Influenza Vaccine Effectiveness, 2016-17

US Flu VE Network
&
US Hospitalized Adult Influenza Vaccine Effectiveness Network (HAIVEN)

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CDC Influenza Division
Meeting of the Advisory Committee on Immunization Practices (ACIP)
June 21, 2017
Objectives

- Review end-of-season estimates of 2016-17 influenza vaccine effectiveness (VE) from US Flu VE Network (outpatient flu, all ages)
- Introduce US Hospitalized Adult Influenza Vaccine Effectiveness Network (HAIVEN) (inpatient flu, adults) and present preliminary 2016-17 VE estimates
US Flu VE Networks 2016-2017 Outpatients All Ages
US Flu VE Network and principal investigators

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University of Michigan
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Emily Martin

University of Pittsburgh
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Tricia Nowalk

CDC
Brendan Flannery
Alicia Fry
US Flu VE Network Methods

Enrollees: Outpatients aged ≥6 months with acute respiratory illness with cough ≤7 days duration

Design: Test-negative case-control design

- Odds of PCR-confirmed influenza among vaccinated compared to unvaccinated enrollees
- Vaccinated: at least one dose of 2016–17 flu vaccine according to medical records, immunization registries, and/or self-report with date and location

Analysis: VE = (1 – adjusted OR) x 100%

- Adjusted for site, age, sex, race/ethnicity, self-rated general health status, days from onset to enrollment, and calendar time of onset
US Flu VE Enrollment, 2016–17 (N=7205)

Cases by subtype (N=2052)*

- Flu B
- Flu A
- Flu Negative

* Cases in analytic dataset (after exclusions)

<table>
<thead>
<tr>
<th>Any influenza A or B virus</th>
<th>Influenza positive</th>
<th>Influenza negative</th>
<th>Unadjusted</th>
<th>Adjusted*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N vaccinated/Total (%)</td>
<td>N vaccinated/Total (%)</td>
<td>VE %</td>
<td>95% CI</td>
</tr>
<tr>
<td>All ages</td>
<td>883/2052 (43)</td>
<td>2761/5153 (54)</td>
<td>35 (27 to 41)</td>
<td>42 (35 to 48)</td>
</tr>
<tr>
<td>Age group (yr)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6 mo–8 yr</td>
<td>106/353 (30)</td>
<td>709/1318 (54)</td>
<td>63 (53 to 71)</td>
<td>61 (49 to 70)</td>
</tr>
<tr>
<td>9–17</td>
<td>123/402 (31)</td>
<td>245/606 (40)</td>
<td>35 (15 to 50)</td>
<td>35 (13 to 61)</td>
</tr>
<tr>
<td>18–49</td>
<td>203/529 (38)</td>
<td>716/1629 (44)</td>
<td>21 (3 to 35)</td>
<td>19 (-1 to 34)</td>
</tr>
<tr>
<td>50–64</td>
<td>203/442 (46)</td>
<td>537/909 (59)</td>
<td>41 (26 to 53)</td>
<td>42 (26 to 55)</td>
</tr>
<tr>
<td>≥65</td>
<td>248/326 (76)</td>
<td>554/691 (80)</td>
<td>21 (-8 to 43)</td>
<td>25 (-5 to 46)</td>
</tr>
</tbody>
</table>

* Multivariate logistic regression models adjusted for site, age, sex, race/ethnicity, self-rated general health status, days from illness onset to enrollment, and calendar time of illness onset
US Flu VE Network: Vaccine effectiveness by subtype, 2016–17

<table>
<thead>
<tr>
<th>Influenza A/H3N2</th>
<th>Influenza positive</th>
<th>Influenza negative</th>
<th>Vaccine Effectiveness</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N vaccinated/Total (%)</td>
<td>N vaccinated/Total (%)</td>
<td>Unadjusted</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>VE %</td>
</tr>
<tr>
<td>All ages</td>
<td>619/1349 (46)</td>
<td>2761/5153 (54)</td>
<td>27 (17 to 35)</td>
</tr>
<tr>
<td>Age group (yr)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6 mo–8 yr</td>
<td>71/203 (35)</td>
<td>709/1318 (54)</td>
<td>54 (37 to 66)</td>
</tr>
<tr>
<td>9–17</td>
<td>78/258 (30)</td>
<td>245/606 (40)</td>
<td>36 (13 to 53)</td>
</tr>
<tr>
<td>18–49</td>
<td>143/352 (41)</td>
<td>716/1629 (44)</td>
<td>13 (-10 to 31)</td>
</tr>
<tr>
<td>50–64</td>
<td>145/299 (49)</td>
<td>537/909 (59)</td>
<td>35 (15 to 50)</td>
</tr>
<tr>
<td>≥65</td>
<td>182/237 (77)</td>
<td>554/691 (80)</td>
<td>18 (-17 to 43)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Influenza A/H1N1pdm09</th>
<th>Influenza positive</th>
<th>Influenza negative</th>
<th>Vaccine Effectiveness</th>
</tr>
</thead>
<tbody>
<tr>
<td>All ages</td>
<td>8/26 (31)</td>
<td>2761/5153 (54)</td>
<td>61 (11 to 83)</td>
</tr>
</tbody>
</table>

* Multivariate logistic regression models adjusted for site, age, sex, race/ethnicity, self-rated general health status, days from illness onset to enrollment, and calendar time of illness onset.
<table>
<thead>
<tr>
<th>Influenza B Lineage</th>
<th>All ages</th>
<th>N vaccinated/Total (%)</th>
<th>Influenza positive</th>
<th>Influenza negative</th>
<th>Vaccine Effectiveness</th>
<th>Unadjusted</th>
<th>Adjusted*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Influenza B</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All ages</td>
<td></td>
<td>238/650 (37)</td>
<td>2761/5153 (54)</td>
<td>50 (41 to 58)</td>
<td>56 (47 to 64)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Influenza B/Yamagata</td>
<td></td>
<td>215/579 (37)</td>
<td>2761/5153 (54)</td>
<td>49 (39 to 57)</td>
<td>55 (45 to 63)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Influenza B/Victoria</td>
<td></td>
<td>21/63 (33)</td>
<td>2761/5153 (54)</td>
<td>57 (27 to 74)</td>
<td>60 (31 to 77)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Multivariate logistic regression models adjusted for site, age, sex, race/ethnicity, self-rated general health status, days from illness onset to enrollment, and calendar time of illness onset.
INPATIENT
ADULTS

HAVEN VE Estimates, 2016-17

INPATIENT
ADULTS

HAVEN VE Estimates, 2016-17
US Hospitalized Adult Influenza Vaccine Effectiveness Network (HAIVEN)

• CDC-funded study to estimate effectiveness of influenza vaccine for prevention of influenza hospitalizations among adults
• 2015-16 was pilot year with 7 hospitals
• 2016-17 through 2019-20 enrollment at 10 hospitals with 5000+ acute care beds
HAIVEN Methods

Similar to US Flu VE Network

Enrollees: Adults aged ≥18 years old hospitalized for <72 hr with acute respiratory illness with cough ≤10 days duration

Design: Test-negative case-control design

- Odds of PCR-confirmed influenza among vaccinated compared to unvaccinated enrollees
- Vaccinated: At least one dose of 2016–17 flu vaccine ≥14 days prior to illness onset by patient self-report

Analysis: VE = (1 – adjusted OR) x 100%

- Adjusted for site, age, sex, race/ethnicity, days from onset to enrollment, calendar time of onset, number of hospitalizations in past year, frailty, and home oxygen use

Underline indicates difference in methodology from US Flu VE Network
HAIVEN Enrollment, 2016–17* (N=2275)

- Preliminary analysis through April 14
- End of study period: May 13
- Preliminary VE estimates include HAIVEN enrollees through April 14, 2017
- ** Cases in analytic dataset (after exclusions)

Cases by subtype (N=382)**

- A/H3N2 70%
- B/Victoria 4%
- B/Yamagata 17%

Number of enrollees:
- Flu B
- Flu A
- Flu Negative

Graph showing enrollment trends from 20-Nov to 20-Apr 2016 and 2017.
# HAIVEN: Vaccine effectiveness against influenza A/B, 2016–17 (preliminary)

<table>
<thead>
<tr>
<th>Any influenza A or B virus</th>
<th>Influenza positive</th>
<th>Influenza negative</th>
<th>Vaccine Effectiveness</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>N vaccinated/Total (%)</td>
<td>N vaccinated/Total (%)</td>
</tr>
<tr>
<td>Age ≥18 yr</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age group (yr)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18-49</td>
<td>510</td>
<td>37/78 (47)</td>
<td>240/432 (56)</td>
</tr>
<tr>
<td>50-64</td>
<td>787</td>
<td>59/107 (55)</td>
<td>441/680 (65)</td>
</tr>
<tr>
<td>≥65</td>
<td>978</td>
<td>139/197 (71)</td>
<td>621/781 (80)</td>
</tr>
</tbody>
</table>

* Multivariate logistic regression models adjusted for site, age group, sex, race/ethnicity, days from illness onset to specimen collection, calendar time of illness onset, home oxygen use, frailty score, and number of self-reported hospitalizations in the past year.
### HAIVEN:
#### Vaccine effectiveness by virus type, 2016–17 (preliminary)

<table>
<thead>
<tr>
<th>Influenza Type</th>
<th>Age ≥18 yr</th>
<th>N vaccinated/Total</th>
<th>(%)</th>
<th>N vaccinated/Total</th>
<th>(%)</th>
<th>Vaccine Effectiveness</th>
<th>Unadjusted</th>
<th>Adjusted*</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Influenza A/B</strong></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>Vaccine Effectiveness</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Influenza positive</td>
<td></td>
<td>Influenza negative</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>N vaccinated/Total</td>
<td>(%)</td>
<td>N vaccinated/Total</td>
<td>(%)</td>
<td>VE %</td>
<td>95% CI</td>
<td>VE %</td>
<td>95% CI</td>
</tr>
<tr>
<td>Influenza A/B</td>
<td>Age ≥18 yr</td>
<td>2275</td>
<td>235/382</td>
<td>(62)</td>
<td>1302/1893</td>
<td>(69)</td>
<td>27</td>
<td>(9, 42)</td>
</tr>
<tr>
<td>Influenza A/H3N2</td>
<td>Age ≥18 yr</td>
<td>2167</td>
<td>177/274</td>
<td>(65)</td>
<td>1302/1893</td>
<td>(69)</td>
<td>17</td>
<td>(-8, 37)</td>
</tr>
<tr>
<td>Influenza B</td>
<td>Age ≥18 yr</td>
<td>1984</td>
<td>49/91</td>
<td>(54)</td>
<td>1302/1893</td>
<td>(69)</td>
<td>47</td>
<td>(19, 65)</td>
</tr>
</tbody>
</table>

* Multivariate logistic regression models adjusted for site, age group, sex, race/ethnicity, days from illness onset to specimen collection, calendar time of illness onset, home oxygen use, frailty score, and number of self-reported hospitalizations in the past year.
HAIVEN:
Vaccine effectiveness by virus type, 2015-16 and 2016-17

- 2015-16 Flu A/B: 50%
- 2016-17 Flu A/B: 30%
- 2015-16 Flu A/H3N2: 20%
- 2016-17 Flu A/H3N2: NR
- 2015-16 Flu A/H1N1pdm: 51%
- 2016-17 Flu A/H1N1pdm: NR
- 2015-16 Flu B: 53%
- 2016-17 Flu B: 53%

NR = not reported
Vaccine effectiveness against PCR-confirmed influenza A/B in HAIVEN\(^1\) (inpatient) and US Flu VE Network\(^2\) (outpatient) by adult age group, 2016-17

\[\begin{align*}
\text{Vaccine effectiveness (\%)} \\
\text{INPATIENT} & \geq 18 \text{ years} & \text{OUTPATIENT} & \geq 18 \text{ years} \\
& 30 & 30 \\
\text{INPATIENT} & 18-49 \text{ years} & \text{OUTPATIENT} & 18-49 \text{ years} \\
& 23 & 19 \\
\text{INPATIENT} & 50-64 \text{ years} & \text{OUTPATIENT} & 50-64 \text{ years} \\
& 31 & 42 \\
\text{INPATIENT} & \geq 65 \text{ years} & \text{OUTPATIENT} & \geq 65 \text{ years} \\
& 37 & 25
\end{align*}\]

\(^1\) Multivariate logistic regression models adjusted for site, age group, sex, race/ethnicity, days from illness onset to specimen collection, calendar time of illness onset, home oxygen use, frailty, and number of hospitalizations in past year

\(^2\) Multivariate logistic regression models adjusted for site, age, sex, race/ethnicity, self-rated general health status, days from onset to specimen collection, and calendar time of illness onset
Summary

- Vaccine reduced outpatient influenza visits by 42% for influenza A and B viruses and by 34% for influenza A/H3N2 viruses.
- Vaccine effectiveness was similar to previous A/H3N2 predominant seasons when vaccine was antigenically like circulating influenza viruses.
- Vaccine offered significant protection against influenza hospitalizations:
  - Vaccine reduced influenza hospitalizations by 30% among all adults and by 37% among adults ≥65 years of age (influenza A and B viruses).
  - Results are preliminary and may change when final dataset is available.
For more information, contact CDC
1-800-CDC-INFO (232-4636)

The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.