COVID-19 vaccine effectiveness during Omicron for children and adolescents

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ACIP
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Pediatric Research Observing Trends and Exposures in COVID-19 Timelines (PROTECT)

- **Design**: Prospective cohort study
- **Population**: Children ages 4 months - 17 years
- **Methods**: Weekly surveillance and self-swab
  - SARS-CoV-2 testing by RT-PCR and whole genome sequencing
  - Electronic surveys during and after SARS-CoV-2 infection
  - Multi-method vaccination documentation
- **Analysis**: Cox proportional hazards model adjusted by propensity to be vaccinated, site, SARS-CoV-2 circulation, and community mask use
  - Timeframe for analysis during local Omicron predominance
    - December 14, 2021 - April 23, 2022


Recruitment includes children of adult participants in a similar study (HEROES-RECOVER) of frontline workers and from the local community.
PROTECT: VE against SARS-CoV-2 infection by age group during Omicron variant predominance, Dec 2021-Apr 2022

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Person-days</th>
<th>SARS-CoV-2 positive</th>
<th>Adjusted VE % (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>5 - 11 years</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 doses (≥14 days)</td>
<td>60,290</td>
<td>212</td>
<td>31 (10-48)</td>
</tr>
<tr>
<td>2 doses (14-59 days)</td>
<td>26,411</td>
<td>156</td>
<td>43 (24-57)</td>
</tr>
<tr>
<td><strong>12 - 17 years</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 doses (≥14 days)</td>
<td>14,501</td>
<td>59</td>
<td>49 (23-67)</td>
</tr>
<tr>
<td>2 doses (14-59 days)</td>
<td>785</td>
<td>20</td>
<td>57 (22-76)</td>
</tr>
<tr>
<td>2 doses (≥60 days)</td>
<td>13,716</td>
<td>39</td>
<td>43 (4-67)</td>
</tr>
<tr>
<td>3 doses (≥7 days)*</td>
<td>8,340</td>
<td>8</td>
<td>83 (62-93)</td>
</tr>
</tbody>
</table>

* Median time from vaccination to test was 95 days

Increasing Community Access to Testing (ICATT) Partnership: VE analysis for symptomatic infection

- Nationwide community-based drive-through COVID-19 testing via pharmacies
- Self-reported vaccine history at time of registration for COVID-19 testing; excluded those who did not report vaccination status
- **Design:** Test-negative, case-control analysis
- **Population:** Persons with ≥1 COVID-like symptom and nucleic acid amplification testing (NAAT)
- **Adjusted for:**
  - Calendar day, race, ethnicity, gender, site’s HHS region, site census tract’s social vulnerability index (SVI)
  - Not adjusted for prior infection
- **Period:**
  - **Adults:** Tested December 10, 2021 – January 1, 2022, also adjusted for number of underlying conditions and tests, excluded if prior positive test within 90 days (Omicron defined by s-gene target failure)
  - **Children:** Tested December 26, 2021 – February 21, 2022 (Omicron variant increased from 74 to >99% weekly in nationally sequenced specimens)
ICATT: Pfizer-BioNTech 2-dose VE against symptomatic infection by variant and time since 2nd dose receipt, adults ages ≥18 years, Dec 10, 2021-Jan 1, 2022

- VE for 2 doses of Pfizer-BioNTech against symptomatic Omicron infection:
  - Starts lower than 2-dose VE against Delta infection
  - No longer significant by 3 months after second dose receipt

*Vaccination dose dates are collected as month and year. Month 0 represents tests in the same month as 2nd dose (at least 2 weeks after 2nd dose). For all months greater than or equal to 1 the value represents the difference between calendar month of test and calendar month of 2nd dose receipt (at least 2 weeks after 2nd dose).

ICATT: Pfizer-BioNTech 2-dose VE against symptomatic infection, by age group and variant

Delta, adults ≥18 years
Omicron, adults ≥18 years
Omicron, adolescents 12–15 years
Omicron, children 5–11 years
95% CIs

Adults: Tested Dec 10, 2021 – Jan 1, 2022
Children: Tested Dec 26, 2021 – Feb 21, 2022

A booster dose in ages 12-15 years increased VE to 71% (66-76%) in the 2-6.5 weeks after 3rd dose.

*Vaccination dose dates are collected as month and year. Month 0 represents tests in the same month as 2nd dose (at least 2 weeks after 2nd dose). For all months greater than or equal to 1 the value represents the difference between calendar month of test and calendar month of 2nd dose receipt (at least 2 weeks after 2nd dose).

VISION Multi-State Network of Electronic Health Records

- Delta vs. Omicron determined by time when Omicron predominated in study site (mid-December 2021)
- VE adjusted by propensity to be vaccinated weights, calendar time, region, local virus circulation, and age
- Vaccination documented by electronic health records and state and city registries

Cases: COVID-like illness (CLI) with positive PCR for SARS-CoV-2 within 14 days before or 72 hours after the admission or encounter

Controls: CLI with negative PCR for SARS-CoV-2
VISION: mRNA VE for ED/UC visits by number of doses and time since last dose receipt for children and adolescents during Omicron, Dec 2021–Mar 2022

<table>
<thead>
<tr>
<th></th>
<th>Total</th>
<th>SARS-CoV-2 positive, N (%)</th>
<th>VE (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5-11 years</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unvaccinated</td>
<td>1361</td>
<td>2736 (20)</td>
<td>Ref.</td>
</tr>
<tr>
<td>2 doses 14-59 days</td>
<td>1297</td>
<td>205 (16)</td>
<td>50 (39-59)</td>
</tr>
<tr>
<td>12-15 years</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unvaccinated</td>
<td>4034</td>
<td>1192 (30)</td>
<td>Ref.</td>
</tr>
<tr>
<td>2 doses 14-59 days</td>
<td>151</td>
<td>22 (15)</td>
<td>54 (22-73)</td>
</tr>
<tr>
<td>2 doses ≥60 days</td>
<td>2219</td>
<td>573 (26)</td>
<td>21 (8-32)</td>
</tr>
<tr>
<td>3 doses ≥7 days*</td>
<td>236</td>
<td>8 (3)</td>
<td>73 (34-89)</td>
</tr>
</tbody>
</table>

* Median days from 3rd dose to ED/UC encounter: 45 (IQR 27-64)

CDC, preliminary unpublished data. Individuals with prior infections excluded. Logistic regression conditioned on calendar week and geographic area, and adjusted for age, sex, race, ethnicity, local virus circulation, respiratory or non-respiratory underlying medical conditions, and propensity to be vaccinated COVID-like illness: included acute respiratory illness (e.g., COVID-19, respiratory failure, or pneumonia) or related signs or symptoms (cough, fever, dyspnea, vomiting, or diarrhea)
VISION: mRNA VE against hospitalization, all variants, ages 5-15 years, Apr 9, 2021-Jan 29, 2022

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Total SARS-CoV-2 positive, no. (%)</th>
<th>Adjusted VE % (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5-11 years</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unvaccinated</td>
<td>262</td>
<td>59 (22.5)</td>
</tr>
<tr>
<td>2 doses, 14-59 days earlier</td>
<td>23</td>
<td>2 (8.7)</td>
</tr>
<tr>
<td>12-15 years</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unvaccinated</td>
<td>496</td>
<td>149 (30)</td>
</tr>
<tr>
<td>2 doses, 14-149 days earlier</td>
<td>182</td>
<td>7 (3.8)</td>
</tr>
<tr>
<td>2 doses, ≥150 days earlier</td>
<td>63</td>
<td>13 (20.6)</td>
</tr>
</tbody>
</table>

Note: estimates include all variants.
- 5-11 years: 190 (67%) due to Omicron
- 12-15 years: 111 (15%) due to Omicron

Overcoming COVID-19 Methods

- **Design:** Case-control test-negative design

- **Population:** Children and adolescents hospitalized at 31 pediatric medical centers in 23 U.S. states

- **Case status (RT-PCR or antigen)**
  - Cases tested SARS-CoV-2 positive
  - Controls tested SARS-CoV-2 negative

- **Vaccination status (documented or plausible self-report)**
  - Fully vaccinated with Pfizer-BioNTech vaccine (dose 2 is ≥14 days prior to illness onset)
  - Or unvaccinated by illness onset

- **Logistic regression to estimate VE against hospitalization (VEₜ)**
  - Comparing odds of being fully vaccinated vs unvaccinated in COVID-19 cases and controls
  - \( \text{VE}_t = 100 \times (1 - \text{adjusted odds ratio}) \)
    - Adjusting for admission date, hospital region, age, sex, race/ethnicity
**Overcoming COVID-19 platform: VE for 2 doses of Pfizer-BioNTech vaccine against hospitalization, Dec 19, 2021-Apr 27, 2022**

<table>
<thead>
<tr>
<th>No. vaccinated COVID-19 patients/Total no. COVID-19 patients (%)</th>
<th>Adjusted VE % (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5–11 years*</td>
<td>25/325 (8) 68 (48-81)</td>
</tr>
<tr>
<td>12–18 years</td>
<td>109/286 (38) 51 (31-65)</td>
</tr>
<tr>
<td>2–22 weeks since vaccination</td>
<td>42/219 (19) 58 (34-74)</td>
</tr>
<tr>
<td>23–45 weeks since vaccination</td>
<td>67/244 (27) 42 (14-61)</td>
</tr>
</tbody>
</table>

*median time from vaccination to hospitalization is 37 days

Overcoming COVID-19 platform: VE for 2 doses of Pfizer-BioNTech vaccine against MIS-C, Jul 1, 2021-Apr 7, 2022

<table>
<thead>
<tr>
<th>Age Group</th>
<th>No. vaccinated MIS-C patients/Total no. MIS-C patients (%)</th>
<th>Adjusted VE % (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5–11 years</td>
<td>10/144 (7)</td>
<td>78 (48-90)</td>
</tr>
<tr>
<td>12–18 years</td>
<td>14/160 (9)</td>
<td>90 (81-95)</td>
</tr>
<tr>
<td>28-120 days since vaccination</td>
<td>7/153 (5)</td>
<td>90 (75-96)</td>
</tr>
<tr>
<td>≥121 days since vaccination</td>
<td>7/131 (5)</td>
<td>92 (78-97)</td>
</tr>
</tbody>
</table>
Summary

- Infection
  - 2-dose VE declines quickly in children and adolescents, following similar pattern to adults during Omicron
  - A booster dose in adolescents significantly improved VE at least 6 weeks-3 months after the 3rd dose

- Emergency department/urgent care visits
  - 2-dose VE was higher for ED/UC visits compared to infection.
    - Declined once >60 days after the 2nd dose for adolescents
  - A booster doses in ages 12-15 years significantly improved VE

- Severe disease: hospitalization and MIS-C
  - 2-doses provided protection for both children and adolescents, with some waning evident for hospitalization in adolescents
  - Not enough data to assess waning in 5-11 or impact of booster dose in 12-15
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  - Mark Thompson
  - Laura Zambrano
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.