Update on Immunization Practices
For Younger & Older Adults

Supported by an educational grant from Merck & Co., Inc.

Jointly provided by Center for Independent Healthcare Education and Vemco MedEd
Activity Description

Target Audience
This activity is designed as a comprehensive approach to address the practice needs of primary care providers, including primary care physicians, doctors of osteopathy, physician assistants, nurse practitioners, and allied healthcare professionals, who are at the forefront of caring for adult patients eligible for immunizations and/or at risk for vaccine-preventable diseases.

Learning Objectives
At the conclusion of the educational activity, the learner should be able to:

▪ Evaluate the latest clinical research on the impact of HPV vaccination in the prevention of various types of cancer in men and women
▪ Identify strategies to adhere to ACIP HPV vaccination recommendations and overcome barriers by both healthcare providers and patients to vaccinate younger adults
▪ Describe the clinical consequences of pneumococcal disease and its associated complications among older adults
▪ State the latest ACIP recommendations for pneumococcal vaccination among older adults
Faculty and Disclosure

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Dr. Michael Donnelly does not have any relevant financial relationships to disclose. Dr. Donnelly does not intend to discuss off-label uses of products.

No (other) speakers, authors, planners or content reviewers have any relevant financial relationships to disclose.

Content review confirmed that the content was developed in a fair, balanced manner free from commercial bias. Disclosure of a relationship is not intended to suggest or condone commercial bias in any presentation, but it is made to provide participants with information that might be of potential importance to their evaluation of a presentation.
Burden of Vaccine-Preventable Disease

- Influenza
  - Since 2010
    - 140,000–710,000 flu-related hospitalizations per year
    - Between 12,000 and 56,000 deaths yearly
- Hepatitis B
  - 700k–1.4M people live with chronic hepatitis B
- We will take a close look at pneumococcal disease and HPV today

Vaccination Rates
2016

Why are adults harder to vaccinate?

Vaccine Costs
Supply Chain
Storage
Access
More Problems to Address
Adults don't need school forms
Reimbursement
Outlay of money
Is it part D?
Refusal
Guidelines
Antivax
Insurance companies
Moving Target
Ever Changing
Adult Vaccination Rate for HPV and Pneumococcus Over Time

Any pneumococcal vaccine in pts age >65

HPV in women

Any pneumococcal vaccine in high risk patients 19-64

HPV vaccine in males

Vaccine Refusal

Friends!!! I am desperate here: I am a newly non vaccinator and I want to write about vaccination dangers for my final thesis in college; however, I need that I can use to prove my point effectively! Thank you all!!!❤❤❤❤

The fact that you cannot find any journals to back up your viewpoint MAY suggest you need to reassess your viewpoint...
US Adults Attitudes Toward Vaccines

American Osteopathic Association

- The Harris Poll
- >2,000 US adults
- May 2019
45% of American Adults Doubt Vaccine Safety

Which of the following have caused you to doubt the safety of vaccines?
  • Nothing—I don’t doubt the safety of vaccines 55%

Safety and Efficacy

82% favorable
9% unsure
8% negative

Sources of Information

Top 3:
16% said Online Articles
12% past wrongdoing by industry
11% info from Medical Experts

HPV vaccine

it’s not just warts

Image Source: https://dermatologycharleston.com/medical-dermatology-services/warts/

Kansas Vaccination Rates

Percentage of adolescents who are up to date on HPV vaccination

National coverage is 49%
Coverage by state:
- 39% and under
- 40-49%
- 50-59%
- 60% or greater

Source: MMWR August 24, 2018

www.cdc.gov/hpv
HPV-Related Cancer Incidence

In 2015 alone-

CDC estimate- **43,371** HPV-related cancers

- From 1999–2015
  - HPV-associated cancer incidence
    - rose by 0.9%
    - cervical cancer dropped by 1.6%

- Estimated to result in ~**18,000 deaths**

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Over 90% of Anal and Cervical Cancers and 60% of Penile Cancers are HPV+

Quiz

Which serotype of HPV is most carcinogenic?
A) 6
B) 11
C) 16
D) 18
E) 31
Genotype Attribution for Cervical Cancer

Genotype Attribution: Oropharyngeal Cancer

Viral Prevalence
- 28% HPV 16, 18
- 62% other HPV
- 10% no HPV

Second Cancers Occur in Both Genders

Cumulative incidence of 2nd HPV-associated primary cancers among men

Vaccine is Effective for HPV 16 & 18

<table>
<thead>
<tr>
<th>Reduces Cervical Infection</th>
<th>Reduces Oropharyngeal Infection</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Reduced incidentally detected 6- and 12-month infection by 94% and 91%(^1)</td>
<td>• Estimated vaccine efficacy: 93%(^2)</td>
</tr>
</tbody>
</table>

From 2003–06 to 2009–2012, 4vHPV-type prevalence decreased:

• 64% in 14–19-yr-olds
• 34% in 20–24-yr-olds\(^3\)

Vaccine Rates in Teens are Increasing

NIS-Teen 2017 rates

<table>
<thead>
<tr>
<th></th>
<th>2017</th>
<th>2016</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Teen Girls</td>
<td>53.1%</td>
<td>49.5%</td>
</tr>
<tr>
<td>• Teen Boys</td>
<td>44.3%</td>
<td>37.5%</td>
</tr>
</tbody>
</table>

HPV vaccine was initially recommended in the US in 2009 in women. Since that time, which of the following have been shown regarding the incidence of vaccine type HPV?

A) Cervical infection has decreased in women who have been unvaccinated.

B) Cervical infection is unchanged in women who are unvaccinated.

C) Oropharyngeal infection in males has decreased.

D) Both A and C are correct.
Prevalence of infection decreased 86% and 71%

From 03-06 to 13-16
How Do We Make It??

Fig 1. Schematic picture of formation of L1 proteins into HPV VLP.

ACIP Recommendations for HPV 9

• Earliest: age 9 years
• Recommended: age 11–12 years
• 2 doses: 0 then 6–12 months if <15 years otherwise 3 doses

• Catchup
  • Males: 13–21 years, “may” vaccinate up to 26 years
  • Females: age 13 up to 26 years
FDA Expands Indication to age 45 in October 2018

• 10-year efficacy in women 27–45 years using quadrivalent HPV, not 9vHPV
  • (Merck study done in Columbia)
2 votes:

- HPV vaccination recommended for both males and females through age 26 years
- For ages 27 to 45 years, decision to vaccinate based on “shared clinical decision-making”
HPV Vaccination Coverage Among Adolescents 13-17 years by State, HHS Region, and the US, National Immunization Survey-Teen (NIS-TEEN), 2018
KS HPV rates for Girls (top) and Boys (bottom) ages 13-17
HPV Over the Ages

HPV DNA prevalence and report of at least 1 new sex partner — United States, 2013-2014

Prevalence of any genital HPV, NHANES

Percent reporting >1 new sex partner in the past year, NHANES

Lewis et al, JID 2018;  Gargano et al, JID 2017
NHANES, National Health and Nutrition Examination Survey
*among sexually experienced persons  +CDC, unpublished data
Shared Decision Making Framework
HPV Vaccine in 27-45 year olds

LEANS toward VACCINATE
• Having a new/multiple sex partners is a risk
• Vaccine efficacy is high if you haven’t been exposed to that serotype

LEANS toward DON’T VACCINATE
• Monogamous long term relationships
• Not likely ever to be sexually active

Available at: https://www.cdc.gov/mmwr/volumes/68/wr/mm6832a3.htm#B1_down.
Vaccine Hesitancy

- Hesitancy has been increasing among patients and parents.
- It is a spectrum: many are neither pro nor anti-vaccine but are in the middle.
- Provider introduction and recommendation is very important.
Hesitancy

• Presumptive style of communication
  • (continue discussion about why the vaccine is important vs deferring vaccination)

• Strong, direct communication
  • Even when parents verbally assertively expressed hesitancy, 33% were vaccinated same day.

Pneumococcal Vaccines

Remember there are 2 of them

PPSV23
- Introduced in 1983

PCV7
- Licensed in 2000

PCV13
- Licensed in 2010

PCV13
- Okayed for adults in 2012

PCV13
- For >65yo in 2014
Pneumococcal vaccination coverage among adults 18–64 years at increased risk and ≥65 years, Td and Tdap vaccination coverage among adults ≥18 years, and shingles vaccination coverage among adults ≥60 years by selected local area, state, HHS Region, and the United States, BRFSS, 2008 through 2017
Pneumococcal Vaccines Effects in Children


*PCV13 serotype: 1, 3, 4, 5, 6A, 6B, 7F, 9V, 14, 18C, 19A, 19F, and 23F

Which of the following had the largest impact on the incidence of IPD in US adults?

A) PPSV23 Vaccination for 65 year olds
B) PCV7 Vaccination in children
C) PCV7/13 Vaccination of High Risk 19-64 yr olds
D) PPSV23 Vaccination of High Risk 19-64 year olds
Trends in Adults

Rate of Invasive Pneumococcal infection age >65

Polysaccharide vs. Conjugate

Image Source: https://www2a.cdc.gov/nip/isd/ycts/mod1/courses/genrec/10351.asp?seg=H.
Vaccine Effectiveness

• PPSV23 is only **modestly** effective protecting against invasive disease (~50% reduction)

• **Poor** against non-bacteremic pneumonia (NPP) (4–17%)

• NPP is ~10 times more common than bacteremic pneumonia in adults

Conjugates vs Polysaccharides

- Induces herd immunity by decreasing naso-pharyngeal carriage. (Seen in Hib previously)
- Long-term immunity via T-cell activation also may decrease need for booster doses.
So Who was Getting the Adults Sick?

http://news.hugofox.com/2013/10/07/project-wild-thing-make-your-childs-heart-sing/
### Whom to Vaccinate: ACIP 2012

#### Immunocompetent Patients

<table>
<thead>
<tr>
<th>Underlying medical condition</th>
<th>PCV13</th>
<th>PPSV23</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chronic heart/lung/liver disease</td>
<td></td>
<td>✔</td>
</tr>
<tr>
<td>Diabetics/smokers/alcoholism</td>
<td></td>
<td>✔</td>
</tr>
<tr>
<td>CSF leak</td>
<td>✔</td>
<td>✔</td>
</tr>
</tbody>
</table>

#### Immunocompromised Persons

<table>
<thead>
<tr>
<th>Underlying medical condition</th>
<th>PCV13</th>
<th>PPSV23 + rpt in 5yrs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Renal failure/nephrotic</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Generalized or heme malignancy</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Iatrogenic immunosuppression/transplant</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Congenital or acquired asplenia</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Sickle cell/hemoglobinopathy</td>
<td>✔</td>
<td>✔</td>
</tr>
</tbody>
</table>
For immunocompetent adults ≥65 years and no history of pneumococcal vaccine:

- Remove the recommendation for a single dose of PCV13
- “Shared clinical decision making” can be used to decide whom to vaccinate with PCV13
- A single dose of PPSV23 vaccine should continue to be administered

Trends in IPD Among Adults ≥65 Years, 1998–2016

Indirect Effect of Pediatric Vaccines

- 9-fold reduction in IPD in adults >65 years
  In PCV13 types alone: 3-fold reduction
- Steady rate since 2014

- ~ Same as Europe
  - 77% reduction in PCV7 types
  - 38% reduction in PCV13-non7 types

### 16 Country Risk of Invasive Pneumococcal Disease, Before and After the Introduction of 13-valent Pneumococcal Conjugate Vaccine

<table>
<thead>
<tr>
<th>Author(s) and year</th>
<th>Pro-PCV13</th>
<th>Post-PCV13</th>
<th>Incidence Rate Ratio (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>18–49 years</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Camara et al., 2017 [29]</td>
<td>327</td>
<td>131</td>
<td>0.42 (0.35–0.52)</td>
</tr>
<tr>
<td>Corroy et al., 2016 [30]</td>
<td>1258</td>
<td>1565</td>
<td>0.91 (0.84–0.98)</td>
</tr>
<tr>
<td>Demeceux et al., 2013, [31]</td>
<td>584</td>
<td>1237</td>
<td>1.09 (0.99–1.20)</td>
</tr>
<tr>
<td>Harboe et al., 2014 [36]</td>
<td>471</td>
<td>400</td>
<td>0.94 (0.74–1.26)</td>
</tr>
<tr>
<td>Mendes et al., 2014 [44]</td>
<td>153</td>
<td>311</td>
<td>1.02 (0.54–2.34)</td>
</tr>
<tr>
<td>Moore et al., 2015 [46]</td>
<td>3107</td>
<td>2764</td>
<td>0.66 (0.33–1.37)</td>
</tr>
<tr>
<td>Regov et al., 2017 [50]</td>
<td>239</td>
<td>334</td>
<td>0.57 (0.40–0.86)</td>
</tr>
<tr>
<td>Steens et al., 2013 [55]</td>
<td>389</td>
<td>358</td>
<td>0.76 (0.63–0.90)</td>
</tr>
<tr>
<td>Von Gottberg et al., 2014 [57]</td>
<td>1516</td>
<td>1262</td>
<td>0.82 (0.76–0.89)</td>
</tr>
<tr>
<td><strong>Subtotal (I² = 96.9%, P &lt; 0.0001)</strong></td>
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<tr>
<td><strong>50–64 years</strong></td>
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<tr>
<td>Camara et al., 2017 [29]</td>
<td>223</td>
<td>158</td>
<td>0.71 (0.58–0.86)</td>
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<tr>
<td>Corroy et al., 2016, [30] Demeceux et al., 2013, [31] Mendes et al., 2014 [44]</td>
<td>1018</td>
<td>1362</td>
<td>0.96 (0.88–1.04)</td>
</tr>
<tr>
<td>2014 [44]</td>
<td>688</td>
<td>1385</td>
<td>0.97 (0.89–1.06)</td>
</tr>
<tr>
<td>Moore et al., 2015 [46]</td>
<td>185</td>
<td>336</td>
<td>0.84 (0.70–1.00)</td>
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<tr>
<td>Regov et al., 2017 [50]</td>
<td>3323</td>
<td>4006</td>
<td>0.83 (0.79–0.86)</td>
</tr>
<tr>
<td>Steens et al., 2013 [55]</td>
<td>239</td>
<td>367</td>
<td>0.78 (0.69–0.89)</td>
</tr>
<tr>
<td>Stolte et al., 2016 [37]</td>
<td>706</td>
<td>774</td>
<td>0.83 (0.75–0.92)</td>
</tr>
<tr>
<td><strong>Subtotal (I² = 70.8%, P = 0.0017)</strong></td>
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<tr>
<td><strong>&lt;65 years</strong></td>
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<tr>
<td>Galani et al., 2016 [32]</td>
<td>175</td>
<td>247</td>
<td>0.85 (0.70–1.03)</td>
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<tr>
<td>Grau et al., 2014 [34]</td>
<td>471</td>
<td>155</td>
<td>0.65 (0.54–0.78)</td>
</tr>
<tr>
<td>Leproux et al., 2015 [42] Rodrigo et al., 2015 [51] Simonsen et al., 2014 [52]</td>
<td>2234</td>
<td>1740</td>
<td>0.71 (0.55–0.92)</td>
</tr>
<tr>
<td>2015 [50]</td>
<td>84</td>
<td>84</td>
<td>0.71 (0.55–0.92)</td>
</tr>
<tr>
<td>2016 [54]</td>
<td>10637</td>
<td>8401</td>
<td>0.79 (0.77–0.81)</td>
</tr>
<tr>
<td><strong>Subtotal (I² = 95.0%, P &lt; 0.0001)</strong></td>
<td></td>
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<tr>
<td><strong>&gt;=65 years</strong></td>
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<td>399</td>
<td>320</td>
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<td>1508</td>
<td>2210</td>
<td>0.96 (0.90–1.03)</td>
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<tr>
<td>2014 [32]</td>
<td>967</td>
<td>1821</td>
<td>0.94 (0.97–1.02)</td>
</tr>
<tr>
<td>Grau et al., 2014 [34]</td>
<td>183</td>
<td>260</td>
<td>0.91 (0.75–1.10)</td>
</tr>
<tr>
<td>Guerra et al., 2014 [35] Houseman et al., 2017 [40]</td>
<td>408</td>
<td>152</td>
<td>0.76 (0.59–0.96)</td>
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<td>Leproux et al., 2016 [42] Mendes et al., 2014 [44]</td>
<td>206</td>
<td>114</td>
<td>0.77 (0.61–0.97)</td>
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<tr>
<td>2014 [44]</td>
<td>581</td>
<td>570</td>
<td>0.89 (0.79–1.00)</td>
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<tr>
<td>Moore et al., 2015 [46]</td>
<td>182</td>
<td>362</td>
<td>0.85 (0.61–1.00)</td>
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<tr>
<td>Regov et al., 2017 [50]</td>
<td>2947</td>
<td>4673</td>
<td>0.93 (0.77–1.11)</td>
</tr>
<tr>
<td>Rodrigo et al., 2015 [51]</td>
<td>449</td>
<td>878</td>
<td>0.86 (0.77–0.96)</td>
</tr>
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<td>Simonsen et al., 2014 [52]</td>
<td>268</td>
<td>123</td>
<td>0.69 (0.56–0.85)</td>
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<tr>
<td>Stolte et al., 2016 [37]</td>
<td>9068</td>
<td>6464</td>
<td>0.86 (0.80–0.93)</td>
</tr>
<tr>
<td>Steens et al., 2013 [55]</td>
<td>1583</td>
<td>1884</td>
<td>0.80 (0.75–0.85)</td>
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<tr>
<td>2015 [56]</td>
<td>1162</td>
<td>945</td>
<td>0.75 (0.69–0.82)</td>
</tr>
<tr>
<td><strong>Subtotal (I² = 87.8%, P &lt; 0.0001)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>&gt;=18 years</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bruce et al., 2015 [28]</td>
<td>402</td>
<td>375</td>
<td>0.91 (0.79–1.05)</td>
</tr>
<tr>
<td>Mechi et al., 2014 [43] Horacio et al., 2013 [38]</td>
<td>402</td>
<td>375</td>
<td>0.91 (0.79–1.05)</td>
</tr>
<tr>
<td>2015 [50]</td>
<td>776</td>
<td>703</td>
<td>0.89 (0.81–0.95)</td>
</tr>
<tr>
<td>van der Linden et al., 2015 [56]</td>
<td>652</td>
<td>473</td>
<td>0.96 (0.80–1.10)</td>
</tr>
<tr>
<td>2016 [56]</td>
<td>5764</td>
<td>8636</td>
<td>0.91 (0.88–0.94)</td>
</tr>
<tr>
<td><strong>Overall (I² = 93.99%, P &lt; 0.0001)</strong></td>
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<td></td>
</tr>
</tbody>
</table>

### Annual Number Needed to Vaccinate (NNV) among Adults ≥65 Years Old*

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Incidence per 100,000</th>
<th>Vaccine Effectiveness (VE)</th>
<th>(95% CI)</th>
<th>NNV (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PCV13-type IPD</td>
<td>5^a</td>
<td>76%^b</td>
<td>(48, 89)</td>
<td>26,300</td>
</tr>
<tr>
<td>PCV13-type pneumonia, inpatient</td>
<td>17^c–76^d</td>
<td>43%^e</td>
<td>(12, 63)</td>
<td>3,000–14,000</td>
</tr>
<tr>
<td>PCV13-type pneumonia, outpatient</td>
<td>88^f</td>
<td>43%^e</td>
<td>(12, 63)</td>
<td>2,600</td>
</tr>
</tbody>
</table>

*Calculation: NNV = 1/(incidence rate*VE)

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^a Unpublished ABCs data [3]
^b Bonten [1]^*
^c Gierke [11], estimated by applying the %PCV13-type IPD to the NIPP incidence estimate
^d Swerdlow [10]^*
^e Webber [6]^*
^f Nelson et al. 2008, estimated as 5.1% of all-cause outpatient pneumonia is PCV13-type

While reasonable to remove the recommendation to vaccinate with PCV13, what does that mean for reimbursement, etc.?
In conclusion, tremendous advances in science have given us new vaccines

Which one of the following is NOT a method of developing a currently licensed vaccine?

A) use entire genome’s open reading frames to synthesize proteins, inject them in a rodent to test immunogenicity, find one that evokes a response, then purify it.

B) Make envelope protein from pentamers, get it to self-assemble to a larger particle.

C) Get a harmless recombinant insect virus to infect a moth ovary and then secrete a target protein.

D) Get a target protein, add HbSag to it, then also add AS01 adjuvant.

E) Take a part of a polysaccharide capsule, and connect it to tetanus toxoid.
The End