COVID-19 Vaccine Effectiveness by Product and Timing in New York State

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Our earlier approach

- New York State: Population 20 million; 15 million age 18+

- Match of 3 statewide databases
  - Laboratory testing (ECLRS)
  - Hospital admissions (HERDS)
  - Vaccine registries (NYSIIS/CIR)

- For fully-vaccinated vs. unvaccinated adults...
  - Age-specific rates of cases and hospitalization estimated weekly
  - Compared using VE = 1 – IRR

- Open cohort approach
  - Unvaccinated persons can become vaccinated → contribute person-time and outcomes in either vaccine state.
  - Rates computed as aggregate events/PT weekly. Individuals not specifically followed across time steps.
  - Maximally utilizes population and transparent, with potential bias tradeoffs
Results from this method

Laboratory-confirmed cases
- May 3 week: VE = 91.8%
- Decline coincides with Delta variant increase to >99%,
- Mid-July minimum, small rebound thereafter

Hospitalization
- Consistent VE between 89.5% and 95.2%

Challenging to understand sources of VE changes
Products, time since vaccination, time period when variants and behaviors changed ...
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medRxiv 2021.10.08.21264595; doi: https://doi.org/10.1101/2021.10.08.21264595
Enhanced approach to focus on roles of products and timing

- **Closed cohort** approach
  - Closed cohorts, defined by combinations of:
    - Age (18-49, 50-64, ≥65 years)
    - Product (Pfizer-BioNTech, Moderna, Janssen)
    - Time of full-vaccination (January/February, March, April)
    - Comparison group: Never vaccinated by Sept 23 data freeze (for each age group)

  - **Follow-up:** May 1 to September 3 (cases), August 31 (hospitalization)

- **Laboratory-confirmed COVID-19 cases** (*1 per person*)
  - Time-to-diagnosis, life-table method (7 day intervals)
    - Cumulative incidence, hazard rates, with 95% CI
    - VE = 1 – HR, with 95% CI

- **Laboratory-confirmed COVID-19 hospitalizations** (*repeats possible within person, ~9% of admissions*)
  - Aggregate "events/PT" rates (1 month intervals)
    - Incidence rates, with exact 95% CI
    - VE = 1 – IRR, with exact 95% CI
<table>
<thead>
<tr>
<th>Cohort</th>
<th>Persons</th>
<th>Incident cases</th>
<th>Incident hospitalizations</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>18-49 years</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pfizer-BioNTech</td>
<td>980,353</td>
<td>10,738</td>
<td>95</td>
</tr>
<tr>
<td>Moderna</td>
<td>752,322</td>
<td>5,658</td>
<td>60</td>
</tr>
<tr>
<td>Janssen</td>
<td>276,481</td>
<td>3,307</td>
<td>38</td>
</tr>
<tr>
<td>Unvaccinated</td>
<td>2,070,251</td>
<td>85,667</td>
<td>4,689</td>
</tr>
<tr>
<td><strong>50-64 years</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pfizer-BioNTech</td>
<td>846,664</td>
<td>5,602</td>
<td>228</td>
</tr>
<tr>
<td>Moderna</td>
<td>624,226</td>
<td>2,723</td>
<td>104</td>
</tr>
<tr>
<td>Janssen</td>
<td>184,120</td>
<td>1,406</td>
<td>92</td>
</tr>
<tr>
<td>Unvaccinated</td>
<td>606,411</td>
<td>20,175</td>
<td>3,380</td>
</tr>
<tr>
<td><strong>≥65 years</strong></td>
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<td></td>
</tr>
<tr>
<td>Pfizer-BioNTech</td>
<td>984,464</td>
<td>5,302</td>
<td>972</td>
</tr>
<tr>
<td>Moderna</td>
<td>1,023,748</td>
<td>3,291</td>
<td>545</td>
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<tr>
<td>Janssen</td>
<td>115,439</td>
<td>751</td>
<td>229</td>
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<tr>
<td>Unvaccinated</td>
<td>370,125</td>
<td>10,472</td>
<td>4,430</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>8,834,604</td>
<td>155,092</td>
<td>14,862</td>
</tr>
</tbody>
</table>
Cases: Hazard rates and VE
Weekly hazard rates for Laboratory-confirmed COVID-19 cases by Vaccine Product, Age, and Timing of Vaccination
Simultaneous drop-off in VE against cases for all cohorts
- When Delta increased & mask guidance changed
- Not ~1 month offset, consistent with waning
- Drop-off ceased when Delta reached >90%, followed by revised mask guidance
- Gradient by time-cohort in August, supportive of waning, but lesser magnitude than earlier drop
• Similar patterns observed for persons 50-64 years as for 18-49 years
Hospitalizations: VE
Pfizer-BioNTech, Moderna: >90% hospitalization VE each month, age, and time-cohort, but one (87%)
Janssen: >86% for every month, age, and time-cohort, but one (54%)
• **Pfizer-BioNTech**
  • May to August hospitalization VE declines 5-7%; August VE >86%
  • Greatest declines for January-February cohort. Group enriched for long-term care residents.

• **Moderna**
  • May to August VE declines 2-4%; August VE >93%

• **Janssen**
  • Little time trend. VE range 81-90%
Conclusions

Cases
• Declines in VE observed across product, age, timing-cohort
  • Slowed in August when Delta reached >85%, guidance changed
  • May be more linked to Delta increase, behavioral, or other changes than time-since-vaccination

Hospitalizations
• 18-49, 50-64 years: consistently high VE across age & products
• For ≥65 years
  • Modest declines evident for both Pfizer and Moderna
  • Lowest VE for Janssen, but no decline
Sensitivity analyses, remaining limitations, strengths

Sensitivity analyses: VE estimates re-estimated for scenarios addressing

• Uncertainty in population census
• Restriction of hospitalization to “for COVID-19”
• Other scenarios for denominator uncertainty

Limitations remain

• Unmeasured confounding due to behavioral, medical, exposure, testing differences between groups
• Ongoing work demonstrating potential impact
• Potential for indirect effects

Strengths to consider

• Very large population → finer view of time, analyses with fewer assumptions
• Consistency of temporal patterns across subgroups and sensitivity analyses
• Although early prioritization by age/setting/occupation/comorbidities, broad expansion of eligibility in early months studied
Thank you!

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With much thanks to co-authors

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