Literature screening report

COVID-19 vaccines in the WHO’s Emergency Use Listing (EUL) Report (6)

Report submission date: 15.10.2021

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Abstract

This report focuses on the World Health Organization’s (WHO) Emergency Use Listing (EUL) of authorized vaccines as of 15 October 2021. Currently six vaccines are authorised for emergency use: BNT162b2/COMIRNATY (Pfizer-BioNTech, USA), Spikevax/Moderna COVID-19 Vaccine/ mRNA-1273 (Moderna, USA), Vaxzevria/ChAdOx1 nCoV-19/AZD1222/Covishield (AstraZeneca/Oxford, UK, India), Janssen Covid-19 vaccine/Johnson & Johnson (Janssen, USA), Sinopharm/BBIBP-CorV (China), and Sinovac/CoronaVac (China). This report provides a condensed summary concerning vaccine efficacy, safety, protection against variants, and further important information for each vaccine, in the form of a synoptic table. The information and data in this synoptic table was extracted from phase III clinical trials and from observational studies. This report particularly focuses on the latest data on vaccine effectiveness, duration of protection and waning immunity, booster doses, efficacy and safety of NVX-CoV2372, and myocarditis.
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Preamble

A large number of scientific publications become available on a daily basis, reflecting the rapid development of knowledge and progress of science on COVID-19 related issues. Leading authorities should base decisions or policies on this knowledge; hence they need to master the actual state of this knowledge. Due to the large number of publications shared daily, decision makers heavily depend on accurate summaries of these publications, in the different public health domains. Therefore, the authors of this report were mandated by the Swiss School of Public Health plus (SSPH+), upon request of the Federal Office of Public Health (FOPH), to inform the FOPH on recent findings from the literature.

Background

According to the current global data on vaccinations, 48% of the world populations, of which only 2.5% of people in low-income countries, have received at least one dose of a marketed COVID-19 vaccine as of 15 October 2021\(^1\). Currently, six vaccines [namely, Pfizer-BioNTech, USA), Spikevax/Moderna COVID-19 Vaccine/ mRNA-1273 (Moderna, USA), Vaxzevria/ChAdOx1 nCoV-19/AZD1222/Covishield (AstraZeneca/Oxford, UK, India), Janssen Covid-19 vaccine/Johnson & Johnson (Janssen, USA), Sinopharm/BIBP- CorV (China), and Sinovac/CoronaVac (China)] were assessed and granted an authorization by WHO as of 29 September 2021.

Articles regarding the latest data on vaccine effectiveness, vaccine effectiveness against hospitalization, booster doses protection across different age groups, new data on the duration of protection and waning immunity, the efficacy and safety of NVX-CoV2373 in adults in the United States and Mexico, and data on myocarditis were prioritized during the literature search and are the latest additions to the table. Data from clinical trials and observational studies for the six EUL-accepted vaccines and the vaccine candidate Novavax regarding these highlighted topics were summarized and can be found in the synoptic table below.

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\(^1\) [https://ourworldindata.org/covid-vaccinations](https://ourworldindata.org/covid-vaccinations) (accessed on 15.10.2021).

Methodology

We screened the data for the EUL-accepted vaccines and the vaccine candidate Novavax as of 15 October 2021 from PubMed, Embase, medRxiv, bioRxiv, Cochrane, and clinical trials databases such as ClinicalTrials and WHO Trial Registry. The methods used were reported previously and can be found in prior reports2.

Results

As phase III COVID-19 vaccine trials confirmed vaccine efficacy and safety for all six WHO EUL authorized vaccines, and as the share of fully vaccinated people begin to increase across countries, it is important to assess vaccine effectiveness in real-world conditions, especially in relation to evolving variants of concern (VOC).

Latest Data on Vaccine Effectiveness

There have not been substantial updates on vaccine effectiveness studies since the previous synoptic table’s (30 September 2021) publication. Recently published studies continue to report waning mRNA vaccine protection over time3 (i.e. BNT162b2: VE declined from 93.6% in May to 65.8% in July4; mRNA-1273: VE declined from to 94.1% 14-60 days after vaccination to 80.0% 151-180 days after vaccination5) and


3 mRNA vaccine effectiveness against asymptomatic SARS-CoV-2 infections over a seven-month period. Infection Control & Hospital Epidemiology. https://www.cambridge.org/core/journals/infection-control-and-hospital-epidemiology/article/mrna-vaccine-effectiveness-against-asymptomatic-sarscov2-infection-over-a-sevenmonth-period/0B67BE19509C88E93B73C1F773E52FC97

4 COVID-19 vaccine effectiveness by product and timing in New York State. medRxiv. https://www.medrxiv.org/content/10.1101/2021.10.08.21264595v1.full-text

against the Delta variant\textsuperscript{6,7}. See summary paragraph and the synoptic table below for more in-depth information on waning vaccine immunity\textsuperscript{8,9,10,11,12}. While both mRNA vaccines demonstrate reduced effectiveness levels, Moderna’s mRNA-1273 vaccine has continued to demonstrate higher effectiveness levels\textsuperscript{13} and reduced number of breakthrough infections\textsuperscript{14} than Pfizer-BioNTech’s BNT162b2 vaccine. However, one Belgian study demonstrated that the BNT162b2 vaccine had higher vaccine effectiveness against onwards transmission (62\%; 95\% CI, 57-67) than the mRNA-1273 vaccine (52\%; 95\% CI, 33-69)\textsuperscript{15}.

A pre-print reported the mRNA-1273 vaccine demonstrated higher effectiveness levels against the Mu (B.1.621) variant of concern (90.4\% (95\% CI, 73.9-96.5) than the Delta variant (86.7\% (95\% CI, 84.3-88.7)).\textsuperscript{16}

The latest vaccine effectiveness data on AstraZeneca’s ChAdOx1 nCoV-19/Vaxzevria (VE of 53\% (95\% CI, 12-84) in June)\textsuperscript{17} or Ad26.COV2.S Janssen vaccines (VE

\begin{itemize}
\item \textsuperscript{6} Transmission event of SARS-CoV-2 delta variant reveals multiple vaccine breakthrough infections. \textit{BMC Medicine}. https://bmcmedicine.biomedcentral.com/articles/10.1186/s12916-021-02103-4
\item \textsuperscript{7} The impact of SARS-CoV-2 vaccination on Alpha & Delta variant transmission. medRxiv. https://www.medrxiv.org/content/10.1101/2021.09.28.21264260v1
\item \textsuperscript{9} Effectiveness of mRNA-1273 against Delta, Mu, and other emerging variants. medRxiv. https://www.medrxiv.org/content/10.1101/2021.09.29.21264199v1
\item \textsuperscript{10} Effectiveness of mRNA BNT162b2 COVID-19 vaccine up to 6 months in a large integrated health system in the USA: A retrospective cohort study. \textit{The Lancet}. https://www.thelancet.com/journals/lancet/article/PIIS0140-6736(21)02183-8/fulltext
\item \textsuperscript{11} mRNA vaccine effectiveness against asymptomatic SARS-CoV-2 infections over a seven-month period. \textit{Infection Control & Hospital Epidemiology}. https://www.cambridge.org/core/journals/infection-control-and-hospital-epidemiology/article/mrna-vaccine-effectiveness-against-asymptomatic-sarscov2-infection-over-a-sevenmonth-period/0B67BE1950C88E93B73C15F75E2FC497
\item \textsuperscript{12} COVID-19 vaccine effectiveness by product and timing in New York State. medRxiv. https://www.medrxiv.org/content/10.1101/2021.10.08.21264595v1
\item \textsuperscript{13} Effectiveness of mRNA BNT162b2 COVID-19 vaccine up to 6 months in a large integrated health system in the USA: A retrospective cohort study. \textit{The Lancet}. https://www.thelancet.com/journals/lancet/article/PIIS0140-6736(21)02183-8/fulltext
\item \textsuperscript{14} A retrospective analysis of COVID-19 mRNA vaccine breakthrough infections – Risk factors and vaccine effectiveness. medRxiv. https://www.medrxiv.org/content/10.1101/2021.10.05.21264583v1
\item \textsuperscript{16} Effectiveness of mRNA-1273 against Delta, Mu, and other emerging variants. medRxiv. https://www.medrxiv.org/content/10.1101/2021.09.29.21264199v1
\item \textsuperscript{17} Vaccine effectiveness against infection and onwards transmission of COVID-19: Analysis of Belgian contact tracing data, January–June 2021. \textit{Vaccine}. https://www.sciencedirect.com/science/article/pii/S0264410X21011087?via%3Dihub
\end{itemize}
decreased from 89.4% [1 May] to 51.7% [10 July])\(^{18}\) corroborate previously reported data on waning vaccine protection.

Effectiveness data on Sinopharm’s BBIBP-CorV and Sinovac’s CoronaVac remains scarce. A recent study highlighted that the BBIBP-CorV vaccine induced high levels of IgG anti-spike antibodies (GMC: 377.0 IU/ml; 95% CI, 324.3-438.3) in SARS-CoV-2 naïve individuals, however antibody (GMC) concentrations reduced to 125.4 IU/ml (95% CI, 88.2-178.4) three months after receiving the second dose (most individuals received their second dose 54 days after their first dose and not the suggested 21 days apart)\(^{19}\). The authors did not specify which SARS-CoV-2 lineage was utilised.

Another neutralizing antibody titre (NAb) quantification study demonstrated that the CoronaVac vaccine could not effectively neutralise variants of concern, particularly the delta variant, advocating for the administration of a third CoronaVac or heterologous vaccine dose to maintain long-term immunity against SARS-CoV-2\(^{20}\). Although both inactivated virus studies only analysed neutralization level data and not vaccine effectiveness, neutralization levels against SARS-CoV-2 assays have been shown to be highly predictive of immune protection against symptomatic SARS-CoV-2 infection\(^{21}\).

Despite reports of reduced effectiveness against SARS-CoV-2 infection, vaccine effectiveness remains high against severe infection, hospitalization, and death for all vaccines. Further vaccine effectiveness data can be found in the synoptic table below.

**Duration of Protection and Waning Immunity**

The waning immunity of vaccine protection against SARS-CoV-2 infection and COVID-19 disease remains a concern, especially when trying to control and contain...
the ongoing COVID-19 pandemic. Two longitudinal studies examining the waning immunity of the BNT162b2 vaccine provide insightful data on the longitudinal dynamics of the immune response to the vaccine. The first study was conducted over a period of 6 months in which vaccinated health care workers were tested monthly for the presence of anti-spike IgG and neutralizing antibodies\(^ {22}\). Based on the results, six months after receipt of the second dose of the BNT162b2 vaccine, humoral response substantially decreased, especially among men, among persons 65 years of age or older, and among persons with immunosuppression. Similar results were reported in the second study in which a test-negative, case-control study design was used to estimate the vaccine effectiveness against any SARS-CoV-2 infection and Covid-19 disease in Qatar\(^ {23}\). The results demonstrated that the BNT162b2-induced protection against SARS-CoV-2 infection appeared to wane rapidly following its peak after second dose, but protection against hospitalization and death persisted at robust level for 6 months after the second dose.

Since the roll-out of COVID-19 vaccines such as mRNA (BNT162b2, mRNA-1273), adenoviral virus (ChAdOx1 nCoV-19), and inactivated virus vaccines (CoronaVac, Sinopharm), concerns regarding the duration of protection and waning immunity have emerged, especially when aiming to compare vaccine platforms. A study seeking to address the duration of protection and waning immunity of BNT162b2, ChAdOx1 nCoV-19, and CoronaVac in younger and older age groups, comparatively analysed the spike RBD IgG antibody titers in those three vaccine platforms\(^ {24}\). When comparing the three different vaccine types, the BNT162b2 induced the highest overall seropositivity and anti-spike RBD IgG antibody levels in both younger and older age groups, followed by ChAdOx1, and then by CoronaVac vaccine. In regards of the rate


\(^{24}\) Longitudinal comparison of SARS-CoV-2 anti-Spike RBD IgG antibody response after CoronaVac, BNT162b2, ChAdOx1 nCoV-19 vaccines and evaluation of a single booster dose of BNT162b2 or CoronaVac after a primary CoronaVac regimen. SSRN – Preprint. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3929973
of declining antibodies, the CoronaVac group had the fastest decline followed by ChAdOx1, and then by BNT162b2. Another study aiming to understand the duration of protection and waning immunity, analysed the humoral response to the BBIBP-CorV (Sinopharm) vaccine over time in healthcare workers with or without exposure to SARS-CoV-2. Based on those results, three months after the second dose individuals with SARS-CoV-2 exposure prior to vaccination and individuals without prior exposure showed a decline in antibody levels, being more abrupt in unexposed subjects. Overall, the results showed a trend towards lower antibody concentrations over time following BBIBP-CorV vaccination.

Protection of Booster Doses across age groups

Earlier this month of October, the European Medicines Agency (EMA) released their recommendations on extra doses and boosters. Regarding the administration of extra doses, the EMA concluded that an extra dose of the COVID-19 vaccines Comirnaty (BioNTech/Pfizer) and Spikevax (Moderna) may be given to people with severely weakened immune systems, at least 28 days after their second dose. This conclusion was based on the multiple studies demonstrating the benefits of a third dose in immunocompromised individuals. In terms of their recommendation for booster doses in populations with normal immune systems, the EMA concluded that booster doses of the Comirnaty vaccine may be considered at least 6 months after the second dose for people aged 18 years and older. Their decision only applies for the BioNTech/Pfizer COVID-19 vaccine, as the EMA is currently evaluating data to support a booster for Spikevax. Many of the decision regarding the administration of

25 Humoral response to the BBIBP-CorV vaccine over time in healthcare workers with or without exposure to SARS-CoV-2. medRxiv. https://www.medrxiv.org/content/10.1101/2021.10.02.21264432v1
booster doses rely on data from Israel where boosters started being offered to the whole population early on. One of the first studies to provide data on the protection of BNT162b2 against COVID-19 infections and severe illnesses was their study on the protection of the BNT162b2 vaccine booster against COVID-19 in 60-years-old and over\textsuperscript{29}. The study demonstrated that a booster dose lowered the rate of confirmed infection and severe illness in older populations\textsuperscript{21}, and their newest preprint on the protection of BNT162b2 vaccine booster against COVID-19 across age groups shows that the rate of confirmed infection and severe illness were substantially lowered among those who received a booster dose across all age groups\textsuperscript{30}. Overall, the newest results on the protection of BNT162b2 vaccine booster show that confirmed infection rates were approximately 10-fold lower in the booster group compared to the non-booster group (ranging from 8.8-17.6 for ≥12 days post booster administration and 4.8-11.2 for 3-7 days post booster administration across the five different age groups), while the severe illness rates were 18.7 fold (95% CI, 15.7-22.4) ≥12 days post booster administration and 6.5-fold (95% CI, 5.1-8.3) lower 3-7 days post booster administration for ages 60 and over, and 22-fold (95% CI, 10.3-47.0) ≥12 days post booster administration and 3.2-fold (95% CI, 1.1-9.6) lower 3-7 days post booster administration for ages 40-60\textsuperscript{10}. In terms of COVID-19 associated death rates, for ages 60 and over, the rates were 14.7-fold (95% CI, 9.4-23.1) ≥12 days post booster administration and 4.8-fold (95% CI, 2.8-8.2) lower 3-7 days post booster administration\textsuperscript{10}.

**New Data on Efficacy and Safety of Novavax Vaccine**

The Novavax COVID-19 vaccine candidate is an adjuvant, recombinant S protein nanoparticle vaccine that has previously demonstrated clinical efficacy for prevention of COVID-19 in phase 2b/3 trials in the United Kingdom and South Africa. New results


from a phase 3, randomized, observer-blinded, placebo-controlled trial performed in the United States and Mexico evaluated the efficacy and safety of NVX-CoV2373 in adults over 18-years of age\textsuperscript{31}. Based on the results, a vaccine efficacy of \textbf{90.4}\% \:(95\% CI: 82.9-94.6) and a vaccine efficacy against any variant of concern/interest (i.e., Alpha, Delta, Kappa) of \textbf{92.6}\% \:(95\% CI: 83.6-96.7) were reported. In terms of reactogenicity, most reported side effects or adverse events were mild-to-moderate and transient and mainly occurring in the NVX-CoV-2373 recipients and after the second dose. Overall, the Novavax COVID-19 vaccine candidate was well tolerated and demonstrated a high overall VE for prevention of COVID-19 where the most sequenced viral genomes were classified as variants of concern or interest.

Further (biweekly) updated data on the six WHO EUL vaccines and the vaccine candidate Novavax are synthesized in the synoptic table and new data has been highlighted in yellow.

\textsuperscript{31} Efficacy and Safety of NVX-CoV2373 in the United States and Mexico. medRxiv. https://www.medrxiv.org/content/10.1101/2021.10.05.21264567v1
Synoptic Table

Synoptic table about SARS-CoV-2 vaccines accepted in the WHO’s Emergency Use Listing and Novavax Vaccine (as of 15 October 2021)

<table>
<thead>
<tr>
<th>Platform</th>
<th>mRNA-based vaccine</th>
<th>mRNA-based vaccine</th>
<th>Non-replicating vector-based vaccine</th>
<th>Non-replicating vector-based vaccine</th>
<th>Inactivated virus (Vero cell)</th>
<th>Inactivated virus (Vero cell)</th>
<th>Recombinant protein (nanoparticle) vaccine with Matrix-M adjuvant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dose and frequency</td>
<td>2 doses, 21 days apart</td>
<td>2 doses, 28 days apart</td>
<td>2 doses, 4-12 weeks apart</td>
<td>1 dose, once</td>
<td>2 doses, 21 days apart</td>
<td>2 doses, 14 days apart</td>
<td>2 doses, 21 days apart</td>
</tr>
</tbody>
</table>

BNT162b2/COMIRNATY (Pfizer-BioNTech, USA)
Spikevax/Moderna COVID-19 Vaccine/mRNA-1273 (Moderna, USA)
Vaxzevria/ChAdOx1 nCoV-19/AZD1222/Covishield (AstraZeneca/Oxford, UK, India)
Janssen COVID-19 vaccine/Johnson & Johnson (Janssen, USA)
Sinopharm/BBIBP-CorV, China
Sinovac CoronaVac, China
Novavax/NVX-CoV2373

AWAITING APPROVAL FROM WHO EUL
<table>
<thead>
<tr>
<th>Target population</th>
<th>12 years old and over</th>
<th>12 years old and over</th>
<th>18 years old and over</th>
<th>18 years old and over</th>
<th>18 years old and over</th>
<th>18 years old and over</th>
<th>18 years old and over</th>
</tr>
</thead>
<tbody>
<tr>
<td>Storage conditions</td>
<td>2°C to 8 °C (for 1 month)</td>
<td>2°C to 8 °C (for 1 month)</td>
<td>2°C until 8 °C</td>
<td>2°C to 8 °C (for 3 months)</td>
<td>2°C until 8 °C</td>
<td>2°C until 8 °C</td>
<td>2°C to 8 °C</td>
</tr>
<tr>
<td>Approving authorities</td>
<td>FDA (11.12.20); EMA (21.12.20); WHO EUL (31.12.20); and list of countries (including Switzerland – approved on 20.12.20)</td>
<td>FDA (18.12.20); EMA (06.01.21); WHO EUL (30.04.21); and list of 51 countries (including Switzerland – approved 12.01.21)</td>
<td>FDA (awaiting on approval); EMA (29.01.21); WHO EUL (15.02.21); and list of 121 countries (Switzerland awaiting on approval)</td>
<td>FDA (27.02.21); EMA (11.03.21), WHO EUL (12.03.21), and list of 59 countries (including Switzerland – approved 22.03.21)</td>
<td>WHO EUL (07.05.21); and list of 55 countries (e.g., Argentina, Bahrain, Brazil, China, Indonesia, United Arab Emirates, Zimbabwe)</td>
<td>Waiting on approval (Not-yet-approved by countries or WHO for emergency use)</td>
<td></td>
</tr>
<tr>
<td>Booster shot approving authorities</td>
<td>EMA approves booster for those aged 18 and above, 6 months after the 2nd dose</td>
<td>EMA authorises booster dose for immunocompromised individuals</td>
<td>FDA approves a third booster dose</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>


FDA approves booster for those ages 16 and above, 6 months after the 2nd dose

<table>
<thead>
<tr>
<th>Effectiveness single dose</th>
<th>General population</th>
<th>General population</th>
<th>General population</th>
<th>Partial protection¹⁴, x</th>
<th>15.5% for preventing COVID-19; 37.4% for preventing hospitalization; 44.7% for preventing admission to the ICU; and 45.7% for preventing of COVID-19 related death¹⁵</th>
<th>Ongoing studies in South Africa¹⁷ and United Kingdom¹⁸</th>
</tr>
</thead>
<tbody>
<tr>
<td>General population</td>
<td>Against infection: 70%². 77.6% (95% CI, 70.9-82.7)³ 36.8% (95% CI, 33.2-40.2) [3 weeks after first dose]¹</td>
<td>General population: Symptomatic disease: 60% (95% CI, 57-64; &gt;2 weeks after dose)⁵, vi</td>
<td>General population: Asymptomatic or symptomatic disease: 64%; Symptomatic disease: 67%⁸.</td>
<td>50.6% (95% CI, 14.0-74.0) in preventing SARS-CoV-2 infection (&lt;2 weeks after dose); 76.7% (95% CI, 30.3-95.3) in preventing SARS-CoV-2 infection (&gt;2 weeks after dose)⁸.</td>
<td>79% (95% CI, 77-80) (when corrected for Hospitalization risk reduced by 35-45%⁶.</td>
<td></td>
</tr>
<tr>
<td>Individuals &gt; 70:</td>
<td>Symptomatic disease: 88.9% (95% CI, 78.7-94.2)³</td>
<td>Individuals &gt; 70: Symptomatic disease: 64% (95% CI, 46-78;</td>
<td>50.6% (95% CI, 14.0-74.0) in preventing SARS-CoV-2 infection (&lt;2 weeks after dose); 76.7% (95% CI, 30.3-95.3) in preventing SARS-CoV-2 infection (&gt;2 weeks after dose)⁸.</td>
<td>5.6% (95% CI, 17.6-19.6) against SARS-CoV-2</td>
<td>15.5% for preventing COVID-19; 37.4% for preventing hospitalization; 44.7% for preventing admission to the ICU; and 45.7% for preventing of COVID-19 related death¹⁵</td>
<td>Ongoing studies in South Africa¹⁷ and United Kingdom¹⁸</td>
</tr>
<tr>
<td>Symptomatic disease: 58%⁶.</td>
<td></td>
<td></td>
<td></td>
<td>15.5% for preventing COVID-19; 37.4% for preventing hospitalization; 44.7% for preventing admission to the ICU; and 45.7% for preventing of COVID-19 related death¹⁵</td>
<td>Ongoing studies in South Africa¹⁷ and United Kingdom¹⁸</td>
<td></td>
</tr>
</tbody>
</table>

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⁵ mRNA-aggregated data (results do not disaggregate between BNT162b2 and mRNA-1273).
⁶ Study did not report numerical data on vaccine effectiveness. Further studies are required to validate results.
<table>
<thead>
<tr>
<th>Hospitalization risk reduced by 35-45%&lt;sup&gt;5&lt;/sup&gt;.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Risk of death reduced by 54%&lt;sup&gt;5&lt;/sup&gt;.</td>
</tr>
<tr>
<td><strong>Individuals ≥ 50:</strong></td>
</tr>
<tr>
<td>≥14 days after first dose: 54% (95% CI, 47-61) effectiveness against hospitalization [1 January-22 June]&lt;sup&gt;6&lt;/sup&gt;.</td>
</tr>
<tr>
<td>≥2 weeks after dose)&lt;sup&gt;x&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

**Individuals ≥ 50:**

- Under-recording, VE was estimated to be 69% (95% CI, 67-71)<sup>10</sup>.
- 81% (95% CI, 79-84) for preventing hospitalization when corrected for under-recording, VE was estimated to be 73% (95% CI, 69-76)<sup>10</sup>.
- 75% (95% CI, 65-82) against severe critical COVID-19<sup>11</sup>.
- 71% (95% CI, 56-81) [11 March – 15 August]<sup>12</sup>.
- 61% (95% CI, 29-84) [January-June]<sup>13</sup>.

**Individuals ≥ 50:**

- 73% (95% CI, 69-76) against hospitalization, 28.1% (95% CI, 26.3-29.9) against hospitalization, 28.5% (95% CI, 25.4-31.4) against ICU admission, and 29.4% (95% CI, 26.7-31.9) against death [January-April]<sup>16</sup>.

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<sup>vi</sup> mRNA-aggregated data (results do not disaggregate between BNT162b2 and mRNA-1273).

<sup>vii</sup> mRNA-aggregated data (results do not disaggregate between BNT162b2 and mRNA-1273).

<sup>ix</sup> mRNA-aggregated data (results do not disaggregate between BNT162b2 and mRNA-1273).
<table>
<thead>
<tr>
<th>Effectiveness of two doses</th>
<th>SARS-CoV-2 infection: 85% (^2)</th>
<th>SARS-CoV-2 infection: 100% (^7)</th>
<th>68% (95% CI, 50-79) (^6).</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>94.6% (^{19})</td>
<td>86% (95% CI, 81-90.6) [January-July] (^21).</td>
<td>Not Applicable (one dose schedule)</td>
</tr>
<tr>
<td></td>
<td>94.5% (^{20})</td>
<td>85% (95% CI, 80-90) [January-June] (^3)</td>
<td>SARS-CoV-2 infection: 85%; 53% (95% CI, 12-84) [January-June] (^13)</td>
</tr>
<tr>
<td></td>
<td>76% (95% CI, 69-81) [January-July] (^21).</td>
<td>96.3% (95% CI, 91.3-98.4) [December-May] (^3)</td>
<td>Symptomatic disease: 90% (^8).</td>
</tr>
<tr>
<td></td>
<td>88.8% (95% CI, 84.6-91.8) [December-May] (^3)</td>
<td>85% (95% CI, 80-90) [January-June] (^3)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>74% (95% CI, 72-76) [January-June] (^13)</td>
<td>Symptomatic disease: 91% (95% CI, 89-93; &gt;2 weeks after dose) (^3). (^{11})</td>
<td></td>
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<tr>
<td></td>
<td>77.5% (95% CI, 76.4-78.6) [first month after second dose] (^4)</td>
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</tbody>
</table>

\(^{11}\) Results do not disaggregate between BNT162b2 and mRNA-1273.

\(^{16}\) Study did not report numerical data on vaccine effectiveness. Further studies are required to validate results.

<table>
<thead>
<tr>
<th>Asymptomatic SARS-CoV-2 infection:</th>
<th>Asymptomatic SARS-CoV-2 infection:</th>
</tr>
</thead>
<tbody>
<tr>
<td>90.6% (95% CI, 70.3-75.5)</td>
<td>90.6% (95% CI, 71-78)</td>
</tr>
<tr>
<td>73.1% (95% CI, 70.3-75.5)</td>
<td>[January-August]^{23}</td>
</tr>
<tr>
<td>Hospitalization: 85% (95% CI, 73-93) [January-July]^{21}.</td>
<td>Hospitalization: 91.6% (95% CI, 81-97) [January-July]^{21}.</td>
</tr>
<tr>
<td>88% (95% CI, 85-91) [11 March – 15 August]^{12}.</td>
<td>93% (95% CI, 91-95) [11 March – 15 August]^{12}.</td>
</tr>
<tr>
<td>89% (95% CI, 87-91) for individuals ( \geq 50 ) years [1 January-22 June]^{6}.</td>
<td>89% (95% CI, 87-91) for individuals ( \geq 50 ) years [1 January-22 June]^{6}.</td>
</tr>
</tbody>
</table>

**EFFECTIVENESS AGAINST VARIANTS**^{18}

\(^{xi}\) Results do not disaggregate between BNT162b2 and mRNA-1273

\(^{xii}\) mRNA-aggregated data (results do not disaggregate between BNT162b2 and mRNA-1273).

\(^{xiv}\) Results do not disaggregate between BNT162b2 and mRNA-1273

\(^{xv}\) mRNA-aggregated data (results do not disaggregate between BNT162b2 and mRNA-1273).

\(^{xvii}\) Effectiveness data against the latest variant of interest (Mu) will be included in upcoming reports based on data availability.
### Alpha (B.1.1.7)

**Single dose:**
- 48.7% (95% CI, 45.5 to 51.7)\(^{24}\)
- 66% (95% CI, 64-68)\(^{25}\)
- 54.5% (95 CI, 50.4-58.3)\(^{26}\)

**Two doses:**
- 93.7% (95% CI, 91.6 to 95.3)\(^{24}\)
- 92% (95% CI, 90-93)\(^{27}\)
- 89% (95% CI, 86-91)\(^{25}\)
- 76% (95% CI, 68-84)\(^{28}\)
- 84.4% (95 CI, 81.8-86.5)\(^{26}\)

**Single dose:**
- 88.1% (95% CI, 83.7 to 91.5)\(^{29}\)
- 83% (95% CI, 80-86)\(^{29}\)

**Two doses:**
- 100% (95% CI, 91.8 to 100)\(^{29}\)
- 92% (95% CI, 86-96)\(^{25}\)
- 98.4% (95% CI, 96.9-99.1)\(^{29}\)

**Single dose:**
- 48.7% (95% CI, 45.5 to 51.7)\(^{24}\)
- 64% (95% CI, 60-68)\(^{25}\)

**Two doses:**
- 74.5% (95% CI, 68.4 to 79.4)\(^{24}\)
- 73% (95% CI, 66-78)\(^{27}\)
- 79% (95% CI, 56-90)\(^{28}\)

**Neutralization capacity was decreased by factor 5.27**\(^{31}\).

### Beta (1.351)

**Single dose:**
- 60% (95% CI, 52-67)\(^{25}\)

**Two doses:**
- 84% (95% CI, 69-92)\(^{25}\)

**Single dose:**
- 61.3% (95% CI, 56.5 to 65.5)\(^{25}\)
- 77% (95% CI, 69-92)\(^{25}\)

**Two doses:**
- 96.4% (95% CI, 91.9 to 98.7)\(^{25}\)

**Single dose:**
- 48% (95% CI, 28-63)\(^{25}\)

**Two doses:**
- Equally effective (~76%) in neutralizing D614G, B.1.1.7 and B.1.429 as the wild-type strain.

### Literature screening report: COVID-19 vaccines in the WHO’s Emergency Use Listing (EUL) Report (6) - Sabina Rodriguez Velásquez, Gabriela Guizzo Dri

Ongoing studies in South Africa\(^{17}\) and United Kingdom\(^{18}\)

No published data

Neutralization capacity was decreased by factor 5.27\(^{31}\).

No available data
### Literature screening report: COVID-19 vaccines in the WHO's Emergency Use Listing (EUL) Report (6)

**Sabina Rodriguez Velásquez, Gabriela Guizzo Dri**

#### Gamma (P.1)

<table>
<thead>
<tr>
<th></th>
<th>Neutralization activity reduced by 3.3-fold$^{32}$</th>
<th>-</th>
<th>-</th>
<th>-</th>
<th>No published data</th>
</tr>
</thead>
</table>

#### Delta (1.617.2)

<table>
<thead>
<tr>
<th>Vaccine</th>
<th>Single dose</th>
<th>Two doses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single dose:</td>
<td>72% effective against symptomatic SARS-CoV-2 infection$^{39}$</td>
<td>67% (95% CI, 61.3 to 71.8)$^{24}$</td>
</tr>
<tr>
<td>&gt;14 days after second dose:</td>
<td>76% (95% CI, 58-87)$^{21}$</td>
<td>60% (95% CI, 53-66)$^{27}$</td>
</tr>
<tr>
<td>Two doses:</td>
<td>67.0% (95% CI, 61.3 to 71.8)$^{24}$</td>
<td>50.6% (95% CI, 45.0-55.7) [among 78% (95% CI, 73-82) against SARS-CoV-2 infection$^{10}$]</td>
</tr>
<tr>
<td>Individuals ≥50:</td>
<td>83% (95% CI, 81-85)$^{10}$</td>
<td>66.7% (95% CI, 45-49.6) [2-9 weeks after second dose]$^{36}$</td>
</tr>
<tr>
<td></td>
<td></td>
<td>47.3% (95% CI, 66.3-67.0) [≥20 weeks after second dose]$^{36}$</td>
</tr>
</tbody>
</table>

- **Single dose: 30.7% (95% CI, 25.2 to 35.7)$^{24}$, 57% (95% CI, 50-63)$^{38}$, 22.5% (95% CI, 17.0-27.4)$^{26}$
- **Two doses:** 88.0% (95% CI, 85.3 to 90.1)$^{24}$, 80% (95% CI, 77-83)$^{38}$, 79% (95% CI, 75-82)$^{27}$, 80% (95% CI, 77-83)$^{28}$

**Demonstrated 42% vaccine effectiveness in a setting with high P.1 transmission, in individuals aged 70 and above$^{33}$.

- **50.2% against P.1 (>14 days after 2nd dose)$^{24}$.

Neutralization was decreased by factor 3.92$^{31}$.

- **No available data**
<table>
<thead>
<tr>
<th>Mu (B.1.621)</th>
<th>No available data</th>
<th>Two doses: 90.4% (95% CI, 73.9-96.6)^39 (demonstrated similar protective measures as against the Alpha variant)</th>
<th>No available data</th>
<th>No available data</th>
<th>No available data</th>
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<th>No available data</th>
<th>No available data</th>
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</thead>
</table>
|              | 40.5% (95% CI, 8.7-61.2)^35, 42% (95% CI, 13-62)^21, 89.8% (95% CI, 89.6-90.0) [2-9 weeks after second dose]^36, 69.7% (95% CI, 68.7-70.5) [≥20 weeks after second dose]^36, 64.6% (95 CI, 60.6-68.2)^26, 52.4% (95% CI, 48.0-56.4) [among nursing home residents]^37, 53% (95% CI, 39-65) [4 months after second dose]^38 | weeks after second dose: 86.7% (95% CI, 84.3-88.7)^39 | 10-14 weeks after second dose: 90.3% (95% CI, 67.2-97.1)^38 | Odds ratio of 5.45 (95% CI, 1.39-21.4) to become infected with B.1.167.2 compared to non-B.1.167.2^40 | 36.69% (95% CI, 35.42-37.4%)

Odds ratio of 5.45 (95% CI, 1.39-21.4) to become infected with B.1.167.2 compared to non-B.1.167.2.
### EFFECTIVENESS AGAINST HOSPITALIZATION

<table>
<thead>
<tr>
<th>Vaccine</th>
<th>Single dose:</th>
<th>Two doses:</th>
<th>Beta 67% effective at preventing hospitalizations</th>
<th>Delta 91.4% (95% CI, 82.5-95.7)</th>
<th>No available data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alpha</td>
<td>83% (95% CI, 62-93)</td>
<td>95% (95% CI, 78-99)</td>
<td>76% (95% CI, 61-85)</td>
<td>94.1% (95% CI, 91.8-95.8) [2-9 weeks]</td>
<td>-</td>
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<tr>
<td></td>
<td>90.2% (95% CI, 85.1-93.8) [≥20 weeks]</td>
<td>88% (95% CI, 83-91)</td>
<td>94% (95% CI, 91-99)</td>
<td>91% (95% CI, 90-93)</td>
<td>-</td>
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</tbody>
</table>

- **Delta**
  - Against severe COVID-19: 88% (95% CI, 83-91) [≥20 weeks]
  - Against death: 96% effective at preventing death

- **Beta**
  - Against death: 67% effective at preventing hospitalizations

**Note:**

- [xix] Study does not differentiate between the two inactivated vaccines, BBIBP-CorV and CoronaVac.
- [xxi] Study does not differentiate between the two inactivated vaccines, BBIBP-CorV and CoronaVac.
| Two doses: | 84% (95% CI, 80-87)\(^44\) |
| Two doses: | 96% (95% CI, 86-99)\(^42\), 88% (95% CI, 78.9-93.2)\(^35\), 75% (95% CI, 24-93.9)\(^21\), 84% (95% CI, 79-89)\(^45\), 98.4% (95% CI, 97.9-98.8) [2-9 weeks]\(^36\), 92.7% (95% CI, 90.3-94.6) [≥20 weeks]\(^36\), 96% (95% CI, 95-96)\(^44\), 93% (95% CI, 84-96)\(^38\), 96.8% (95% CI, 93.9-98.3) (2 months after the second dose)\(^4\) |
| Against ICU admission: | 86% (95% CI, 79-90)\(^44\) |
| 96% against severe COVID-19 infection\(^39\). |

**SAFETY AND ADVERSE EVENTS**

\(^{xx}\) Study does not differentiate between the two inactivated vaccines, BBIBP-CorV and CoronaVac.

\(^{xxii}\) Study does not differentiate between the two inactivated vaccines, BBIBP-CorV and CoronaVac.
<table>
<thead>
<tr>
<th>Common side effects</th>
<th>Pain at the injection site, fatigue, headache, myalgia, chills and fever. Optimal safety for asthma patients. The vaccine is considered safe for cancer patients undergoing treatments.</th>
<th>Pain at injection site, headache, fatigue, myalgia, arthralgia. Covid arm (cutaneous hypersensitivity). The vaccine is considered safe for cancer patients undergoing treatments.</th>
<th>Fatigue, myalgia, arthralgia, headache, lethargy, fever, &amp; nausea.</th>
<th>Headache, fever, chills, fatigue, myalgia, and nausea.</th>
<th>Pain at the injection site, dizziness, fever, headache, fatigue, nausea, vomiting, &amp; allergic dermatitis.</th>
<th>Pain at injection site, headache, fatigue, tremors, &amp; flushing, inflammatory reaction, urticaria.</th>
<th>Pain at injection site, headache, muscle pain, fatigue.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rare adverse events</td>
<td>Myocarditis &amp; myopericarditis, anaphylaxis and swelling of the lips, face, and tongue related to anaphylaxis (11 anaphylaxis cases per million doses administered), axillary lymphadenopathy, paroxysmal ventricular arrhythmia, leg paresis, pityriasis rosea (lesions improved completely after).</td>
<td>Myocarditis &amp; myopericarditis, orofacial swelling &amp; anaphylaxis. Potential risk factor for Bell’s palsy (most improve upon follow-up), herpes zoster reactivation, varicella zoster reactivation, herpes zoster ophtalmicus, eczema &amp; urticaria, transverse myelitis, high fever.</td>
<td>Transverse myelitis, high fever and headache, cutaneous hypersensitivity, vasculitis, cerebral venous sinus thrombosis, increased risk of developing Guillain-Barré syndrome post vaccination, herpes zoster ophtalmicus.</td>
<td>Rare adverse events were similar among the vaccine groups and control group within 7 days. Pityriasis rosea (lesions improved completely after ~8 weeks).</td>
<td>Myalgia, fever, pityriasis rosea (lesions improved completely after ~8 weeks), reactivation of herpes zoster and herpes simplex. Most reactions improved without treatment within a few weeks. Most reactions improved without treatment within a few weeks.</td>
<td>Myocarditis was reported in one vaccine recipient, occurring 3 days after second dose.</td>
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<td>Condition</td>
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<td>~8 weeks, lymphocytic vasculitis</td>
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<td>varicella-zoster reactivation</td>
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<td>Kikuchi-Fujimoto disease</td>
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<td>thrombotic thrombocytopenic purpura</td>
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<td>IgA nephropathy flare-up</td>
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<td>Bell's Palsy</td>
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<td>Guillain-Barré syndrome</td>
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<td>Guillain-Barré syndrome</td>
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<tr>
<td>Vaccination in individuals with adrenal</td>
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<td>insufficiency can lead to adrenal crises</td>
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</tbody>
</table>

All cases occurred in patients with chronic urticaria and were being treated with cyclosporine.
### Literature screening report: COVID-19 vaccines in the WHO’s Emergency Use Listing (EUL) Report (6)

**Guizzo Dri**

<table>
<thead>
<tr>
<th>Potential associated adverse events (causal links not yet proven)</th>
<th>Exacerbation of subclinical hyperthyroidism(^{89}), rhabdomyolysis(^{90})</th>
<th>Disease(^{129}), Vaccine induced acute localized exanthematous pustulosis(^{121}), Henoch-Schönlein Purpura(^{122}), rhabdomyolysis(^{123})</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cerebral venous sinus thrombosis and intracranial haemorrhage(^{130}), aseptic meningitis(^{131}), autoimmune hepatitis(^{132, 133}), multiple sclerosis relapse(^{134}), myeloperoxidase anti-neutrophil cytoplasmic antibody-positive optic perineuritis(^{135}), central retinal vein occlusion(^{136}), paracentral acute middle maculopathy &amp; Cerebral venous sinus thrombosis and intracranial haemorrhage(^{130}), aseptic meningitis(^{131}), autoimmune hepatitis(^{132, 133}), multiple sclerosis relapse(^{134}), myeloperoxidase anti-neutrophil cytoplasmic antibody-positive optic perineuritis(^{135}), central retinal vein occlusion(^{136}), paracentral acute middle maculopathy &amp;</td>
<td>Autoimmune hepatitis(^{132}), myocardial infarction(^{140}), autoimmune haemolytic anaemia(^{141}), hypophysitis &amp; panhypopituitarism(^{142})</td>
<td></td>
</tr>
<tr>
<td>Autoimmune hepatitis(^{132}), Acute hyperglycaemic crisis(^{144}), Facial nerve palsy, cervical myelitis(^{112}), alopecia areata(^{145})</td>
<td>Autoimmune hepatitis(^{132}), Acute hyperglycaemic crisis(^{144}), Facial nerve palsy, cervical myelitis(^{112}), alopecia areata(^{145})</td>
<td>No available data</td>
</tr>
</tbody>
</table>

One case developed IgA Nephropathy after receiving the second dose of mRNA-1273 (causal link not yet proven)\(^{143}\).
<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td><strong>Myocarditis data</strong></td>
</tr>
<tr>
<td>Mainly reported in young adults and adolescents</td>
</tr>
<tr>
<td><strong>Israeli study:</strong> Estimated incidence within 42 days after receipt of first dose per 100,000 vaccinated persons was 2.13 cases (95% CI, 1.56-2.7)</td>
</tr>
<tr>
<td>Male patients Incidence of 4.12 (95% CI, 2.99-5.26) per 100,000 vaccinated</td>
</tr>
<tr>
<td>Male patients (16-29 years)</td>
</tr>
</tbody>
</table>

Myocarditis was reported as viral myocarditis. Participant fully recovered after 2 days of hospitalisation. No episode of anaphylaxis or vaccine-associated enhanced COVID-19 was reported.
### Incidence of COVID-19 after vaccination

<table>
<thead>
<tr>
<th>Incidence</th>
<th>95% CI</th>
<th>Per 100,000 vaccinated</th>
</tr>
</thead>
<tbody>
<tr>
<td>10.69</td>
<td>6.93-14.46</td>
<td>148</td>
</tr>
<tr>
<td>Female patients</td>
<td>0.23</td>
<td>0.49</td>
</tr>
<tr>
<td>16-29 years</td>
<td>5.49</td>
<td>3.59-7.39</td>
</tr>
<tr>
<td>&gt;30 years</td>
<td>1.13</td>
<td>0.66-1.60</td>
</tr>
</tbody>
</table>

### Disease severity

- **Mild**: 1.62 (95% CI, 1.12-2.11)
- **Intermediate**: 0.47 (95% CI, 0.21-0.74)
- **Fulminant**: 0.04 (95% CI, 0-0.12)
### Immunogenicity

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Time Period</th>
<th>GMT Ranges</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>18-85 years</td>
<td>14 days after second dose</td>
<td>18-55 years: 211.2 (95% CI, 158.9 - 280.6)</td>
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<tr>
<td></td>
<td>56-70 years: 211.2 (95% CI, 158.9 - 280.6)</td>
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</tr>
<tr>
<td></td>
<td>65+ years: 211.2 (95% CI, 158.9 - 280.6)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>25 ug: IgG GMT</td>
<td></td>
<td>46,459 EU/ml (95% CI, 40,839-52,853)</td>
<td></td>
</tr>
<tr>
<td>50 ug: IgG GMT</td>
<td></td>
<td>44,421 EU/ml (95% CI, 37,929-52,024)</td>
<td></td>
</tr>
<tr>
<td>75 ug: IgG GMT</td>
<td></td>
<td>40,519 EU/ml (95% CI, 34,540-48,693)</td>
<td></td>
</tr>
</tbody>
</table>

**Note:** GMT: Geometric Mean Titre, CI: Confidence Interval

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*Sabina Rodriguez Velásquez, Gabriela Guizzo Dri*
### Literature screening report: COVID-19 vaccines in the WHO’s Emergency Use Listing (EUL) Report (6) - Sabina Rodríguez Velásquez, Gabriela Guizzo Dri

#### Transmission prevention

| Prior Delta Variant: Vaccine effectiveness against infectiousness given infections | 41.3%<sup>158</sup> |
| Vaccine effectiveness against transmission | 88.5%<sup>158</sup> |
| During Delta Variant: Similar Ct values (<25) were found in both vaccinated and unvaccinated groups<sup>159</sup> | 52% (95% CI, 33-69)<sup>13</sup> |
| Studies from Scotland and England | 

#### 57 days after vaccination:

- 18-55 years: 754 (95% CI, 592-961); GMT 288 (95% CI, 221-376)<sup>154</sup>

#### 11.48% of participants did not develop sufficient antibody titres (<25.6 IU ml)<sup>156</sup>

#### (95% CI, 181-557)<sup>152</sup> AU/mL [IQR 9,705 - 37,796]<sup>153</sup>

- ≥70 years: 17,561 AU/mL [IQR 9,705 - 37,796]<sup>153</sup>

#### 15.57 days after vaccination:

- 15-55 years: 754 (95% CI, 592-961); GMT 288 (95% CI, 221-376)<sup>154</sup>
demonstrated reductions in secondary infections among families of vaccinated individuals compared to families of unvaccinated individuals\textsuperscript{160,161}.

**VE against onwards transmission:** \textit{62\% (95\% CI, 57-67)}\textsuperscript{13}

### Duration of protection

| Median time between second dose and infection: | \textit{146 days (IQR, 121-167)}\textsuperscript{163} |
| Preliminary phase I results: | Antibody activity remained high in all age groups at \textbf{day 209} (approximately 6 months) GMT were lower in ≥56 years old\textsuperscript{168} |
| Antibody Response: | After single dose, antibody response declined within one year, but remained above baseline levels. Antibody levels after \textbf{day 180}: 0.54 GMR (CI, 0.47-0.61). Antibody levels after \textbf{day 320}: |
| Neutralizing antibodies: | Remained largely stable for 8-9 months\textsuperscript{171} |
| Antibody Response: | Unexposed subjects: After 1\textsuperscript{st} dose: \textbf{43.6 IU/mL} (95\% CI, 30.3-62.8) After 2\textsuperscript{nd} dose: \textbf{377.0 IU/mL} (95\% CI: 324.3-438.3) 3 months after 2\textsuperscript{nd} dose: \textbf{125.4 IU/mL} (95\% CI: 88.2-178.4)\textsuperscript{172} |
| Antibody Response: | Unexposed subjects: After 1\textsuperscript{st} dose: \textbf{80-90\%} of anti-S IgG and Nab titers against wild type waned 6 months |

**Antibody Response:**

- \textbf{Unexposed subjects:}
  - After 1\textsuperscript{st} dose: \textbf{43.6 IU/mL} (95\% CI, 30.3-62.8)
  - After 2\textsuperscript{nd} dose: \textbf{377.0 IU/mL} (95\% CI: 324.3-438.3)
  - 3 months after 2\textsuperscript{nd} dose: \textbf{125.4 IU/mL} (95\% CI: 88.2-178.4)

**Neutralizing antibodies:** Remained largely stable for 8-9 months\textsuperscript{171}

**Anti-SARS-CoV-2 Antibodies:**

- 1 month after 2\textsuperscript{nd} dose: \textbf{1762 KU/L} (IQR: 933-3761)
- 3 months after 2\textsuperscript{nd} dose: \textbf{125.4 IU/mL} (95\% CI: 88.2-178.4)\textsuperscript{172}
Literature screening report: COVID-19 vaccines in the WHO's Emergency Use Listing (EUL) Report (6) - Sabina Rodríguez Velásquez, Gabriela Guizzo Dri

3 months after 2nd dose: 1086 KU/L (IQR: 629-2155)
6 months after 2nd dose: 802 KU/L (IQR, 447-1487)

No health worker had antibodies BELOW method-dependent cut-off (0.8 KU/L)

VE reduced by 22% (95% CI, 6-41) for every 30 days from the second dose for those aged 18 to 64 years.

Effectiveness against any SARS-CoV-2 Infection:
After reaching peak VE (77.5%) 1 month after 2nd dose, VE dropped to 20% in months 5-7 after 2nd dose.

0.30 GMR (CI, 0.24-0.39)

Cellular Immune Response:
Day 182 after first dose: median of 237 SFUx10^6 PBMC (IQR, 109-520)

6 months after second dose: (median 1240, IQR 432-2002) in groups with 15-25 week interval between doses

VE reduced by 7% (95% CI, -18 - 2) for every 30 days from the second dose for those aged 18 to 64 years.

Humoral & Cellular Immune Response:
Antibody responses were detected in all vaccine recipients on day 239 (stable response for at least 8 months).

A study observed sustained and stable vaccine effectiveness starting 14 days post vaccination to a maximum of 152 days after vaccination.

VE decreased from 89.4% in May to 51.7% in July.

Exposed subjects:
Before 1st dose: 203.2 UI/mL (95% CI: 42.9-962.4)
After 1st dose: 761.7 UI/mL (95% CI: 381.1-1522)
After 2nd dose: 719.9 UI/mL (95% CI: 264.6-1959)
3 months after 2nd dose: 484.4 IU/mL (95% CI: 147.3-1593)

Anti-spike Protein RBD IgG Antibodies:
Younger age groups (<60): 1 month after 2nd dose: 97% seropositivity, 11.3 (IQR, 6.2-20.7)
3 months after 2nd dose: 76% seropositivity, 2.4 (IQR, 1.0-5.0)

Older age groups (≥60): 1 month after 2nd dose: 88% seropositivity, 6.4 (IQR, 2.5-13.6)
3 months after 2nd dose: 60% seropositivity, 1.3 (IQR, 0.5-3.3)

Anti-spike Protein RBD IgG Antibodies:
Younger age groups (<60): 1 month after 2nd dose: 97% seropositivity, 11.3 (IQR, 6.2-20.7)
3 months after 2nd dose: 76% seropositivity, 2.4 (IQR, 1.0-5.0)

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3 months after 2nd dose: 60% seropositivity, 1.3 (IQR, 0.5-3.3)

A study observed sustained and stable vaccine effectiveness starting 14 days post vaccination to a maximum of 152 days after vaccination.

VE decreased from 89.4% in May to 51.7% in July.
Effectiveness against Hospitalization and Death:
After reaching peak VE (96.8%) 2 months after 2nd dose, VE did not decline over time, except for 7th months (VE 55.6%) with very few cases.

Anti-spike Protein RBD IgG Antibodies:
Younger age groups (<60):
- 1 month after 2nd dose: 100% seropositivity, 53.3% (IQR, 27.6-40.0)
- 3 months after 2nd dose: 100% seropositivity, 19.2% (IQR, 8.2-23.1)

Older age groups (≥60):
- 1 month after 2nd dose: 96% seropositivity, 13.3% (IQR, 6.9-27.7)
- 3 months after 2nd dose: 90% seropositivity, 3.9% (IQR, 1.9-8.4)

**Report**

Sabina Rodriguez Velásquez, Gabriela Guizzo Dri

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Seropositivity: 29.4% (IQR, 22.5 - 33.3) 3 months after 2nd dose: 100% seropositivity, 14.8% (IQR, 7.4 - 18.7)

Sub-populations:

**Older age (≥65):**
- 38% to 42% decrease of humoral antibodies compared to 18- to 45-year-old women
- **Older age (≥65) AND men:** 37% to 46% decrease compared to 18- to 45-year-old women

**Immunosuppression:**
- 65% to 70% decrease compared to non-immunosuppressed
### Obesity (BMI ≥30): 31% increase in neutralizing antibody compared with nonobese

### Children Vaccination

<table>
<thead>
<tr>
<th>Efficacy</th>
<th>Adolescents (12-15): After one dose had efficacy of 75% (CI, 7.6-95.5)</th>
<th>Adolescents (12-17): After one dose had efficacy of 92.7% (CI, 67.8-99.2)</th>
<th>After second dose efficacy of 93.3% (CI, 47.9-99.9)</th>
<th>Adolescents (16-17): PREVENT-19 clinical trial expanded to assess efficacy, safety, and immunogenicity in 12-17-year-old adolescents</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Ongoing trials177</td>
<td>No available data</td>
<td>No available data</td>
<td>Unknown. Clinical trial only looked at safety, tolerability, and immunogenicity181.</td>
</tr>
<tr>
<td>Children (5-11): Ongoing trials177</td>
<td></td>
<td>Paused ongoing trials in children aged 6-17 due to concerns over rare blood clots reported in adult population180.</td>
<td>Announced at begging of April ongoing study in adolescents but paused to investigate blood clots in adult population180.</td>
<td></td>
</tr>
<tr>
<td>Children (Under 5 years): Ongoing trials177</td>
<td></td>
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</tbody>
</table>

* The study design administered three doses of 2 μg, 4 μg, or 8 μg of vaccine

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<table>
<thead>
<tr>
<th>Immuneogenicity</th>
<th>Adolescents (12-15) serum-neutralizing titer: 1 month after 2nd dose had 1283.0 GMN50 (CI, 1095.5-1402.5)178.</th>
<th>Adolescents (12-17): Neutralizing antibody titer after 2nd dose was 1401.7 GMN50 (CI, 1276.3-1539.4)</th>
<th>No available data</th>
<th>No available data</th>
<th>Ongoing clinical trial185</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adolescents/young adult (16-25) serum-neutralizing titer: 1 month after 2nd dose had 705.1 GMN50 (CI, 621.4-800.2)176.</td>
<td>Serological response was 98.8% (CI, 97.0-99.7)</td>
<td>Neutralizing antibodies after 28 days after 2nd dose ranged from 105.3-180.2 GMT in 3-5 years cohort, 84.1-168.6 GMT in 6-12 years cohort, and 88.0-155.7 GMT in 13-17 years cohort.</td>
<td>No available data</td>
<td>No available data</td>
<td>No available data</td>
</tr>
<tr>
<td>Children (5-11): 1 month after 2nd dose had 1,197.6 GMT (95% CI, 1106.1-1296.6) SARS-CoV-2-neutralizing antibody183</td>
<td>Children (6month-11): Ongoing trials179</td>
<td>Neutralizing antibodies after 28 days after 3rd dose ranged from 143.5-224.5 GMT in 3-5 years cohort, 127-184.8 GMT in 6-12 years cohort, and 150.7-199 GMT in 13-17 years cohort.184</td>
<td>No available data</td>
<td>Ongoing clinical trial185</td>
<td>No available data</td>
</tr>
<tr>
<td>Children (Under 5): Ongoing trials177</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Age Group</td>
<td>Local and Systemic Events</td>
<td>Severe Injection Site Pain</td>
<td>Fever</td>
<td>High Fever</td>
<td>Severe Adverse Events</td>
</tr>
<tr>
<td>-------------------</td>
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<td>-----------------------</td>
</tr>
<tr>
<td>Adolescents (12-15)</td>
<td>Local and systemic events were generally mild to moderate</td>
<td>Severe injection-site pain (1.5%)</td>
<td>Fever (20%)</td>
<td>High Fever (0.1%)</td>
<td>Adverse events (6%)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Severe adverse events (0.6%)176</td>
</tr>
<tr>
<td>Adolescents (12-17)</td>
<td>Solicited local reactions after 2nd dose (93.4%)</td>
<td>Injection-site pain (92.7%)</td>
<td>Headache (70.2%)</td>
<td>Fatigue (67.8%)</td>
<td>Grade 3 adverse events (6.8%)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Few reported cases of acute myocarditis and pericarditis (mainly in males)186</td>
</tr>
<tr>
<td>Children (3-17)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Injection-site pain in 3-5 year group (4%), 6-12 year group (1.2%), and 13-17 year group (7.9%)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Most common systemic reactions in all three age cohorts were mild to moderate fever and cough</td>
</tr>
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<td></td>
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<td></td>
<td></td>
<td></td>
<td>Adverse events were mostly mild to moderate in severity184</td>
</tr>
<tr>
<td>Children (6-month-11)</td>
<td>Ongoing trials179</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Children (6-month-11)</td>
<td>Ongoing trials179</td>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

Adolescent/young adults (16-25): Local and systemic events were generally mild to moderate. Severe injection-site pain (3.4%). Fever (17%). Adverse events (6%). Severe adverse events (1.7%)176.

Children (5-11): Preliminary results on safety profile.

Children (3-17): Adverse reactions in 12-17 year group (35%), 3-5 year group (26%), and 6-11 year group (18%) reported at least one adverse event (27%). Most reported events were mild and moderate and only (<1%) grade 3 events. Injection-site pain (13%). Fever (25%)181.

Ongoing clinical trial185.
### Literature screening report: COVID-19 vaccines in the WHO’s Emergency Use Listing (EUL) Report (6)

Sabina Rodriguez Velásquez, Gabriela Guizzo Dri

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#### Children (Under 5):

- Ongoing trials

- Few reported cases of acute myocarditis and pericarditis in 16-25 year olds (mainly in males)

- Few reported cases of acute myocarditis in adolescents and young adults

- No available data

- No available data

- No available data

- No available data

- No available data

---

#### Heterologous Vaccination

<table>
<thead>
<tr>
<th>Vaccine Schedule</th>
<th>BNT162b2/ChAd Ox1</th>
<th>ChAdOx1/mRNA-1273</th>
<th>ChAdOx1/BNT162b2</th>
<th>Not Applicable (one dose schedule)</th>
<th>BBIBP/BNT162b2</th>
<th>CoronaVac/ChAd Ox1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Administration of ChAdOx1 as second/booster dose</td>
<td>Administration of mRNA-1273 as second/booster dose</td>
<td>Administration of BNT162b2 as second/booster dose</td>
<td>For more information refer to booster section</td>
<td>Press releases have confirmed that Thailand will use the AstraZeneca vaccine as the booster</td>
<td>Ongoing trial (Com-Cov2)</td>
<td></td>
</tr>
</tbody>
</table>

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### Vaccine Immunogenicity

<table>
<thead>
<tr>
<th>Vaccine</th>
<th>GMCs of SARS-CoV-2 anti-spike IgG at 28 days post booster:</th>
<th>RBD antibody titres:</th>
<th>Spike-specific IgG antibodies:</th>
<th>Neutralizing antibodies:</th>
<th>IgG antibody titres:</th>
<th>Not Applicable (one dose schedule)</th>
<th>Unknown (ongoing clinical trial)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CoronaVac/Convivacia</td>
<td>Heterologous (7133 ELU/mL, CI 6415-7932) vs. Homologous (14080 ELU/mL, CI 12491-15871)</td>
<td>Heterologous (7756.68 BAU/mL, CI 7371.53-8161.96) vs. Homologous (99.84 BAU/mL, CI 76.93-129.59) at day 14.</td>
<td>Heterologous (3602 BAU/mL) vs. Homologous (4189 BAU/mL)</td>
<td>Heterologous (100%) vs. Homologous (100%)</td>
<td>Heterologous (3684 BAU/mL) vs. Homologous (101.2 BAU/mL) at day 14.</td>
<td>For more information refer to booster section</td>
<td>For more information refer to booster section</td>
</tr>
<tr>
<td>CoronaVac/ChAdOx1: Anti-S Antibodies:</td>
<td>Heterologous (797 U/mL; 95% CI, 598.7-1062) vs. Homologous CoronaVac (94.4 U/mL; 95% CI: 76.1-122.1) vs. Homologous ChAdOx1 (818 U/mL; 95% CI: 662.5-1010)</td>
<td>Neutralizing antibodies:</td>
<td></td>
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</tr>
<tr>
<td>CoronaVac/Convivacia</td>
<td>Heterologous (7756.68 BAU/mL, CI 7371.53-8161.96) vs. Homologous (99.84 BAU/mL, CI 76.93-129.59) at day 14.</td>
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</tr>
</tbody>
</table>

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### Literature screening report: COVID-19 vaccines in the WHO’s Emergency Use Listing (EUL) Report (6)

- **Sabina Rodríguez Velásquez, Gabriela Guizzo Dri**

#### Reactogenicity

<table>
<thead>
<tr>
<th>Vaccines</th>
<th>Reactogenicity</th>
<th>Neutralizing antibodies:</th>
<th>GMT</th>
<th>Adverse events in heterologous:</th>
<th>Adverse events in homologous:</th>
<th>Severity of adverse events in heterologous:</th>
<th>Contraindications</th>
</tr>
</thead>
<tbody>
<tr>
<td>CoronaVac/ChAd Ox1:</td>
<td>Unknown</td>
<td></td>
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<tr>
<td>CoronaVac/Convivencia:</td>
<td>Convidecia recipients reported more adverse reactions and reported higher occurrence of solicited injection-site pain</td>
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<td></td>
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<tr>
<td></td>
<td>Unknown (ongoing clinical trial)</td>
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<tr>
<td></td>
<td>No available data</td>
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<tr>
<td></td>
<td>Ongoing trial</td>
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</tbody>
</table>

#### Table Notes:

**Results based on immunosuppressed population**

- **Neutralizing antibodies:**
  - Heterologous (100%) at day 14 vs. Homologous (30%) at day 14
  - 54.4 GMT (95% CI, 37.9-78) vs. Homologous CoronaVac 12.8 GMT (95% CI, 9.3-17.5)

- **Adverse events in heterologous:**
  - Pain at injection site, Swelling at injection site, Fever, Headaches, Fatigue, Chills, GI effects, Myalgia, Arthralgia
  - Headache (44%), Myalgia (43%), Malaise (42%), Fever (2%), Injection site pain (88%), Induration (35%), Erythema (31%)
  - Mild (68%), Moderate (30%), Severe (2%)

- **Adverse events in homologous:**
  - Adverse events self-reported were Pain at injection site, Swelling at injection site, Fever, Headaches, Fatigue, Chills, GI effects, Myalgia, Arthralgia
  - Arthralgia, Migraine, Back Pain

- **Not Applicable** (one dose schedule)

- **For more information refer to booster section**

- **CoronaVac/ChAd Ox1:** Unknown

- **CoronaVac/Convivencia:** Convidecia recipients reported more adverse reactions and reported higher occurrence of solicited injection-site pain

- **Unknown (ongoing clinical trial)**

- **No available data**

- **Ongoing trial**

### Adverse events

<table>
<thead>
<tr>
<th>Grade</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>59.3%</td>
</tr>
<tr>
<td>2</td>
<td>39.5%</td>
</tr>
<tr>
<td>3</td>
<td>1.2%</td>
</tr>
<tr>
<td>4</td>
<td>0%</td>
</tr>
</tbody>
</table>

### BOOSTER DOSES

<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>Approved Administration</td>
<td>Israel: 12-year-old and over can received homologous booster shot 5 months after full jab.xxviii</td>
<td>Phase II booster trial of three booster doses are ongoing.194</td>
<td>Preliminary results on tolerability and immunogenicity of third dose of ChAdOx1 vaccines showed strong boost to the Johnson &amp; Johnson has said it will submit all of their new data to the FDA for potential consideration for</td>
<td>UES: Offering booster doses of Pfizer and Sinopharm to people who received full</td>
<td>UAE: Turkey and the United Arab Emirates began homologous booster shots</td>
<td>Ongoing phase II trials.196</td>
<td>Results below are based on</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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<table>
<thead>
<tr>
<th>Country</th>
<th>Time-to-booster dose</th>
<th>Notes</th>
</tr>
</thead>
</table>
| United States| 6 months to 8 months after | its COVID-19 vaccine boosterxxxi  
Starting September, adults who received mRNA vaccine 8 months ago are eligible for booster. |
| United States| 6 months to 8 months after | immune response¹⁹⁵  
Starting September, adults who received mRNA vaccine 8 months ago are eligible for booster. |
| Europe       | 6-9 months after initial two-dose regimen | adding a booster dose and consideration to authorize two-dose regimenxxxii |
|              | 6 months after initial two-dose regimen | Sinopharm jab ≥6 months ago |
| Indonesia    | 6 months after initial two-dose regimen | Homologous:  
Indonesia and Thailand are considering giving homologous booster shot to HCWxxxiii |
|              | 6 months after initial two-dose regimen | Ongoing phase II trial |

xxx A country-by-country guide to coronavirus vaccine booster plans. POLITICO [press release].  


xxxii Two dose version of Johnson & Johnson shot 94% effective against Covid-19, study finds. CNN.  

xxxiii Indonesia and Thailand consider booster shots amid doubts over Sinovac vaccine. Reuters [press release].  
https://www.reuters.com/world/china/indonesia-thailand-consider-booster-shots-amid-doubts-over-sinovac-vaccine-2021-07-08/
<table>
<thead>
<tr>
<th>Immunogenicity</th>
<th>Booster doses (mRNA1273 or mRNA1273.351) increased neutralizing antibody titers against wild-type&lt;sup&gt;199&lt;/sup&gt;</th>
<th>Higher levels after third dose (IgG EU 3746; IQR: 2047-6420) &lt;sup&gt;195&lt;/sup&gt;</th>
<th>5X10&lt;sup&gt;10&lt;/sup&gt; vp booster dose elicited 9-fold increase at day 7 compared to first dose after 29 days in 18-55-year-olds&lt;sup&gt;171&lt;/sup&gt;</th>
<th>60% higher NAb activity against wild-type compared to 2 doses&lt;sup&gt;175&lt;/sup&gt;</th>
<th>Increase of 4.6-fold compared to peak response after 2&lt;sup&gt;nd&lt;/sup&gt; dose (Day 217 GMEU = 200408; 95% CI: 159796-251342)&lt;sup&gt;196&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Neutralizing titers: Elicits &gt;5-8 more for wild type after 6 months after 2&lt;sup&gt;nd&lt;/sup&gt; dose&lt;sup&gt;198&lt;/sup&gt;</td>
<td>Spike Cellular Immune Response: Increased from 200 SFUx10&lt;sup&gt;6&lt;/sup&gt; PBMC (IQR, 127-389) after the second dose to 1.25X10&lt;sup&gt;10&lt;/sup&gt; vp booster dose elicited 6-7.7-fold increase at day 28 compared to first</td>
<td>Homologous: Neutralizing Antibodies: 20-fold increase 4 weeks post</td>
<td>Anti-S IgG and NAb: 20-fold increase 4 weeks post</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Antibody Levels:</td>
<td>Homologous: Anti-S IgG and NAb:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Initial two-dose regimen</td>
<td>Initial two-dose regimen</td>
<td>6 months after one dose regimen&lt;sup&gt;171&lt;/sup&gt;</td>
<td>After primary vaccination</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Israel offers up to 5 months after initial two-dose regimen</td>
<td></td>
<td>Heterologous: 4 months after initial two-dose BNT162b2 regimen&lt;sup&gt;197&lt;/sup&gt;</td>
<td>Heterologous 1: 21 to 26 days after full jab of CoronaVac</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Heterologous 2: 6 months after primary vaccination of CoronaVac</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>After primary vaccination</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Note:**
- **Homologous:**
  - Neutralizing Antibodies: 60% higher NAs compared to 2 doses after 2<sup>nd</sup> dose (Day 217 GMEU = 200408; 95% CI: 159796-251342)<sup>196</sup>
  - Anti-S IgG and NAb: 20-fold increase 4 weeks post

**References:**
- 171
- 175
- 195
- 196
- 197
- 198
- 199

399 SFUx10⁶ PBMC (IQR, 314-662) after the third dose after 29 days in 18-55 and ≥65-year-old.

**Heterologous:**
14.8 to 32.4-fold increase in neutralization titers against wild-type virus.

booster vaccination:
NAbs were maintained 60 to 180 days post booster.

**Heterologous 1:** Heterologous vaccination had a 9-fold greater GMT (7,947 U/mL) than fully vaccinated patients fully vaccinated with AZD1222 and the highest antibody response, IgA, and neutralizing antibodies than other groups.

**Heterologous 2:** Median values of IgG-S titers were higher in group that received BNT162b2 as booster than CoronaVac BNT162b2 boosted IgG-S median titers by 4.3-fold compared to peak response after 2nd dose (IC50 = 6231; 95% CI: 4738-8195).

Older Participants (60-84):
5.4-fold increase in antibody response.

Younger Participants (18-59):
3.7-fold increase in antibody response.
## Immunogenicity against variants

<table>
<thead>
<tr>
<th>Beta (B.1.351):</th>
<th>Preliminary results of booster doses of mRNA-1273 vaccine show robust antibody response against Delta variant[^194]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elicits 15-21 more neutralizing titers for Beta variant after 6 months after 2nd dose[^198]</td>
<td></td>
</tr>
<tr>
<td>Delta (B.1.671.2):</td>
<td></td>
</tr>
<tr>
<td>&gt;5-fold increase in neutralizing titers against Delta compared to dose 2 titers in 18–55-year-olds</td>
<td></td>
</tr>
<tr>
<td>&gt;11-fold increase in neutralizing titers against Delta</td>
<td></td>
</tr>
</tbody>
</table>

**Homologous:** No available data

**Heterologous:**
- **Beta (B.1.351):** 10.9 to 21.2-fold increase in pseudovirus neutralization assay (one volunteer did not have any against fB.1.351)[^197]
- **Delta (B.1.671.2):** Ongoing trial[^193]

**High levels of functional antibodies against Alpha (B.1.1.7), Beta (B.1.351), and Delta (B.1.671.2)^[196**]

**Delta (B.1.671.2):**
- Increase of 6.6-fold in antibody response compared to Delta response observed with

**Beta (B.1.351):**
- 3.0-fold decrease in neutralizing antibodies compared to wild type[^75]

**Gamma (P.1):**
- 3.1-fold decrease in neutralizing antibodies compared to wild type[^75]

---

[^194]: Preliminary results
[^197]: One volunteer did not have any against fB.1.351
[^198]: Elicits 15-21 more neutralizing titers for Beta variant after 6 months after 2nd dose
[^199]: >5-fold increase in neutralizing titers against Delta compared to dose 2 titers in 18–55-year-olds
[^200]: >11-fold increase in neutralizing titers against Delta
[^193]: Ongoing trial
[^75]: Increase of 6.6-fold in antibody response compared to Delta response observed with
<table>
<thead>
<tr>
<th>Reactogenicity</th>
<th>Preliminary results show consistent tolerability (^{198})</th>
<th>Similar safety and tolerability compared to second dose (^{194})</th>
<th>Lower reactogenicity after third dose compared to first dose (^{70})</th>
<th>No available data</th>
<th>Ongoing trial (^{193})</th>
<th>The third shot is considered to be safe (^{74}).</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>2.3-fold decrease in neutralizing antibodies compared to wild type</strong></td>
<td><strong>2.5-fold higher neutralizing potency than 2-dose vaccination</strong> (^{175})</td>
<td><strong>Heterologous 1:</strong> Neutralizing activity against the wild type and variant strains showed higher neutralizing activity in the following order: <strong>wild type &gt; B.1.617.2 &gt; B.1.1.7 &gt; B.1.351</strong> (^{200})</td>
<td><strong>Common side effects:</strong> Pain at the injection site.</td>
<td><strong>Booster dose was well tolerated</strong></td>
<td><strong>Local and systemic reactogenicity increased between Dose</strong></td>
</tr>
</tbody>
</table>

**Note:** Compared to dose 2 titers in 65–85-year-olds \(^{198}\).
<table>
<thead>
<tr>
<th>Injection-site pain (68.4% for mRNA-1273.351, 90% for mRNA-1273)</th>
<th>Adverse events: Unrelated to the vaccination</th>
</tr>
</thead>
<tbody>
<tr>
<td>fatigue (36.8% for mRNA-1273.351, 70% for mRNA-1273)</td>
<td>1, Dose 2, and Dose 3</td>
</tr>
<tr>
<td>headache (36.8% for mRNA1273.351, 55.0% for mRNA-1273)</td>
<td>90% of symptoms were rated as mild or moderate</td>
</tr>
<tr>
<td>myalgia (31.6% for mRNA-1273.351, 45.0% for mRNA-1273)</td>
<td></td>
</tr>
<tr>
<td>arthralgia (21.1% for mRNA-1273, 50.0% for mRNA-1273)</td>
<td></td>
</tr>
</tbody>
</table>

**Confirmed Infection:**

**Protection against COVID-19**

- Youngest age group (16-29): 17.6 (95% CI, 15.6-19.9) lower rate in booster group
- 30-39 age group: No available information

199

196
8.8 (95% CI, 8.2-9.5) lower rate in booster group\(^{202}\)

40-49 age group:
9.7 (95% CI, 9.2-10.4) lower rate in booster group\(^{202}\)

50-59 age group:
12.2 (95% CI, 11.4-13.1) lower rate in booster group\(^{202}\)

Oldest age group (≥60):
11.3 (95% CI, 10.4-12.3) lower rate in booster group\(^{203}\)
12.4 (95% CI, 11.9-12.9) lower rate in booster group\(^{202}\)

**Severe Illness:**

40-59 age group:
22.0 (95% CI, 10.3-47.0) lower rate
### Rate in booster group

**Older population (≥60):**
- 19.5 (95% CI, 12.9-29.5) lower rate in booster group
- 18.7 (95% CI, 15.7-22.4) lower rate in booster group

---

### Other

- Detailed report from Pfizer regarding booster doses can be found here: [https://www.fda.gov/media/152161/download](https://www.fda.gov/media/152161/download)

- For more detailed information regarding immunogenicity of third dose refer to study

- Ongoing clinical trial examining the immunogenicity and safety of a third dose vaccination with ChAdOx1 or BNT162b2

---

*xxxiv* A third dose of inactivated vaccine augments the potency, breadth, and duration of anamnestic responses against SARS-CoV-2. *medRxiv.* [https://www.medrxiv.org/content/10.1101/2021.09.02.21261735v1](https://www.medrxiv.org/content/10.1101/2021.09.02.21261735v1)
Third Dose Vaccination with AstraZeneca or Pfizer COVID-19 Vaccine Among Adults Received Sinovac COVID-19 Vaccine. ClinicalTrials.gov. https://clinicaltrials.gov/ct2/show/NCT05049226
**ANNEXES**

<table>
<thead>
<tr>
<th>BNT162b2/COMIRNATY (Pfizer-BioNTech, USA)</th>
<th>Spikevax/Moderna COVID-19 Vaccine/mRNA-1273 (Moderna, USA)</th>
<th>Vazzevria/ChAdOx1 nCoV-19/ AZD1222/Covishield (AstraZeneca/Oxford, UK, India)</th>
<th>Janssen COVID-19 vaccine/Johnson &amp; Johnson (Janssen, USA)</th>
<th>Sinopharm/BBIB P-CorV, China</th>
<th>Sinovac CoronaVac, China</th>
<th>Novavax/NVX-CoV2373</th>
</tr>
</thead>
</table>

**FURTHER INFORMATION**

<table>
<thead>
<tr>
<th>Storage conditions</th>
<th>2°C to 8 °C (for 1 month)</th>
<th>2°C to 8 °C (for 1 month)</th>
<th>2°C until 8 °C</th>
<th>2°C to 8 °C (for 3 months)</th>
<th>2°C until 8 °C</th>
<th>2°C to 8 °C</th>
</tr>
</thead>
</table>

| Approving authorities | FDA (11.12.20)xxxvi; EMA (21.12.20); WHO EUL (31.12.20); and list of countries (including Switzerland – approved 12.01.21) | FDA (awaiting on approval); EMA (29.01.21); WHO EUL (15.02.21); and list of 121 countries (including Switzerland – approved 22.03.21) | FDA (27.02.21); EMA (11.03.21); WHO EUL (12.03.21); and list of 59 countries (including Switzerland – approved 22.03.21) | WHO EUL (07.05.21); and list of 55 countries (e.g., Argentina, Bahrain, Brazil, China, Indonesia, United Arab Emirates, Zimbabwe) | WHO EUL (01.06.21); and list of 33 countries (e.g., Albania, Chile, Egypt, Hong Kong, Malaysia, Tunisia, Turkey, Ukraine) | Waiting on approval (Not-yet-approved by countries or WHO for emergency use) |

Literature screening report: COVID-19 vaccines in the WHO’s Emergency Use Listing (EUL) Report (6) - Sabina Rodriguez Velásquez, Gabriela Guizzo Dri

<table>
<thead>
<tr>
<th>APPROVED</th>
<th>Awaiting on approval</th>
<th>Efficacy</th>
<th>Unknown</th>
<th>35.1% (95% CI, 6.6 to 60.5) [conducted in a setting with high P.1 transmission]</th>
</tr>
</thead>
<tbody>
<tr>
<td>52% (95% CI, 29.5 to 68.4; starting at 12 days)</td>
<td>95.2% (95% CI, 91.2 to 97.4; starting at &gt;14 days)</td>
<td>72.8% (starting at 22 days up to 60 days)</td>
<td>Single dose vaccine</td>
<td>83.4% (95% CI, 73.6-89.5) starting at ≥14 days</td>
</tr>
<tr>
<td>91% (95% CI, 85-94)</td>
<td>88% (95% CI, 75-94)</td>
<td>66.9% (95% CI, 59.0-73.4)</td>
<td>Unknown</td>
<td>89.7% (95% CI, 80.2-94.6) starting at ≥7 days</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>EFFICACY</th>
<th>Single dosexxxvii</th>
<th>Two dosesxxxix</th>
<th>94.1% (95% CI, 89.3-96.8) after median follow-up of less than 63 days</th>
<th>63.1% (95% CI, 51.8-71.7) starting at &gt;14 days for two standard doses</th>
<th>66.1% (95% CI 55.0-89.1) after 28 days for VE against moderate-severe-critical COVID-19</th>
<th>72.8% (95% CI 58.1-82.4; in WIV04 vaccine)</th>
<th>78.1% (95% CI 64.8 to 86.3; in HBO2 vaccine)</th>
<th>99.17% of NAb titres were above or equal to the median</th>
</tr>
</thead>
<tbody>
<tr>
<td>94.6% (95% CI, 89.9-97.3) starting at ≥7 days in population without prior SARS-CoV-2 infection</td>
<td>94.1% (95% CI, 89.3-96.8) after median follow-up of less than 63 days</td>
<td>63.1% (95% CI, 51.8-71.7) starting at &gt;14 days for two standard doses</td>
<td>66.9% (95% CI, 59.0-73.4) after 14 days and 66.1% (95% CI 55.0-89.1) after 28 days for VE against moderate-severe-critical COVID-19</td>
<td>72.8% (95% CI 58.1-82.4; in WIV04 vaccine)</td>
<td>78.1% (95% CI 64.8 to 86.3; in HBO2 vaccine)</td>
<td>99.17% of NAb titres were above or equal to the median</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

xxxvii Against SARS-CoV-2 infection
xxxviii Conducted between 8 December 2020 and 8 February 2021. Study sample = ≤1 million participants.
xxxix Against SARS-CoV-2 infection.
<table>
<thead>
<tr>
<th>Against severe disease:</th>
<th>standard second dose(^{207})</th>
<th>76.7% (95% CI 54.6 to 89.1) after 14 days and 85.4% (95% CI 54.2 to 96.9) after 28 days for VE against severe-critical COVID-19(^{210})</th>
<th>Nab positivity cut-off (20 units) against wild-type(^{211})</th>
<th>Severe COVID-19(^{19\text{a}\text{212}})</th>
</tr>
</thead>
<tbody>
<tr>
<td>98.2% (95% CI, 92.8-99.6)(^{209})</td>
<td>66.7% (95% CI, 57.4-74.0) starting at ≥14 days for pooled analysis efficacy(^ {207})</td>
<td>Sometimes non-statistically significant reduction of 22.2% (95% CI -9.9 to 45.0) for asymptomatic cases</td>
<td>Efficacy against symptomatic and asymptomatic cases was 64% (95% CI 48.8 to 74.7; in WIV04 vaccine) or 73.5% (95% CI 60.6 to 82.2; in HBO2 vaccine)(^{128})</td>
<td>100% (95% CI, 34.6-100) against severe COVID-19(^{19\text{a}\text{212}})</td>
</tr>
</tbody>
</table>

**Against asymptomatic infection**

| 90% (starting at 14 days) regardless of symptom status\(^{213}\) | 63.0% (95% CI, 56.6-68.5)\(^{209}\) | Statistically non-significant reduction of 22.2% (95% CI -9.9 to 45.0) for asymptomatic cases | At day 71, vaccine efficacy against asymptomatic infections was 65.5% (95% CI 39.9 to 81.1)\(^{210}\). | Unknown |

**Efficacy against variants**

<table>
<thead>
<tr>
<th>Alpha (B.1.1.7)</th>
<th>Two doses of the vaccine effectively neutralize the B.1.1.7 variant and the D614G substitution(^{214}).</th>
<th>NAbs remained high and consistent with titres of the wildtype for the B.1.1.7 variant(^ {215}).</th>
<th>70.4% (95% CI, 43.6-84.5) against symptomatic infection with alpha variant (B.1.1.7); 28.9% (95% CI, -77.1 to 71.4) against asymptomatic infection with B.1.1.7(^ {162}).</th>
<th>Demonstrated reduced neutralizing capacity. However, there were no differences in the NAbs titres against B.1.351 in vaccinated individuals vs. Two dose efficacy against the B.1.1.7 variant 83.6% (95% CI, 71.3-93.5)(^ {50})</th>
</tr>
</thead>
<tbody>
<tr>
<td>70.4% (95% CI, 43.6-84.5) against symptomatic infection with alpha variant (B.1.1.7); 28.9% (95% CI, -77.1 to 71.4) against asymptomatic infection with B.1.1.7(^ {162}).</td>
<td>3.6-fold reduction in neutralization capacity when compared to wildtype.</td>
<td>Demonstrated reduced neutralizing capacity. However, there were no differences in the NAbs titres against B.1.351 in vaccinated individuals vs. Two dose efficacy against the B.1.1.7 variant 83.6% (95% CI, 71.3-93.5)(^ {50})</td>
<td>10.4-fold reduction in neutralization capacity when compared to natural infection sera(^ {211}).</td>
<td></td>
</tr>
</tbody>
</table>

| Nab positivity cut-off (20 units) against wild-type\(^{211}\) | Unknown |

**Nab positivity cut-off (20 units) against wild-type**

<table>
<thead>
<tr>
<th>Against wild-type</th>
<th>Nab positivity cut-off (20 units) against wild-type(^{211})</th>
</tr>
</thead>
<tbody>
<tr>
<td>20 units</td>
<td>&quot;Unknown&quot;</td>
</tr>
</tbody>
</table>

**Efficacy of NAb titres**

| NAb positivity cut-off (20 units) against wild-type\(^{211}\) | "Unknown" |

**Efficacy of NAb titres**

| NAb positivity cut-off (20 units) against wild-type\(^{211}\) | "Unknown" |
### Literature screening report: COVID-19 vaccines in the WHO’s Emergency Use Listing (EUL) Report (6) - Sabina Rodríguez Velásquez, Gabriela Guizzo Dri

<table>
<thead>
<tr>
<th>Variant</th>
<th>Neutralization was diminished by a factor of 5. Despite this, the BNT162b2 mRNA vaccine still provides some protection against B.1.351(^{218})</th>
<th>Efficacy against moderate-severe-critical Covid-19 due to the variant was 52.0% (&gt;14 days) and 64.0% (&gt;28 days). Efficacy against severe-critical COVID-19 was 73.1% (&gt;14 days) and 81.7% (&gt;28 days)(^{210}).</th>
<th>Neutralization titres were decreased by 6.7-fold(^{222}).</th>
<th>Nab positivity cut-off (20 units) against wild-type(^{211}).</th>
<th>Neutralization decreased by 4.1-fold when compared to wild-type(^{217}).</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beta (B.1.351)</td>
<td>Neutralization was diminished by a factor of 5. Despite this, the BNT162b2 mRNA vaccine still provides some protection against B.1.351(^{218})</td>
<td>Efficacy against moderate-severe-critical Covid-19 due to the variant was 52.0% (&gt;14 days) and 64.0% (&gt;28 days). Efficacy against severe-critical COVID-19 was 73.1% (&gt;14 days) and 81.7% (&gt;28 days)(^{210}).</td>
<td>Neutralization titres were decreased by 6.7-fold(^{222}).</td>
<td>Nab positivity cut-off (20 units) against wild-type(^{211}).</td>
<td>Neutralization decreased by 4.1-fold when compared to wild-type(^{217}).</td>
</tr>
</tbody>
</table>

\(^{210}\) Demonstrated 3.6-fold reduction in neutralization sensitivity\(^{221}\).

\(^{211}\) Neutralization titres were above or equal to the Nab positivity cut-off (20 units) against wild-type\(^{211}\).
<table>
<thead>
<tr>
<th>Vaccine</th>
<th>Single dose:</th>
<th>Two doses:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gamma (P.1)</td>
<td>Single dose: ≥21 days: 83% against hospitalization and death(^{224}).</td>
<td>Two doses: ≥14 days: 98% against hospitalization and death(^{224}).</td>
</tr>
<tr>
<td></td>
<td>3.2-fold reduction in neutralization capacity when compared to wild-type(^{225}).</td>
<td>Demonstrated 3.4-fold reduction in neutralization sensitivity(^{221}).</td>
</tr>
<tr>
<td></td>
<td>Single dose: ≥21 days: 94% against hospitalization and death(^{224}).</td>
<td>No published data</td>
</tr>
<tr>
<td></td>
<td>Two doses: 64% (95% CI, -2-87) ([n=18])(^{226}).</td>
<td>Neutralization decreased by 7.5-fold when compared to wild-type(^{217}).</td>
</tr>
<tr>
<td></td>
<td>Efficacy against Zeta (P.2) [2 doses]: 69% (95% CI, 55-78)(^{226}).</td>
<td>No available data</td>
</tr>
<tr>
<td>Delta (1.671.2)</td>
<td>Reduced NAb activity relative to B.1.1.7 strain(^{227}).</td>
<td>Demonstrated reduced neutralizing capacity. However, there were no differences in the NAb titres against B.1.617.2 in vaccinated individuals vs. those naturally infected, suggesting the vaccine has a similar level of protection against infection as NT(_{GM}) 24.48 (95% CI,19.2-31.2)(^{211}).</td>
</tr>
<tr>
<td></td>
<td>2.1-fold reduction in neutralization capacity when compared to wild-type(^{225}).</td>
<td>69.17% of NAb titres were above or equal to the NAb positivity cut-off (20 units) against wild-type(^{211}).</td>
</tr>
<tr>
<td></td>
<td>Single dose: ≥21 days: 90% against hospitalization and death(^{224}).</td>
<td>No available data</td>
</tr>
<tr>
<td></td>
<td>Demonstrated 1.6-fold reduction in neutralization sensitivity(^{221}).</td>
<td>Neutralization titres were decreased by 5.4-fold(^{222}).</td>
</tr>
<tr>
<td></td>
<td>Neutralization titres were decreased by 5.4-fold(^{222}).</td>
<td>No available data</td>
</tr>
</tbody>
</table>

\(^{224}\) Data from WHO\(^{193}\).

\(^{225}\) Efficacy estimated from clinical trials\(^{184}\).

\(^{226}\) Neutralization reduction reported in preclinical studies\(^{221}\).

\(^{227}\) Reduced NAb activity compared to wild-type reported in preclinical studies\(^{217}\).

\(^{228}\) Neutralization titres reported in preclinical studies\(^{221}\).

\(^{229}\) Neutralization titre cut-off reported in preclinical studies\(^{211}\).
PHASE III TRIALS RESULTS

| Number of participants (vaccine/placebo) | 43,448 (21,720/21,728) | 30,420 (15,210/15,210) | 17,178 (8,597/8,581) | 39,321 (19,630/19,691) | 26,917 (13,459/13,458); or 26,914 (13,465/13,458) | 9,823 (4,953/4,870) | 14,039 (7,020/7,019) |
| Total COVID-19 cases (vaccine/control) | 170(8/162) | 196 (11/185) | 332 (84/248) | 464 (116/348) | 121(26/95) or 116(21/95) | 253(85/168) | 106(10/96) |

Efficacy estimates in Phase III trials

- Starting from 7 days after 2nd dose: **95.0%** (95% CI, 90.3 to 97.6) in population without prior SARS-CoV-2 infection. Efficacy of **94.6%**.

- After a median follow-up of less than 63 days: Efficacy of **94.1%** (95% CI, 89.3 to 96.8; P<0.001). **100%** among adolescents (12 to <18 years old).

- Two standard doses: efficacy was **63.1%** (95% CI 51.8 to 71.7; ≥14 days) while those with first low dose and standard 2nd dose the efficacy **66.1%** (95%).

- VE against moderate-severe-critical Covid-19 was **66.9%** (95% CI 59.0 to 73.4) after 14 days post vaccine administration, and **66.1%** (95%).

- After 14 days, efficacy against symptomatic cases was **72.8%** (95% CI 58.1 to 82.4; in WIV04 vaccine) or **78.1%** (95% CI 64.8 to 89.7%)

- After 14 days, efficacy against symptomatic cases was **50.7%** (95% CI 35.9 to 0-62.0).

- After 14 days, efficacy against symptomatic cases was **83.4%** (95% CI, 73.6-89.5) starting at ≥14 days after first dose.

- **89.7%** (95% CI, 80.2-94.6) starting at ≥7 days after second dose.

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**Note**: Phase III trials were conducted between 27 July and 14 November 2020 for BNT162b2/COMIRNATY, 27 July and 23 October 2020 for Spikevax/Moderna, 23 April and 6 December 2020 for Vaxzevria/ChAdOx1 nCoV-19/AZD1222/Covishield, 21 September 2020 and 22 January 2021 for Janssen Covid-19 vaccine/Johnson & Johnson, 16 July and 20 December 2020 for Sinopharm/BBIB-CorV, 21 July and 16 December 2020 for the Sinovac/CoronaVac vaccine, and 28 September 2020 and 28 November 2020 for the Novavax vaccine. All trials were conducted prior to the transmission of the more contagious variant strains, particularly the delta variant (B.1.617.2). Studies are currently ongoing to determine the effectiveness of the vaccines against the delta variant.
### Literature screening report: COVID-19 vaccines in the WHO's Emergency Use Listing (EUL) Report (6) - Sabina Rodríguez Velásquez, Gabriela Guizzo Dri

**Efficacy against hospitalization and death**

<table>
<thead>
<tr>
<th>100% (after 7 days)</th>
<th>100% (≥14 days)</th>
<th>100% (after 21 days)</th>
<th>76.7% (≥14 days) or 85.4% (≥28 days)</th>
<th>100% (&gt;14 days)</th>
<th>100% (&gt;14 days)</th>
<th>100% (after 7 days)</th>
</tr>
</thead>
</table>

- **Phase III clinical trial serious adverse events**

  - **Serious adverse events** were observed in a similar proportion of vaccine (0.6%) and placebo (0.5%) recipients. These events also occur at a similar frequency within the general population.

  - **Frequency of grade 3 adverse events** was similar in both the vaccine (1.5%) and placebo groups (1.3%). Serious adverse events were observed in a similar proportion in both groups (0.6%). 3 Bell’s Palsy cases occurred in the vaccine group and one Bell’s Palsy case in the placebo group.

  - **Serious adverse events** were balanced across the study arms. 79 cases occurred in the vaccine group and 89 cases in the placebo group – 3 cases were considered related to the experimental or control vaccine (out of 11,636 vaccine recipients).

  - **Serious adverse events** were reported in 0.4% of vaccine recipients and 0.4% of placebo recipients. Seven of the serious adverse events were considered to be related to the vaccine: Guillain-Barré syndrome (1), pericarditis (1), brachial radiculitis (1), A cross-sectional survey collected data on adverse events following vaccination in the UAE - none of the symptoms were of serious nature or required hospitalization.

- **Overall incidence of serious adverse events** was 0.5% (31 in placebo group and 33 in vaccine group). All adverse events were determined to be unrelated to the vaccine.

- **Phase II: Nine serious adverse events** were reported, only one of which was assessed as related to the vaccine: acute colitis.

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**Note:**

- Efficacy against COVID-19 cases was 76.7% (95% CI 54.6 to 89.1) after 14 days and 85.4% (95% CI 54.2 to 96.9) after 28 days. VE against severe-critical COVID-19 cases was 86.3% in HBO2 vaccine.

- Pooled analysis efficacy was 66.7% (95% CI 57.4 to 74.0). For any nucleic acid amplification test-positive swab: efficacy was 54.1% (95% CI 44.7 to 61.9).

- A cross-sectional survey collected data on adverse events following vaccination in the UAE - none of the symptoms were of serious nature or required hospitalization.

- Overall incidence of serious adverse events was 0.5% (31 in placebo group and 33 in vaccine group). All adverse events were determined to be unrelated to the vaccine.

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**A cross-sectional survey collected data on adverse events following vaccination in the UAE - none of the symptoms were of serious nature or required hospitalization.**

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**Overall incidence of serious adverse events was 0.5% (31 in placebo group and 33 in vaccine group). All adverse events were determined to be unrelated to the vaccine.**
### PHASE III TRIAL OTHER

<table>
<thead>
<tr>
<th>Comments</th>
<th>2-DOSE EFFICACY</th>
<th>Novavax is currently awaiting FDA, EMA, and WHO EUL approval. Upcoming information regarding results of clinical trials or approval will be updated in upcoming reports</th>
</tr>
</thead>
<tbody>
<tr>
<td>Specific populations were excluded (HIV and immunocompromised patients, and pregnant women). Calculation of efficacy were not based on the total number of confirmed Covid-19 cases.</td>
<td><strong>Efficacy against symptomatic (moderate to severe/ critical) SARS-CoV-2 infection</strong> 94% (95% CI, 58-100) in the US. 75% (95% CI, 55-87) globally. <strong>Efficacy against severe/ critical SARS-CoV-2 infection</strong> 100% (95% CI, 33-100)^11</td>
<td></td>
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</tbody>
</table>

Only 2 severe cases occurred in the control group and none in the vaccine group (very few cases to get a reliable estimate). |

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## VACCINE PRODUCTION SITES

<table>
<thead>
<tr>
<th>EUL holder</th>
<th>BioNTech Manufacturing GmbH (Germany)</th>
<th>ModernaTX, Inc. (USA)</th>
<th>AstraZenea AB (Sweden)</th>
<th>Janssen-Cilag International NV (Belgium)</th>
<th>Beijing Institute of Biological Products Co., Ltd. (BIBP) (China)</th>
<th>Sinovac Life Sciences Co., Ltd. (China)</th>
<th>Novavax (USA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BNT162b2/COMIRNATY (Pfizer-BioNTech, USA)</td>
<td>Spikevax/Moderna COVID-19 Vaccine/mRNA-1273 (Moderna, USA)</td>
<td>Vaxzevria/ChAdOx1 nCoV-19/AZD1222/Covishield (AstraZeneca/Oxford, UK, India)</td>
<td>Janssen COVID-19 vaccine/Johnson &amp; Johnson (Janssen, USA)</td>
<td>Sinopharm/BBIB P-CorV, China</td>
<td>Sinovac CoronaVac, China</td>
<td>Novavax/ NVX-CoV2373</td>
<td></td>
</tr>
</tbody>
</table>

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xliii WHO recommendation AstraZeneca/ EU approved sites COVID-19 vaccine (ChAdOx1-S) [recombinant]. WHO. [https://extranet.who.int/pqweb/vaccines/covid-19-vaccine-chadox1-s-recominant](https://extranet.who.int/pqweb/vaccines/covid-19-vaccine-chadox1-s-recominant)


<table>
<thead>
<tr>
<th>Production sites (Drug substance)</th>
<th>BioNTech Manufacturing GmbH (Mainz, Germany)</th>
<th>Henogen S.A (Belgium)</th>
<th>BioNTech Manufacturing Marburg (Marburg, Germany)</th>
<th>Catalent Maryland, Inc. (USA)</th>
<th>Lonza Biologics, Inc., (USA)(^1)</th>
<th>Moderna TX, Inc. (USA)(^1)</th>
<th>Lonza AG (Switzerland)(^2)</th>
<th>Janssen Vaccines &amp; Prevention B.V. (The Netherlands)</th>
<th>Janssen Biologics B.V. (The Netherlands)</th>
<th>Beijing Institute of Biological Products Co., Ltd. (China)</th>
<th>Sinovac Life Sciences Co., Ltd. (China)</th>
<th>Novavax (Bohumil, Czech Republic)</th>
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</thead>
<tbody>
<tr>
<td>Production sites (Drug product)</td>
<td>Baxter Oncology GmbH (Halle/Westfalen, Germany)</td>
<td>Catalent Anagni (Italy)</td>
<td>BioNTech Manufacturing GmbH (Mainz, Germany)</td>
<td>CP Pharmaceuticals (United Kingdom)</td>
<td>Baxter Pharmaceutical Solutions, LLC. (USA)(^1)</td>
<td>Catalent Indiana, LLC. (USA)(^1)</td>
<td>Rovi Pharma Industrial Services, S.A. (Spain)(^2)</td>
<td>Janssen Biologics B.V. (The Netherlands)</td>
<td>Janssen Pharmaceutica NV (Belgium)</td>
<td>Beijing Institute of Biological Products Co., Ltd. (China)</td>
<td>Sinovac Life Sciences Co., Ltd. (China)</td>
<td>Novavax (Bohumil, Czech Republic)</td>
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<tr>
<td>Diluent suppliers</td>
<td>Novartis Pharma Stein AG (Switzerland)</td>
<td>Mibe GmbH Arzneimittel (Brehna, Germany)</td>
<td>Universal Farma, S.L. (&quot;Chemo&quot;) (Spain)</td>
<td>Amylin Ohio LLC (USA)</td>
<td>Grand River Aseptic Manufacturing Inc. (USA)</td>
<td>Catalent Anagni S.R.L. (Italy)</td>
<td>Pfizer Perth, Australia</td>
<td>Fresenius Kabi, USA</td>
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References


https://doi.org/10.1111/trf.16672

https://doi.org/10.1177/23247096211043386

https://doi.org/10.1016/j.xkme.2021.05.002

https://doi.org/10.1111/dme.14631

https://doi.org/10.1111/jocd.14459

https://doi.org/10.7759/cureus.16612

https://doi.org/10.1016/NEJMoa210737

https://doi.org/10.1056/NEJMoa2027906

https://doi.org/10.1016/S1477-3185(20)30831-8
<table>
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</thead>
<tbody>
<tr>
<td>156. Karamese M, Tutuncu EE. The effectiveness of inactivated SARS-CoV-2 vaccine (CoronaVac) on antibody response in participants aged 65 years and older. <em>Journal of Medical Virology</em>. 2021. <a href="https://doi.org/10.1002/jmv.27289">https://doi.org/10.1002/jmv.27289</a></td>
</tr>
</tbody>
</table>


177. A Study to Evaluate Safety, Tolerability, and Immunogenicity of an RNA Vaccine Candidate Against COVID-19 in Healthy Children <12 Years of Age. In: https://ClinicalTrials.gov/show/NCT04816643;


179. A Study to Evaluate Safety and Effectiveness of mRNA-1273 COVID-19 Vaccine in Healthy Children Between 6 Months of Age and Less Than 12 Years of Age. In: https://ClinicalTrials.gov/show/NCT04796896;


https://doi.org/10.1016/s1473-3099(21)00462-x


https://doi.org/10.3390/children8070607


https://doi.org/10.1016/s0140-6736(21)01699-8


223. Buntz B. *AstraZeneca, Pfizer Moderna vaccines fare well against Beta, Gamma and Delta variants in study. Drug Discovery & Development.*


