Published in final edited form as:

Ann Allergy Asthma Immunol. 2016 August ; 117(2): 132–134. doi:10.1016/j.anai.2016.06.004.

Who to Vax:

A free online tool to identify adults for pneumococcal vaccination

Cosby A. Stone Jr, MD, MPH and Tina V. Hartert, MD, MPH

Division of Allergy, Pulmonary, and Critical Care Medicine, Vanderbilt University, Nashville, Tennessee

Introduction

We live in an exciting but sometimes overwhelming time to be practicing medicine. The evidence base for population-based decision making is rapidly advancing and continually changing. At the same time, individual patient details and their clinical relevance may fall through the cracks in our complex integrated medical system, requiring vigilance on our part for capturing those details and for improving systems of care.¹ Integrating a personal, patient-centered history and examination with evidence-based guidelines is the new art of medicine.

Deciding which version of pneumococcal vaccine to give an adult patient epitomizes the complexity of this integration of personalized care and guidelines. It is now recommended that healthy adults without medical comorbidities receive any form of pneumococcal vaccination until the age of 65 years. At the same time, vaccination against disease-causing serotypes of pneumococcus is known to be an important intervention for prevention of invasive pneumococcal disease in a variety of preexisting comorbid conditions and age groups,^{2,3} and for these groups, there are both age- and disease-specific recommendations on which version of the vaccine to give.

The Centers for Disease Control and Prevention's (CDC) Advisory Committee on Immunization Practices (ACIP), a group of medical and public health experts who develop recommendations on use of vaccines in the civilian population of the United States, recommends pneumococcal vaccination as beneficial for patients with immunosuppressed states, cigarette smokers, patients with asthma, patients with chronic obstructive pulmonary disease, and other patients who cross our doors routinely.⁴ For example, patients with asthma are in a higher risk category for invasive pulmonary disease caused by pneumococcus,^{5–8} and remembering to vaccinate them may yield higher prevention dividends per vaccine than other groups.⁹

Reprints: Cosby A. Stone Jr, MD, MPH, Division of Allergy, Pulmonary, and Critical Care Medicine, Vanderbilt University, 1161 21st Ave S, T-1218, MCN, Nashville, TN 37232-2650; cosby.a.stone@vanderbilt.edu.

Disclosures: Authors have nothing to disclose.

Barriers to Vaccinating Against Pneumococcal Disease

The CDC reports that only 20% of all adults who are advised to be vaccinated against invasive pneumococcal disease were vaccinated as of 2014.¹⁰ Why are vaccination rates so low? Analyzing the problem of low vaccination rates requires looking at the barriers to successfully performing the task of identifying and then vaccinating our high-risk patients. Some of the more obvious barriers include the temperature controls required in the maintenance of these vaccines before immunization, lack of awareness of a patient's qualifying risk factor during a visit for another problem, lack of awareness of changing vaccine guidelines, not considering vaccination during routine encounters, difficulty in obtaining the patient's previous vaccination records, and the complexity of the guidelines regarding which version of the vaccine to give. We also may not be vaccinating our patients because of the time required to figure out whether the patient is eligible within the constraints of an office visit involving other issues.

It is our perception that the greatest current barrier to adult pneumococcal vaccination in a busy practice is recognizing eligible patients because of the complexity of the guidelines regarding which patients are candidates for vaccination and which version of the vaccine should be used. The current CDC guidelines are an excellent synthesis of the available evidence on which groups are advised to receive pneumococcal vaccination and should be relied on. However, even with frequent use of the guidelines, it is easy to make errors unless the guidelines are pulled up while the patient and the vaccine record are available.

Summary of Current Adult Pneumococcal Vaccine Guidelines

The 23-valent pneumococcal polysaccharide vaccine (PPSV23) was approved by the US Food and Drug Administration in 1983 for the prevention of invasive pneumococcal disease and has been recommended for all adults older than 65 years and for persons aged 2 to 64 years with impaired immunity and a variety of selected health conditions since 1997.¹¹ Most recently, use was expanded for persons aged 19 to 64 years who smoke cigarettes or have asthma.¹² In addition, 5 years after the initial receipt of PPSV23, a one-time revaccination with PPSV23 is recommended by the ACIP for patients with immune compromise, cochlear implants, or asplenia because of a recognized phenomenon of waning antibody titers after 5 to 10 years.¹² Many experts revaccinate the same group of patients every 5 years, although this practice needs additional study.

The 13-valent pneumococcal conjugate vaccine (PCV13) was approved by the US Food and Drug Administration in 2010 for the prevention of invasive pneumococcal disease, given initially as a routine vaccination to infants,¹³ but is also newly recommended for persons with selected health conditions (immune deficiency, asplenia, cochlear implants) from ages 2 to 64 years¹⁴ and for all adults older than 65 years.¹⁵ Under the most recent guideline recommendations, a typical patient whose age or health conditions qualify them for both vaccines should receive PCV13 first, with a minimum interval of 8 weeks for a follow-up dose of PPSV23.¹⁶ If the order of vaccine receipt is reversed, a 1-year interval is recommended.¹⁶

Because there are some health conditions (asthma, smoking) for which only PPSV23 is recommended before the age of 65 years, other conditions (immune deficiency, asplenia) for which both vaccines are recommended, and many health conditions for which neither vaccine is recommended, there is often confusion from patients and practitioners regarding which vaccine should be used and when to dose.

Who to Vax: A Quick Web-Based Decision Tool for Adult Pneumococcal Vaccination

We therefore sought not to reinterpret or revise the current guidelines but to (1) make it easier to quickly identify whether a patient is a candidate for pneumococcal vaccination and (2) determine which vaccine to use. Collaborating in a multidisciplinary fashion with a team composed of physicians and computer scientists, we first designed a pneumococcal vaccination decision tree using the current CDC guidelines (Fig 1). We then used a decision tree-generating software (which will soon be released under an open source license) and via this tool created a webpage portal (Who to Vax). Using Who to Vax, the health care professional can access an interactive questionnaire to determine whether the patient should be vaccinated and with which vaccine. We have made the webpage portal both patient and practitioner friendly, available to any who might benefit, by using the phrase “Who to Vax” in search engines or using the following link: <https://medicine.mc.vanderbilt.edu/whotovax/>.

We imagine that this tool may have the most utility as a preencounter or triage tool for patients with conditions that would qualify them for vaccination or who are 65 years or older. They could then be flagged for vaccination or for obtaining vaccination records. In our own practice, we anticipate that this approach will reduce time and increase the likelihood that we administer same-visit vaccination to appropriate patients, although we have not yet assessed this formally. It is fast enough to be pulled up and used while sitting with the patient and generally takes fewer than 4 clicks to complete. Although this is not how we are currently using it, the patient could even complete it before the encounter and assist in identifying their need for vaccination.

Assisted Decision Making in Medicine

Assisted decision making is nothing new. We turn to our textbooks, to our medical journals, and to our trusted electronic resources on a daily basis to help inform the care that we give. Computer-assisted decision support, however, is currently underused. There are many different kinds of medical decision making that could be made simpler using computerized tool-based support, particularly where stepwise integration of multiple pieces of information to inform either a diagnosis or a decision is the right method. Our approach has been to create tools that speed up the process of using trusted decision trees, especially where those trees are complex and have many different, nonoverlapping outcomes. Other groups have reported early attempts in using bayesian network modeling based on individual patient factors to perform rapid triage of best available treatment options for conditions such as rhinosinusitis¹⁷ and laryngeal cancer.¹⁸

Computer-Assisted Decision Making and Personalized Medicine

We think that the future benefit of the big data era of medicine will be in the gradual accumulation of small but powerful tools that enable rapid multifactorial decision making for personalized medicine, although a proliferation of individual decision tools that require constant updating will in and of themselves become another burden. Ultimately, these tools will need to be integrated so that all preventive guidelines applicable to a given patient are integrated into a checklist of recommendations. Such a system would need automated updates based on available clinical data so that a patient's information could be used to identify all the preventive interventions an individual might need at any given time.

Some will worry that this kind of approach may, in the future, undermine the physician as the ultimate authority of medical information or even, tongue-in-cheek, predict this as one more step toward the rise of our robot overlords. However, physicians will always be needed to provide the touchpoint with medical decision making, to interpret the patient's story, to provide the hands-on examination, to fact check any automated recommendations, and to be the trusted, skilled artisans wielding ever more powerful tools derived from evidence.

Tools such as Who to Vax are also important for personalized medicine because they can empower patients to be involved in their own health. Although it would be very difficult for most patients to interpret the ACIP guidelines, they can easily use tools such as Who to Vax and let their practitioner know that they are eligible for a vaccine—another important means to involve individuals in their own preventive care and ensure that eligible patients are vaccinated.

Conclusions

Who to Vax is free and easily accessible, and it is our hope that it will be useful in the practice of medicine, speeding up a decision-making process that might otherwise be a barrier to vaccinating a vulnerable patient. In a larger way, the benefit of any time-saving in a busy practice is obvious, and we predict that the right application of computer-assisted decision help on routinely complex matters will free us to focus on other healing aspects of the art of medicine, such as the much loved, much sought after patient-physician relationship. We also predict that it will empower patients with tools that distill complex information, allowing them to be more involved in and take responsibility for their own preventive health.

Acknowledgments

We acknowledge the anonymous developer who created the software used in the creation of Who to Vax.

References

- [1]. Becker-Dreps S, Kistler C, Ward K, et al. Pneumococcal carriage and vaccine coverage in retirement community residents. *J Am Geriatr Soc* 2015;63:2094–2098. [PubMed: 26456473]
- [2]. Griffin M, Michel E, Moore M, Whitney C, Grijalva C. Declines in pneumonia hospitalizations of children aged <2 years associated with pneumococcal conjugate vaccines, Tennessee 1998-2012. *MMWR Morb Mortal Wkly Rep* 2014;63:995–998. [PubMed: 25375070]

- [3]. Moberly S, Holden J, Tatham D, Andrews R. Vaccines for preventing pneumococcal infection in adults. *Cochrane Database Syst Rev* 2013;1:CD000422.
- [4]. Centers for Disease Control and Prevention. PCV13 (pneumococcal conjugate) vaccine: recommendations, scenarios and Q&As for healthcare professionals about PCV13 for adults, <http://www.cdc.gov/vaccines/vpd-vac/pneumo/vac-PCV13-adults.htm>. Accessed March 14, 2016.
- [5]. Boikos C, Quach C. Risk of invasive pneumococcal disease in children and adults with asthma: a systematic review. *Vaccine*. 2013;31:4820–4826. [PubMed: 23965221]
- [6]. Talbot T, Hartert T, Mitchel E, et al. Asthma as a risk factor for invasive pneumococcal disease. *N Engl J Med* 2005;352:2082–2090. [PubMed: 15901861]
- [7]. Juhn Y, Kita H, Yawn B, et al. Increased risk of serious pneumococcal disease in patients with asthma. *J Allergy Clin Immunol* 2008;122:719–723. [PubMed: 18790525]
- [8]. Hartert T Are persons with asthma at increased risk of pneumococcal infections, and can we prevent them? *J Allergy Clin Immunol* 2008;122:724–725. [PubMed: 19014764]
- [9]. Okapuu J, Chétrit E, Lefebvre B, Quach C. How many individuals with asthma need to be vaccinated to prevent one case of invasive pneumococcal disease? *Can J Infect Dis Med Microbiol* 2014;25:147–150. [PubMed: 25285110]
- [10]. Williams W, Lu P, O'Halloran A, et al. Noninfluenza vaccination coverage among adults—United States 2012. *MMWR Morb Mortal Wkly Rep* 2014;63:95–102. [PubMed: 24500288]
- [11]. Centers for Disease Control and Prevention. Prevention of pneumococcal disease: recommendations of the Advisory Committee on Immunization Practices (ACIP). *MMWR*. 1997;46:1–24.
- [12]. Nuorti J, Whitney C. Updated Recommendations for prevention of invasive pneumococcal disease among adults using the 23-valent pneumococcal polysaccharide vaccine (PPSV23). *MMWR Morb Mortal Wkly Rep* 2010;59:1102–1106. [PubMed: 20814406]
- [13]. Nuorti J, Whitney C. Prevention of pneumococcal disease among infants and children—use of 13-valent pneumococcal conjugate vaccine and 23-valent pneumococcal polysaccharide vaccine: recommendations of the Advisory Committee on Immunization Practices (ACIP). *MMWR Morb Mortal Wkly Rep* 2010;59:1–18. [PubMed: 20075837]
- [14]. Bennett N, Whitney C, Moore M, Dooling K, Pilishvili T. Use of 13-valent pneumococcal conjugate vaccine and 23-valent pneumococcal polysaccharide vaccine for adults with immunocompromising conditions: recommendations of the Advisory Committee on Immunization Practices (ACIP). *MMWR Morb Mortal Wkly Rep* 2012;61:816–819. [PubMed: 23051612]
- [15]. Tomczyk S, Bennett N, Stoecker C, et al. Use of 13-valent pneumococcal conjugate vaccine and 23-valent pneumococcal polysaccharide vaccine among adults aged ≥ 65 years: recommendations of the Advisory Committee on Immunization Practices (ACIP). *MMWR Morb Mortal Wkly Rep* 2014;63:822–825. [PubMed: 25233284]
- [16]. Kobayashi M, Bennett N, Gierke R, et al. Intervals between PCV13 and PPSV23 vaccines: recommendations of the Advisory Committee on Immunization Practices (ACIP). *MMWR Morb Mortal Wkly Rep* 2015;64:944–947. [PubMed: 26334788]
- [17]. Cypko M, Hirsch D, Koch L, Stoehr M, Strauss G, Denecke K. Web-tool to support medical experts in probabilistic modelling using large bayesian networks with an example of rhinosinusitis. *Stud Health Technol Inform* 2015;216:259–263. [PubMed: 26262051]
- [18]. Cypko M, Stoehr M, Denecke K. Web-based guiding of clinical experts through the modeling of treatment decision models using MEBN with an example of laryngeal cancer. *Int J CARS*. 2014;10.

Figure 1. Decision tree for Who to Vax based on current Centers for Disease Control and Prevention guidelines. CHF indicates congestive heart failure; COPD, chronic obstructive pulmonary disease; HIV, human immunodeficiency virus; PPSV23, 23-valent pneumococcal polysaccharide vaccine; PCV13, 13-valent pneumococcal conjugate vaccine.