Results of COVID-19 Vaccine Effectiveness Studies:
An Ongoing Systematic Review

Forest Plots: Vaccine Effectiveness against Omicron Variant of Concern

Updated July 8, 2024

Prepared by:
International Vaccine Access Center,
Johns Hopkins Bloomberg School of Public Health
and
World Health Organization
and
Coalition for Epidemic Preparedness Innovations

For comments or questions, please contact: Melissa Higdon at mhigdon@jhu.edu.
# TABLE OF CONTENTS

Methods for Inclusion in Forest Plots .................................................................. 3
Abbreviations ....................................................................................................... 4
Forest Plots by Vaccine ..................................................................................... 5
  Ad26.COV2.S (Janssen) .................................................................................. 5
  Ad5.nCoV (Cansino) .................................................................................... 5
  Gam-Covid-Vac (Gamaleya) ......................................................................... 6
  AZD1222 (AstraZeneca) .............................................................................. 6
  BBIBP-CorV (Beijing CNBG) ....................................................................... 7
  Covaxin (Bharat Biotech) .......................................................................... 7
  CoronaVac (Sinovac) .................................................................................. 8
  Monavalent Comirnaty (Pfizer) ................................................................ 9
  Monovalent Spikevax (Moderna) .............................................................. 10
  MVC-COV1901 (Medigen) ....................................................................... 11
Forest Plots by Population of Special Interest ............................................ 12
  Older Adults .............................................................................................. 12
  Children ..................................................................................................... 13
  Healthcare workers ................................................................................. 14
  Immunocompromised ............................................................................... 14
Second Booster Dose ...................................................................................... 15
Duration of Vaccine Effectiveness against Omicron ..................................... 17
Bivalent Vaccines ............................................................................................. 19
Monovalent XBB.1.5 Vaccines ....................................................................... 20
Vaccine Effectiveness against Omicron XBB Subvariant ............................ 22
Vaccine Effectiveness against Omicron BA.2.86/JN.1 Subvariant ............... 23
METHODS FOR INCLUSION IN FOREST PLOTS

Vaccine Effectiveness (VE) estimates included in these plots are from an ongoing systematic review of COVID-19 vaccine effectiveness studies. Due to the predominance of the Omicron variant across the globe, the plots in this document are restricted to studies conducted during a period when the Omicron variant was the dominant circulating variant. The previous version of the plots (posted regularly between November 18, 2021 and June 2, 2022) also showed results for the Delta variant, and an earlier version (prior to November 18, 2021) showed results from all studies, regardless of dominant variant at the time. These earlier versions are available on the VIEW-hub resources page (https://view-hub.org/resources). Complete details on the method of the systematic review as well as a summary table of results can also be found on the VIEW-hub Resources Page:

- “COVID-19 Vaccine Effectiveness and Impact Studies Review Methods”
- “COVID-19 Vaccine Effectiveness Results Summary Table”

The VE estimates included in the plots are a subset of the estimates abstracted from the systematic literature review. A single study can include many VE estimates. In an effort to not overrepresent the amount of evidence that exists for each vaccine, the following criteria are used to determine which VE estimates are displayed in the forest plots located on the VIEW-hub resources page (https://view-hub.org/resources). There are some instances when more than one estimate from a study will be displayed in the same plot (e.g. a study includes VE estimates from two distinct populations). Reference numbers are included for each VE estimate displayed so users can identify when a study is represented more than once within a plot. More information on each reference can be found in the weekly literature review summary table located on VIEW-HUB (https://view-hub.org/resources).

- Complete vaccination is defined as ≥7 days post final dose
- If a study reports results for the same outcome for both combined and individual vaccines, only individual vaccine VE estimates are displayed. This criterion only applies to studies evaluating VE of BNT162b2 (Pfizer) and mRNA-1273 (Moderna) vaccines.
- If a study reports results from 2 different evaluation designs (e.g. test-negative design and cohort design) on the same population, VE estimates from the primary analysis only are displayed.
- If a study reports VE estimates for the same disease outcome for different populations, the general population VE estimate is displayed when available. If a general population estimate is not available, the VE from each population is displayed (except when there are estimates for similar age groups in which case the more stable VE estimate will be displayed).
- If a study reports VE estimates on more than one ‘severe’ disease outcome (e.g. ‘severe disease’, ‘hospitalization’, and ‘ICU admission’), the more inclusive disease outcome including a larger population is displayed. These different types of severe outcomes are labeled as ‘severe disease’ in the plots, however it is important to keep in mind that the definition of severe disease varies and may explain some differences in VE estimates for severe disease outcomes.
- If a study reports VE estimates for different time intervals from the final dose, those from the earlier time intervals are plotted in an effort to remove the effect of possible waning of immunity. Studies that report only VE estimates that include a follow-up time that extends beyond 4 months post final dose are indicated with a ‘+’ following the reference number located in the label on the y-axis; these estimates appear at the bottom of each disease outcome panel for all plots.
ABBREVIATIONS

asymp = asymptomatic
HCW = healthcare workers
HHC = household contacts
LTCF = long-term care facility
pop = population
SNF = skilled nursing facility
PRIMARY SERIES AND FIRST BOOSTER DOSE EFFECTIVENESS AGAINST OMICRON

BY VACCINE

Ad26.CoV2.S (Janssen) Primary Series + Booster Vaccine Effectiveness, Omicron Variant
(ref no) country, population, subvariant (if known)

(444) South Africa, 18 years, BA.4/BA.5
(444) South Africa, 18 years, BA.1/BA.2
(194) Czech Republic, general pop, omicron
(271) South Africa, HCW, omicron
(444) South Africa, 18 years, BA.4/BA.5
(444) South Africa, 18 years, BA.1/BA.2
(219+) USA, general pop, omicron
(272+) USA, general pop, BA.1/BA.2/BA.5
(418+) Colombia, general pop, BA.1
(251) Zambia, inmates 18+ years, omicron
(418) Colombia, general pop, BA.1
(214+) USA, general pop, omicron
(194) Czech Republic, general pop, omicron
(251) Zambia, inmates 18+ years, omicron
(326) USA, general pop, omicron
(350+) USA, general pop, omicron
(312) China, general pop, omicron

Booster Vaccine
- Vaxzevria (AstraZeneca)
- Spikevax (Moderna)
- Comirnaty (Pfizer BioNTech) OR Spikevax (Moderna)

+ Indicates estimates that that include a follow-up time extending beyond 4 months post final dose.
+ Indicates estimates that that include a follow-up time extending beyond 4 months post final dose.
+ Indicates estimates that include a follow-up time extending beyond 4 months post final dose.
+ Indicates estimates that include a follow-up time extending beyond 4 months post final dose.
+ Indicates estimates that include a follow-up time extending beyond 4 months post final dose.
**Spikevax (Moderna) Primary Series + Booster Dose Vaccine Effectiveness, Omicron Variant**

(ref no) country, population, subvariant (if known)

<table>
<thead>
<tr>
<th>Effectiveness</th>
<th>Spikevax primary series</th>
<th>Spikevax primary series + booster</th>
</tr>
</thead>
<tbody>
<tr>
<td>Severe disease</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Symptomatic disease</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Any Infection</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

+ Indicates estimates that include a follow-up time extending beyond 4 months post final dose.
+ Indicates estimates that include a follow-up time extending beyond 4 months post final dose.
BY STUDY POPULATION OF SPECIAL INTEREST

Vaccine Effectiveness Among Older Adults/Skilled Nursing Facility Residents, Omicron Variant

(ref no) country, population, subvariant (if known), prior infection status

Primary series vaccination

Booster vaccination

Death

Severe disease

Symptomatic disease

Any Infection

Effectiveness

Primary Series Vaccine

Booster Vaccine

+ Indicates estimates that that include a follow-up time extending beyond 4 months post final dose.
Vaccine Effectiveness Among Children, Omicron Variant
(ref no) country, population, subvariant (if known)

+ Indicates estimates that include a follow-up time extending beyond 4 months post final dose.
+ Indicates estimates that that include a follow-up time extending beyond 4 months post final dose.
SECOND BOOSTER DOSE ABSOLUTE VACCINE EFFECTIVENESS AGAINST OMICRON

Absolute Vaccine Effectiveness of a Second Booster Dose, Omicron Variant

(booster table ref no) country, population, subvariant (if known)

Primary series and first booster vaccine
- Comirnaty (Pfizer BioNTech)
- Spikevax (Moderna)
- any mRNA
- CoronaVac (Sinovac) primary + Spikevax (Moderna) booster
- Comirnaty (Pfizer BioNTech) primary + any mRNA booster
- CoronaVac (Sinovac) primary + CoronaVac (Sinovac) booster
- CoronaVac (Sinovac) primary + Comirnaty (Pfizer BioNTech) booster
- Any primary vaccine + any mRNA booster
- Vazzevia (AstraZeneca) primary + any mRNA booster
- Vazzevia (AstraZeneca) primary + any mRNA booster
- Vazzevia (AstraZeneca) or any mRNA

Second Booster Dose Vaccine
- Vazzevia (AstraZeneca) or any mRNA
- Comirnaty (Pfizer BioNTech)
- Spikevax (Moderna)
- any mRNA

+ Indicates estimates that that include a follow-up time extending beyond 4 months post final dose.
SECOND BOOSTER DOSE RELATIVE VACCINE EFFECTIVENESS AGAINST OMICRON

(Note: For more information on interpreting relative VE, see the special focus on relative vaccine effectiveness from the WHO June 29th Weekly Epidemiologic Update.)

+ Indicates estimates that that include a follow-up time extending beyond 4 months post final dose.
DURATION OF VACCINE EFFECTIVENESS AGAINSTomicron: PRIMARY SERIES, FIRST BOOSTER DOSE, AND SECOND BOOSTER DOSE (WHERE DATA AVAILABLE)

Dots represent point estimates of VE from each study; dark black horizontal lines represent median VE across all studies in stratum. Vertical panels represent VE for full primary series (grey dots) and VE for homologous or heterologous booster vaccination (other colored dots) following completion of primary series vaccination with vaccine of primary series noted in panel header. Not shown in plot: VE against severe disease at 0.5–<3 month post primary series of Beijing CNBG-BBIBP-CorV (59%). Additional details on the methods for inclusion of the estimates in the plots provided below.
Methods for Duration of Vaccine Effectiveness Figure

- VE studies included in the plot were identified from an ongoing systematic review of COVID-19 vaccine effectiveness studies. All studies were cohort or test-negative designs conducted when Omicron was the predominant circulating variant. Methods for the systematic review and inclusion/exclusion criteria are available on view-hub.org.
- Only studies providing VE estimates of individual vaccines are included in the plot; studies assessing combined VE of more than one vaccine are excluded except for studies of heterologous primary and booster schedules where all participants included in a VE estimate received the same brands of vaccines in the same order.
- Only studies providing VE estimates for discrete time intervals since vaccination or estimates with limited follow-up time (such that the median time point falls clearly in one of the intervals for the plot) are included. Studies that only provide VE estimates over a cumulative period of time covering more than one time interval are excluded because they are difficult to interpret due to the marked waning of VE over time with Omicron.
- Only estimates of absolute vaccine effectiveness (i.e., the comparison group is unvaccinated persons) are included in the plot; estimates of relative vaccine effectiveness (e.g., the comparison group for booster doses is persons having completed the primary series) are excluded as the interpretation of relative vaccine effectiveness is not comparable to absolute vaccine effectiveness.
BIVALENT VACCINE ABSOLUTE VACCINE EFFECTIVENESS AGAINST OMICRON

Absolute Vaccine Effectiveness of Bivalent mRNA Vaccines Received as Most Recent Dose

(booster table ref no) country, population, subvariant (if known)

Booster Dose Vaccine
- Pfizer BioNTech Omicron BA.1 bivalent mRNA
- Moderna Omicron BA.1 bivalent mRNA
- any Omicron BA.4/BA.5 bivalent mRNA
- Pfizer BioNTech Omicron BA.4/BA.5 bivalent mRNA
- Moderna Omicron BA.4/BA.5 bivalent mRNA
- any Omicron BA.1 or BA.4/BA.5 bivalent mRNA

Primary and Previous Booster Vaccines
- Any monovalent mRNA
- Any COVID-19 vaccine
- Any primary series + any monovalent or bivalent mRNA booster

* Indicates estimates that that include a follow-up time extending beyond 4 months post final dose.
MONOVALENT XBB.1.5 RELATIVE VACCINE EFFECTIVENESS AGAINST OMICRON

(Nota: For more information on interpreting relative VE, see the special focus on relative vaccine effectiveness from the WHO June 29th Weekly Epidemiologic Update; “Up-to-Date” refers to XBB.1.5 vaccine being received as any dose, regardless of the number of doses received previously with comparator group including both unvaccinated individuals and individuals previously vaccinated with non-XBB.1.5 vaccines.)

Early (<3 m) Relative or Up-to-Date Vaccine Effectiveness of Omicron XBB.1.5 Vaccines

+ Indicates estimates that include a follow-up time extending beyond 4 months post final dose.
VACCINE EFFECTIVENESS AGAINST OMICRON XBB SUBVARIANT

Absolute Booster Dose Vaccine Effectiveness against Omicron XBB Sublineages

(booster table ref no) country, population, time since last dose)

Evaluating booster
- any BA.4/5 bivalent mRNA (primary or any booster)
- Pfizer BA.4/5 bivalent mRNA (1st-4th)
- Moderna BA.4/5 bivalent mRNA (1st-5th)
- Pfizer XBB.1.5 monovalent mRNA (primary or any booster)

Vaccination history
- any ancestral mRNA
- any ancestral vaccine
- any ancestral vaccine or any BA.4/5 bivalent mRNA

+ Indicates estimates that include a follow-up time extending beyond 4 months post final dose.
Early (<3 months post vaccination) Relative Booster Dose Vaccine Effectiveness against Omicron XBB Sublineages

*(Note: For more information on interpreting relative VE, see the special focus on relative vaccine effectiveness from the WHO June 29th Weekly Epidemiologic Update.)*

(booster table ref no) country, population, time since last dose
Early (<3 months post vaccination) Relative Booster Dose Vaccine Effectiveness against Omicron BA.2.86/JN.1

(Note: For more information on interpreting relative VE, see the special focus on relative vaccine effectiveness from the WHO June 29th Weekly Epidemiologic Update.)

(booster table ref no) country, population, subvariant, time since last dose

<table>
<thead>
<tr>
<th>Country</th>
<th>Age Group</th>
<th>Last Dose</th>
<th>Time Since Last Dose</th>
<th>Evaluation</th>
<th>Disease Severity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Denmark</td>
<td>65-79 years</td>
<td>BA.2.86, 14+</td>
<td>6 months</td>
<td>JN.1, 36</td>
<td>Death</td>
</tr>
<tr>
<td>Denmark</td>
<td>80+ years</td>
<td>BA.2.86, 14+</td>
<td>6 months</td>
<td>JN.1, 36</td>
<td>Severe disease</td>
</tr>
<tr>
<td>Norway</td>
<td>65-79 years</td>
<td>BA.2.86, 14+</td>
<td>6 months</td>
<td>JN.1, 36</td>
<td>Symptomatic disease</td>
</tr>
<tr>
<td>Portugal</td>
<td>65-79 years</td>
<td>BA.2.86, 14+</td>
<td>6 months</td>
<td>JN.1, 36</td>
<td>Any infection</td>
</tr>
<tr>
<td>USA</td>
<td>≥6 months</td>
<td>JN.1, 36</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Belgium</td>
<td>65-79 years</td>
<td>BA.2.86, 14+</td>
<td>6 months</td>
<td>JN.1, 36</td>
<td>Death</td>
</tr>
<tr>
<td>Belgium</td>
<td>80+ years</td>
<td>BA.2.86, 14+</td>
<td>6 months</td>
<td>JN.1, 36</td>
<td>Severe disease</td>
</tr>
<tr>
<td>Denmark</td>
<td>65-79 years</td>
<td>BA.2.86, 14+</td>
<td>6 months</td>
<td>JN.1, 36</td>
<td>Symptomatic disease</td>
</tr>
<tr>
<td>Denmark</td>
<td>80+ years</td>
<td>BA.2.86, 14+</td>
<td>6 months</td>
<td>JN.1, 36</td>
<td>Any infection</td>
</tr>
<tr>
<td>Italy</td>
<td>65-79 years</td>
<td>BA.2.86, 14+</td>
<td>6 months</td>
<td>JN.1, 36</td>
<td>Death</td>
</tr>
<tr>
<td>Italy</td>
<td>80+ years</td>
<td>BA.2.86, 14+</td>
<td>6 months</td>
<td>JN.1, 36</td>
<td>Severe disease</td>
</tr>
<tr>
<td>Netherlands</td>
<td>65-79 years</td>
<td>BA.2.86, 14+</td>
<td>6 months</td>
<td>JN.1, 36</td>
<td>Symptomatic disease</td>
</tr>
<tr>
<td>Netherlands</td>
<td>80+ years</td>
<td>BA.2.86, 14+</td>
<td>6 months</td>
<td>JN.1, 36</td>
<td>Any infection</td>
</tr>
<tr>
<td>Norway</td>
<td>80+ years</td>
<td>BA.2.86, 14+</td>
<td>6 months</td>
<td>JN.1, 36</td>
<td>Death</td>
</tr>
<tr>
<td>Portugal</td>
<td>65-79 years</td>
<td>BA.2.86, 14+</td>
<td>6 months</td>
<td>JN.1, 36</td>
<td>Severe disease</td>
</tr>
<tr>
<td>Portugal</td>
<td>80+ years</td>
<td>BA.2.86, 14+</td>
<td>6 months</td>
<td>JN.1, 36</td>
<td>Symptomatic disease</td>
</tr>
<tr>
<td>UK</td>
<td>≥65 years</td>
<td>JN.1, 2-4 weeks</td>
<td>6 months</td>
<td>JN.1, 36</td>
<td>Death</td>
</tr>
<tr>
<td>USA</td>
<td>general pop</td>
<td>JN.1, 14+ (median 57)</td>
<td>6 months</td>
<td>JN.1, 36</td>
<td>Severe disease</td>
</tr>
<tr>
<td>USA</td>
<td>general pop</td>
<td>JN.1, 14-59</td>
<td></td>
<td></td>
<td>Symptomatic disease</td>
</tr>
<tr>
<td>USA</td>
<td>≥6 months</td>
<td>JN.1, 36</td>
<td></td>
<td></td>
<td>Any infection</td>
</tr>
<tr>
<td>Canada</td>
<td>12+ years</td>
<td>JN.1/HV.1, 14+ (median 35)</td>
<td>6 months</td>
<td>JN.1, 36</td>
<td>Death</td>
</tr>
<tr>
<td>USA</td>
<td>general pop</td>
<td>JN.1, 14-59</td>
<td></td>
<td></td>
<td>Severe disease</td>
</tr>
<tr>
<td>USA</td>
<td>≥18 years</td>
<td>JN.1, ≥60</td>
<td></td>
<td></td>
<td>Symptomatic disease</td>
</tr>
<tr>
<td>USA</td>
<td>≥6 months</td>
<td>JN.1, 36</td>
<td></td>
<td></td>
<td>Any infection</td>
</tr>
</tbody>
</table>