



WHITEPAPER

# Improving Adult Vaccination Rates Through EHR Workflow Messaging

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## EXECUTIVE SUMMARY

Routinely recommended vaccinations for influenza, pneumococcal, tetanus, and shingles are cost-effective, prevent high-incidence conditions that widely affect older adults, are generally available in ambulatory care and community settings, and are covered by health insurance plans, including Medicaid. In spite of this, vaccination rates among older adults are substantially lower than targets set by the CDC's *Healthy People 2020* initiative. CDC taskforce recommendations for addressing this problem have identified several key focus areas, including provider or system based interventions.

The goal of this paper is to describe how vaccination rates among adult patients can be improved through the use of real-time workflow messaging in an electronic health records system. The paper focuses specifically on influenza and pneumococcal vaccinations for older adults (65+ years of age). With regard to these two vaccinations, the current adult immunization situation is reviewed, including *Healthy People 2020* goals and CDC estimates of current and recent vaccination rates. The paper discusses a patient-centric model of beliefs, patient characteristics, and health system actions that may influence individuals' decisions about vaccinations.

While patient education, media and outreach programs, and payment assistance programs are components of an effective immunization program, proactive health care provider outreach is perhaps the most important element. Research shows that most adults believe vaccines are important and that a recommendation from their healthcare professional is the strongest predictor of adults getting vaccinated.

The use of computerized information systems can assist providers in improving vaccination coverage in their own practices. Using the Practice Fusion platform as an example, this white paper provides a case study of how information systems can efficiently and economically impact adult vaccination rates through workflow-integrated messaging and reminders in an electronic health records system. The paper illustrates the use of information systems to provide point-of-care recommendations and reminders embedded in the clinical workflow. Processes and results from the recent influenza and pneumococcal PHM program sponsored by Pfizer on the Practice Fusion platform are used to demonstrate the workings and efficacy of the system.

## BACKGROUND

Influenza and pneumonia are significant public health problems, particularly for older adults (65+ years of age). Both can cause serious illness and death among at-risk individuals, which include not only older adults but also very young children, pregnant women, and people with chronic medical conditions. According to the CDC:

- Influenza and pneumonia related death rates vary year by year. Between the 1976–77 and 2006–07 season flu seasons, influenza related deaths of older Americans are estimated to have been between a low of 3,300 (1986-87) and a high of nearly 49,000 (2003-04) each year (CDC, Estimates of deaths associated with seasonal influenza - United States, 1976-2007.). This is equivalent to 1.4 to 16.7 deaths per 100,000 per year.
- 90% of deaths related to influenza occur in people 65 and older ( National Center for Immunization, 2015). Between the 1976–2007 flu seasons, 21,098 annual influenza-related deaths occurred each year among older adults, compared to 124 annual deaths among people <19 years and 2,385 annual for people 19-64 (CDC, Estimates of deaths associated with seasonal influenza - United States, 1976-2007.).
- Influenza is a common cause of pneumonia in the elderly. Older adults, as well as young children, are particularly at risk for contracting pneumonia (CDC, Risk Factors and Transmission, 2016).

Vaccinations for influenza and pneumonia are widely available, cost effective, and covered by health insurance plans, including Medicare and Medicaid. They are available in many places, including community locations (pharmacies, retail outlets), ambulatory care settings, and at vaccination drives. However, the rate of adult vaccination is substantially lower than targets set by the CDC's *Healthy People 2020* (ODPHP, 2016) initiative, and has remained relatively stable over time.

Disparities in vaccination rates exist overall and in most age groups (Lu PJ, 2013). Minorities are less likely than white older adults to observe vaccination recommendations for either influenza or pneumococcal infections (Table 1). Black and Hispanic adults exhibit the lowest rates of vaccination, up to 10 percentage points lower than their white counterparts.

**Table 1. US vaccination rates for older (65+ years of age) adults**

	Seasonal Influenza	Pneumococcal Infection
Target vaccination rate	90%	90%
2008 baseline rate (ODPHP, 2016)	66.6% received an influenza vaccine in 2008	60% had ever received a pneumococcal vaccination
2014 rates (Williams WW, 2016)		
All	71.4 <sup>a</sup>	61.3 <sup>b</sup>
White	73.4	64.7
Black	60.5	49.8
Hispanic or Latino	64.0	45.2
Asian	72.5	47.7
Other	63.6	69.4

<sup>a</sup>2013-2014 influenza season

<sup>b</sup>Reported ever receiving a vaccination, 2014

## WHY ARE VACCINATIONS UNDERUTILIZED? INCENTIVES AND BARRIERS

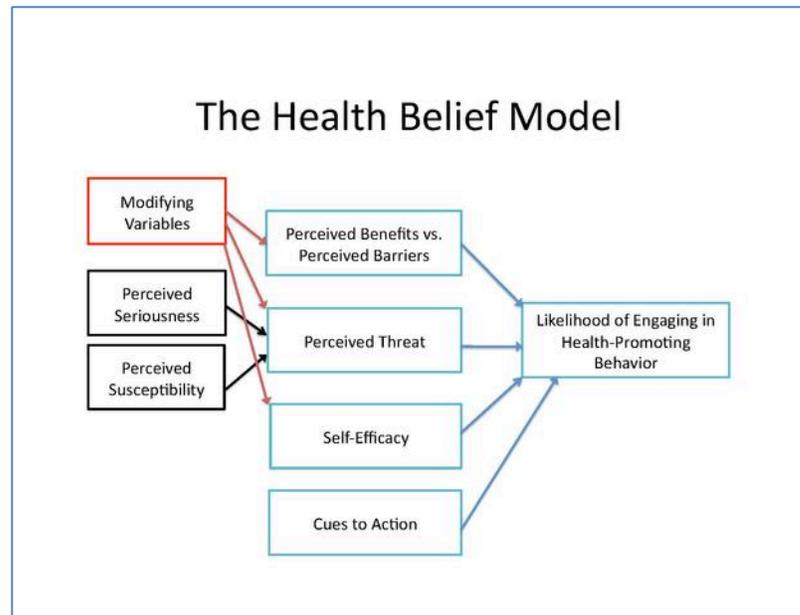
Research shows that most adults believe vaccines are important, yet vaccination rates remain below *Healthy People 2020* goals. Additionally, rates have not improved substantially despite strenuous long-term efforts of public health agencies, leading to a call for developing new understandings and strategies to reach individuals who are indifferent or resistant to vaccination programs (Cheney, 2013) (Briss, 2000).

CDC taskforce recommendations for addressing under-vaccination have tended to concentrate on several health system focus areas. Possible explanations for below-goal vaccination rates and disparities in rates include barriers to access such as cost, insurance status, and language differences; underestimation of personal risk and misunderstanding of vaccination risks; and feelings of mistrust toward the health care system. Policy strategies to reduce these disparities have been proposed, including changes to health care system structural factors that serve as access barriers, education to increase awareness and improve demand for vaccines, involvement of community-based organizations to assess local needs and design responsive solutions (Logan, 2009).

Public health researchers recognize that motivating individuals is as important as redesigning health systems to meet public health goals. They have developed several models of health behavior and behavioral change that offer insights into the likelihood of individuals

accepting vaccinations. The Health Belief Model (HBM), developed by the US Public Health Service (Janz, 1984), is a widely used theory of individuals' health behavior (Glanz, 2010). The model (Figure 1) explains engagement in a health-related activity or behavior that recognizes the importance and interaction of contextual or social factors (modifying variables), multiple personal beliefs, and external cues or stimuli in a person's behavior. They are briefly described below. Context and belief factors are largely personal in nature, but, as we will see, cues to action can include health system events, and particularly EHR-based actions.

Figure 1 . The Health Belief Model



- *Contextual or Social Factors:* Individual and social characteristics (labeled *modifying variables* in the model) provide the context and basis for the existence of many of the personal beliefs that are believed to drive decision making. These are relatively immutable in the short term and are essentially the background that affects perceptions and beliefs. They include, for example, demographic characteristics (age, sex, race, ethnicity, and education), psychosocial characteristics (personality characteristics, social class, peer and reference group pressure), and knowledge about or experience with the health issue of interest.
- Personal Beliefs
  - *Seriousness or severity* is an individual's subjective understanding of the seriousness of a health problem (e.g., influenza or pneumonia) and its possible consequences for themselves. These include the physical impact of the disease (Is it life threatening? Painful? Disabling?) as well as its broader personal effects (e.g., ability to continue in social roles or work)
  - *Susceptibility* refers to a person's evaluation of the likelihood of contracting a disease or developing a health problem. The greater their assessment of risk, the more likely they are to engage in behaviors to avoid it. Thus, people may decline vaccination if they believe that it's unlikely that they can contract influenza or pneumonia, particularly if they've never had it before.

- *Benefits and Barriers* refer to the value and cost of taking action. Belief that a particular course of action is an effective way of avoiding a particular risk increases the likelihood of taking that action. However, there may be impediments that discourage the decision to act. Barriers to action include perceived inconvenience, cost, discomfort, and fear of the consequences of taking action. For example, lack of health insurance (cost) and fear of needles may deter a person from receiving a flu vaccine if they outweigh their belief in the benefits of being vaccinated.
- *Self Efficacy* refers to a person's confidence in themselves to engage in effective healthy behaviors, particularly long-term behaviors such as exercise, diet modification, or smoking cessation. Confidence in the ability to carry out the required behavior is an important component in turning intentions into actions.
- *Cues to Action* are prompts or triggers that suggest or encourage health-positive behaviors. Some cues are internal (e.g., physical symptoms), but many are external (e.g., events, information, or the actions and behavior of other people). External cues come in many forms and will have different levels of relevance depending on their interaction with other components of the model. Common cues to action include
  - Media (advertising, PSAs, movie/TV/Internet events)
  - Recommendations and reminders from friends and family members
  - Prompts and reminders from the health care system

## THE ROLE OF HEALTH INFORMATION SYSTEMS

Patient education, media and outreach programs, and payment assistance programs are all key components of an effective immunization program, but proactive health care system outreach is perhaps the most effective element. Recommendations or reminders from a healthcare professional are strong predictors of adults' decisions about getting vaccinated.

The Community Preventive Services Task Force (CPSTF), recommends using *reminders to providers* to let them know that individual patients are due for specific vaccinations (Jacob, 2016). Reminders to providers can be handled by notes prepared in advance and posted in client charts or by alerts and notifications in electronic medical records.

Patient-targeted *reminders from providers* are also recommended (Jacob, 2016) to help patients remember that vaccinations are due or late. Patient reminders can be delivered in

many ways including direct contact during an office visit or as follow-ups by telephone, mail, or electronically. Health care providers can be prompted to make office visit reminders through the same techniques used for prompting recommendations. Reminders offer the opportunity to include information about the importance of vaccination.

### A real-world example

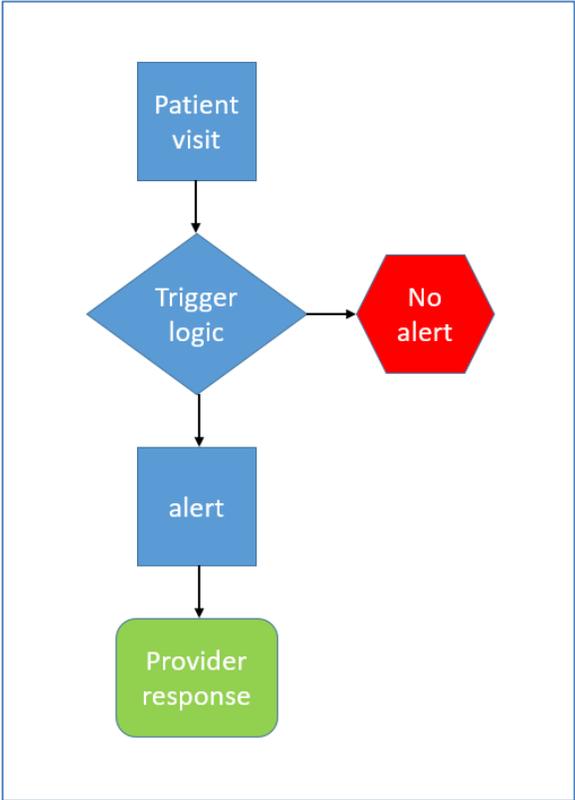
In line with CDC and CPSTF recommendations, an influenza and pneumococcal vaccination alert program for older patients was implemented on the Practice Fusion Electronic Health Records (EHR) system to assist providers in improving vaccination coverage. The goal of the project, sponsored by Pfizer, was to enhance uptake of influenza and pneumococcal vaccinations among older adults. The program began operating in November 2015 as part of the Clinical Decision Support (CDS) program on the Practice Fusion EHR platform.

The Practice Fusion EHR platform is a large, nationwide cloud-based ambulatory-care EHR system currently in use throughout the United States. A majority of Practice Fusion practices are single provider or small group practices, and over 60% of them are engaged in primary care. Because the majority of practices using the platform provide family and general primary care, the Practice Fusion system is in an excellent position to deliver public health related alerts and messages to providers who are in a position to reach at-risk populations.

The vaccination CDS program utilized in-workflow point-of-care alerts to determine a patient’s eligibility for one or both vaccines, and to remind providers to document newly administered and historic vaccination activity in the medical record. Figure 2 shows the real-time flow of events during a patient’s office visit:

- When the visit begins, the provider opens the patient’s chart, activating the CDS logic engine.
- The patient’s record is checked for eligibility for any alerts currently active on CDS. In the case of the vaccine CDS, this includes:
  - The patient must be 65+ years of age AND

Figure 2 . Patient visit flow



- For the pneumococcal vaccine, they must be due for a pneumococcal vaccination based on Clinical Quality Measure guidelines updated for 2015 revisions.
- For the pneumococcal vaccine, the CDC Advisory Committee on Immunization Practice guidelines (CDC Advisory Committee on Immunization Practices, 2016) were followed with regard to previous vaccination history (pneumococcal vaccine-naïve, PPSV23 at 65+, or PPSV23 before 65 years of age).
- For the influenza vaccine, the patient has not received an influenza vaccination in the current flu season.
- If the alert criteria aren't met, no messages are displayed.
- If either or both sets of criteria are met, a message is displayed on the patient's chart suggesting that the physician take action, by administering and/or documenting the appropriate vaccine.
- Each alert includes a suggested action, a citation for the recommendation (CDC Advisory Committee on Immunization Practices, 2016), a link to carrying out the action, a link for additional information, and acknowledgement of the CDS funding source, Pfizer. Direct links in the chart make it possible for providers to take actions without leaving the chart or interrupting the flow of the visit.
- The provider's responses (administering, documenting) are recorded as part of the patient's electronic chart. Both recommendations include direct action links, allowing the provider to use a single mouse click to record his/her action without leaving the chart.

A screenshot of part of a patient chart is shown in Figure 3. The fictional patient, James Patient, is a 65 year old male who visited his physician on October 10, 2016. At that time his record showed no evidence that his influenza and pneumococcal vaccinations were up to date, so both alerts were displayed when his physician opened his chart.

To take an action, the physician simply clicks on the recommendation link to open a dialogue box (Figure 4). Here, he/she can

**Figure 3. Patient chart displaying vaccination alerts**

The screenshot shows the Practice Fusion interface for a patient named James Patient. The patient's information includes: PPN: 9546704, 65 yrs M, Patient Portal: Enrolled, Astria, DOB: 12/30/1951, M: 666.123.4567. The chart is dated 10/10/2016. Two alerts are displayed:

- Pneumococcal vaccination:** Patient has no record of or may be due for a pneumococcal vaccine. Consider administering and/or document. Intervention Developer: Practice Fusion, Inc. Funding Source: Pfizer, Inc. Reference Information: Citation: CDC / Advisory Committee on Immunization Practices (ACIP): Recommended Adult Immunization Schedule. Action: Add vaccine.
- Influenza Vaccine:** Patient has no record of influenza vaccination this season. Consider administering and/or document influenza vaccine. Intervention Developer: Practice Fusion, Inc. Funding Source: Pfizer, Inc. Reference Information: Citation: CDC / Advisory Committee on Immunization Practices (ACIP): Recommended Adult Immunization Schedule. Action: Add vaccine.

Encounter details:

ENCOUNTER TYPE	NOTE TYPE	DATE	AGE AT ENCOUNTER	SEEN BY	FACILITY	STATUS
Office Visit	SOAP Note	10/10/2016	64 yrs	Stephanie Provider	North Office	Unsigned

Chief complaint: Record. No chief complaint recorded.

administer and record a vaccination. The details of the vaccination (type, date and time administered, dose, etc.) can also be recorded. If the patient received a vaccination elsewhere (e.g., at the pharmacy, in a community campaign, or at another physician's office), that can also be recorded in the chart as historical data. Finally, if the patient chooses not to be vaccinated, his or her decision can also be recorded. All of this information becomes structured data in the medical record, where it is available to both the physician and patient for review, and can be used by the physician to summarize his practice's success in providing immunizations (e.g., for a meaningful use metric).

Figure 4. Immunization dialogue box

In terms of the HBM model (Figure 1), the Practice Fusion CDS has an impact on the patient's decision to be vaccinated in a number of ways:

- It provides a reliable data-driven way of assessing a patient's need or eligibility for a vaccination.
- It prompts healthcare providers to recommend vaccination for their patients. Provider recommendations are among the most potent factors that influence the decision to be vaccinated.
- It can promote physician/patient discussions that can give the health care provider an opportunity to educate patients about the importance, effectiveness, and safety of vaccines. Discussions can also open up an opportunity to explore and solve problems that are barriers to getting vaccinated. Interactions like this can affect patients' beliefs about disease severity, susceptibility, and self- efficacy – all key factors that influence patients' decision making processes.

Additionally, the CDS program automates record keeping, making health care records more complete and over time building a more systematic in-depth view into individual patients' lives.

The CDS vaccination program went into operation in November 2015. Between then and March 2016, a five-month period, CDS messages were displayed to over 55,000 health care providers on behalf of over 2 million unvaccinated, eligible patients (Table 2). Because of the importance of vaccinations for older adults, messages were made available to all providers on the platform. Although nearly 60% of physicians on the Practice Fusion platform are in primary care, all active practices regardless of specialty were included to obtain the widest possible coverage, so some patients may have received vaccination information from more than one doctor. Patients might have also been asked about vaccinations by a particular doctor more than once because messages were displayed until the provider took an action (administering a vaccination, documenting a previous vaccination, or recording a patient’s decision not to be vaccinated). Pneumococcal and influenza CDS alerts are independent of one another, so it is also possible that a provider could have received one or both messages during a patient’s visit.

Both flu and pneumococcal vaccination rose significantly with the introduction of the CDS (Table 2). Among unvaccinated older patients during the same five-month period in 2014-15, only 1.6% had a pneumococcal vaccination administered or recorded by a Practice Fusion physician. In contrast, that rate increased to 3.4% in the 2015-16 period while the CDS program was active, an increase of 113% over the previous year’s rate. For influenza, the vaccination rate in 2014-15 was 4.2% and increased to 5.6% in 2015-16, an increase of 33% over the previous year’s rate.

**Table 2. CDS Program Metrics**

Vaccination	Unique HCPs	Unique Eligible Patients	Patient to HCP Ratio	Vaccination rate among previously unvaccinated patients		YoY change in rate <sup>1</sup>
				11/2014 – 3/2015	11/2015 – 3/2016	
<b>Pneumococcal</b>	55,649	2,287,842	41.11	1.6%	3.4%	113%
<b>Influenza</b>	55,421	2,199,274	39.68	4.2%	5.6%	33%

The results of the pneumococcal program show an incremental year-on-year increase of 40,265 patients with an administered or documented vaccine (Table 3). This represents a 110% increase in the number of vaccinated patients, who either received a vaccination at the point of care or were documented to have received it elsewhere.

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<sup>1</sup> The Year on Year (YoY) change in rate was calculated as:

$$\text{Change in rate} = ((\text{rate during program}) - (\text{rate in previous year})) / \text{rate in previous year}$$

**Table 3. YoY increase in eligible patients receiving pneumococcal vaccinations**

Pneumococcal Vaccine Activity	Patient Counts		YoY increase in vaccinations
	11/2014 – 3/2015	11/2015 – 3/2016	
<b>Administered or same-day documentation</b>	18,731	34,050	81.8% <sup>2</sup>
<b>Historical documentation</b>	17,731	42677	140.7%
<b>Total</b>	36,462	76727	110.4%

The pneumococcal program results showed that there was:

- An 82% increase in the number of administered vaccines (recorded as either ‘administered’ or ‘same-day documented’).
- A 141% increase in the number of documented vaccinations. This may represent both an increase in the number patients who received their pneumococcal vaccinations at locations other than the practice site and an improvement in provider documentation of off-site patient activities.

## PROGRAM SUMMARY

Motivating older patients to adhere to the CDC/ACIP recommendations for influenza and pneumococcal vaccinations is a complex process. The Health Beliefs Model provides a framework for understanding the many factors that play a role in influencing patient behavior and decision making related to vaccination recommendations. EHRs clearly have a potential role in influencing patients’ decision processes providing prompts and reminders to patients and by promoting physician recommendations and patient-physician interactions, known to be one of the most powerful influences on patient behavior.

The EHR plays multiple roles in promoting patient care through vaccination. By relying on structured, coded health data and dates, an EHR can systematically identify eligible patients on the basis of objective criteria in compliance with CDC guidelines. Cloud based systems, such as Practice Fusion, can readily target appropriate patient populations, physician

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<sup>2</sup> Administered vaccinations were recorded in the EHR chart as ‘administered’, while same-day documented vaccines are those where the recorded date was the same as the office visit date, but the action was erroneously flagged as ‘historical’ rather than ‘administered’.

specialties, and localities. The Pfizer/Practice Fusion program reached out to all specialties on the platform across the entire country to maximize the reach of the program, but CDS messaging can be limited as needed by specialty and location as well as by medical criteria.

The Practice Fusion CDS program operates in real time, identifying eligible patients at the time of their office visit. Having done this, the CDS program informs the health care provider about the patient's status and prompts the provider to recommend vaccination for their patients. This is a critical factor in influencing patient behavior because provider recommendations are among the most potent factors that influence the decision to be vaccinated.

The CDS messaging can promote physician/patient discussions that can give the health care provider additional opportunities to influence patient behavior by providing education about the importance, effectiveness, and safety of vaccines. Discussions can also explore and solve issues that are barriers to getting vaccinated. Interactions like this can affect patients' beliefs about disease severity, susceptibility, and self-efficacy, and resolve misconceptions the patient might have – all key factors that influence patients' decision making processes.

The CDS program also contributes to improved record keeping and thus to improved management of patients' health care. CDS messaging during the office visit can result in a fuller, more complete picture of patients' healthcare, including documentation of out-of-office vaccinations, such as those often offered at pharmacies, supermarkets, and community health events. The vaccination related data are available in the electronic chart as structured data elements that can be quickly reviewed by both the physician and the patient.

The effectiveness of the Pfizer/Practice Fusion CDS program in increasing the vaccination rates among eligible older patients clearly demonstrates the importance of electronic health records systems in influencing patient behavior. The rate of vaccination among previously unvaccinated older patients increased significantly compared to the same time period a year earlier, making an important contribution to the protection of the health and wellbeing of those patients.

## REFERENCES

- Briss, P. R. (2000). Reviews of evidence regarding interventions to improve vaccination coverage in children, adolescents, and adults. *American Journal of Preventive Medicine*, 18, pp. 97-140.
- CDC. (2016, May 31). *Risk Factors and Transmission*. Retrieved Sept 15, 2016, from Pneumococcal Disease: <https://www.cdc.gov/pneumococcal/about/risk-transmission.html>
- CDC Advisory Committee on Immunization Practices. (2016). *Recommended Adult Immunization Schedule*. Retrieved Sept 16, 2016, from <http://www.cdc.gov/vaccines/schedules/downloads/adult/adult-schedule.pdf>
- CDC. (n.d.). Estimates of deaths associated with seasonal influenza - United States, 1976-2007. *MMWR Morb Mortal Wkly*, 2010(59), pp. 1057-1062.
- Cheney, M. a. (2013). Underutilization of influenza vaccine: A test of the Health Belief Model. SAGE Open.
- Glanz, K. a. (2010). The role of behavioral science theory in development and implementation of public health interventions. *Annual Review of Public Health*, 31, pp. 399-418.
- Jacob, V. C. (2016). Increasing appropriate vaccination: a Community Guide systematic economic review. *Am J Prev Med*, 6, pp. 797-808. Retrieved August 24, 2016, from The Community Preventive Services Task Force: [www.thecommunityguide.org/vaccines/providerreminder.html](http://www.thecommunityguide.org/vaccines/providerreminder.html).
- Janz, N. a. (1984). The Health Belief Model: A decade later. *Health Education and Behavior*, 11(1), pp. 1-47.
- Logan, J. (2009). Disparities in influenza immunization among US adults. *J Natl Med Assoc.*, 101(2).
- Lu PJ, S. J. (2013). Seasonal influenza vaccination coverage among adult populations in the United States, 2005-2011. *Am J Epidemiol*, 178(9).
- National Center for Immunization. (2015). *Epidemiology and Prevention of Vaccine Preventable Diseases - 13th Edition*. Centers for Disease Control and Prevention. Retrieved Sept 15, 2016, from <http://www.cdc.gov/vaccines/pubs/pinkbook/index.html>
- ODPHP, Office of Disease Prevention and Health Promotion. (2016). *Immunization and Infectious Diseases: Objectives*. Retrieved August 20, 2016, from <https://www.healthypeople.gov/2020/topics-objectives/topic/immunization-and-infectious-diseases/objectives>
- Williams WW, L. P. (2016). Surveillance of Vaccination Coverage Among Adult Populations — United States, 2014. *MMWR Surveill Summ* 2016, 65(1), pp. 1-36.

## ABOUT PRACTICE FUSION

Practice Fusion is the #1 cloud-based electronic health record (EHR) platform for doctors and patients in the U.S., with a mission of connecting doctors, patients and data to drive better health and save lives. By facilitating over five million patient visits a month with more than 600 connected partners, Practice Fusion helps coordinate care within the largest healthcare ecosystem in the U.S. As the most widely used cloud-based ambulatory EHR, Practice Fusion is helping to reshape the future of healthcare.



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