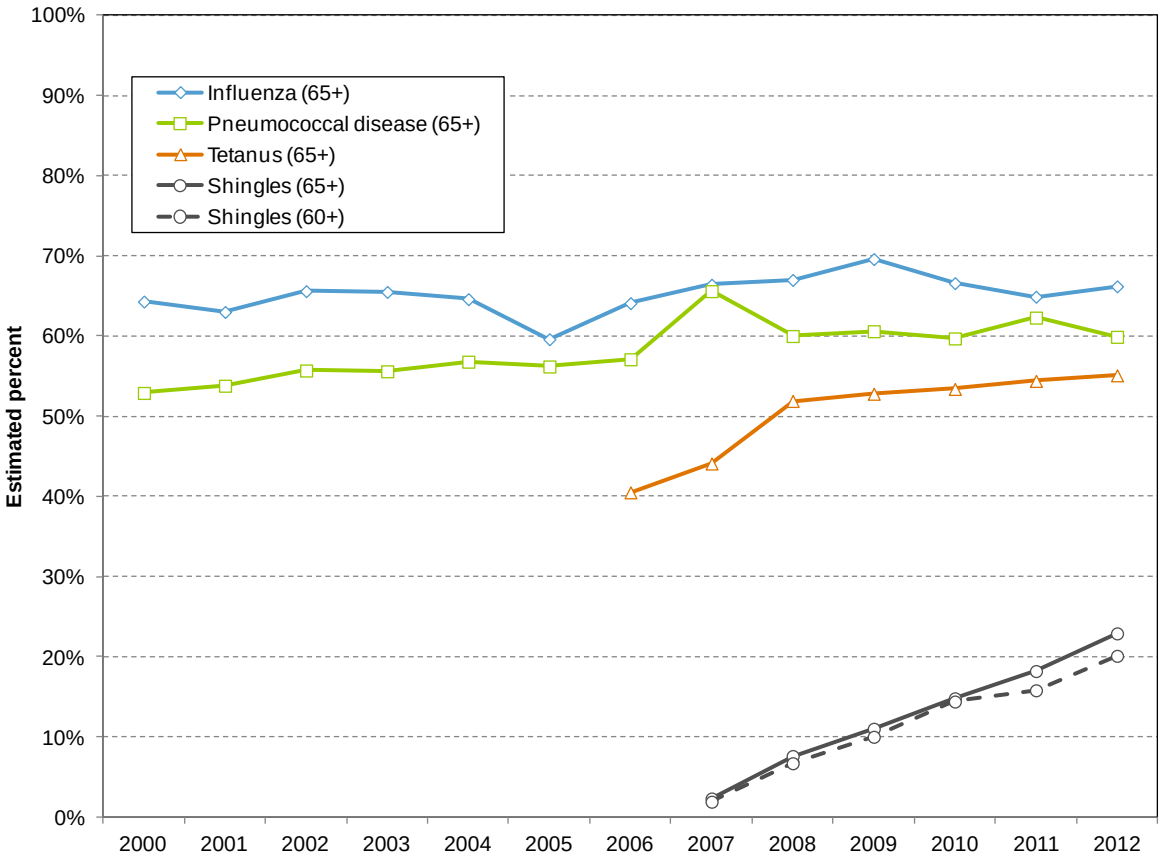
[19] Risk groups covered include: those with End-Stage Renal Disease (ESRD), hemophiliacs, clients and staff at institutions for the developmentally disabled, those who live in the same household as an hepatitis B carrier, homosexual men, illicit drug users, and health care professionals who have frequent contact with blood or other body fluids during routine work. Medicare Interactive, "Medicare coverage of hepatitis B shots," http://www.medicareinteractive.org/page2.php?topic=counselor&page=script&script_id=204, accessed September 18, 2014.

[20] In the remainder of this paper, the tetanus vaccine refers to either Td or Tdap.

[21] Starting in 2009, influenza vaccination rates reflect flu seasons rather than calendar years. For example, the 2012 vaccination rate of 66.2% represents the 2012-2013 flu season. The pneumococcal vaccination rate represents patients who have been vaccinated with either the 23-valent pneumococcal polysaccharide vaccine, the 7-valent pneumococcal conjugate vaccine, or the 13-valent pneumococcal conjugate vaccine, all of which target *S. pneumoniae*. Tetanus vaccination rate are not available prior to 2006.

should be noted that there is an element of incomparability across the utilization of vaccine types since the influenza vaccination is recommended to be an annual event, tetanus is recommended once in 10 years and the pneumococcal and shingles vaccines are recommended once only. This suggests that it ought to be easier to achieve higher immunization compliance with the shingles, pneumococcal and tetanus vaccines.

Figure 2: Influenza, pneumococcal, tetanus, and shingles vaccination rates among older adults (2000-2012)



Sources: CDC National Immunization Survey, CDC National Health Interview Survey, CDC Behavioral Risk Factor Surveillance System, Minnesota Population Center and State Health Access Data Assistance Center Integrated Health Interview Series[22]

[22] National Health Interview Survey, "Self reported influenza vaccination coverage trends 1989 - 2008 among adults by age group, risk group, race/ethnicity, health-care worker status, and pregnancy status, National Health Interview Survey," Centers for Disease Control, available at http://www.cdc.gov/flu/pdf/professionals/nhis89_08fluvaxtrendtab.pdf (Influenza years 2000-2008).

Centers for Disease Control, "Final estimates for 2009–10 Seasonal Influenza and Influenza A (H1N1) 2009 Monovalent Vaccination Coverage– United States, August 2009 through May, 2010," Centers for Disease Control, available at http://www.cdc.gov/flu/fluvaxview/coverage_0910estimates.htm (Influenza year 2009).

Centers for Disease Control, "Final state-level influenza vaccination coverage estimates for the 2010–11 season–United States, National Immunization Survey and Behavioral Risk Factor Surveillance System, August 2010 through May 2011," Centers for Disease Control, available at http://www.cdc.gov/flu/fluvaxview/coverage_1011estimates.htm

All vaccination rates are generally stable or increasing over time, which is consistent with increased awareness of vaccine benefits, comfort with vaccine safety, and development of less expensive and more convenient products. Obviously, starting from a low base, the shingles vaccination rate has increased faster than the influenza and pneumococcal vaccines – 20 percentage points from 2007 through 2012 compared to influenza and pneumococcal, whose rates actually fell slightly. This is consistent with the shingles vaccine being a new product gaining awareness and acceptance among physicians and patients. However, the shingles vaccination rate remains much lower than the influenza and pneumococcal rates. In 2012, only 22% of Americans over 65 were vaccinated for shingles, whereas 66% and 60% were vaccinated against influenza and pneumonia, respectively. Fewer older adults also received the tetanus vaccine compared to the influenza and pneumococcal vaccines.

The influenza vaccination rate declined in 2005 due to shortages in supply. In particular, expected vaccine supply for the 2004-2005 flu season decreased by approximately 50% because Chiron suffered bacterial contamination at a factory and was unable to distribute any flu vaccine in the US. Providers were unable to fully vaccinate even high risk populations because of the shortage.[23] There

(Influenza year 2010).

Centers for disease Control, "Flu Vaccination Coverage, United States, 2011-12 Influenza Season," Centers for disease Control, available at http://www.cdc.gov/flu/fluvaxview/coverage_1112estimates.htm (Influenza year 2011).

Centers for disease Control, "Flu Vaccination Coverage: United States, 2012-13 Influenza Season," Centers for disease Control, available at http://www.cdc.gov/flu/fluvaxview/coverage-1213estimates.htm (Influenza year 2012).

Minnesota Population Center and State Health Access Data Assistance Center, Integrated Health Interview Series: Version 5.0. Minneapolis: University of Minnesota, 2012, available at http://www.ihis.us (Pneumonia (2000-2006), tetanus (2006), shingles 65+ series).

Euler, Gary L., Peng-Jun Lu, and James A. Singleton, "Vaccination coverage among U.S. adults: National Immunization Survey – Adult, 2007," Centers for disease Control, available at http://www.cdc.gov/vaccines/imz-managers/coverage/nis/child/downloads/nis-adult-summer-2007.pdf (Pneumonia, tetanus, shingles 2007)

Schiller, Jeannine S., and Gary L. Euler, "Vaccination coverage estimates from the National Health Interview Survey: United States, 2008," Centers for disease Control, available at http://www.cdc.gov/nchs/data/hestat/vaccine_coverage/vaccine_coverage.pdf (Pneumonia, tetanus, shingles 2008).

Greby, Stacie M., Peng-Jun Lu, Gary Euler, Walter W. Williams, and James A. Singleton, "NHIS 2009 Adult Vaccination Coverage," Centers for disease Control, available at http://www.cdc.gov/vaccines/imz-managers/coverage/nhis/2009-nhis.html (Pneumonia, tetanus, shingles 2009).

Williams, Walter W., "Adult Vaccination Coverage - United States, 2010," Morbidity and Mortality Weekly Report, 61, no. 4 (February 3, 2012): page 67, available at http://www.cdc.gov/mmwr/preview/mmwrhtml/mm6104a2.htm?s_cid=mm6104a2_w. (Pneumonia, tetanus, shingles 2010)

Williams, Walter W., "Noninfluenza Vaccination Coverage Among Adults - United States, 2011," Morbidity and Mortality Weekly Report, 62, no. 4 (February 1, 2013): page 66, available at http://www.cdc.gov/mmwr/preview/mmwrhtml/mm6204a2.htm?s_cid=mm6204a2_w. (Pneumonia, tetanus, shingles 2011)

Williams, Walter W., Peng-Jun Lu, Alissa O'Halloran, Carolyn B. Bridges, Tamara Pilishvili, Craig M. Hales, Lauri E. Markowitz, "Noninfluenza Vaccination Coverage Among Adults - United States 2012," Morbidity and Mortality Weekly Report, 63, no. 5 (February 7, 2014): page 95, available at http://www.cdc.gov/mmwr/preview/mmwrhtml/mm6305a4.htm?s_cid=mm6305a4_w. (Pneumonia, tetanus, shingles 2012)

[23] Deborah Callender, "Vaccine Shortages: Implications for Pediatric Nurse Practitioners," Journal of Pediatric Health Care 20, no. 6 (2006): 426-429, accessed October 14, 2014, http://www.medscape.com/viewarticle/551205.

were additional shortages during the 2012-2013 flu season, which was unexpectedly severe.[24] The shingles vaccine also experienced a shortage shortly after it was introduced because (1) its manufacturer needed to divert a key ingredient to produce the varicella vaccine in response to evolving ACIP recommendations and (2) the lengthy and complex manufacturing process resulted in delays.[25] However, Merck has not reported any supply issues since late 2011.[26]

Although the influenza, pneumococcal, and shingles vaccines are recommended for virtually all older adults with a few exceptions, actual vaccination rates are substantially lower than 100% as well as lower target vaccination rates established by the CDC.[27] Figure 3 below shows the 2012 vaccination rate for influenza, pneumococcal, and shingles compared to targeted rates set by Healthy People 2020 (HP2020). HP2020's methodology for setting these targets was "[maintaining] consistency with national programs, regulations, policies, and laws." HP2020 typically uses an approach based on forecasts of current epidemiological trends for determining its targets, but in the absence of appropriate data the methodology relies on other benchmarks.[28] The designers of the HP2020 targets were instructed that "targets need to be more realistic, systematic and transparent than HP2010 targets."[29] Actual vaccination rates are lower than the targeted rates for all vaccines. (Note that HP2020 did not set a target rate for tetanus.) The shingles vaccination rate is approximately 10 percentage points below its conservative target of 30%. During an October 2013 meeting to discuss recommendations on the shingles vaccine, the ACIP noted that "vaccine uptake is not optimal and the coverage rate for adults remains very unsatisfactory at this point."[30]

[24] U.S.News & World Report, "'Spot' Shortages of Flu Vaccine, Tamiflu Reported, FDA Head Says," January 15, 2013, http://health.usnews.com/health-news/news/articles/2013/01/15/spot-shortages-of-flu-vaccine-tamiflu-reported-fda-head-says?utm_source=huffingtonpost.com&utm_medium=referral&utm_campaign=pubexchange_article.

[25] Government Accountability Office, "Many Factors, Including Administrative Challenges, Affect Access to Part D Vaccinations," *available at* http://www.gao.gov/assets/590/587009.pdf.

[26] North Shore-LIJ Health System, "Medical Experts Blast Shingles Vaccine Usage," February 17, 2014, http://www.northshorelij.com/hospitals/news/medical-experts-blast-shingles-vaccine-usage, accessed October 15, 2014.

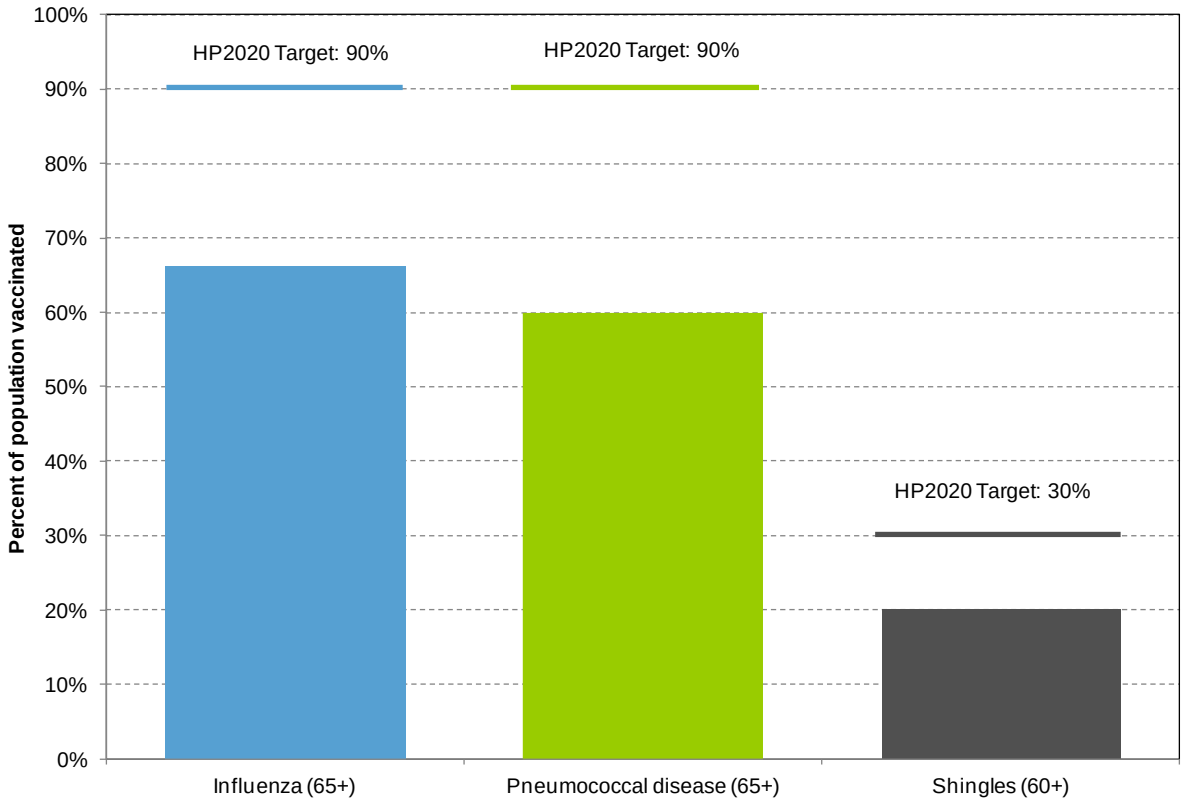
[27] For example, the shingles vaccine is contraindicated for those with primary or acquired immunodeficiency, including with leukemia, lymphomas, or other malignant neoplasms affecting the bone marrow or lymphatic system and those with AIDS. Centers for Disease Control, "Prevention of Herpes Zoster: Recommendations of the Advisory Committee on Immunization Practices (ACIP)," June 6, 2008, page 20.

[28] U.S. Department of Health and Human Services, "IID-14 Data Details," Office of Disease Prevention and Health Promotion, Healthy People 2020, Washington, DC, http://www.healthypeople.gov/2020/topicsobjectives2020/DataDetails.aspx?hp2020id=IID-14, accessed September 24, 2014.

[29] Leda Gurley, "Healthy People 2020: A Methodological Approach," (presentation, 2010 National Conference on Health Statistics, August 18, 2010), *available at* http://www.cdc.gov/nchs/ppt/nchs2010/43_Gurley.pdf.

[30] Advisory Committee on Immunization Practices, *Summary Report: October 23-34, 2013*, (Atlanta: Centers for disease Control and Prevention), 85, *available at* http://www.cdc.gov/vaccines/acip/meetings/downloads/min-archive/min-oct13.pdf.

Figure 3: Influenza, pneumococcal, and shingles vaccination rates in 2012 compared with Healthy People 2020 targets



Incidence of diseases prevented by recommended vaccines

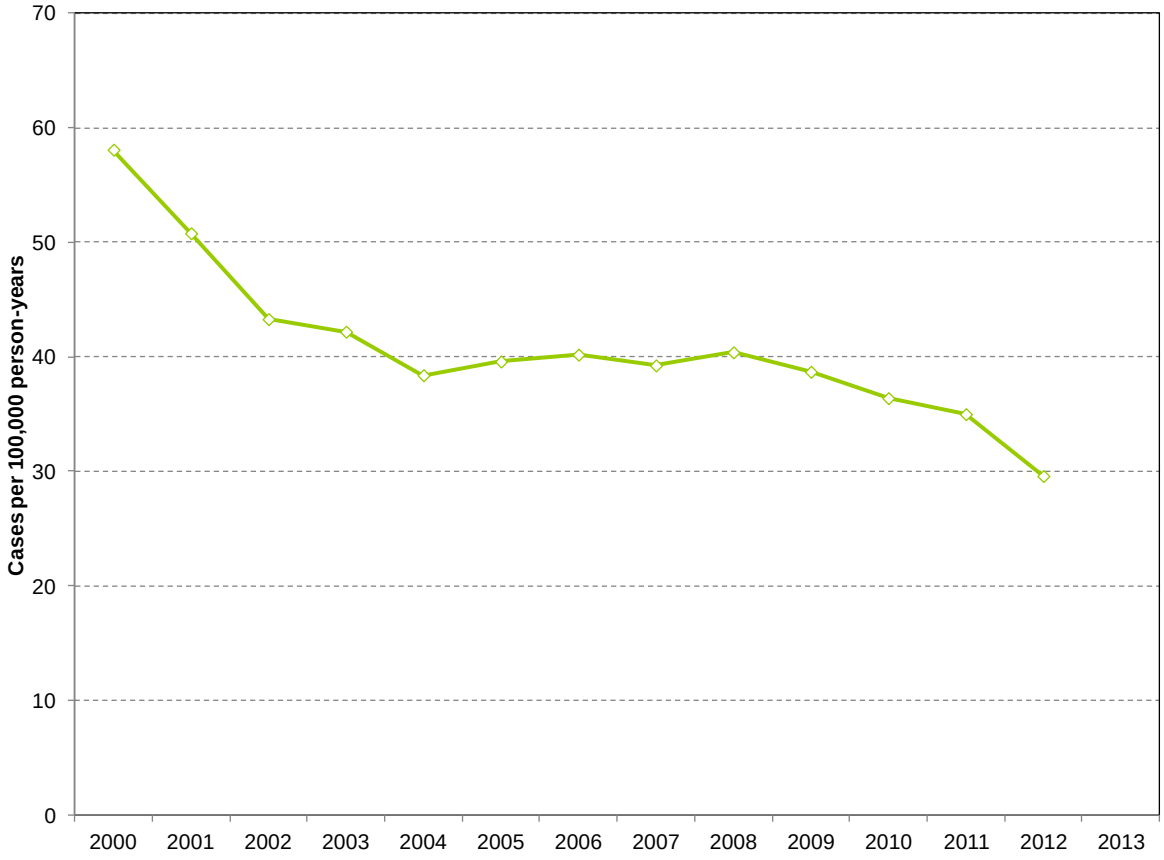
Figure 4, Figure 5, and Figure 6 below show the incidence, or the number of new cases in a given year, for pneumococcal disease, influenza, and shingles among the older U.S. adult population.[31] Specifically, Figure 4 and Figure 5 show estimates for the incidence of pneumococcal disease and influenza as measured by the CDC.[32] Both are estimated from the number of lab-confirmed cases which caused hospitalizations in Americans over the age of 65. Influenza rates spiked in 2012 as influenza activity intensified earlier in the season than expected. Older adults were particularly affected – the cumulative hospitalization rate among people 65 years and older was the highest observed since this kind of record-keeping began during the 2005-2006 flu season (182 per 100,000

[31] Tetanus incidence rates are consistently less than 0.03 cases per 100,000 person-years.

[32] The rates of influenza and pneumonia were estimated using lab confirmed hospitalizations due to *S. pneumoniae* and an influenza strain, respectively. Appendix A shows the percent of hospital visits in which the patient exhibited influenza-like illness. This data series is available for a longer time period but is not restricted to adults aged 65 and over.

during the week ending March 23, 2013).[33] Pneumonia incidence rates have decreased over time, consistent with an increase in vaccination rates as shown in Figure 2 above.

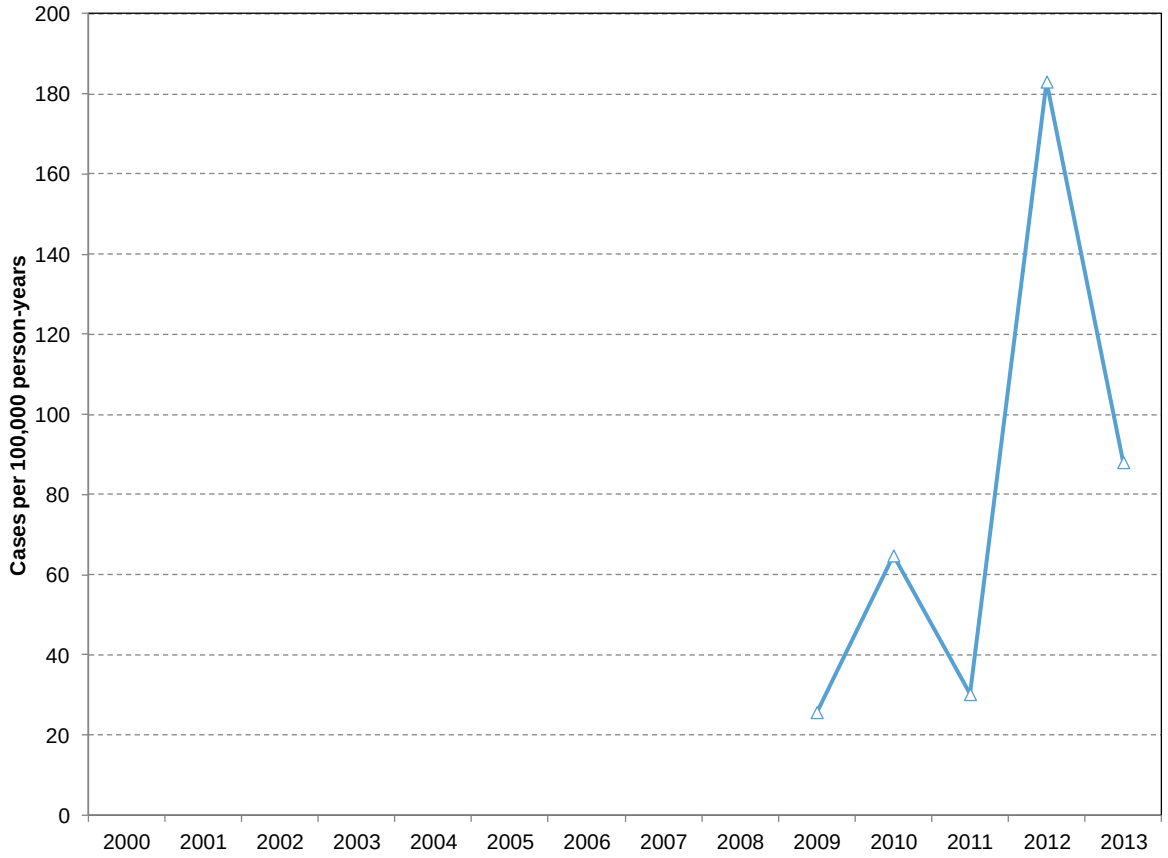
Figure 4: Incidence of pneumococcal disease among adults aged 65 and over



Sources: Centers for Disease Control and Prevention, Active Bacterial Core Surveillance Report, Emerging Infections Program Network, *Streptococcus pneumoniae*, 2000-2012, *available at* http://www.cdc.gov/abcs/reports-findings/surv-reports.html.

[33] Centers for Disease Control, "2012-2013 Flu Season Drawing to a Close," http://www.cdc.gov/flu/spotlights/2012-2013-flu-season-wrapup.htm, accessed September 29, 2014.

Figure 5: Incidence of influenza among adults aged 65 and over estimated from lab confirmed cases

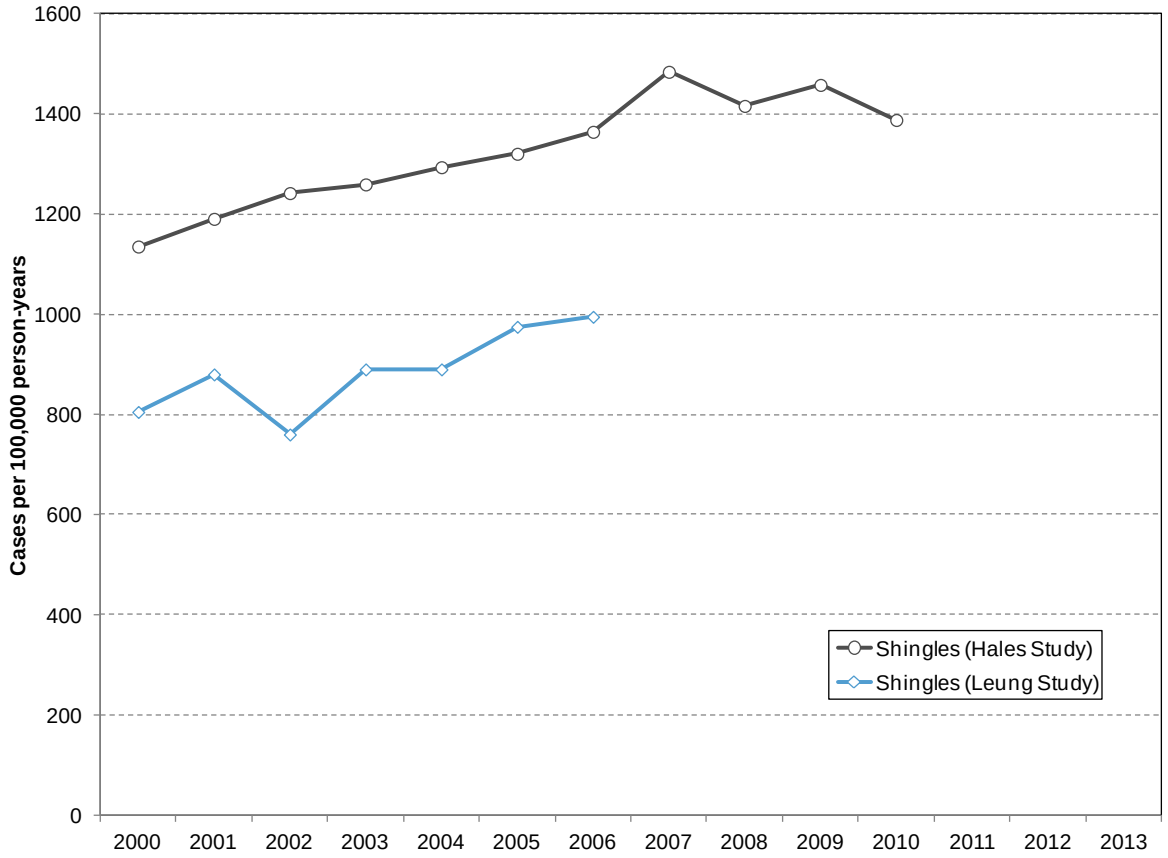


Source: Data are for adults over the age of 65. Laboratory-Confirmed Influenza Hospitalizations, Centers for Disease Control via FluSurv-NET, accessed October 14, 2014, http://gis.cdc.gov/GRASP/Fluview/FluHospRates.html.

Because the CDC does not track lab-confirmed cases of shingles, Figure 6 shows two estimates of the shingles incidence rate using health insurance claims data.[34] Shingles incidence consistently increased prior to the introduction of the shingles vaccine in 2006. Incidence decreased in 2008 and has been on a downward trajectory thereafter.

[34] Leung et al. (2011) used data from MarketScan®, and Hales et al. (2013) used data from Medicare.

Figure 6: Shingles incidence in people aged 65 or over using the medical claims methodology



Sources: Data are for adults over the age of 65. Leung, Jessica, Rafael Harpaz, Noelle-Angelique Molinari, Aisha Jumaan, and Fangjun Zhou, "Herpes Zoster Incidence Among Insured Persons in the United States, 1993–2006: Evaluation of Impact of Varicella Vaccination," Clinical Infectious Diseases, 52, no. 3 (2011): 332-340, *available at* http://cid.oxfordjournals.org/; Hales, Craig M., Rafael Harpaz, M. Riduan Joesoef, and Stephanie R. Bialek, "Examination of Links Between Herpes Zoster Incidence and Childhood Varicella Vaccination," Annals of Internal Medicine, 159, no. 11 (2013): 739-745, *available at* http://annals.org/article.aspx?articleid=1784289.

Cost-effectiveness of recommended vaccinations

Studies suggest that all of the routinely-recommended vaccines are cost-effective using standard economic metrics. This is consistent with the fact that they are recommended by ACIP, which takes cost-effectiveness into account. A high degree of cost effectiveness suggests that both public health and economic well being would be enhanced with high levels of immunization among target populations.

Figure 7 below shows incremental cost-effectiveness ratios (ICERs) for the shingles, influenza, and pneumococcal vaccinations compared to standard economic cost-effectiveness metrics.[35] Figure 7

[35] The ICER is the ratio of the incremental costs to the incremental benefits of a treatment (here vaccination). Costs are

also includes the ICER for the pertussis vaccine as a point of comparison. Figure 7 shows that the costs of the shingles, influenza, and pneumococcal vaccines, when compared to the life-years gained, are far below two generally accepted thresholds for cost-effectiveness: the "standard" $50,000 per quality-adjusted life year threshold[36] and the widely accepted World Health Organization threshold of three times gross domestic product per capita (155,901 in the US).[37]

measured in terms of dollars, and benefits are measured in terms of quality-adjusted life years (QALYs) gained or lost. A QALY (pronounced kwah-lee) is a common metric economists use to evaluate the effectiveness of a treatment. QALYs are a numeric way of expressing the burden of a particular disease, where a QALY of one indicates perfect health for one year. QALY values (or weights) can be determined by a number of methods. One popular method is to use a questionnaire called the EQ-5D, which assigns numerical values for problems associated with physical activity, anxiety or depression, and pain. To illustrate, a disease state in which a disease or condition causes someone to have problems washing or dressing, unable to perform usual activities, and is in some pain or discomfort is assigned an EQ-5D "health state" value of 0.33. If this person is in the health state for one-half a year, but is otherwise healthy for the other half, then the QALY value for the entire year would be:

$$(0.5 \times 1) + (0.5 \times 0.33) = 0.67$$

Medical or other interventions that could cure this health state are said to have gained 0.33 quality adjusted life year.

[36] See: Peter J. Neumann, Joshua Cohen and Milton Weinstein, "Updating cost-Effectiveness – The Curious Resilience of the $50,000-per-QALY Threshold," *New England Journal of Medicine* 2014; 371:796-797, which recommends the application of a thresholds up to $200,000 per QALY in evaluating health interventions in the U.S.

[37] Scott Grosse, "Assessing Cost-effectiveness in Healthcare: History of the $50,000 per QALY threshold," *Expert Review of Pharmacoeconomics and Outcomes Research* 8, no. 2 (2008): 165

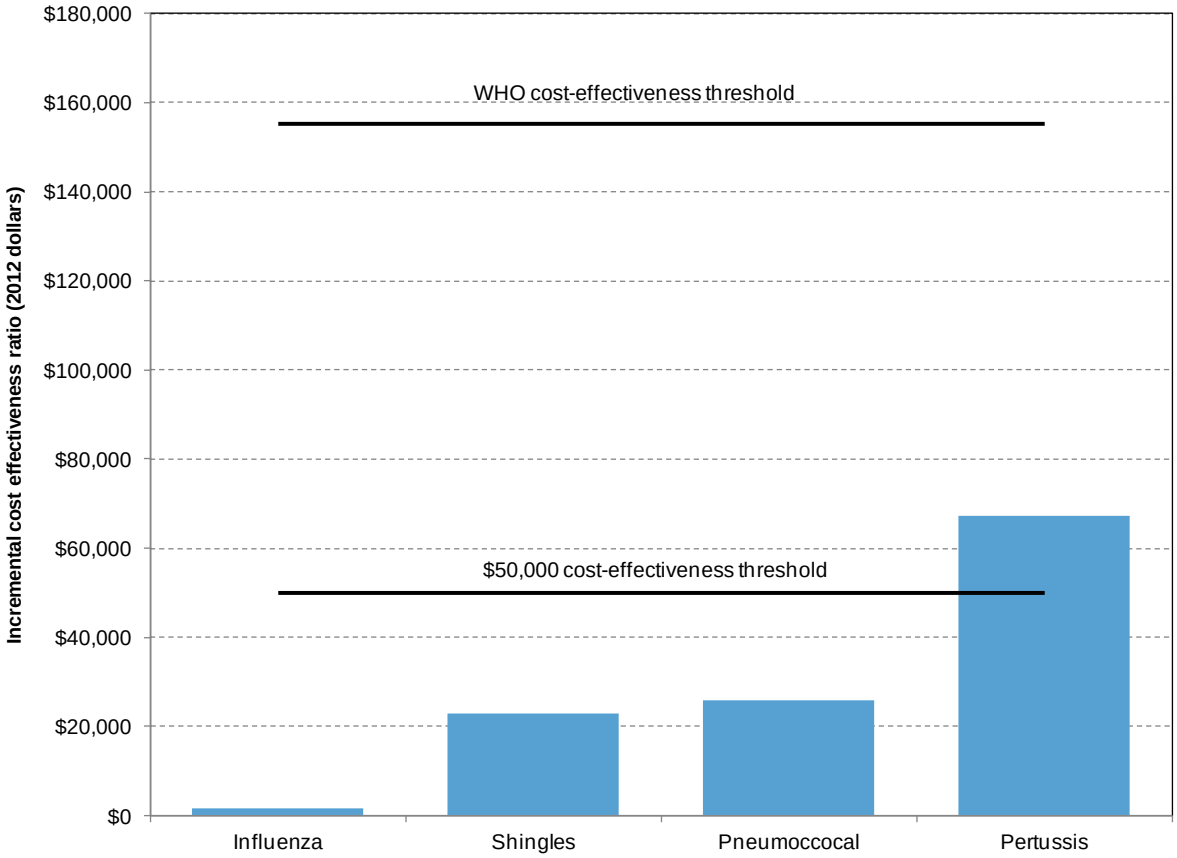
US 2012 Gross domestic product per capita of $51,967 is calculated from Bureau of Economic Analysis data adjusted to the 2012 price level reported by the Bureau of Labor Statistics:

Bureau of Economic Analysis, "2012 Per capita real GDP by state (chained 2009 dollars)," accessed November 7, 2014, http://bea.gov/itable/iTable.cfm?ReqID=70&step=1#reqid=70&step=10&isuri=1&7003=1000&7035=-1&7004=naics&7005=1&7006=00000&7036=-1&7001=11000&7002=1&7090=70&7007=2012&7093=levels.

Bureau of Labor Statistics, "CPI inflation calculator," accessed November 7, 2014, http://www.bls.gov/data/inflation_calculator.htm

The three times GDP WHO threshold is from: Hutubessy R, et al., "Generalized cost-effectiveness analysis for national-level priority-setting in the health sector," Cost-effectiveness and resource allocation, (2003), no.1, 8.

Figure 7: Comparison of ICERs for selected vaccinations



Sources: Chen J et al., "Cost-effectiveness of pneumococcal vaccines for adults in the United States," *Advances in Therapy*, 2014, no. 31: 392-409. Maciosek MV et al., "Influenza vaccination: health impact and cost effectiveness among adults aged 50 to 64 and 65 and older," *American Journal of Preventive Medicine*, 2006, no. 31: 72-79. Kawai et al. "Cost-effectiveness of vaccination against herpes zoster and postherpetic neuralgia: a critical review," *Vaccine*, 2014, no. 32: 1645-1653. McGarry LJ, et al., "Cost-effectiveness analysis of Tdap in the prevention of pertussis in the elderly," *PLoS One*, 2013, 8, no.9.

Shingles case study

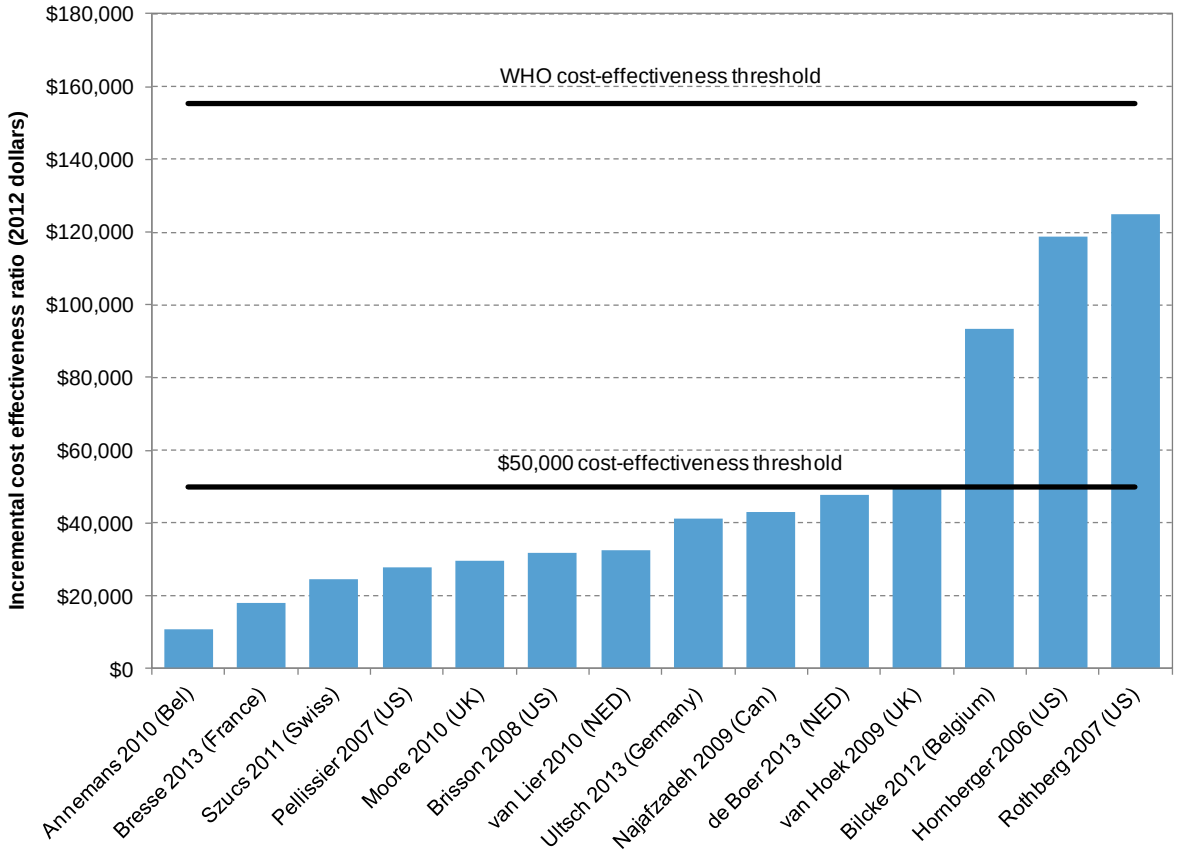
Because shingles incidence rates are relatively high, the shingles vaccine is relatively new to the market, and it is specifically targeted to older adults, the shingles vaccine has received considerable attention from policymakers, academics, and health care professionals in terms of its cost, effectiveness, and uptake. It is thus worth discussing these factors for shingles in greater detail.

The ICER for shingles shown in Figure 7 is the weighted average of the estimated costs and QALYs gained from 14 studies included in a recently published survey of the shingles cost-effectiveness literature ($22,950 per QALY gained).[38] In particular, as shown in, as shown in Figure 8 below, 11 of

[38] Bilcke (2012) found an ICER ranging from $3,024-93,333 per quality-adjusted life year. The low and the high estimates are treated as two observations in the average as if they came from separate studies.

the 14 studies found that the shingles vaccine met the $50,000 per quality-adjusted life year threshold for cost-effectiveness.[39] Using the less stringent World Health Organization threshold, the shingles vaccine would be considered cost-effective in all 14 studies.

Figure 8: Shingles incremental cost effectiveness ratios published in academic literature



Source: Kawai et al. "Cost-effectiveness of vaccination against herpes zoster and postherpetic neuralgia: a critical review," *Vaccine*, 2014, no. 32: 1645-1653. Bilcke (2012) found an ICER ranging from $3,024-93,333 per quality-adjusted life year. The $93,333 estimate is shown.

Of the recommended vaccines, increasing the shingles vaccination rate would likely have the greatest impact in terms of disease burden and costs. Since shingles is brought on by decreasing immunity over time to the varicella zoster virus, its incidence is disproportionately higher among seniors. Despite comprising only 14 percent of the population, seniors account for more than a third of shingles cases annually.[40] Post-herpetic neuralgia (PHN), a potentially debilitating complication that

[39] Kawai et al. "Cost-effectiveness of vaccination against herpes zoster and postherpetic neuralgia: a critical review," *Vaccine*, 2014, no. 32: 1645-1653.

Scott Grosse, "Assessing Cost-effectiveness in Healthcare: History of the $50,000 per QALY threshold," *Expert Review of Pharmacoeconomics and Outcomes Research* 8, no. 2 (2008): 165.

[40] Calculated using an incidence of 10 per 1000 among those 65 and over estimated by Leung et al. (2011) based on 2006

can cause severe pain in the affected areas for months or years, occurs in up to 1 out of 5 cases. Nearly one-half of individuals who live to 85 will experience at least one episode of shingles.[41]

The disease burden and health care utilization due to herpes zoster (shingles) and its complications is significant, but it can be reduced by vaccination. The total costs associated with shingles due to medical care alone are estimated to be more than a billion dollars per year.[42] Among the elderly, herpes zoster and PHN are estimated to account for more than 1.3 million visits to the doctor, approximately 87,000 emergency room visits, approximately 28,000 inpatient admissions, and more than 3.3 million prescriptions each year.[43] According to Dr. Rafael Harpaz of the CDC and an author of the ACIP's shingles recommendations, "The burden of the disease is so great that reducing it by half is a real public health benefit."[44]

Herpes zoster and its associated complications can also exact a significant psychological and social cost. For uncomplicated cases, pain and discomfort from a shingles rash can last from 2 to 4 weeks. For PHN, the costs can be much higher. The pain from PHN can persist for months and years, can either come in episodes or be constant throughout the day, and has been described as "horrible" or "excruciating." The pain from PHN has been tied to social withdrawal, depression, and, based on anecdotal reports, suicide.[45] Dr. Michael Oxman, who led the first large shingles vaccine clinical trial, stated, "You can have your life ruined."[46]

Conditional on the level of its effectiveness in preventing herpes zoster, an increase in vaccination rates could have significant and long-lasting effects on health care utilization. The results of an unpublished Centers for Disease Control analysis suggests that a 60% vaccination rate among adults

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health insurance claims data. The overall population incidence is estimated to be 4.4 per 1000. Age-specific population estimates are from:

US Census Bureau, "Annual estimates of the resident population by single year of age and sex for the United States", accessed October 22, 2014, http://factfinder2.census.gov/faces/tableservices/jsf/pages/productview.xhtml?src=bkmk.

This estimate is likely to be conservative since the incidence rate among those 65 and over was increasing at a faster rate over time relative to the other younger age groups.

41 Centers for Disease Control and Prevention (CDC), "Prevention of herpes zoster: recommendations of the advisory committee on immunization practices," Morbidity and Mortality Weekly Report, June 6, 2008, http://www.cdc.gov/mmwr/preview/mmwrhtml/rr5705a1.htm, accessed September 22, 2014.

42 White et al., "Incremental 1-year medical resource utilization and costs for patients with herpes zoster from a set of U.S. health plans," *Pharmacoeconomics*, 2009, no. 27: 781-792.

43 Numbers are estimated using resource utilization rates from White et al. (2009), age-specific incidence of herpes zoster from Leung et al. (2011), age-specific 2013 population estimates from the Census, and post-herpetic neuralgia incidence estimates from:

Yawn et al., "A population-based study of the incidence and complication rates of herpes zoster before zoster vaccine introduction," *Mayo Clinic Proceedings* 2007, no. 82: 1345.

44 Paula Span, "Drive to Stem Shingles Meets Few Expectations," *New York Times*, Jul. 11, 2011.

45 Centers for Disease Control and Prevention (CDC), "Prevention of herpes zoster: recommendations of the advisory committee on immunization practices," Morbidity and Mortality Weekly Report, June 6, 2008, http://www.cdc.gov/mmwr/preview/mmwrhtml/rr5705a1.htm, accessed September 22, 2014.

46 Paula Span, "Drive to Stem Shingles Meets Few Expectations," *New York Times*, Jul. 11, 2011.

between the ages of 65 and 70 would reduce their lifetime herpes zoster and PHN incidence by 250,000 and 71,821 cases, respectively. By extension, this would reduce their health care utilization by approximately 1.25 million doctor visits, 115,000 emergency department visits, 23,000 inpatient admissions, and 1.2 million prescriptions over their lifetime.[47]

Research has also shown that individuals are willing to pay substantial amounts to avoid herpes zoster. In a survey of randomly sampled community members, respondents indicated a willingness-to-pay of $450 to avoid an episode of herpes zoster. For PHN, their willingness-to-pay to avoid an episode increased to $1,384. Among a sample of individuals with a recent history of shingles, their willingness-to-pay was much higher – $2,319 to avoid a herpes zoster episode and $18,184 to avoid an episode of PHN.[48] As a policy matter, if patients were willing to pay to alleviate such pain it might suggest that it would be politically feasible to increase, Part B premiums to cover the cost of including this vaccine in the Part B benefit. This is an issue that merits more complete exploration.

Health insurance coverage policies

Cost and health insurance coverage are key determinants of health care utilization. Because Medicare covers most of the elderly adults in the U.S., understanding the determinants of vaccine use in this population requires an understanding of the cost-sharing and coverage policies for adult vaccines of Medicare, Medicaid, as well as private insurance.

Medicare

Coverage

Established in 1965, Medicare is the federal program that provides health insurance to Americans aged 65 and older, as well as those with end-stage renal disease (ESRD) and certain disabilities. Medicare consists of four parts: Part A, Part B, Part C, and Part D. Loosely speaking, Part A covers inpatient hospital care, Part B covers outpatient drugs and services provided at hospitals and physician clinics, Part C includes Medicare Advantage (Part A, Part B, and Part D coverage provided by private insurers), and Part D covers prescription drugs. Enrollment in Part A is automatic, but

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47 Vaccine efficacy based on results presented in Ortega-Sanchez IR, "Decision and cost-effectiveness analyses of herpes zoster vaccination in adults 50 years of age and older, (presentation, Advisory Committee on Immunization Practices Herpes Zoster Work Group, Atlanta, GA, October 23, 2013), *available at* http://www.cdc.gov/vaccines/acip/meetings/downloads/slides-oct-2013/04-hzv-redacted-ortega-sanchez.pdf.

Estimates derived from using age-specific population US Census numbers for 2013 assuming the same level of reductions described in Ortega-Sanchez. Age-specific population estimates are from:

US Census Bureau, "Annual estimates of the resident population by single year of age and sex for the United States", accessed October 22, 2014, http://factfinder2.census.gov/faces/tableservices/jsf/pages/productview.xhtml?src=bkmk.

48 Lieu et al., "Community and patient values for preventing herpes zoster," *Pharmacoeconomics*, 2008, no. 26: 235-249.

enrollment in Part B, Part C, and Part D is optional. In 2013, 51.5 million Americans were enrolled in Part A, 47.6 million in Part B, 14.4 million in Part C, and 38.5 million in Part D.[49]

Certain vaccines for elderly adults are covered under Part B, some are covered by both Part B and Part D depending on the circumstances, and the remainder are covered under Part D as was indicated in Figure 1. Of the vaccines routinely recommended for older adults, the influenza and pneumococcal vaccines are covered under Part B, and the shingles vaccine is covered under Part D.[50] Tetanus is covered under Part B if administered following possible exposure to tetanus, such as after stepping on a rusty nail, and under Part D otherwise. Hepatitis B is covered under Part B for beneficiaries at high or immediate risk of contracting the disease (including those receiving hemodialysis, using injectable drugs, or living in an institution for those with developmental disabilities), or at high risk of developing diabetes and under Part D otherwise.

Cost-sharing

Medicare beneficiaries typically incur higher out-of-pocket costs for vaccines covered under Part D.

- Part B-covered vaccines: Even though Medicare beneficiaries typically pay 20% coinsurance for physician-administered drugs and services covered by Part B, as of August 2011, the influenza and pneumococcal vaccines are covered by Part B at no additional cost to the patient.[51]
- Part D-covered vaccines: Patient cost-sharing for Part D-covered vaccines varies based on the beneficiary's prescription drug plan or Medicare Advantage plan's formulary. According to the GAO, average cost-sharing in 2009 was $57 for shingles and $25 for tetanus, ranging from $0-$195 for shingles and from $0-$70 for tetanus.[52]

[49] Centers for Medicare & Medicaid Services, "2013 CMS Statistics," US Department of Health and Human Services, page 6, *available at* http://www.cms.gov/Research-Statistics-Data-and-Systems/Statistics-Trends-and-Reports/CMS-Statistics-Reference-Booklet/Downloads/CMS_Stats_2013_final.pdf; Henry J. Kaiser Family Foundation, "Medicare at a Glance," accessed September 18, 2014, http://kff.org/medicare/fact-sheet/medicare-at-a-glance-fact-sheet/.

[50] Government Accountability Office, "Many Factors, Including Administrative Challenges, Affect Access to Part D Vaccinations," pages 9-10, *available at* http://www.gao.gov/assets/590/587009.pdf.

Department of Health and Human Services, "Vaccine Payments under Medicare Part D," page 2, *available at* http://www.cms.gov/Outreach-and-Education/Medicare-Learning-Network-MLN/MLNProducts/Downloads/Vaccines-Part-D-Factsheet-ICN908764.pdf.

[51] Government Accountability Office, "Many Factors, Including Administrative Challenges, Affect Access to Part D Vaccinations," page 9, *available at* http://www.gao.gov/assets/590/587009.pdf.

[52] Government Accountability Office, "Many Factors, Including Administrative Challenges, Affect Access to Part D Vaccinations," Table 10, *available at* http://www.gao.gov/assets/590/587009.pdf.

Administration and prescription requirements

Medicare beneficiaries can receive Part B- and Part D-covered vaccinations at a physician's office or at a pharmacy/immunization clinic; however, claims submission and reimbursement policies differ substantially between the two settings.[53]

- Physician's office: Physicians can bill Part B and obtain reimbursement for Part B-covered vaccinations using the same electronic claims processing system that is used for other physician-administered drugs and services. However, because physicians are out-of-network providers for Part D plans (contracted pharmacies being in-network providers), they cannot verify beneficiaries' eligibility and bill Part D directly unless they enroll in the privately-run web-based TransactRx system.[54] However, the TransactRx system is not commonly used and may not include all Part D plans and beneficiaries.[55] As a result, physicians who are not enrolled may require beneficiaries to pay the full cost of the vaccine up front and then seek reimbursement from their Part D plan.[56] Specifically, in 2009, 18% of shingles vaccination reimbursement requests and 84% of Td vaccination requests were submitted by a beneficiaries paying up front for vaccinations (compared to less than 1% of all other Part D reimbursement requests).[57]
- Pharmacy/immunization clinic: Beneficiaries can also obtain Part B and Part D vaccinations at a pharmacy or immunization clinic.[58] Because pharmacies are considered in-network providers for Part D plans, beneficiaries would only be required to pay cost-sharing for the shingles vaccine.[59]

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53 Government Accountability Office, "Many Factors, Including Administrative Challenges, Affect Access to Part D Vaccinations," page 10, *available at* http://www.gao.gov/assets/590/587009.pdf.

54 Government Accountability Office, "Many Factors, Including Administrative Challenges, Affect Access to Part D Vaccinations," page 11, *available at* http://www.gao.gov/assets/590/587009.pdf.

55 In a GAO survey, only approximately 1 in 4 physicians were aware of it and only 10% of Part D shingles vaccination reimbursements in 2009 were processed through TransactRx. As of 2013, only approximately 10,000 physician practices and medical facilities were enrolled in TransactRx, accounting for less than 10% of all practices in the US.

The CDC reported that there were approximately 163,800 physician practices in 2005-2006. US Department of Health and Human Services, "Characteristics of Office-Based Physicians and Their Practices: United States, 2005-2006, page 11, *available at* http://www.cdc.gov/nchs/data/series/sr_13/sr13_166.pdf. "TransactRx Releases Part 4 of Series – Physician Office Medicare Part D Reimbursement for Vaccines," http://www.prweb.com/releases/prwebtransactrx/vaccine-physician-billing/prweb10776714.htm, accessed October 14, 2014. Government Accountability Office, "Many Factors, Including Administrative Challenges, Affect Access to Part D Vaccinations," page 31, *available at* http://www.gao.gov/assets/590/587009.pdf.

56 Department of Health and Human Services, "Vaccine Payments under Medicare Part D," page 3, *available at* http://www.cms.gov/Outreach-and-Education/Medicare-Learning-Network-MLN/MLNProducts/Downloads/Vaccines-Part-D-Factsheet-ICN908764.pdf.

57 Government Accountability Office, "Many Factors, Including Administrative Challenges, Affect Access to Part D Vaccinations," pages 29-30, *available at* http://www.gao.gov/assets/590/587009.pdf.

58 As of 2014, all states allow pharmacists to administer the shingles and influenza vaccines to adults. Pharmacists are not allowed to administer the pneumococcal vaccine in South Dakota and are not allowed to administer the tetanus vaccine in New York, Florida, South Dakota, and New Hampshire. American Pharmacists Association, "Pharmacist Administered Vaccines," pages 8-9, *available at* http://www.pharmacist.com/sites/default/files/PharmacistIZAuthority.pdf.

59 Department of Health and Human Services, "Vaccine Payments under Medicare Part D," pages 5-6, *available at* http://www.cms.gov/Outreach-and-Education/Medicare-Learning-Network-MLN/MLNProducts/Downloads/Vaccines-Part-D-Factsheet-ICN908764.pdf.

As of 2000, Medicare beneficiaries were not required to obtain a physician's prescription in order to receive the pneumococcal or influenza vaccines from a nurse or pharmacist (as allowed by state regulations).[60] Whether a prescription is required for the shingles vaccine varies by Part D plan and state. Although receiving vaccines and other healthcare services at pharmacies is becoming increasingly commonplace, patients may be less likely to follow through and make an additional trip to the pharmacy to fill the doctor's prescription. One physician estimated that only 60% of his patients prescribed the shingles vaccine eventually received it at a pharmacy.[61]

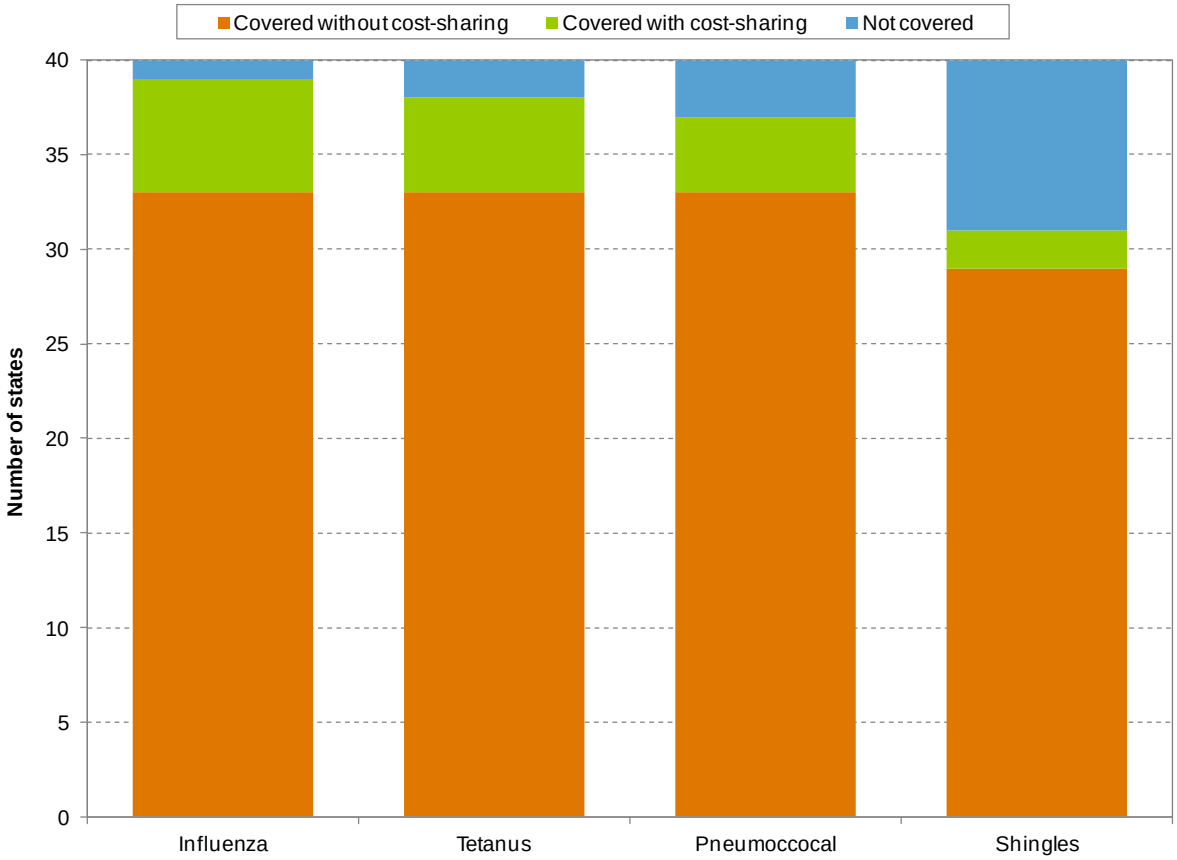
Medicaid

Individuals who are over 65 and meet certain low income requirements may also be dual-eligible for Medicaid. Medicaid vaccination coverage and cost-sharing policies vary by state and by vaccine, as indicated in a 2014 Kaiser Commission survey and reported in Figure 9 and Figure 10 below. Among the 40 states for which data are available, the influenza, tetanus, and pneumococcal vaccines are the most favorably covered, with 33 states covering them with no patient cost-sharing. In contrast, only 29 states cover the shingles vaccine with no cost-sharing, two cover it with some cost-sharing, and nine do not cover it. This suggests that a worthwhile policy effort would be to focus on increasing immunization on states whose Medicaid programs do not provide coverage.

[60] Centers for Medicare & Medicaid Services, "2012- 2013 Immunizers' Question & Answer Guide to Medicare Part B, Medicaid and CHIP Coverage of Seasonal Influenza and Pneumococcal Vaccinations," page 13, *available at* http://www.cms.gov/Medicare/Prevention/Immunizations/Downloads/2012-2013_Flu_Guide.pdf.

[61] Pauline W. Chen, M.D., "Why Patients Aren't Getting the Shingles Vaccine," *New York Times*, Jun. 10, 2010.

Figure 9: Summary of Medicaid vaccination coverage and patient cost-sharing requirements (as of January 2013)



Notes: Data are limited to adult fee-for-service. Data are not available for the following states: FL, GA, IN, LA, KS, NE, NM, OH, SC, VT, and, WI.

Source: Kaiser Commission on Medicaid and the Uninsured, "Coverage of Preventive Services for Adults in Medicaid," November 2014, page 16, *available at* http://files.kff.org/attachment/coverage-of-preventive-services-for-adults-in-medicaid-issue-brief.

Figure 10: State-level Medicaid vaccination coverage and patient cost-sharing requirements (as of January 2013)

State	Tetanus		Pneumoccocal		Influenza		Shingles	
	Covers	Copay	Covers	Copay	Covers	Copay	Covers	Copay
Alabama[62]	Y	N	Y	N	Y	N	N	N
Alaska	Y	Y	N	-	Y	Y	Y	Y
Arizona	Y	N	Y	N	Y	N	Y	N
Arkansas	Y	N	Y	N	Y	N	N	N
California[63]	Y- SPA	N	Y- SPA	N	Y- SPA	N	Y- SPA	N
Colorado	N	-	N	-	Y	Y	N	-
Connecticut	Y	N	Y	N	Y	N	Y	N
Delaware	Y	N	Y	N	Y	N	Y	N
DC	Y	N	Y	N	Y	N	N	-
Hawaii	NR	NR	-	-	NR	NR	NR	NR
Idaho	Y	N	Y	N	Y	N	Y	N
Illinois	Y	N	Y	N	Y	N	Y	N
Iowa[64]	Y	N	Y	N	Y	N	Y	N
Kentucky	Y	Y	Y	Y	Y	Y	Y	Y
Maine	Y	N	Y	N	Y	N	Y	N
Maryland[65]	Y	N	Y	N	Y	N	Y	N
Massachusetts	Y	N	Y	N	Y	N	Y	N
Michigan	Y	N	Y	N	Y	N	Y	N
Minnesota	Y	N	Y	N	Y	N	Y	N
Mississippi	Y	Y	Y	Y	Y	Y	N	-
Missouri[66]	Y	Y	Y	Y	Y	Y	Y	Y
Montana	Y	Y	Y	Y	Y	Y	Y	Y
Nevada	Y	N	Y	N	Y	N	Y	N
New Hampshire	Y- SPA	N	Y- SPA	N	Y- SPA	N	Y- SPA	N
New Jersey	Y- SPA	N	Y- SPA	N	Y- SPA	N	Y- SPA	N
New York	Y- SPA	N	Y- SPA	N	Y- SPA	N	Y- SPA	N
North Carolina[67]	Y	N	Y	N	Y	N	N	-
North Dakota	Y	N	Y	N	Y	N	Y	N
Oklahoma	Y	N	Y	N	Y	N	Y	N
Oregon	Y	N	Y	N	Y	N	Y	N
Pennsylvania	Y	N	Y	N	Y	N	Y	N
Rhode Island	Y	N	Y	N	Y	N	Y	N

62 Tdap is limited to age 7 years and older. Td booster is limited to age 10-55 years for SBRW recipients (no age restriction for other benefit plans).

63 All copays listed are $1.

64 The following immunizations are payable but require an appropriate supporting diagnosis code and are not unsupported screenings: Td booster and Tdap, and Zoster.

65 All of the services, immunizations and tests listed are covered when medically necessary for adults. The cost of the vaccine is covered along with the administration (under the office visit).

66 All copays listed for covered vaccinations are $0.50 - $2.

67 The state noted that all services are covered under an annual preventive health exam or office visit. Td boosters are also covered for wound management when needed. Injectable Influenza vaccine (for all ages) and FluMist (for 19-20 year olds) are covered.

State	Tetanus		Pneumoccocal		Influenza		Shingles	
	Covers	Copay	Covers	Copay	Covers	Copay	Covers	Copay
South Dakota	Y	N	Y	N	Y	N	Y	N
Tennessee[68]	Y	N	Y	N	Y	N	Y	N
Texas	Y	N	Y	N	Y	N	Y	N
Utah	Y	N	Y	N	Y	N	Y	N
Virginia[69]	Y	N	Y	N	Y	N	N	-
Washington	Y	N	Y	N	Y	N	NR	NR
West Virginia	Y	N	Y	N	Y	N	Y	N
Wyoming	Y	N	Y	N	Y	N	Y	N
Total	**38**	**33**	**37**	**33**	**39**	**33**	**31**	**29**

Notes: Data are limited to adult fee-for-service. Data are not available for the following states: FL, GA, IN, LA, KS, NE, NM, OH, SC, VT, and, WI. "NR" indicates that the state did not respond to the survey. "SPA" indicates that the state had submitted or planned to submit a state plan amendment to receive the enhanced match for covering all the recommended services without cost sharing.

Source: Kaiser Commission on Medicaid and the Uninsured, "Coverage of Preventive Services for Adults in Medicaid," November 2014, pages 17-20, *available at* http://files.kff.org/attachment/coverage-of-preventive-services-for-adults-in-medicaid-issue-brief.

Private insurance

Under the Affordable Care Act, private health insurers must cover ACIP-recommended vaccinations (and other preventative health measures) for patients enrolling in new plans without requiring any patient cost-sharing, as long as the vaccine is delivered by an in-network provider.[70] Prescription requirements and pharmacy authorization vary by plan.

68 The state noted that all services are covered as medically necessary.

69 Virginia Medicaid does not cover routine immunizations for adults (age 21 and older.) However, Virginia Medicaid covers adult immunizations when medically indicated on an individual basis. When adult immunization is covered, Virginia Medicaid does not require a copay for the vaccine itself, but there is a copay for the physician or clinic visit.

70 US Department of Health and Human Services, "The Affordable Care Act and Immunization," http://www.hhs.gov/healthcare/facts/factsheets/2010/09/The-Affordable-Care-Act-and-Immunization.html, accessed Dec. 11, 2014.

Determinants of vaccine utilization among older adults

As described in the sections above, despite the facts that the influenza, pneumococcal, tetanus, and shingles vaccines are routinely recommended for older adults, are cost-effective, are covered to varying degrees by health insurance, and prevent conditions which have relatively high incidence rates and disease burdens, vaccination rates are lower than realistic HP2020 targets and much lower than 100%. In order to identify the types of barriers that prevent older adults from receiving these vaccines, it is helpful to develop a conceptual model of vaccineutilization, focusing on the factors that cause patients to demand vaccines and the factors that lead physicians to supply vaccines. Within that context one can analyze to what extent these demand and supply factors empirically affect vaccination rates, and develop policy recommendations from the analysis.

Vaccine demand and supply

Although it is not our intention here to develop an estimate a fully specified economic model of supply and demand, it is helpful to categorize the factors that affect vaccine utilization along those lines. With that in mind, in order for a vaccine to be administered, two steps have to take place:

1. A patient must **demand** the vaccine. Patients may demand the vaccine independently or because a medical provider recommended or prescribed the vaccine.
2. A provider (physician, pharmacy, or immunization clinic) must stock or **supply** the vaccine.

Obviously, if either fewer patients demand or are encouraged to demand vaccines by providers and/or if fewer providers supply the vaccine, then fewer vaccinations will occur. On the demand side, from a theoretical standpoint, the following factors are those that seem most likely to contribute to patients demanding a vaccine or accepting a recommendation from a provider to receive a vaccine:

- Financial factors: These will be factors that determine affordability (or willingness to pay) and access to vaccine utilization, such as income, access to transportation, health insurance coverage, health insurance cost-sharing requirements or other out of pocket costs, the regularity with which one sees a physician, etc. Economic theory suggests that greater affordability and access to care will typically be associated with greater vaccine utilization.
- Information: These factors include awareness of vaccine recommendations, knowledge of disease burden, concerns regarding vaccine safety, concerns regarding vaccine contraindications, knowledge of vaccine effectiveness, knowledge of health insurance coverage and cost-sharing policies, knowledge of where to receive the vaccine, familiarity with others who received the vaccine, etc. The amount of relevant information a patient has will be associated with education

and access to accurate information sources. There is not necessarily a clear prediction about the relationship between information and vaccine utilization, as individual risk/benefit assessment may not necessarily be related to information. However, assuming that the evidence of the cost effectiveness of the vaccines under consideration here is compelling to most people, one can reasonably conjecture that more information will increase the likelihood of vaccination.

- Health status: This factor includes general health status as well as things such as previously having had the vaccine-relevant disease or another vaccine-preventable disease, physical activity limitations/disabilities, mental limitations/disabilities, willingness to accept injections, or other medical conditions. Again, it is not obvious whether different elements of health status will increase or decrease the demand for vaccines. Obviously, as with other factors as well, there will be interaction between health status and the other factors, further complicating any prediction about the impact of health status on vaccine utilization.
- Demographics: These factors include personal characteristics such as gender and ethnicity in addition to geographic location. There is again non clear prediction to be made about demographics and vaccine utilization other than certain tendencies that have been regularly observed, such as that women tend to be more frequent consumers of health care than are men, but even these patterns may not hold with respect to vaccine use among the elderly.

Similarly, on the supply side, a provider's willingness to stock and recommend a vaccine will depend upon the financial and information factors as well plus certain administrative factors that come into play:

- Financial factors: These include the vaccine cost to the provider including the terms of the purchase (i.e., having to pay up front). The patient population may affect the relative cost of stocking the vaccine – so, for example, a pediatrician, or a general practitioner working in a city with a relatively young population may find it cost ineffective to stock a vaccine indicated primarily for older adults. Theory suggests that the lower the relative cost of maintaining a supply of the vaccine, the more likely a physician would be to stock and administer the vaccine. Similar predictions apply to a pharmacy.
- Information: On the supplier side, information includes knowledge or acceptance of the vaccine's relative effectiveness or appropriateness for a given patient population, side effects, contraindications, recommended administration schedules and the patient's vaccination history, etc. Although there may be little variance in information factors among suppliers, one would typically expect greater information to lead to greater tendency to recommend and administer the vaccines under consideration.
- Administrative factors: These factors include things such as difficulty obtaining a purchase agreement with a manufacturer/wholesaler, the cost of collecting payment from patients or billing insurers and obtaining reimbursement, the ability to verify patient's insurance coverage and cost-

sharing requirements, etc. One would expect that lower administrative burdens would be associated with greater willingness to stock and administer vaccines to elderly adults.

Identifying demand and supply factors that influence vaccination rates

Ideally, to test this conceptual model, one would obtain data on the factors described above for patients and providers along with data on whether a vaccine was demanded, recommended, supplied, and ultimately administered. Unfortunately, all of the factors above cannot be empirically observed and such detailed data on vaccination encounters is not systematically recorded. However, within a broad construct it is possible to identify the extent to which the factors described above impact vaccine administration using survey data. Specifically, it is possible to analyze how vaccination rates differ across population subgroups that vary according to dimensions that serve as proxies for the factors described above.

Demand factors

There are a handful of sources that provide information on demand factors that affect vaccination rates, and thus potential barriers to patients receiving vaccines. Perhaps most useful among these is the Integrated Health Interview Series (IHIS) survey.

IHIS data analysis

The IHIS data are comprised of "a harmonized set of data and documentation based on material originally included in the public use files of the U.S. National Health Interview Survey (NHIS)," compiled by the Minnesota Population Center at the University of Minnesota through a grant from the National Institute of Child Health and Human Development (NICHD).[71] The IHIS data include over 14,000 variables and 51 years of data. Many of the variables describe the same characteristic in multiple ways (e.g., "Total combined family income," "Person's total earnings," and "Above or below poverty threshold"), are plainly unrelated to vaccination rates or the older adult population (e.g., "Currently taking birth control pills"), or were not asked in all recent years of the survey. Of the variables available, 42 are available that seem to reasonably be direct or indirect proxies for the factors listed above and are available during at least a subset of the 2000-2013 period.

[71] Integrated Health Interview Series, "Frequently Asked Questions," https://www.ihis.us/ihis-action/faq, accessed Dec. 12, 2014.

To provide an overview of the IHIS data and trends observed in the surveys, Figure 22, Figure 23 and Figure 24 presented in Appendix B, illustrate show pair-wise correlations between vaccination rates across these 42 dimensions for the influenza, pneumococcal, and shingles vaccines, respectively. The "P-value" column indicates whether the differences are statistically significant at the 5% level (i.e., P-values less than 0.05 indicate significance).

I.A.1.a.i. Multiple regression analysis of IHIS data

Focusing on demand side considerations, the IHIS data allow us to evaluate the impact of t of the variables available in these data on vaccine utilization . The estimated regression coefficient on each factor included as an independent variable in the regression equation indicates the magnitude and significance of a particular factor on the vaccination rate, controlling for all other factors included in regression. In other words, the regression coefficient indicates how much the vaccination rate would increase if the independent variable increased by one unit, holding all other factors constant. In this case, since all of the independent variables are binary (yes/no) variables, the coefficient indicates how much the vaccination rate would increase if the answer were yes instead of no (e.g., if a person were covered by Medicare versus not being covered by Medicare). Available variables were selected that measured or served as proxies for relevant financial, information, health status and demographic factors described above. A time trend was included so as not to conflate changes in demographic subgroups over time with changes in vaccination rates over time, particularly for shingles, but the estimated impact of time trends are not reported.

The detailed results of the regression analyses are provided in Figure 25 and Figure 26 in Appendix C with a simplified summary provided in Figure 11 below. Figure 11 the independent variables are grouped to illustrate the effects of the key demand factors.. In this figure, cells with green shading indicate variables that have a positive statistically significant relationship (with all statistical significance evaluated at the 5% level) to vaccination utilization in the respective column. Cells with red shading indicate variables with a negative statistically significant relationship, and cells without shading indicate no statistically significant relationship. Within each of the colored cells is a general indicator of the relative size (large, moderate or small[72]) of the estimated effect of each variable on the respective vaccination rate. The actual coefficient estimates corresponding to these general characterizations are provided in the regression tables in Appendix C.

The regression results suggest a somewhat mixed relationship between the financial factors and vaccination. For example, affordability is a more significant and consistent barrier for vaccination

[72] The magnitudes are identified arbitrarily as follows: Large effects are those with significant parameter estimates that are 0.07 or larger in absolute value, Small effects are those with absolute value less than 0.033 and Moderate are those between 0.033 and 0.07 in absolute value.

against shingles than against the other diseases. While being below the poverty level reduces the utilization rate for all of the vaccines, the effect is larger for the shingles vaccine, and remains relatively large up to 3 times the poverty level. For the other vaccines, being below the poverty level reduces vaccination by a relatively moderate amount, but that effect goes away as income rises to more than 2 times the poverty level.

The health care coverage variables show greater consistency across the different vaccines. Interestingly, the largest significant coefficient of any in the regressions is for respondents having a usual place for care, but 97% of the respondents do report having a usual place for care, suggesting that not having a place for care is a substantial barrier to adult vaccination. Relative to those having Medicare alone, having military coverage has a substantial positive effect on the likelihood of vaccination across all vaccines, but being a dual Medicare and Medicaid eligible individual has no significant impact on any of the vaccination rates exept for the pneumococcal vaccine where the effect is moderately negative or smaller before 2009, and having Medicare part D has a modest positive impact on all the vaccination rates with the exception of Tetanus.

Although there are limited variables on which to measure information factors in these regressions (having attended some college or more, and having used the Internet to look up heath information), both these variables are generally positively related to vaccination to a moderate or large extent. This lends support to the suggestion that having access to more information leads to greater vaccine uptake in the elderly adult population.

The health status variables paint somewhat of a mixed picture. Having had hepatitis has no effect on shingles or influenza vaccination but people who have received the hepatitis B or the tetanus vaccine are significantly more likely to have had each of the other vaccines. These effects are all moderate or large. Self reported health status, in terms of limitations of mental activity limitations or being in fair or poor health has no consistent impact. For some of the vaccines being in poor health increases vaccination rates, in others it reduces vaccination, for others the estimated effects are not significant.

Finally, the demographic variables show a mix of results with one somewhat surprising outcome – that being that women are less likely to have received the Tetanus vaccine than are men, while they are more likely to have received the others. Reasons for this gender specific difference are unclear. Further, after accounting for income and other demographic factors, minorities are less likely than others to have received all the vaccines, and US citizens are more likely to have received them. The data also show that there are generally not strong or consistent regional effects on vaccine utilization.

Figure 11 Summary of regression results

Variable	VariableType	Share of Respondants	Shingles (2009 to 2013)	Tetanus (2009 to 2013)	Influenza (2000 to 2013)	Pneumococcal (2000 to 2013)
ACA preventive care coverage implemented (after 2011)	Affordability	25%	N/A	N/A	Not signif.	Not signif.
Needed but couldn't afford medical care, past 12 months	Affordability	3%	Moderate	Not signif.	Moderate	Moderate
Needed but couldn't afford Rx, past 12 months	Affordability	4%	Not signif.	Not signif.	Not signif.	Small (Not sig. before 2009)
Delayed care because lacked transportation	Affordability	3%	Not signif.	Large	Not signif.	Not signif.
Ratio of family income to poverty level (0 - 1)	Affordability	10%	Large	Moderate	Large (Moderate before 2009)	Moderate
Ratio of family income to poverty level (1 - 2)	Affordability	25%	Large	Moderate	Moderate (not sig. after 2009)	Not signif.
Ratio of family income to poverty level (2 - 3)	Affordability	21%	Moderate	Not signif.	Not signif.	Not signif.
Has usual place for medical care	Coverage	97%	Large	Large	Large	Large
Medicare Part D (relative to Medicare only - 2009 to 2013)	Coverage	40%	Moderate	Not signif.	Moderate	Small (Moderate before 2009)
Medicare with Medicaid (relative to Medicare only)	Coverage	6%	Not signif.	Not signif.	Not signif.	Moderate (Small before 2009)
Medicare with military coverage (relative to Medicare only)	Coverage	5%	Moderate	Large	Large	Large
Medicare with private coverage (relative to Medicare only)	Coverage	50%	Small	Small	Moderate (Large before 2009)	Moderate (Large before 2009)
Not on Medicare	Coverage	7%	Not signif.	Moderate	Not signif.	Moderate (Small before 2009)
Some college or more	Information	45%	Moderate	Large	Small (not sig. after 2009)	Moderate (not sig. after 2009)
Looked up health information on Internet (2009 to 2013)	Information	32%	Large	Large	Moderate	Moderate
Activities limited by difficulty remembering	Health status	7%	Not signif.	Not signif.	Not signif.	Small (not sig. after 2009)
Ever had hepatitis	Health status	4%	Not signif.	Moderate	Not signif.	Moderate (not sig. after 2009)
Ever received hepatitis B vaccine	Health status	11%	Moderate	Large	Moderate	Moderate (Large before 2009)
Fair or poor health	Health status	23%	Small	Not signif.	Small (Moderate before 2009)	Moderate
Tetanus shot in last 10 years (2009 to 2013)	Health status	55%	Large	N/A	Large	Large
Has any activity limitation	Health status	34%	Small	Small	Moderate	Large
African American	Demographics	8%	Large	Large	Large	Large
Female	Demographics	56%	Moderate	Large	Moderate (not sig. bef. 2009)	Moderate
Hispanic ethnicity	Demographics	7%	Large	Small	Moderate (Large before 2009)	Large
U.S. citizenship	Demographics	98%	Moderate	Moderate	Large (not sig after 2009)	Large
Region (Northeast relative to Midwest)	Demographics	19%	Not signif.	Large	Moderate (not sig. bef. 2009)	Not signif.
Region (South relative to Midwest)	Demographics	37%	Not signif.	Moderate	Not signif.	Not signif.
Region (West relative to Midwest)	Demographics	21%	Moderate	Not signif.	Not signif.	Small (not sig. before 2009)

Source: Bates White analysis of IHIS survey data.

Published survey results

As far as we know, this is the first time the IHIS data have been used to assess the drivers of adult vaccine use, but these results are broadly consistent with other analyses of this question that have used other methodologies, some of which we will discuss here.

- Financial factors: The potential impact of coverage and of removing financial barriers has been shown to have substantial potential to increase vaccine uptake among elderly adults. In particular, starting on September 1, 2013, the National Health Service of the United Kingdom offered the shingles vaccine to elderly patients at no cost. The program began by offering the vaccine to all patients at either the age of 70 or 79. General practitioners were instructed to recommend the vaccine to all patients in the targeted cohort. Among the targeted population, the vaccination rate increased from under 20% to 54% within an 8 month period.[73] These results are also consistent with the results of GAO data analysis and surveys:
  - Medicare beneficiaries with a low-income subsidy were more than three times less likely to have submitted a claim for shingles and tetanus vaccinations than those not on the subsidy.[74]
  - In a physician survey, as indicated in Figure 12, approximately 62%, 32%, and 10% of physicians reported that beneficiaries decline the shingles, tetanus, and pneumococcal vaccines half the time or more when it is recommended to them.[75] Lack of Part D or other insurance coverage and difficulty affording cost sharing were the most frequently cited reasons for shingles and the second and third most frequently cited reason for tetanus behind safety concerns.[76]

[73] Public Health England, *Health Protection Report*, (London: Public Health England, May 2014), 3, *available at* https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/345744/hpr2114_hzvip.pdf.

[74] Government Accountability Office, "Many Factors, Including Administrative Challenges, Affect Access to Part D Vaccinations," page 55, *available at* http://www.gao.gov/assets/590/587009.pdf.

[75] Government Accountability Office, "Many Factors, Including Administrative Challenges, Affect Access to Part D Vaccinations," page 57, *available at* http://www.gao.gov/assets/590/587009.pdf.

[76] Government Accountability Office, "Many Factors, Including Administrative Challenges, Affect Access to Part D Vaccinations," page 57, *available at* http://www.gao.gov/assets/590/587009.pdf.

Figure 12: Selected results from GAO physician survey (2010)

Question	Percent responding yes		
	Shingles	Tetanus	Pneumococcal
Frequency of beneficiary declinations after physician recommendation			
Never decline the vaccination	1 (0, 2)	9 (6, 12)	11 (8, 14)
Occasionally decline the vaccination	31 (28, 34)	55 (49, 60)	78 (74, 82)
Decline the vaccination about half the time	35 (31, 38)	17 (13, 20)	9 (5, 12)
Usually decline the vaccination	25 (21, 29)	14 (11, 18)	1 (1, 2)
Always decline the vaccination	2 (0, 4)	2 (0, 3)	0 (0, 0)
Do not know	6 (4, 8)	4 (2, 6)	1 (0, 1)
Reasons for beneficiary declinations			
Lack of Part D or other insurance coverage	50 (45, 54)	28 (24, 31)	N/A[a]
Difficulty affording cost sharing	48 (44, 53)	23 (20, 27)	N/A[a]
Concerns about safety	26 (23, 29)	29 (24, 33)	37 (34, 40)
Concerns about efficacy	15 (12, 18)	7 (5, 9)	11 (8, 14)
Need to obtain vaccination outside of physician's office	24 (20, 27)	8 (5,12)	4 (2, 6)

Sources: Government Accountability Office, "Many Factors, Including Administrative Challenges, Affect Access to Part D Vaccinations," pages 57, *available at* http://www.gao.gov/assets/590/587009.pdf.

- Also as reported by the GAO, shown in Figure 13, older adults with Part D and private or other coverage are more likely to receive the shingles and tetanus vaccines, which are covered by Part D, than those without any coverage. This is consistent with the fact that older adults with Part D and other supplemental insurance likely obtain Part D-covered vaccines with little or no cost-sharing. Note that older adults with only Part D coverage are (statistically) equally likely to receive a shingles or tetanus vaccine as those without any coverage, suggesting that the cost savings associated with Part D coverage may not outweigh the administrative difficulties.[77]

Figure 13: Percentage of adults age 65 and older reporting ever receiving shingles vaccination or receiving Td vaccination in the previous 10 years, by insurance coverage (2009)

		Without Part D coverage		With Part D coverage	
Vaccination	All respondents	No other coverage	With private or other coverage	No other coverage	With private or other coverage
Shingles	11.0% (10.0%, 12.0%)	10.7% (9.5%, 12.1%)	13.4% (11.4%, 15.8%)	11.5% (10.0%, 13.2%)	14.6% (12.0%, 17.7%)
Td	52.8% (51.0%, 54.5%)	52.8% (50.6%, 55.0%)	54.8% (51.8%, 57.8%)	52.6% (49.6%, 57.8%)	56.0% (51.5%, 60.3%)

Source: Government Accountability Office, "Many Factors, Including Administrative Challenges, Affect Access to Part D Vaccinations," page 15, *available at* http://www.gao.gov/assets/590/587009.pdf.

[77] The GAO used 95% confidence bounds. Medicaid is included in "other coverage." GAO used National Health Immunization Survey data to conduct their analysis.

- Information factors: Consistent with the results above, studies suggest that adult patients may not be well educated regarding the risks of diseases prevented by adult vaccines and the vaccines' safety and effectiveness (particularly the shingles and tetanus vaccines) and that lack of information and physician recommendations may impact vaccination rates. In a 2008 National Foundation of Infectious Diseases survey, only 20% and 43% of respondents reported being extremely or very familiar with pneumococcal disease and shingles, respectively.[78] Accordingly, 68% of adults aged 65 and over reported getting most of their medical information from their personal physician (followed by friends and family and the internet), and 55% of respondents said that they would not receive a vaccination unless it were recommended by their doctor.[79] These results are also consistent with the UK program described above in which vaccination rates increased after physicians were instructed to recommend vaccines.

  However, physicians do not always independently recommend adult vaccines. According to a survey of physicians conducted by the GAO, only 33% and 46% of physicians always recommend the shingles and tetanus vaccines, respectively.[80] The recommendation rate was higher for the pneumococcal vaccine (78%). Even if physicians recommend vaccines, patients may decline them due to concerns about safety and efficacy. As mentioned above, in the GAO survey, approximately 62%, 32%, and 10% of physicians reported that beneficiaries decline the shingles, tetanus, and pneumococcal vaccines half the time or more when it is recommended to them.[81] Concerns about safety were the most frequently cited reason for tetanus and third most frequently cited reason for shingles behind lack of insurance coverage and difficulty affording cost sharing.[82]

78 National Foundation for Infectious Diseases, "Survey: Adults Do Not Recognize Infectious Disease Risks," *available at* http://www.adultvaccination.org/newsroom/events/2009-vaccination-news-conference/nfid-survey-fact-sheet.pdf.

79 Among those aged 65 and over, 10% reported getting most information from the internet. National Foundation for Infectious Diseases, "Survey: Adults Do Not Recognize Infectious Disease Risks," *available at* http://www.adultvaccination.org/newsroom/events/2009-vaccination-news-conference/nfid-survey-fact-sheet.pdf.

80 Government Accountability Office, "Many Factors, Including Administrative Challenges, Affect Access to Part D Vaccinations," page 56, *available at* http://www.gao.gov/assets/590/587009.pdf.

81 Government Accountability Office, "Many Factors, Including Administrative Challenges, Affect Access to Part D Vaccinations," page 57, *available at* http://www.gao.gov/assets/590/587009.pdf.

82 Government Accountability Office, "Many Factors, Including Administrative Challenges, Affect Access to Part D Vaccinations," page 57, *available at* http://www.gao.gov/assets/590/587009.pdf.

Figure 14: Selected results from the NFID vaccine survey (2009) and GAO physician survey (2010)

Question (source)	Percent responding yes			
	Shingles	Tetanus	Pneumococcal	Influenza
Extremely or very familiar with disease (NFID)	43%	N/A	20%	70%
Frequency of physician vaccination recommendations (GAO)				
Always recommend the vaccination	33 (29, 37)	46 (40, 52)	78 (74, 81)	
Usually recommend the vaccination	35 (29, 40)	28 (24, 33)	19 (16, 22)	
Recommend the vaccination about half the time	12 (9, 14)	9 (5, 12)	2 (1, 4)	
Occasionally recommend the vaccination	19 (15, 22)	16 (13, 19)	1 (0, 2)	
Never recommend the vaccination	2 (1, 3)	1 (1,2)	0 (0, 0)	

Sources: National Foundation for Infectious Diseases, "Survey: Adults Do Not Recognize Infectious Disease Risks," *available at* http://www.adultvaccination.org/newsroom/events/2009-vaccination-news-conference/nfid-survey-fact-sheet.pdf. Government Accountability Office, "Many Factors, Including Administrative Challenges, Affect Access to Part D Vaccinations," pages 56, *available at* http://www.gao.gov/assets/590/587009.pdf.

- Coverage and access to care: Consistent with the results above that older adults who have a usual place for medical care are more likely to be vaccinated, the NFID survey found that people who have annual physical exams are more like to be vaccinated (82%) than are those who do not (68%). Additionally, adults who delayed care because they lacked transportation had lower vaccination rates, the GAO's physician survey found that 24% of physicians cited the need to obtain vaccination outside of physician's office as a reason that beneficiaries declined the shingles vaccine. Only 8% and 4% cited this reason for the tetanus and pneumococcal vaccines.[83]

Supply factors

As discussed above, supply factors affect vaccination utilization, but the impact of such factors is not directly observable in the IHIS surveys. In order to identify factors that influence providers' likelihood of supplying vaccines, and thus potential barriers to patients receiving vaccines, one can turn to published surveys of physicians and pharmacies as well as independent analysis of the variation in prescribing and administration rates across providers located in wealthier and poorer areas.

Published survey results

As described above, patients can receive recommended vaccines from physicians or pharmacies. First focusing on physicians, as shown in Figure 15 below, the GAO found that 31% of physicians stock and administer the shingles vaccine, but that 83% and 91% of physicians stock and administer the tetanus and pneumococcal vaccines, respectively. As shown in Figure 16 below, the GAO found that the factors influencing physicians' decisions to stock vaccines and recommend them varied by

[83] Government Accountability Office, "Many Factors, Including Administrative Challenges, Affect Access to Part D Vaccinations," page 57, *available at* http://www.gao.gov/assets/590/587009.pdf.

vaccine; however, vaccine cost and insurance coverage were commonly cited. The GAO also found that smaller practices (1 to 2 physicians), whose practice share of Medicare beneficiaries is higher than larger practices, were less likely to stock vaccines than medium- (3 to 10 physicians) and large-size (more than 10 physician) practices, respectively.[84] The fact that smaller practices are less likely to stock the vaccine is consistent with the fact that these practices may be less willing to incur the up-front cost of purchasing vaccine stock or invest in storage facilities.[85]

Figure 15: Selected results of GAO physician survey on physician stocking practices (2010)

Physician stocking practice	Shingles	Tetanus	Pneumococcal
Stock the vaccine and it is administered in my office	31 (26, 36)	83 (79, 87)	91 (89, 94)
Refer beneficiaries to a pharmacy to purchase the vaccine, and it is administered in my office	26 (22, 31)	4 (1, 7)	1 (0, 1)
Refer beneficiaries to a pharmacy to purchase the vaccine, and it is administered at the pharmacy	28 (22, 34)	3 (1, 6)	3 (1, 5)
Refer beneficiaries to the Public Health Department, and the vaccine is obtained and administered at the Public Health Department	7 (4, 10)	7 (4, 9)	3 (2, 5)
Refer beneficiaries to another clinic or practice, and the vaccine is obtained and administered there	5 (3, 7)	2 (0, 4)	2 (0, 3)
Other	3 (1, 5)	1 (1, 1)	0 (0, 0)

Source: Government Accountability Office, "Many Factors, Including Administrative Challenges, Affect Access to Part D Vaccinations," page 58, *available at* http://www.gao.gov/assets/590/587009.pdf.

[84] Government Accountability Office, "Many Factors, Including Administrative Challenges, Affect Access to Part D Vaccinations," pages 17-18, *available at* http://www.gao.gov/assets/590/587009.pdf.

[85] As an indicator of the cost of carrying vaccine stocks, see: Centers for Disease Control, "CDC Vaccine Price List," http://www.cdc.gov/vaccines/programs/vfc/awardees/vaccine-management/price-list/index.html, accessed Nov. 6, 2014.

Figure 16: Selected results of GAO physician survey on barriers to stocking, administering, or recommending vaccines

Barrier cited	Shingles	Tetanus	Pneumococcal
Cost of purchasing vaccine stock	86 (82, 90)	41 (35, 46)	38 (34, 42)
Low Medicare reimbursement for the cost and/or administration of the vaccine	87 (84, 90)	66 (61, 71)	58 (52, 64)
Inconsistent Part D plans' coverage and reimbursement rates	93 (90, 95)	69 (65, 74)	
The time and effort required to assess beneficiary Medicare coverage for the vaccine and pursue Medicare reimbursement for providing and/or administering the vaccine	84 (80, 88)	60 (54, 65)	45 (39, 51)
Trouble stocking the vaccine due to shortage/order backlog	62 (58, 66)	24 (19, 28)	26 (22, 29)
Storage difficulties (the need to store the vaccine in a refrigerator/freezer)	35 (31, 39)	10 (7, 13)	14 (10, 17)
Physician's concern about vaccine's safety	15 (11, 19)	5 (3, 8)	4 (2, 7)
Physician's concern about vaccine's efficacy	29 (24, 35)	5 (3, 7)	7 (3, 10)
Lack of, or uncertain, beneficiary demand for the vaccine	53 (48, 58)	30 (25, 35)	22 (17, 27)
Beneficiaries' lack of insurance coverage	83 (79, 87)	54 (49, 59)	
Beneficiaries' difficulty affording the cost sharing for the vaccine	85 (80, 89)	55 (49, 60)	
Beneficiaries' concern about vaccine's safety	49 (44, 54)	30 (25, 35)	35 (31, 39)
Beneficiaries' concern about vaccine's efficacy	46 (41, 52)	21 (17, 25)	26 (23, 30)
The need for beneficiaries to transport the vaccine from a pharmacy to a physician to be administered	47 (41, 52)	14 (9, 19)	8 (5, 11)

Source: Government Accountability Office, "Many Factors, Including Administrative Challenges, Affect Access to Part D Vaccinations," pages 59, 62, and 65, *available at* http://www.gao.gov/assets/590/587009.pdf.

Fewer pharmacies stock the recommended vaccines than physicians, suggesting that pharmacy provision of vaccines could provide an opportunity to increase vaccine supply and thus vaccination rates. In particular, the GAO found that 35%, 18%, and 42% of pharmacies routinely stocked the shingles, tetanus, and pneumococcal vaccines, respectively. Among those pharmacies that stocked the vaccines, approximately 1 in 5 did not administer the vaccine. For example, according to the CVS pharmacy website, the shingles vaccine is not available at their Minute Clinic locations.[86] Similar to physicians, pharmacies cited vaccine cost and insurance coverage as factors that influenced their decisions to stock, administer, and recommend vaccines.

[86] CVS Pharmacy, "Vaccinations & Injections," http://www.cvs.com/minuteclinic/services/vaccinations-and-injections/_/N-d8Z3a3joZd5?WT.ac=MC-N-SVC-BROWSE_SERVICES-MCBCC0005-62814-940-OP, accessed October 15, 2014.

Figure 17: Selected results of GAO pharmacy survey on pharmacy stocking practices (2010)

Physician stocking practice	Shingles	Tetanus	Pneumococcal
Stock the vaccine and administer to patients at our pharmacy	26 (20, 31)	18 (13, 24)	42 (34, 50)
Stock the vaccine, but do not administer the vaccine	7 (4, 10)	2 (1, 3)	1 (1, 2)
Stock the vaccine, and our pharmacy employs and/or contracts with medical professionals to administer the vaccine at our pharmacy	2 (2, 2)	1 (1, 2)	3 (2, 3)
Refer beneficiaries to the Public Health Department, and the vaccine is obtained and administered at the Public Health Department	4 (0, 9)	6 (3, 9)	6 (1, 10)
Refer beneficiaries to a physician clinic or practice, and the vaccine is obtained and administered there	40 (34, 46)	60 (54, 67)	40 (35, 45)
Refer beneficiaries to another pharmacy to obtain the vaccine	18 (15, 21)	7 (5, 8)	6 (5, 7)

Source: Government Accountability Office, "Many Factors, Including Administrative Challenges, Affect Access to Part D Vaccinations," page 69, *available at* http://www.gao.gov/assets/590/587009.pdf.

Figure 18: Selected results of GAO pharmacy survey on barriers to stocking, administering, or recommending vaccines

Barrier cited	Shingles	Tetanus	Pneumococcal
Cost of purchasing vaccine stock	42 (32, 53)	20 (12, 29)	20 (12, 28)
Low Medicare reimbursement for the cost and/or administration of the vaccine	53 (43, 64)	51 (46, 57)	46 (43, 50)
Inconsistent Part D plans' coverage and reimbursement rates	71 (68, 74)	61 (54, 68)	
The time and effort required to assess beneficiary Medicare coverage for the vaccine and pursue Medicare reimbursement for providing and/or administering the vaccine	51 (42, 60)	53 (46, 60)	53 (46, 60)
Trouble stocking the vaccine due to shortage/order backlog	64 (54, 75)	30 (23, 38)	33 (24, 42)
Storage difficulties (the need to store the vaccine in a refrigerator/freezer)	45 (36, 54)	25 (20, 31)	23 (16, 31)
State statutes/regulations do not allow pharmacist administration of the vaccine	19 (11, 28)	23 (15, 31)	18 (10, 26)
Pharmacy's concern about vaccine's safety	10 (4, 17)	7 (5, 9)	9 (3, 15)
Pharmacy's concern about vaccine's efficacy	11 (4, 19)	7 (5, 10)	8 (2, 13)
Lack of, or uncertain, beneficiary demand for the vaccine	50 (38, 61)	58 (47, 70)	67 (61, 72)
Beneficiaries' lack of insurance coverage	59 (56, 62)	52 (46, 57)	
Beneficiaries' difficulty affording the cost sharing for the vaccine	68 (64, 72)	58 (52, 64)	
Beneficiaries' concern about vaccine's safety	33 (24, 41)	27 (15, 39)	35 (32, 39)
Beneficiaries' concern about vaccine's efficacy	38 (30, 46)	27 (16, 38)	35 (32, 38)
The need for beneficiaries to transport the vaccine from a pharmacy to a physician to be administered	43 (34, 52)	23 (14, 32)	24 (13, 34)

Source: Government Accountability Office, "Many Factors, Including Administrative Challenges, Affect Access to Part D Vaccinations," pages 70, 73, and 76, *available at* http://www.gao.gov/assets/590/587009.pdf.

Even though fewer pharmacies stock recommended vaccines than physicians, pharmacy provision of vaccines seems to provide an opportunity to increase vaccine supply and thus vaccination rates. In particular, Uscher-Pines et al. (2012) found that the number of visits to the three largest retail clinics in the U.S. in which one or more vaccinations were administered increased four-fold between 2007 2009 – from 469,330 in 2007 to 1,952,610 in 2009.[87] Although the GAO did not analyze the influenza

[87] Lori Uscher-Pines et al., "The Growth of Retail Clinics in Vaccination Delivery in the U.S.," *American Journal of Preventive Medicine* 43, no. 1 (2012): 63-66.

vaccine, Uscher-Pines et al. (2012) found that the influenza vaccine was the most frequently administered vaccine by the two largest retail pharmacy operators among adults aged 65 and older in 2009. The pneumococcal and tetanus vaccines comprised 5.4% and 0.5% administrations, respectively.[88] This is not surprising given that the influenza vaccine is recommended annually. However, it suggests that pharmacies could recommend the one-time pneumococcal, tetanus, and shingles vaccines when patients present themselves for an influenza vaccine to perhaps increase these other vaccination rates.

The GAO's provider surveys also suggest that financial factors not only contribute to patients demanding vaccines but also to providers' decisions to stock and recommend vaccines. Based on the evidence described above, one would expect providers in higher income areas to be more likely to purchase vaccine stock, to invest in vaccine storage capacity, and accept potentially lower reimbursement rates. Providers in higher income areas are probably also more likely to have patients demanding vaccines and accepting recommendations because they may have insurance, can afford cost-sharing, and perhaps are more educated. Thus, patient demand (or perceived demand), which is driven by financial factors, likely also affects a provider's decision to stock and recommend vaccines.

Medicare utilization data analysis

Publicly available physician-level 2012 Medicare Part B and 2011 Part D utilization and prescription data can be used to evaluate the impact of financial factors on vaccination rates. In these data one can analyze the relationship between per capita income in a provider's county with the percent of eligible beneficiaries vaccinated (i.e., the Medicare vaccination rate).[89] Indeed, the data suggest that physicians located in lower income areas are less likely to prescribe vaccines. Specifically, Figure 19 below shows that the average number of prescriptions per person aged 65 and over in 2011/2012 was higher in counties with higher average per capita incomes.[90] Similarly, Figure 20 shows that prescriptions are positively correlated with average per capita income.

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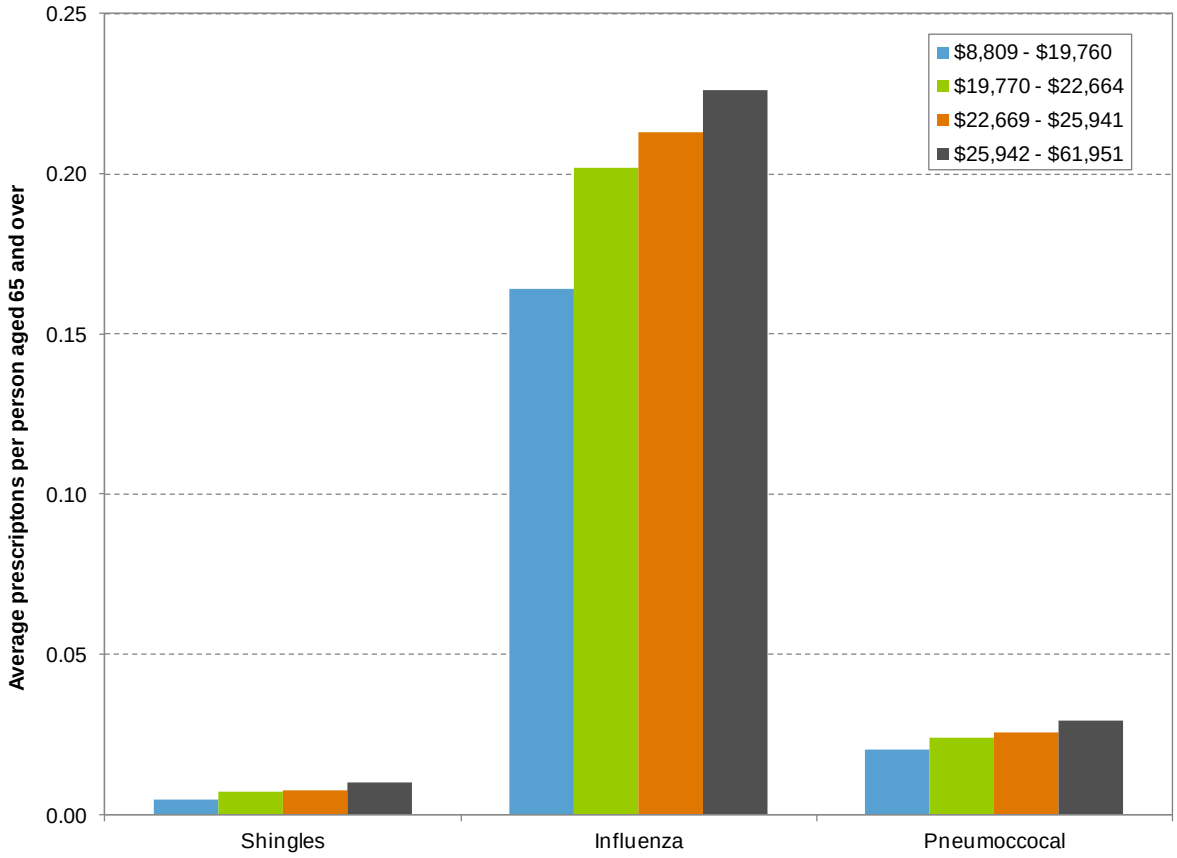
88 Lori Uscher-Pines et al., "The Growth of Retail Clinics in Vaccination Delivery in the U.S.," *American Journal of Preventive Medicine* 43, no. 1 (2012): 63-66.

89 CMS released 2012 Medicare Part B utilization data in April 2014. See, http://www.cms.gov/Research-Statistics-Data-and-Systems/Statistics-Trends-and-Reports/Medicare-Provider-Charge-Data/Physician-and-Other-Supplier.html.

2011 Medicare Part D prescription data was obtained by the public interest group ProPublica through a Freedom of Information Act (FOIA) request and made available to the public in 2013. See, https://projects.propublica.org/data-store/sets/health-mcd11-1. Note that for patient privacy purposes prescriptions are not reported for physicians with less than 11 prescriptions of a particular drug.

90 The average number of prescriptions per person aged 65 and over was calculated using county-level 2012 population data reported by the US Census American Community Survey. In Figure 19, counties are divided into quartiles.

Figure 19: Breakdown of average number of Medicare prescriptions per person aged 65 and over by per capita income in provider's county (2011, 2012)



Sources: 2012 Medicare Part B utilization data, 2011 Medicare Part D prescription data, 2012 American Community Survey

Figure 20: Correlation between vaccinations per person aged 65 and over and per capita county income

Vaccine	Correlation coefficient
Shingles	0.0514
Pneumococcal	0.1740
Influenza	0.1779

Sources: 2012 Medicare Part B utilization data, 2011 Medicare Part D prescription data, 2012 American Community Survey

Therefore, although it is not possible to fully disentangle the specific effects of income on patient demand and provider supply, several data sources support a conclusion that financial factors affect vaccination rates.

Recommendations to increase vaccination rates among older adults

The analyses described in Section 0 identify the key drivers of vaccine utilization and offer support for policy recommendations that would arguable increase the appropriate utilization of adult vaccines. Based on a broad review of both the new evidence provided and the existing evidence discussed here, the following strategies to increase vaccination rates among older adults seem appropriate and merit further investigation.

- **Information strategies.**
  - Expand efforts to provide specific education to adult patients about adult vaccines: According to the GAO and IFID surveys, beneficiaries are not knowledgeable and about vaccine-preventable diseases and do not accept vaccines because of concerns about safety and efficacy, despite ACIP recommendations and other medical evidence. Although not specific to education about vaccination, the regression results also indicate that better educated individuals are more likely to have been vaccinated. It stand to reason that better information provided to adults would increase their likelihood of using these vaccines. A potentially impactful step combining information and financial aspects would be to make vaccination counseling an integral part of the Medicare Wellness Visit, potentially providing supplemental reimbursement to physicians for so doing. Education could also take other forms including sending easy to understand pamphlets to beneficiaries when Medicare ID cards are mailed.
  - Create more general awareness of the importance of adult vaccination: In addition to Vaccine Awareness Month, it may be worth targeting educational opportunities like Medicare Open Enrollment, National Family Caregiver Month, and Grandparents Day to increase awareness of adult vaccination.
  - Encourage retail pharmacy clinics to administer and promote the shingles vaccine: Retail clinics are becoming an increasingly popular option for primary and supplemental health care, especially for basic preventative care measures like vaccines. Educating patients about pharmacy provision and encouraging pharmacies to promote vaccines when patients seek other medical treatment could increase vaccination rates.
  - Evaluate the potential benefit of recommending that seniors with multiple chronic conditions vaccinate with their medical homes, as opposed to in pharmacy settings.
- **Health care and administrative strategies.**
  - Encourage states that do not allow pharmacists to administer the tetanus vaccines to do so.

- Encourage physicians to participate in TransactRx: This would allow physicians to bill Part D plans directly so that beneficiaries do not have to pay full vaccine costs up front.
- Encourage the use of electronic medical records and systems that incorporate adult vaccines into clinical workflow models: Unlike pediatric vaccines, which physicians and parents know are standard, scheduled, and key to early childhood healthcare, adult vaccines have not yet been incorporated into routine clinical workflow models. Moreover, parents are incentivized to request vaccines for their children because such vaccines are often required for enrollment in public schools, whereas similar enforcement mechanisms do not exist for adult vaccines. The use of electronic medical records and accountable care organizations could potentially facilitate and incentivize systematic alerts that vaccines are due so that physicians do not have to keep track of eligibility requirements, contraindications, and vaccine history.[91] Increased provider participation in the CDC's Immunization Information System (IIS) would also improve the flow of information about utilization history and potentially increase appropriate vaccine utilization in this population.
- Evaluate the potential gains from the government sponsoring CDC vaccine distribution and tracking program similar to the Vaccines for Children (VFC) program. Encourage the addition of systemic tracking of adult immunization similar to what already exists for childhood vaccinations.
- Require providers to ascertain beneficiaries' vaccination history and discuss recommended vaccines during the Initial Preventive Physical Examination (IPPE), which is also known as the "Welcome to Medicare Preventive Visit." Additionally, as part of Medication Therapy Management (MTM), a requirement of an immunization status assessment be undertaken as part of the Comprehensive Medication Review (CMR) would increase the available information for both patients and providers and likely result in more appropriate utilization of vaccines.
- Advance the incorporation of vaccine utilization into quality measures into Medicare Star Rating programs and in private quality metrics such as HEDIS.

- **Financial strategies.**
  - Evaluate the impact of a government-sponsored vaccine buy-back program: In view of the survey evidence that providers do not stock vaccines due to payment concerns, additional providers may be incentivized to stock costly vaccines knowing that they will not incur the

[91] For instance, the shingles vaccine is contraindicated for adults with compromised immune systems. This includes those with primary or acquired immunodeficiency (e.g., leukemia, lymphomas, or other malignant neoplasms affecting the bone marrow or lymphatic system) or with AIDS. However, physicians must also consider interactions between vaccines and other treatments. For instance, it is preferable to vaccinate patients with rheumatoid arthritis before they start methotrexate or TNF-blocker treatment, which can weaken the immune system.

costs of unused vaccines. This could also decrease waste if vaccine stock could be re-directed to providers with excess demand.

- Evaluate the potential for CMS to "pre-pay" providers for vaccines: Again, based on survey evidence, additional providers may be incentivized to stock costly vaccines if they do not have to incur up-front costs.
- Consider a proposal that CMS consistently communicate to Part D plans the option of including a $0-vaccine only tier in benefit design: This both increases the information availability about such options to plans and patients, but also operates to reduce real and perceived financial barriers.

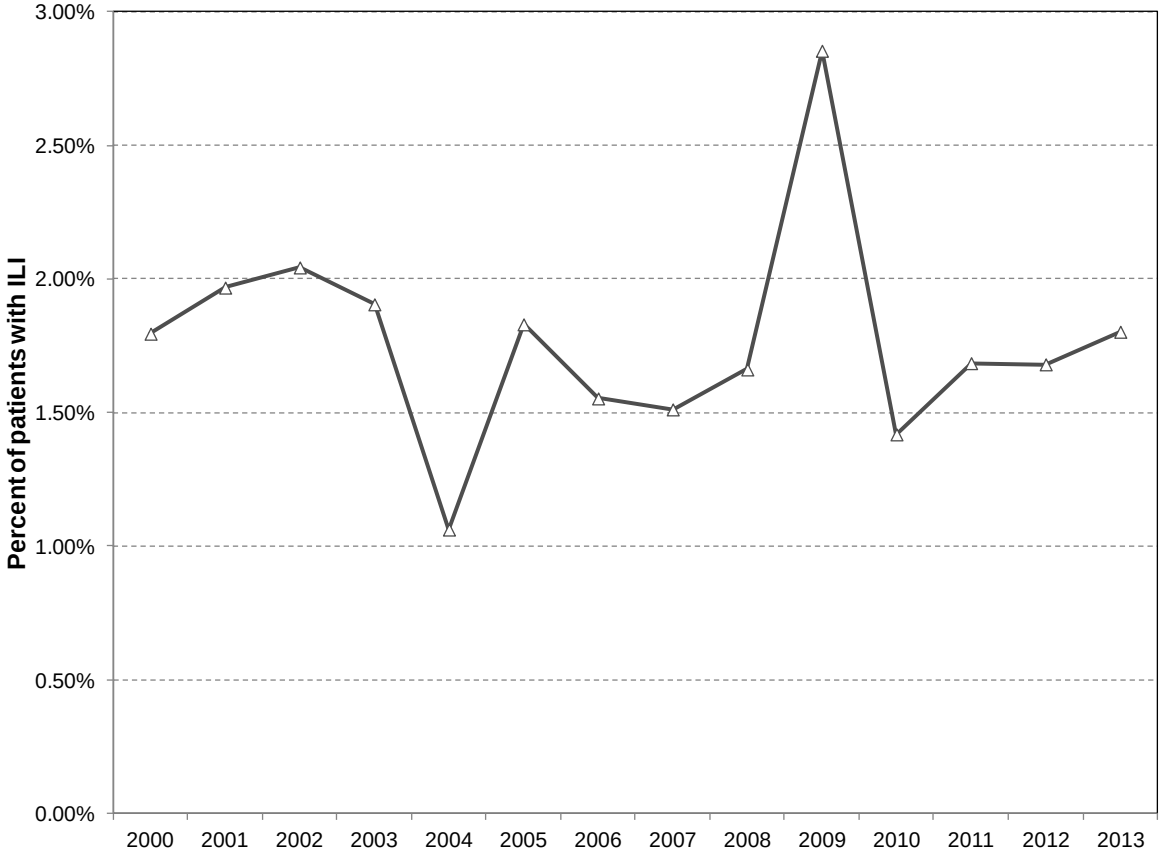
Conclusion

Despite the facts that the influenza, pneumococcal, tetanus, and shingles vaccines are routinely recommended for older adults, are cost-effective, are covered to varying degrees by health insurance, and prevent conditions with have relatively high incidence rates and disease burdens, vaccination rates are lower than realistic HP2020 targets and much lower than 100%. Based on a conceptual model and empirical results using several data sources, the analysis identified numerous financial, information, administrative, and health factors that affect vaccination rates. Following from these results a range of policies designed to eliminate these barriers or mitigate their effect on vaccination rates is recommended.

Appendix A. Influenza incidence based on hospital visits

Figure 5 above presents the number of lab-confirmed influenza cases. Figure 21 below shows the percent of hospital visits in which the patient exhibited influenza-like illness. This data series is available for a longer time period but is not restricted to adults aged 65 and over. The spike in 2009 is likely associated with the swine flu pandemic.

Figure 21: Percent of hospital visits exhibiting influenza like symptoms (ILI) by year



Source: Data are for calendar years in the general population. National and Regional Level Outpatient Illness and Viral Surveillance, via FluView, accessed October 14, 2014, http://gis.cdc.gov/grasp/fluview/fluportaldashboard.html.

Appendix B. Correlations of vaccination rates with individual characteristics

Figure 22: Influenza vaccination rates for adults aged 65 and over given selected demographic information (2000-2013)

Variable description	Percent of those answering no who received the vaccine	Percent of those answering yes who received the vaccine	P-value	Time period
Covered by Medicaid	66.1%	55.2%	0.00	
Covered by Medicare	52.4%	66.1%	0.00	
Covered by VA military health care (conditional on having military health care)	75.9%	76.0%	0.96	2004-2013
Covered by military health insurance	64.6%	74.9%	0.00	
Covered by private health insurance	60.2%	69.0%	0.00	
Delayed care because lacked transportation	65.3%	62.2%	0.03	
Has Medi-Gap insurance	65.0%	72.2%	0.00	
Has no health insurance (excluding single service plans)	65.7%	37.6%	0.00	
Has usual place for medical care	28.4%	66.6%	0.00	
Health insurance offered through workplace (conditional on working)	57.4%	57.4%	0.97	
Looked up health information on Internet, past 12 months	65.2%	71.4%	0.00	2009, 2011-2013
Medical care delayed due to cost, past 12 months	65.7%	54.1%	0.00	
Medicare Part D (conditional on having Medicare)	66.4%	68.7%	0.00	2006-2013
Needed but couldn't afford medical care, past 12 months	65.6%	53.7%	0.00	
Needed but couldn't afford prescription medicines, past 12 months	65.6%	58.4%	0.00	
African American	66.7%	49.9%	0.00	
Below poverty threshold	67.0%	54.9%	0.00	
Born in the United States	55.6%	66.5%	0.00	
Ever served in U.S. Armed Forces, Reserves, or National Guard	66.1%	69.9%	0.00	2011-2013
Female	65.2%	65.3%	0.88	
Hispanic ethnicity	66.2%	52.7%	0.00	
Internet use	64.3%	70.8%	0.00	2012-2013
North central/Midwest region	64.8%	67.0%	0.00	
Received disability pension other than Social Security/RRR	65.3%	66.3%	0.32	
Received income from SSI, previous calendar year	65.7%	55.4%	0.00	
Received income from Social Security/RRR, previous calendar year	56.0%	66.3%	0.00	
Received income from wages/salary, previous calendar year	66.4%	59.8%	0.00	
Received income from welfare/public assistance,	65.4%	56.9%	0.02	

Variable description	Percent of those answering no who received the vaccine	Percent of those answering yes who received the vaccine	P-value	Time period
previous calendar year				
Received other (new welfare reform) assistance from government program	65.3%	61.0%	0.25	
Some college or more	62.8%	69.0%	0.00	
U.S. citizenship	45.8%	65.8%	0.00	
Usually work full time (conditional on working)	61.5%	57.5%	0.11	
Activities limited by difficulty remembering	65.1%	68.0%	0.00	
Ever had hepatitis	65.1%	69.1%	0.00	
Ever received hepatitis B vaccine	64.3%	71.5%	0.00	
Ever told you had influenza or pneumonia	63.3%	73.3%	0.00	2007, 2012
Fair or poor health	64.8%	66.9%	0.00	
Had influenza or pneumonia, past 12 months (conditional on ever being told you had influenza or pneumonia)	73.2%	73.9%	0.80	2007, 2012
Had tetanus shot, past 10 years	57.0%	74.2%	0.00	2008-2013
Has any activity limitation	63.4%	68.8%	0.00	
Has difficulty walking or climbing stairs	65.6%	70.5%	0.00	2008-2013
Has serious difficulty concentrating or remembering	66.7%	68.1%	0.42	2008-2013

Figure 23: Pneumococcal vaccination rates for adults aged 65 and over given selected demographic information (2000-2013)

Variable description	Percent of those answering no who received the vaccine	Percent of those answering yes who received the vaccine	P-value	Time period
Covered by Medicaid	59.0%	43.8%	0.00	
Covered by Medicare	37.8%	59.2%	0.00	
Covered by VA military health care (conditional on having military health care)	72.0%	71.2%	0.62	2004-2013
Covered by military health insurance	57.1%	69.9%	0.00	
Covered by private health insurance	52.0%	62.3%	0.00	
Delayed care because lacked transportation	57.9%	57.6%	0.85	
Has Medi-Gap insurance	57.5%	68.4%	0.00	
Has no health insurance (excluding single service plans)	58.4%	25.5%	0.00	
Has usual place for medical care	24.2%	59.1%	0.00	
Health insurance offered through workplace (conditional on working)	50.6%	43.1%	0.00	
Looked up health information on Internet, past 12 months	58.7%	65.8%	0.00	2009, 2011-2013
Medical care delayed due to cost, past 12 months	58.2%	52.0%	0.00	
Medicare Part D (conditional on having Medicare)	60.8%	61.6%	0.20	2006-2013
Needed but couldn't afford medical care, past 12 months	58.1%	50.7%	0.00	
Needed but couldn't afford prescription medicines, past 12 months	58.0%	55.2%	0.01	
African American	59.4%	41.4%	0.00	
Below poverty threshold	60.4%	44.7%	0.00	
Born in the United States	37.0%	60.6%	0.00	
Ever served in U.S. Armed Forces, Reserves, or National Guard	59.6%	63.8%	0.00	2011-2013
Female	55.7%	59.6%	0.00	
Hispanic ethnicity	59.5%	35.7%	0.00	
Internet use	57.5%	62.9%	0.00	2012-2013
North central/Midwest region	57.3%	60.0%	0.00	
Received disability pension other than Social Security/RRR	57.8%	61.8%	0.00	
Received income from SSI, previous calendar year	58.7%	39.8%	0.00	
Received income from Social Security/RRR, previous calendar year	41.5%	59.8%	0.00	
Received income from wages/salary, previous calendar year	59.7%	49.2%	0.00	
Received income from welfare/public assistance, previous calendar year	58.0%	43.8%	0.00	
Received other (new welfare reform) assistance from government program	58.0%	52.1%	0.12	
Some college or more	55.3%	61.9%	0.00	
U.S. citizenship	27.3%	58.7%	0.00	

Variable description	Percent of those answering no who received the vaccine	Percent of those answering yes who received the vaccine	P-value	Time period
Usually work full time (conditional on working)	53.8%	51.2%	0.33	
Activities limited by difficulty remembering	57.7%	60.8%	0.00	
Ever had hepatitis	57.7%	64.6%	0.00	
Ever received hepatitis B vaccine	56.7%	66.3%	0.00	
Ever told you had influenza or pneumonia	52.5%	72.1%	0.00	2007, 2012
Fair or poor health	56.9%	60.9%	0.00	
Had influenza or pneumonia, past 12 months (conditional on ever being told you had influenza or pneumonia)	72.1%	72.8%	0.79	2007, 2012
Had tetanus shot, past 10 years	47.5%	71.0%	0.00	2008-2013
Has any activity limitation	54.7%	63.9%	0.00	
Has difficulty walking or climbing stairs	58.5%	65.8%	0.00	2008-2013
Has serious difficulty concentrating or remembering	60.3%	60.9%	0.69	2008-2013

Figure 24: Shingles vaccination rates for adults aged 65 and over given selected demographic information (2008-2013)

Variable description	Percent of those answering no who received the vaccine	Percent of those answering yes who received the vaccine	P-value	Time period
Covered by Medicaid	18.0%	7.1%	0.00	
Covered by Medicare	12.2%	17.5%	0.00	
Covered by VA military health care (conditional on having military health care)	23.6%	15.4%	0.00	2004-2013
Covered by military health insurance	17.0%	20.4%	0.00	
Covered by private health insurance	14.4%	19.6%	0.00	
Delayed care because lacked transportation	17.3%	10.4%	0.00	
Has Medi-Gap insurance	17.1%	19.2%	0.13	
Has no health insurance (excluding single service plans)	17.4%	4.8%	0.00	
Has usual place for medical care	6.9%	17.6%	0.00	
Health insurance offered through workplace (conditional on working)	17.0%	18.7%	0.20	
Looked up health information on Internet, past 12 months	18.7%	30.1%	0.00	2009, 2011-2013
Medical care delayed due to cost, past 12 months	17.5%	9.5%	0.00	
Medicare Part D (conditional on having Medicare)	17.0%	18.2%	0.01	2006-2013
Needed but couldn't afford medical care, past 12 months	17.5%	8.5%	0.00	
Needed but couldn't afford prescription medicines, past 12 months	17.6%	8.9%	0.00	
African American	18.2%	6.7%	0.00	
Below poverty threshold	18.8%	7.4%	0.00	
Born in the United States	9.7%	18.3%	0.00	
Ever served in U.S. Armed Forces, Reserves, or National Guard	22.7%	22.8%	0.92	2011-2013
Female	15.5%	18.6%	0.00	
Hispanic ethnicity	18.0%	7.2%	0.00	
Internet use	17.7%	33.7%	0.00	2012-2013
North central/Midwest region	17.2%	17.2%	0.97	
Received disability pension other than Social Security/RRR	17.4%	13.1%	0.00	
Received income from SSI, previous calendar year	17.6%	8.4%	0.00	
Received income from Social Security/RRR, previous calendar year	16.3%	17.3%	0.12	
Received income from wages/salary, previous calendar year	16.9%	18.6%	0.02	
Received income from welfare/public assistance, previous calendar year	17.3%	5.9%	0.00	
Received other (new welfare reform) assistance from government program	17.2%	9.5%	0.04	
Some college or more	12.3%	22.9%	0.00	
U.S. citizenship	4.6%	17.5%	0.00	

Variable description	Percent of those answering no who received the vaccine	Percent of those answering yes who received the vaccine	P-value	Time period
Usually work full time (conditional on working)	19.2%	17.8%	0.65	
Activities limited by difficulty remembering	17.6%	12.0%	0.00	
Ever had hepatitis	17.0%	22.3%	0.00	
Ever received hepatitis B vaccine	15.8%	26.8%	0.00	
Ever told you had influenza or pneumonia	21.4%	25.9%	0.00	2007, 2012
Fair or poor health	18.9%	11.3%	0.00	
Had influenza or pneumonia, past 12 months (conditional on ever being told you had influenza or pneumonia)	27.2%	16.7%	0.00	2007, 2012
Had tetanus shot, past 10 years	11.3%	22.4%	0.00	2008-2013
Has any activity limitation	19.1%	13.5%	0.00	
Has difficulty walking or climbing stairs	20.5%	14.1%	0.00	2008-2013
Has serious difficulty concentrating or remembering	19.4%	13.3%	0.00	2008-2013

Appendix C. Multivariate regression analysis of vaccination rates with individual characteristics

Figure 25: Multivariate regression estimates of influenza and pneumonia vaccination rates on selected demographic factors, persons aged 65 and older (2000-2013)

Variable	Mean	Influenza		Pneumonia	
		Coefficient	p-value	Coefficient	p-value
ACA preventive care coverage implemented	0.251	0.000	0.980	0.014	0.227
Delayed care because lacked transportation	0.018	-0.005	0.721	0.001	0.933
Has usual place for medical care	0.966	0.327	0.000	0.278	0.000
Medicare Part D	0.225	0.050	0.000	0.037	0.000
Medicare with Medicaid	0.058	0.000	0.968	-0.032	0.002
Medicare with military coverage	0.049	0.124	0.000	0.160	0.000
Medicare with private coverage	0.525	0.070	0.000	0.087	0.000
Not on Medicare	0.079	0.001	0.955	-0.021	0.018
Needed but couldn't afford medical care, past 12 months	0.026	-0.053	0.000	-0.037	0.006
Needed but couldn't afford prescription medicines, past 12 months	0.042	-0.019	0.090	0.016	0.145
African American	0.084	-0.153	0.000	-0.176	0.000
Female	0.568	0.008	0.056	0.046	0.000
Hispanic ethnicity	0.067	-0.082	0.000	-0.172	0.000
Ratio of family income to poverty level (0 - 1)	0.100	-0.061	0.000	-0.060	0.000
Ratio of family income to poverty level (1 - 2)	0.255	-0.035	0.000	-0.006	0.344
Ratio of family income to poverty level (2 - 3)	0.221	-0.004	0.526	0.008	0.151
Region (Northeast)	0.197	0.000	0.971	-0.009	0.214
Region (South)	0.365	-0.009	0.144	0.009	0.188
Region (West)	0.201	0.003	0.680	0.006	0.462
Some college or more	0.423	0.031	0.000	0.034	0.000
U.S. citizenship	0.976	0.087	0.000	0.159	0.000
Activities limited by difficulty remembering	0.076	0.002	0.809	-0.029	0.001
Ever had hepatitis	0.038	0.013	0.247	0.046	0.000
Ever received hepatitis B vaccine	0.098	0.058	0.000	0.075	0.000
Fair or poor health	0.245	0.034	0.000	0.046	0.000
Has any activity limitation	0.350	0.052	0.000	0.093	0.000
R^2			0.055		0.077

Source: Integrated Health Interview Series. The unweighted sample size is 71,332. Time trends are included but not shown. Estimates are from a linear probability model.

Figure 26: Multivariate regression estimates of shingles, influenza, and pneumonia vaccination rates on selected demographic factors, persons aged 65 and older (2009-2013)

Variable	Mean	Shingles		Influenza		Pneumonia		Tetanus	
		Coeff.	p-value	Coeff.	p-value	Coeff.	p-value	Coeff.	p-value
Delayed care because lacked transportation	0.017	-0.030	0.172	0.009	0.767	-0.015	0.657	0.107	0.000
Has usual place for medical care	0.968	0.086	0.000	0.339	0.000	0.277	0.000	0.118	0.000
Looked up health information on Internet, past 12 months	0.316	0.060	0.000	0.023	0.019	0.032	0.003	0.066	0.000
Medicare Part D	0.408	0.035	0.000	0.048	0.000	0.025	0.007	0.017	0.085
Medicare with Medicaid	0.059	-0.003	0.811	0.020	0.260	-0.039	0.027	-0.003	0.895
Medicare with military coverage	0.057	0.052	0.005	0.090	0.000	0.112	0.000	0.071	0.001
Medicare with private coverage	0.481	0.028	0.003	0.056	0.000	0.062	0.000	0.023	0.035
Not on Medicare	0.07	-0.019	0.173	0.000	0.997	-0.062	0.001	0.047	0.011
Needed but couldn't afford medical care, past 12 months	0.026	-0.039	0.022	-0.051	0.036	-0.061	0.025	-0.029	0.265
Needed but couldn't afford prescription medicines, past 12 months	0.04	-0.028	0.077	-0.023	0.292	0.018	0.445	0.040	0.109
African American	0.086	-0.086	0.000	-0.125	0.000	-0.116	0.000	-0.077	0.000
Female	0.562	0.050	0.000	0.038	0.000	0.068	0.000	-0.071	0.000
Hispanic ethnicity	0.072	-0.070	0.000	-0.062	0.000	-0.129	0.000	-0.032	0.031
Ratio of family income to poverty level (0 - 1)	0.091	-0.092	0.000	-0.085	0.000	-0.061	0.000	-0.069	0.000
Ratio of family income to poverty level (1 - 2)	0.238	-0.077	0.000	-0.019	0.093	0.017	0.147	-0.047	0.000
Ratio of family income to poverty level (2 - 3)	0.207	-0.057	0.000	-0.008	0.472	0.013	0.241	-0.013	0.251
Region (Northeast)	0.189	-0.008	0.583	0.032	0.023	-0.013	0.288	-0.075	0.000
Region (South)	0.367	0.005	0.675	0.014	0.269	0.001	0.941	-0.041	0.001
Region (West)	0.213	0.040	0.004	0.010	0.484	-0.027	0.021	-0.022	0.091
Some college or more	0.481	0.043	0.000	0.009	0.334	-0.004	0.674	0.081	0.000
U.S. citizenship	0.975	0.062	0.000	0.057	0.051	0.121	0.000	0.059	0.047
Activities limited by difficulty remembering	0.074	0.001	0.946	0.026	0.118	-0.016	0.377	-0.024	0.220
Ever had hepatitis	0.038	0.018	0.383	0.021	0.373	0.021	0.426	0.057	0.007
Ever received hepatitis B vaccine	0.124	0.064	0.000	0.043	0.000	0.067	0.000	0.177	0.000
Fair or poor health	0.224	-0.020	0.025	0.022	0.046	0.039	0.001	-0.011	0.370
Had tetanus shot, past 10 years	0.545	0.097	0.000	0.141	0.000	0.200	0.000	-	-
Has any activity limitation	0.337	-0.032	0.000	0.036	0.000	0.102	0.000	0.024	0.030
R2			0.092		0.077		0.116		0.095

Source: Integrated Health Interview Series. The sample size is 19,347. Time trends were included, but are not shown. Estimates are from a linear probability model.